

# **A Study on the Relationship between Ecological Conservation, Tourism Impacts, and Sustainable Development in an Indigenous Island Context**

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## **Abstract**

This study explores the interconnectedness between the ecological conservation of *Otus elegans botelensis*, its societal implications, tourism impacts, and sustainable development—specifically from the perspective of Lanyu’s indigenous communities. Drawing on Social Exchange Theory and Place Attachment Theory, an integrated conceptual framework was developed to guide the research. A structured questionnaire was designed, yielding 364 valid responses. The primary analytical method employed was Structural Equation Modeling (SEM), which was used to examine the direct effects of ecological conservation on societal outcomes, as well as its indirect influence on local identity and sustainable development through both the positive and negative impacts of tourism.

**JEL classification numbers:** Z30, Z32.

**Keywords:** *Otus elegans botelensis*, Ecological Conservation, Social Implications, Tourism Impact, Sustainable Development, Place Identity.

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## 1. Introduction

The global tourism industry has experienced rapid growth in recent years, generating economic benefits for many regions. However, it has also brought a mix of positive and negative effects (Unurlu, 2021). Lanyu, a scenic island southeast of Taiwan, exemplifies this duality. While tourism has stimulated local economic development, it has also raised concerns about its impacts on culture, ecology, and social dynamics. Of particular concern is the Lanyu Scops Owl (*Otus elegans botelensis*), a nocturnal and endemic species that has become a symbolic figure in this discourse (Lee and Severinghaus, 2004).

Traditionally, the Tao people viewed this owl - often spotted near cemeteries - as an ominous sign. Yet, in the modern tourism context, it has been reimagined as a unique attraction. This transformation highlights the complexity of balancing economic development with cultural and ecological preservation in Lanyu.

Two theoretical frameworks provide insights into this challenge. First, Social Exchange Theory posits that individuals assess costs and benefits in their social interactions, aiming to maximize personal gains (Blau, 1964; Emerson, 1972). In Lanyu, the conservation of *Otus elegans botelensis* may bring tourism-related benefits but also generates environmental and social costs. Second, Place Attachment Theory underscores the emotional and symbolic bonds people develop with specific places (Song, Chen, and Zeng, 2022). These attachments shape how residents perceive and respond to changes brought by tourism and conservation.

Although previous studies, such as Berry, Nickerson, and Metcalf (2016) on gray wolves in Montana, have explored the tourism value of conservation despite economic drawbacks, the nuanced relationship between ecological conservation and local tourism development - especially in unique cultural contexts like Lanyu - remains underexplored. This study aims to address that gap by focusing on the conservation of *Otus elegans botelensis* and its intersection with tourism, local identity, and sustainable development.

By integrating local cultural values, ecological awareness, and stakeholder perspectives, this research seeks to inform strategies for sustainable tourism. Short-term economic gains must be weighed against the long-term goal of preserving natural and cultural heritage.

Focusing on *Otus elegans botelensis*, this study investigates the interplay between ecological conservation, community identity, tourism development, and sustainability.

The central research questions are:

1. How does the role of *Otus elegans botelensis* in ecological conservation influence its social significance within the community?
2. What are the positive and negative impacts of its conservation on Lanyu's tourism industry?
3. How do conservation efforts and tourism outcomes affect residents' sense of place identity?

4. In what ways do evolving perceptions of *Otus elegans botelensis* reshape or reinforce local cultural identity?

5. How does place identity among local residents support or constrain strategies for sustainable development?

As tourism in Lanyu continues to grow, finding a balance between preserving biodiversity and safeguarding community well-being is an urgent challenge. This research intends to uncover the complex interrelations among ecology, culture, and development, offering strategic guidance for a more sustainable future in Lanyu.

## **2. Development of Research Hypotheses**

*Otus elegans botelensis* is an owl species endemic to Lanyu (Lee and Severinghaus, 2004), carrying not only ecological significance in terms of biodiversity but also deep cultural and social symbolism. In many indigenous societies, particular species of flora and fauna are often intertwined with local myths, rituals, and traditional beliefs. Thus, if *Otus elegans botelensis* holds a culturally meaningful status within the Tao community, conservation initiatives may further amplify its symbolic role, strengthening collective cultural identity and social connection.

Moreover, conservation education and outreach centered on this species can enhance public awareness of its ecological and cultural value. This heightened understanding may foster a stronger appreciation of Lanyu's unique natural and cultural landscape, reinforcing both environmental consciousness and cultural pride among locals and visitors alike. From a tourism perspective, the conservation success of *Otus elegans botelensis*, along with its cultural narratives, has the potential to become a key attraction, enhancing the destination's appeal and promoting sustainable tourism development.

In addition, when ecological preservation becomes a shared community goal, it can cultivate stronger social bonds and collective action. As noted by Keling, Ho, Yap, and Entebang (2021), collaborative efforts toward conservation can lead to enhanced social cohesion. In Lanyu's context, joint participation in the protection of *Otus elegans botelensis* may reinforce residents' identification with their cultural heritage and strengthen their sense of community. Based on this reasoning, the following hypothesis is proposed:

**Hypothesis 1a:** The ecological conservation of the *Otus elegans botelensis* has a significant positive impact on societal implications.

As an endemic species, the *Otus elegans botelensis* contributes significantly to Lanyu's distinctiveness and ecological identity. In an age of globalization and standardized tourism experiences, travelers increasingly seek authentic and unique encounters - often rooted in the natural and cultural characteristics of a destination (Kim, 2010). The presence of this rare owl species offers precisely such an opportunity.

When the *Otus elegans botelensis* is effectively protected and its image promoted through strategic media and marketing efforts, it has the potential to evolve into a recognizable symbol or "brand" of Lanyu. This can particularly attract nature-based and ecotourism-oriented travelers who value biodiversity and conservation experiences. Conservation-related activities, such as habitat visits, guided educational tours, or public awareness campaigns, can become central elements of the tourist experience, deepening visitors' ecological understanding and enhancing their emotional connection to the destination.

Additionally, the collaborative involvement of both tourists and local residents in conservation efforts can generate a mutually reinforcing cycle. The revenue generated from tourism can be reinvested into ecological protection, including the continued conservation of *Otus elegans botelensis*, thereby improving the quality of both the natural environment and the tourism experience. This virtuous cycle not only strengthens ecological sustainability but also enhances the long-term attractiveness of Lanyu as a destination. Based on this rationale, the following hypothesis is proposed:

**Hypothesis 1b:** The ecological conservation of the *Otus elegans botelensis* leads to positive tourism impacts on Lanyu.

While the ecological conservation of *Otus elegans botelensis* offers potential economic and branding advantages for Lanyu, it may also bring about certain adverse impacts on tourism that warrant careful consideration.

To safeguard the owl's habitat and ensure its long-term survival, it may become necessary to impose restrictions on tourism in sensitive ecological zones - such as nesting or breeding areas - by designating them as protected or limited-access regions. Although these restrictions are ecologically beneficial, they may reduce tourism revenues in the short term by limiting visitor access to key attractions. Additionally, promotional campaigns highlighting the owl as a unique ecotourism feature could unintentionally lead to increased foot traffic and overcrowding. This, in turn, may impose environmental pressures such as noise pollution, littering, and damage to fragile ecosystems, ultimately threatening the very biodiversity that conservation seeks to protect.

Beyond environmental concerns, increased tourism may also result in socio-cultural impacts. For the indigenous Tao community, the influx of tourists may introduce external cultural influences that clash with local traditions and values.

To accommodate tourism demand, commercial developments or cultural commodification may emerge - potentially eroding authentic cultural practices and disrupting traditional lifestyles.

In summary, while ecological conservation brings long-term ecological and symbolic benefits, it may also contribute to short-term challenges for tourism management and community cohesion.

Based on this reasoning, the following hypothesis is proposed:

**Hypothesis 1c:** The ecological conservation of the *Otus elegans botelensis* leads to negative tourism impacts on Lanyu.

In many sociocultural contexts, specific plant and animal species are deeply embedded in local traditions, cultural narratives, and societal values (Balding and Williams, 2016). As an ecologically unique species, *Otus elegans botelensis* may carry profound symbolic meaning within the Lanyu community. Conservation efforts directed at this species, therefore, not only serve ecological purposes but also represent a form of cultural respect and preservation - safeguarding the sociocultural values it embodies.

When local residents actively participate in the conservation of *Otus elegans botelensis*, such engagement can foster a deeper awareness of the species' societal significance. This growing recognition may lead to greater appreciation for their own cultural heritage, thereby strengthening their sense of place and identity. In this light, the conservation of the owl becomes more than an environmental act - it is perceived as a reaffirmation of local traditions and cultural continuity.

Furthermore, when tourists or outsiders demonstrate genuine interest and respect toward the conservation of *Otus elegans botelensis*, it may reinforce local pride and elevate the perceived value of Lanyu's cultural and ecological uniqueness. This external validation can further strengthen community members' emotional and symbolic identification with their homeland.

In sum, the societal meanings associated with the ecological conservation of *Otus elegans botelensis* have the potential to enhance residents' recognition of their cultural heritage and deepen their local identity. Based on this rationale, the following hypothesis is proposed:

**Hypothesis 2:** The societal implications of the ecological conservation of the *Otus elegans botelensis* have a significant positive impact on local identity.

When a destination experiences positive tourism impacts - such as increased economic revenue, expanded employment opportunities, and enriched cultural exchanges - these benefits can enhance the overall socio-economic vitality of the local community (Slabbert, du Plessis, and Digun-Aweto, 2021). This sense of prosperity and recognition often contributes to a stronger sense of pride and identification among residents.

First, the economic growth brought by tourism may lead locals to feel that their community is valued and appreciated, thereby strengthening their emotional attachment to the place (Prasad, Bindu, and Dixit, 2023). For example, when visitors admire Lanyu's natural beauty, cultural heritage, and unique traditions, residents may experience a heightened sense of pride and affirmation. Second, the development of tourism often leads to improvements in public infrastructure and services, which can enhance quality of life for locals. These tangible benefits may

reinforce the perception that their home is not only livable but also distinctive. Third, increased cultural exchange between tourists and residents can foster mutual understanding. Through these interactions, locals may rediscover and reaffirm their own cultural values, further deepening their sense of cultural and place identity.

Taken together, these positive outcomes suggest that the benefits of tourism can significantly contribute to strengthening residents' identification with their community. Therefore, the following hypothesis is proposed:

**Hypothesis 3:** Positive tourism impacts have a significant positive effect on local identity.

Negative tourism impacts, such as environmental degradation, cultural erosion, and declining quality of life, can significantly influence residents' sense of local identity (Tang, Yuan, Ramos, and Sriboonchitta, 2019). When local communities perceive tourism as a threat to their environment, culture, or values, it may result in feelings of disconnection or disillusionment toward their place of residence.

For instance, environmental pollution or overdevelopment caused by tourism - such as waste accumulation or ecological damage in Lanyu - may diminish the island's natural beauty and lead residents to feel that their homeland is being degraded. Likewise, the commercialization or misrepresentation of cultural traditions for tourist consumption may foster perceptions that local heritage is being undervalued or exploited (Moisescu, Gica, Coros, and Yallop, 2019). Moreover, rapid tourism development often brings social pressures such as increased living costs, overcrowding, and the disruption of community life (Mihalic and Kuscer, 2022). These negative changes may create a sense of alienation and emotional detachment from one's home environment.

Taken together, these adverse tourism effects can erode residents' connection to place, weakening their local identity. Based on this reasoning, the following hypothesis is proposed:

**Hypothesis 4:** Negative tourism impacts have a significant negative effect on local identity.

Place identity refers to the deep emotional and cognitive connection individuals hold toward their place of residence. When this sense of identity is strong, residents are more likely to actively participate in the protection and future development of their community (Yang, Wang, Cai, and Zhou, 2022).

Residents with a strong attachment to their homeland tend to prioritize long-term well-being over short-term gains. This may translate into greater involvement in environmental initiatives, such as participating in conservation efforts (Li, Wu, and Deng, 2022), supporting sustainable community development, or preserving cultural heritage (Siddiqui, Sujood, Bano, and Hamid, 2023). Furthermore, a strong place identity may foster a heightened sense of responsibility for local resources - encouraging the use of renewable materials, sustainable business practices, and

inclusive community planning that balances environmental, social, and economic needs.

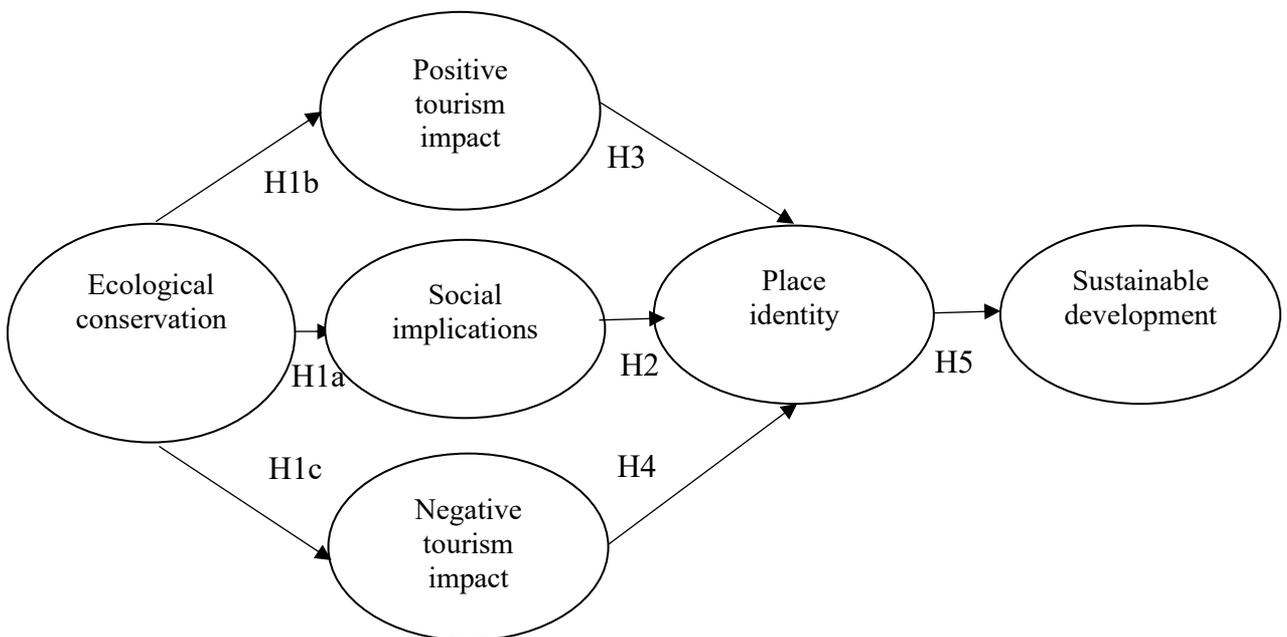
Importantly, shared place identity can also enhance social cohesion and collective action. When residents feel unified through a common connection to place, they are more likely to collaborate on sustainable development strategies (Uzzell, Pol, and Badenas, 2022), working together to ensure the long-term prosperity of their community. Based on this perspective, the following hypothesis is proposed:

**Hypothesis 5:** Place identity has a significant positive impact on sustainable development.

### 3. Methods

#### 3.1 Research framework

Grounded in Social Exchange Theory and Place Attachment Theory, this study adopts the perspective of Lanyu’s local residents to construct an integrated theoretical framework. The model incorporates key variables including the ecological conservation of *Otus elegans botelensis*, its societal implications, both positive and negative tourism impacts, place identity, and sustainable development. This comprehensive framework serves to examine how the conservation of *Otus elegans botelensis* influences Lanyu’s path toward sustainable development. The proposed conceptual framework is presented in Figure 1.



**Figure 1: Conceptual framework**

## **3.2 Operational definition and measurement of variables**

### **3.2.1 Ecological conservation of the *Otus elegans botelensis***

In this study, the ecological conservation of the *Otus elegans botelensis* is operationally defined as a set of strategic, sustainable, and scientifically informed actions and plans aimed at protecting and enhancing the species' habitat, population stability, and overall biodiversity. These efforts are intended to safeguard the owl from excessive human disturbance and ecological degradation.

Building upon the works of Mace & Lande (1991), James, Gaston, and Balmford (1999), and Berkes (2004), this study assesses perceptions of *Otus elegans botelensis* conservation through four measurement items. These items were developed in accordance with the operational definition and relevant literature, and are designed to capture respondents' understanding, awareness, and evaluation of ecological conservation practices related to this endemic species.

- 1) I believe that the local government and organizations of Lanyu have established effective conservation plans for the *Otus elegans botelensis*.
- 2) I believe that the current ecological environment of the *Otus elegans botelensis* is severely affected by human interference or destruction.
- 3) I think that the local community of Lanyu is actively involved in the conservation activities of the *Otus elegans botelensis*.
- 4) I believe that the current conservation resources (such as funding, manpower, facilities, etc.) are sufficient to support the ecological conservation efforts of the *Otus elegans botelensis*.

### **3.2.2 Social implications**

Social implications refer to the meanings, values, and social impacts that an object, phenomenon, or activity carries within a specific cultural or societal context. These implications are closely tied to the community's collective perceptions, attitudes, and behaviors, and they play a role in shaping social interactions and identity formation among members of the community.

Drawing on the theoretical perspectives of Bourdieu (1984) and Douglas (2002), this study assesses the social implications of the *Otus elegans botelensis* through four measurement items. These items are designed to capture respondents' perceptions regarding the cultural, historical, and social significance of the species within the context of Lanyu, and to explore its symbolic role in local society.

- 1) I believe that the *Otus elegans botelensis* represents some cultural or historical significance in Lanyu's society.
- 2) Stories or legends related to the *Otus elegans botelensis* influence my understanding and perception of Lanyu's society.
- 3) I think that the significance of the *Otus elegans botelensis* is widely recognized by members of the Lanyu community.
- 4) I believe that the *Otus elegans botelensis* has an impact on local community activities or rituals in Lanyu.

### **3.2.3 Positive tourism impact**

Positive tourism impact refers to the beneficial outcomes derived from tourism activities, such as economic development, job creation, the promotion and preservation of local culture, and constructive contributions to the local environment and community well-being.

Based on the framework proposed by Sinclair (1998), this study measures positive tourism impact through four items. These items are designed to evaluate respondents' perceptions and assessments of the favorable effects that tourism has brought to Lanyu in economic, cultural, and social dimensions.

- 1) I believe that tourism activities have brought significant economic growth to Lanyu.
- 2) I think that tourism activities have created more job opportunities in Lanyu.
- 3) I feel that due to tourism activities, the culture and traditions of Lanyu have been better promoted.
- 4) I believe that tourism activities have led to an increased focus and investment in environmental protection in Lanyu.

### **3.2.4 Negative tourism impact**

Negative tourism impact refers to the detrimental consequences of tourism activities, including environmental degradation, cultural distortion or commercialization, excessive economic dependency, and the overexploitation of local resources.

Drawing on the studies of Britton (1982) and Gössling (2002), this research measures negative tourism impact through four items. These items aim to assess respondents' awareness, perceptions, and evaluations of the adverse effects that tourism has imposed on Lanyu's ecological, cultural, and socio-economic environment.

- 1) I believe that tourism activities in Lanyu have led to the degradation or destruction of the local natural environment.
- 2) I feel that due to tourism, the traditional culture and values of Lanyu have been distorted or overly commercialized in some aspects.
- 3) I think Lanyu's economy is overly dependent on tourism to the extent that other potential economic development directions are neglected.
- 4) I believe that tourism activities in Lanyu have led to the overconsumption of local resources, such as water or food supply.

### **3.2.5 Place identity**

Place identity refers to the emotional bond, sense of belonging, and identification that individuals or communities develop toward a specific geographical location. This identity is shaped by shared cultural experiences, historical associations, community values, and emotional attachments to the natural and built environment of the place.

Grounded in the theoretical frameworks of Lalli (1992) and Proshansky, Fabian, and Kaminoff (1983), this study measures place identity through four items. These

items are designed to evaluate respondents' sense of connection to Lanyu and their perceptions of its distinctiveness, cultural significance, and personal meaning.

- 1) I feel a close connection to the natural environment and cultural characteristics of Lanyu.
- 2) I feel a sense of belonging when I am in Lanyu.
- 3) I believe the history and traditions of Lanyu have a profound impact on my personal values and perceptions.
- 4) I think Lanyu is distinct and unique compared to other places.

### **3.2.6 Sustainable development**

Sustainable development is commonly defined as the ability to meet present needs without compromising the capacity of future generations to meet their own. It emphasizes a balanced and integrated approach across three key dimensions: economic viability, social equity, and environmental protection, with a focus on long-term resilience and holistic progress.

Building on the work of Lane (1994) and Pearce and Atkinson (1993), this study measures sustainable development through four items. These items are designed to evaluate respondents' perceptions and assessments of sustainable development in the context of Lanyu, specifically regarding the interconnected concerns of environmental stewardship, social well-being, and economic sustainability.

- 1) I believe the development activities in Lanyu take into account the carrying capacity of the local environment.
- 2) In Lanyu's development strategies, I think there is a balanced emphasis on economic growth and community welfare.
- 3) I feel that the development decisions in Lanyu adequately involve and reflect the opinions and needs of local residents.
- 4) I think Lanyu strives to maintain and strengthen local culture and traditional values in its development.

### **3.3 Questionnaire design**

This study employed a questionnaire survey method for data collection. Prior to the questionnaire design, a series of expert interviews were planned to ensure the content validity and contextual relevance of the instrument. Content validity refers to the extent to which measurement items accurately represent the specific domain or behavioral construct under investigation. A widely accepted approach to establishing content validity is expert review, where domain specialists assess the consistency and representativeness of questionnaire items.

To this end, the study will first conduct in-depth interviews with five local residents of Lanyu, aiming to gather authentic insights and contextual information relevant to the research themes. Based on the findings from these interviews, a preliminary version of the questionnaire will be developed. Subsequently, five academic experts in the field of tourism will be invited to evaluate the content, clarity, and relevance of the questionnaire items. Feedback from these experts will inform further

refinement of the instrument before its formal administration.

The finalized questionnaire will consist of two main sections. The first section collects demographic and background information from respondents, including gender, age, education level, marital status, household composition, average monthly income, ethnic identity (indigenous or non-indigenous), and experience working outside the local area. The second section focuses on measuring key constructs of the study: the ecological conservation of *Otus elegans botelensis*, societal implications, positive and negative tourism impacts, place identity, and sustainable development. All items in this section will be measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

### **3.4 Research site**

This study focuses on Lanyu Island, located in eastern Taiwan, as the designated research site. Situated approximately 49 nautical miles southeast of Taitung County, Lanyu is Taiwan's second-largest offshore island, encompassing an area of around 45 square kilometers. Despite its relatively small size, the island has a population density of about 109 people per square kilometer, making it the most densely populated among Taiwan's indigenous townships - and the only one with a density exceeding 100 persons/km<sup>2</sup>.

The island is predominantly inhabited by the Tao people, an indigenous group whose language and cultural practices remain widely preserved. Approximately 90% of the population are Tao, with the remaining residents consisting mainly of Han migrants from Taiwan's main island. Historically, the Tao community was organized into seven tribal settlements; today, the island is administratively divided into four villages. As of the end of 2022, Lanyu had about 2,000 households and a population of roughly 5,300. The island is renowned for its rich biodiversity and vibrant traditional culture, representing a unique convergence of natural and cultural resources.

A key symbol of this ecological richness is the *Otus elegans botelensis*, a scops owl species endemic to Lanyu. As a territorial and nocturnal bird of prey, it inhabits tropical rainforests and primarily feeds on insects. Unable to build its own nests, the owl typically relies on natural tree hollows or those created by other animals (Severinghaus, 2000). The current population is estimated at around 1,000 individuals, though their habitats are increasingly threatened by deforestation, habitat fragmentation, and expanding human activity.

Traditionally, the Tao people rely on marine resources for sustenance and do not practice bird hunting, creating a culturally respectful environment for the species. However, recent land-use changes - such as the decline of primary forests and the expansion of economic crop cultivation - have placed significant pressure on the owl's habitat. In response, *Otus elegans botelensis* is now designated a protected species under Taiwan's Cultural Heritage Preservation Act and the Wildlife Conservation Act.

To balance development with preservation, the Taiwanese government has adopted a strategic vision for Lanyu under the theme: “Cultural-Ecological Sustainable and Livable Homeland.” The plan divides the island into three functional zones: 1. Important Settlement Development Areas, 2. Cultural and Ecological Tourism Sustainable Development Areas, and 3. Coastal Recreation Areas.

This zoning strategy seeks to protect Lanyu’s unique ecological and cultural assets while fostering sustainable tourism and community development, positioning Lanyu as a model destination that integrates natural beauty with cultural depth.

### **3.5 Sample collection**

In the preliminary phase of this study, a pilot test involving 30 residents of Lanyu Island was conducted to refine and validate the questionnaire design. For the formal data collection, the study adopted a convenience sampling approach, selected primarily for its operational efficiency and cost-effectiveness. This method involves recruiting participants who are most easily accessible. While practical, it may introduce sampling bias, thereby limiting the generalizability of the results to the broader population.

The survey was administered on-site, with a team of researchers dispatched to Lanyu to personally distribute questionnaires to local residents. To ensure smooth execution and reduce any potential disruption, all fieldwork was conducted by professionally trained interviewers. Tourists who were available completed the survey on-site; for those unable to do so immediately, researchers requested that they return the completed questionnaires by mail.

In total, 400 questionnaires were distributed and collected. After screening for incomplete or invalid responses, 364 valid responses were retained for analysis, yielding a valid response rate of 91%.

In terms of sample distribution, there were 186 males and 178 females. Age-wise, 115 were 30 years old or younger, 93 were between 31 and 40, 80 were between 41 and 50, 63 were between 51 and 60, and 13 were over 61 years old. Regarding educational level, 278 had high school education or below, 76 had a university degree, and 10 had postgraduate education. For marital status, 150 were single, and 214 were married. Concerning family status, 255 had children, and 109 did not. Regarding average monthly income, 218 earned NT\$30,000 or below, 80 earned between NT\$30,000 and NT\$50,000, 34 earned between NT\$50,000 and NT\$80,000, and 32 earned over NT\$80,000. In terms of identity, 328 were indigenous, and 36 were non-indigenous. Regarding experience working outside the area, 102 had such experience, while 262 did not.

To evaluate the representativeness of the research sample, this study conducted a wave analysis to examine potential non-response bias. Specifically, responses from early and late participants were compared, based on the assumption that late respondents may resemble non-respondents.

Following the method proposed by Armstrong and Overton (1977), a t-test was performed to compare key demographic characteristics - such as age - between the

two groups. The results showed no statistically significant differences at the 5% level, indicating that non-response bias was not a major concern in this study.

## 4. Empirical Results

### 4.1 Analytical results of common method variance

When data for all constructs are collected from the same respondent, the risk of common method variance (CMV) due to single-source bias becomes a concern (Podsakoff, MacKenzie, Lee, and Podsakoff, 2003). To proactively address this issue, the present study implemented procedural remedies, including anonymizing respondent information and incorporating reverse-worded items to reduce response biases and social desirability effects.

In addition to these procedural controls, a post hoc statistical test was conducted to assess the presence of CMV. Specifically, Harman’s single-factor test was employed (Podsakoff and Organ, 1986), where all measurement items were entered into an unrotated exploratory factor analysis. The analysis extracted five distinct factors, collectively accounting for 68.304% of the total variance. The first factor accounted for 43.838%, which is below the commonly accepted threshold of 50%. Therefore, no single factor dominated the variance, suggesting that common method variance is not a significant concern in this study (Mossholder, Bennett, Kemery, and Wesolowski, 1998).

### 4.2 Descriptive statistics and correlation analysis

The results of the descriptive statistics and Pearson correlation analysis for all research variables are summarized in Table 1. The analysis revealed that all variables are positively and significantly correlated with one another, indicating consistent and mutually reinforcing relationships among the core constructs examined in this study.

**Table 1: Descriptive statistics and correlation analysis**

	1	2	3	4	5	6
1. Ecological conservation	1					
2. Social implications	.679**	1				
3. Positive tourism impact	.551**	.644**	1			
4. Negative tourism impact	.603**	.569**	.403**	1		
5. Place identity	.497**	.506**	.530**	.441**	1	
6. Sustainable development	.592**	.547**	.574**	.492**	.481**	1
Mean	4.0179	3.7988	3.6902	4.0185	3.8832	3.9162
S.D.	0.63611	0.74263	0.71029	0.63107	0.57833	0.65701
Cronbach’s $\alpha$	0.831	0.893	0.891	0.880	0.714	0.872
“**” $p < 0.01, n = 364$						

### 4.3 Confirmatory factor analysis (CFA)

This study employed Confirmatory Factor Analysis (CFA) to assess the adequacy of the measurement model. As presented in Table 2, all t-values associated with the factor loadings exceeded the critical value of 1.96, indicating statistical significance. The standardized factor loadings ( $\lambda$ ) of all observed variables on their corresponding latent constructs ranged from 0.49 to 0.91, surpassing the minimum acceptable threshold of 0.45 suggested by Bentler and Wu (1993). These results indicate a satisfactory level of convergent validity.

The individual item reliability ( $\lambda^2$ ) values ranged from 0.24 to 0.85, all above the recommended cutoff of 0.20 (Bentler and Wu, 1993), suggesting that each observed variable reliably reflects its respective latent construct.

In terms of composite reliability (CR), which assesses the internal consistency of each construct, values ranged from 0.71 to 0.89 - well above the commonly recommended threshold of 0.60 (Fornell and Larcker, 1981). This confirms that the constructs in the model exhibit strong internal reliability.

Regarding Average Variance Extracted (AVE), all six constructs yielded AVE values above 0.39. While Fornell and Larcker (1981) recommend an AVE value of 0.50 or higher to indicate acceptable convergent validity, values exceeding 0.36 are considered marginally acceptable. Given that all AVE values in this study fall above the minimum threshold, and combined with strong factor loadings and CR scores, the results provide robust evidence of convergent validity for the measurement model (Bentler and Wu, 1993; Fornell and Larcker, 1981).

**Table 2: Individual item reliability, composite reliability and average variance extracted**

Construct	No. of items	Factor loading ( $\lambda$ )	Individual item reliability ( $\lambda^2$ )	t-value	CR	AVE
1. Ecological conservation	4	0.71~0.82	0.50~0.67	14.88~18.01	0.84	0.56
2. Social implications	4	0.70~0.87	0.49~0.76	14.96~20.42	0.89	0.68
3. Positive tourism impact	4	0.81~0.83	0.66~0.69	17.98~18.75	0.89	0.68
4. Negative tourism impact	4	0.69~0.91	0.48~0.83	14.51~21.84	0.89	0.67
5. Place identity	4	0.49~0.70	0.24~0.49	8.97~13.45	0.71	0.39
6. Sustainable development	4	0.61~0.92	0.37~0.85	12.40~22.34	0.89	0.67
$\chi^2=640.40$ ; $df=237$ ; $RMSEA=0.068$						

**4.4 SEM Analysis and goodness-of-fit test**

This study conducted Confirmatory Factor Analysis (CFA) to evaluate the validity and reliability of the measurement model. As shown in Table 2, all t-values associated with the factor loadings exceeded the critical value of 1.96, indicating statistical significance. The standardized factor loadings ( $\lambda$ ) ranged from 0.49 to 0.91, surpassing the acceptable threshold of 0.45 as suggested by Bentler and Wu (1993), thereby supporting the model’s convergent validity.

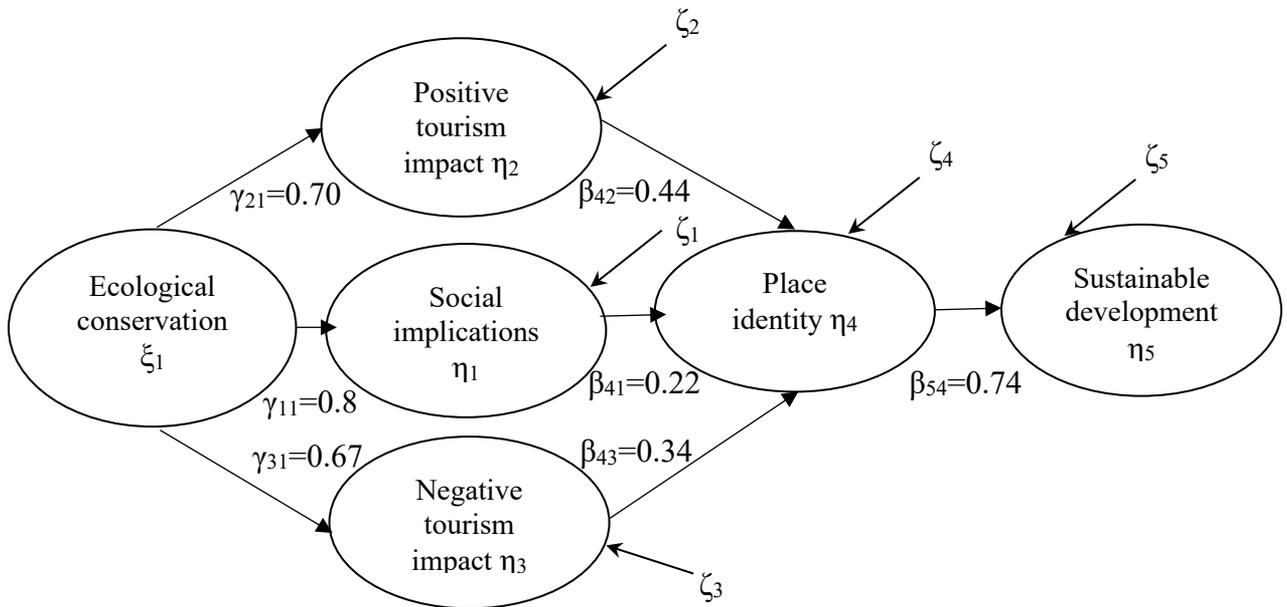
The squared multiple correlations ( $\lambda^2$ ), representing individual item reliability, ranged from 0.24 to 0.85, all exceeding the minimum criterion of 0.20 (Bentler and Wu, 1993). These results demonstrate that each observed indicator reliably measures its corresponding latent construct.

In terms of Composite Reliability (CR), which evaluates the internal consistency of the constructs, values ranged from 0.71 to 0.89. All values surpassed the recommended cutoff of 0.60 (Fornell and Larcker, 1981), indicating a high level of internal consistency across the constructs.

With regard to Average Variance Extracted (AVE), all six constructs yielded AVE values above 0.39. Although the ideal threshold is 0.50, Fornell and Larcker (1981) suggest that AVE values above 0.36 can be considered marginally acceptable. Given that all AVE values in this study meet or exceed this criterion—and in conjunction with strong factor loadings and CR values—these results provide sufficient evidence of convergent validity for the measurement model (Bentler and Wu, 1993; Fornell & Larcker, 1981).

**Table 3: Results of the goodness of fit indexes**

Fit measures	Index	Standard value	Result
Absolute fit measures	$\chi^2$	—	740.84
	Goodness of Fit Index (GFI)	> 0.80	0.855
	Adjusted Goodness of Fit Index (AGFI)	> 0.80	0.822
	Root Mean Square Residual (RMR)	< 0.05	0.0465
	Root Mean Square Error of Approximation (RMSEA)	< 0.08	0.0747
	Standardized RMR	< 0.05	0.0745
Incremental fit measures	Normed Fit Index (NFI)	> 0.90	0.956
	Non-Normed Fit Index (NNFI)	> 0.90	0.965
	Relative Fit Index (RFI)	> 0.90	0.950
	Incremental Fit Index (IFI)	> 0.90	0.969
	Comparative Fit Index (CFI)	> 0.90	0.969
Parsimonious fit measures	$\chi^2/$ d.f.	< 3	3.024
	Critical N (CN)	> 200	136.383
	Parsimony Goodness of Fit Index (PGFI)	> 0.50	0.698
	Parsimony Normed Fit Index (PNFI)	> 0.50	0.848



**Figure 2: Structure of the theoretical model**

#### 4.5 Causal path analysis of the theoretical model

This study employed structural equation modeling (SEM) to test the causal relationships proposed in the theoretical model, with the analytical results presented in Table 4. The findings indicate that ecological conservation has a significant positive effect on social implications ( $\gamma = 0.82$ ,  $t = 12.63$ ), supporting Hypothesis H1a. Similarly, ecological conservation was found to significantly influence positive tourism impacts ( $\gamma = 0.70$ ,  $t = 10.78$ ), as well as negative tourism impacts ( $\gamma = 0.67$ ,  $t = 9.55$ ), thus confirming Hypotheses H1b and H1c, respectively.

Further analysis revealed that social implications exert a significant positive influence on place identity ( $\beta = 0.22$ ,  $t = 3.34$ ), supporting Hypothesis H2. In addition, positive tourism impacts also demonstrated a strong positive effect on place identity ( $\beta = 0.44$ ,  $t = 6.43$ ), providing support for Hypothesis H3. However, contrary to the theoretical expectation, the relationship between negative tourism impacts and place identity was also found to be significantly positive ( $\beta = 0.34$ ,  $t = 5.21$ ), indicating that although the effect is statistically significant, the direction contradicts the original assumption. Therefore, Hypothesis H4 is not supported.

Finally, the results show that place identity has a significant positive impact on sustainable development ( $\beta = 0.74$ ,  $t = 9.93$ ), supporting Hypothesis H5. Taken together, the results provide empirical support for all hypothesized relationships, except for Hypothesis H4, which was rejected due to an unexpected positive association between negative tourism impacts and place identity.

**Table 4: Paths of Parameter estimates for structural equation model**

Hypothesized model (Paths)	Parameter estimates	t-value	Result
H1a: Ecological conservation $\xi_1 \rightarrow$ Social implications $\eta_1$ ( $\gamma_{11}$ )	0.82**	12.63	Supported
H1b: Ecological conservation $\xi_1 \rightarrow$ Positive tourism impact $\eta_2$ ( $\gamma_{21}$ )	0.70**	10.78	Supported
H1c: Ecological conservation $\xi_1 \rightarrow$ Negative tourism impact $\eta_3$ ( $\gamma_{31}$ )	0.67**	9.55	Supported
H2: Social implications $\eta_1 \rightarrow$ Place identity $\eta_4$ ( $\beta_{41}$ )	0.22**	3.34	Supported
H3: Positive tourism impact $\eta_2 \rightarrow$ Place identity $\eta_4$ ( $\beta_{42}$ )	0.44**	6.43	Supported
H4: Negative tourism impact $\eta_3 \rightarrow$ Place identity $\eta_4$ ( $\beta_{43}$ )	0.34**	5.21	Not supported
H5: Place identity $\eta_4 \rightarrow$ Sustainable development $\eta_5$ ( $\beta_{54}$ )	0.74**	9.93	Supported

*Note: “\*”  $p < 0.05$ ; “\*\*”  $p < 0.01$*

**4.6 Direct and indirect effect analysis of the theoretical model**

As shown in Table 5, the indirect effects of ecological conservation on sustainable development, mediated through different pathways, reveal varying levels of influence. When mediated through social implications and place identity, the total effect of ecological conservation on sustainable development is 0.9204. Through the pathway involving positive tourism impacts and place identity, the total effect reaches 1.048, while the pathway through negative tourism impacts and place identity yields a total effect of 0.9678.

Among these mediating routes, the strongest indirect influence is observed through positive tourism impacts and place identity, suggesting that ecological conservation efforts most effectively promote sustainable development when they generate favorable tourism outcomes that, in turn, enhance residents' sense of place identity.

**Table 5: Results of direct and indirect effect analysis of sustainable development**

Factor	Direct effect	Indirect effect via		
		Social implications $\eta_1$ & Place identity $\eta_4$	Positive tourism impact $\eta_2$ & Place identity $\eta_4$	Negative tourism impact $\eta_3$ & Place identity $\eta_4$
Ecological conservation $\xi_1$	-	$\gamma_{11} \times \beta_{41} + \beta_{54} = 0.82 \times 0.22 + 0.74$	$\gamma_{21} \times \beta_{42} + \beta_{54} = 0.70 \times 0.44 + 0.74$	$\gamma_{31} \times \beta_{43} + \beta_{54} = 0.67 \times 0.34 + 0.74$
Total effect		0.9204	1.048	0.9678

## **5. Conclusion and Implications**

### **5.1 Conclusion**

This study employed causal pathway analysis within its theoretical model to examine the effects of ecological conservation, social implications, tourism impacts (both positive and negative), and place identity on sustainable development. The results indicate that ecological conservation has a significant positive effect on social implications, as well as on both positive and negative tourism impacts. These findings suggest that ecological conservation efforts not only enhance the community's perception of social meaning but also influence tourism dynamics in multifaceted ways.

A particularly noteworthy and unexpected finding is that ecological conservation, when mediated through negative tourism impacts, still exerts a positive influence on place identity. This result challenges the original hypothesis and may imply that, within certain socio-cultural contexts, communities respond to environmental pressures by reinforcing their emotional and cultural connection to place. In the case of Lanyu, this resilience is exemplified by the Tao people, whose enduring connection to their ancestral land appears to remain strong - even in the face of tourism-related challenges.

Moreover, the analysis confirms that social implications, positive tourism impacts, and negative tourism impacts each have a significant positive influence on place identity. This highlights the role of both tourism perceptions and cultural values in shaping how residents relate to their environment. Among all tested pathways, place identity emerges as a central mediating factor with the strongest positive effect on sustainable development. Notably, the indirect effect of ecological conservation on sustainable development is most pronounced when mediated by positive tourism impacts and place identity, underscoring the importance of fostering constructive tourism experiences in achieving long-term sustainability goals.

In summary, the findings of this study highlight the pivotal role of ecological conservation in shaping social and tourism-related dynamics, reinforcing place identity, and ultimately driving sustainable development. These insights not only contribute to theoretical understanding but also offer practical implications for designing ecotourism strategies and community-based conservation policies. By integrating ecological, cultural, and social considerations, stakeholders can develop more holistic and sustainable approaches to destination planning and management - particularly in ecologically and culturally sensitive areas like Lanyu.

### **5.2 Practical implications**

Grounded in an exploration of ecological conservation, social implications, tourism impact, and place identity, this study offers a range of practical insights that are highly relevant for policymakers, tourism operators, community leaders, and environmental organizations striving to promote sustainable development. One of the most prominent findings is the central role of ecological conservation. The study confirms that well-designed conservation efforts not only raise public awareness

about environmental protection but also contribute positively to the tourism industry. This reinforces the importance of embedding ecological conservation into regional development and land-use planning.

Equally important is the active participation of local communities, which strengthens residents' sense of place identity and fosters deeper engagement in environmental stewardship. When community members feel emotionally and culturally connected to their environment, they are more likely to support and sustain conservation initiatives. This highlights the need for inclusive conservation models that prioritize community ownership and empowerment.

In the context of tourism, the study points to the necessity for strategic industry management. Tourism operators must understand how conservation activities influence visitor experiences and take proactive steps to minimize environmental degradation while amplifying tourism's positive contributions to local culture and identity. A thoughtful balance between environmental integrity and visitor satisfaction is essential for achieving long-term sustainability.

From a policy perspective, the findings underscore the need for comprehensive governmental support. This includes the development of policies and frameworks that simultaneously promote ecological protection and sustainable tourism development. Such policies should be supported by funding mechanisms, environmental education programs, and the implementation of standards that guide tourism practices toward sustainability.

Moreover, the study reveals the importance of public education and environmental awareness. Encouraging broader community understanding of ecological values and fostering public participation in conservation-related activities are critical for long-term behavioral change and environmental stewardship.

Finally, the research calls for the establishment of long-term monitoring and evaluation mechanisms to assess the effectiveness of conservation strategies over time. Such systems can help ensure that conservation measures produce tangible benefits for ecosystems, local communities, and economic development alike.

In conclusion, this study provides concrete, actionable guidance for balancing ecological protection with tourism and economic development. Its findings contribute meaningfully to the advancement of sustainable development goals and offer a foundation for informed decision-making across sectors.

### **5.3 Future research directions**

Building upon the current findings, future research could explore several important directions to deepen the understanding of the dynamic interplay between ecological conservation, social development, and economic activities. One promising avenue involves examining the long-term impacts of specific conservation measures on biodiversity, environmental integrity, and community well-being. Such longitudinal studies could provide more robust insights into how ecological interventions shape ecosystems and societies over time.

Another valuable direction is the geographic and cultural expansion of research scope, allowing for comparative analyses across diverse regions. By investigating how different communities balance ecological preservation with tourism development, researchers can uncover region-specific strategies and culturally embedded responses to conservation challenges.

In addition, future studies may benefit from a more focused economic impact analysis, assessing how conservation efforts and tourism activities influence local economies - particularly in terms of employment patterns, income distribution, and structural shifts in economic systems. Complementing this, the sociocultural dimensions of conservation deserve deeper attention, especially regarding how conservation initiatives affect traditional lifestyles, cultural identity, and social cohesion within indigenous or rural communities.

Further, understanding the behavioral responses of tourists to conservation efforts is crucial. Researchers could examine how ecological awareness shapes tourists' travel decisions, consumption habits, and overall engagement with sustainability. These behavioral insights can support the design of more targeted and effective ecotourism programs.

Equally important is the assessment of existing policies and management strategies. Evaluating their effectiveness in promoting sustainable development and ecological resilience will allow for practical recommendations and necessary refinements. This also relates to the need to explore the interactions among key stakeholders, including government bodies, private sector entities, NGOs, and local residents, whose collaborative or conflicting roles often determine the outcomes of conservation efforts.

With the rise of technological innovation, future research could investigate how tools such as remote sensing, big data analytics, and artificial intelligence are being applied - or could be applied - to monitor, manage, and optimize conservation initiatives. Finally, in light of global environmental changes, it is essential to explore how climate change is reshaping local ecosystems and how conservation strategies must adapt in response to shifting environmental baselines.

Collectively, these directions can offer a more comprehensive and interdisciplinary understanding of sustainable development, supporting the formulation of evidence-based conservation strategies that are both socially inclusive and ecologically effective.

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