

# ANALYSIS OF KEY FACTORS INFLUENCING PENGHU TOURISM DEVELOPMENT USING THE DELPHI METHOD AND AHP

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## ABSTRACT

*As Taiwan's largest offshore island, Penghu boasts a rich historical and cultural heritage, with a development history that predates Taiwan by 400 years. The island's unique climate, geographical environment, and natural resources have shaped its distinctive landscape. In the past, Penghu's economy mainly relied on fisheries. To promote the transformation of traditional industries and boost local economic growth, the Penghu County Government and the Penghu National Scenic Area Administration have leveraged the local basalt geology, island ecology, and cultural characteristics to promote tourism. They have also organized various festivals and events to attract visitors. This study employs the Analytic Hierarchy Process (AHP) method, drawing on relevant literature and expert opinions, to categorize the factors affecting Penghu's tourism development into four primary levels: "Transportation," "Accommodation," "Tourism Resources," and "Tour Guide Services and Facilities," which are further subdivided into 15 secondary criteria. In terms of transportation, the criteria include: "Air Transport between Taiwan and Penghu," "Sea Transport between Taiwan and Penghu," and "Inter-island Transportation." For accommodation, the criteria cover: "Hotels," "Unique Bed and Breakfasts," and "Local Cuisine." Tourism resources consist of: "Ecological Landscapes," "Traditional Settlement Architecture," "Festivals and Events," "Industrial Tourism," and "Military Heritage." Lastly, tour guide services focus on: "Interpretation Skills," "Professional Knowledge," "Service Attitude," and "Guide Facilities." The results indicate that the priority ranking of the primary levels is: 1. Transportation, 2. Tourism Resources, 3. Accommodation, and 4. Tour Guide Services. Among the secondary criteria, the top five most important factors are: 1. Air Transport between Taiwan and Penghu, 2. Ecological Landscapes, 3. Hotels, 4. Sea Transport between Taiwan and Penghu, and 5. Inter-island Transportation. This study concludes with the research findings and related recommendations, aiming to provide a reference for the future development of tourism in Penghu.*

## KEYWORDS

Tourism Resources, Island Tourism, Analytic Hierarchy Process, Key Tourism Factors

## 1. INTRODUCTION

The COVID-19 pandemic has severely impacted the outbound tourism industry, leading many travel agencies to face bankruptcy or layoffs. Some operators have shifted their focus to the domestic tourism market, intensifying competition within the industry. In light of the rapid changes in tourist demand, the traditional operating models of the tourism sector are proving inadequate, placing Penghu's tourism development at a critical turning point. Identifying the key factors influencing Penghu's tourism development through surveys, statistics, and analysis has become an urgent issue, with the goal of establishing Penghu as a new tourism highlight in the Taiwan Strait.

Since the government approved the "Penghu Low Carbon Island Project" in 2011[1], the Penghu County Government has actively promoted green energy and cultural tourism development. The island's rich natural scenery, including the flavors of fishing villages, the greenery of vegetable gardens, swaying cosmos flowers, pristine beaches, and majestic basalt formations, has left a lasting impression on visitors. Therefore, this paper focuses on promoting and developing domestic island tourism, integrating literature on Penghu's ecology and cultural environment for systematic comparative analysis. It aims to enhance understanding of island tourism in Penghu and provide valuable references for future tourism development.

This research intends to gather and integrate data to gain a deeper understanding of Penghu's unique ecological environment, assess its existing advantages and potential opportunities, improve cultural conditions under adverse circumstances, and create a high-quality ecological tourism environment through thorough planning and expert evaluation. The specific research objectives are as follows:

- Analyze the current state of Penghu's tourism and explore the hierarchical structure of key factors affecting its development.
- Analyze the relationships of relative importance among various key factors.
- Provide directions for the sustainable development of tourism in Penghu in the future.

The research includes the following eight steps:

- Establishment of Research Theme: Define the research theme as "A Study on Key Factors Influencing Penghu's Tourism Development."
- Literature Review and Discussion: Collect literature related to Penghu tourism as a reference for subsequent analysis.
- Establishment of Research Method and Framework: Use the Analytic Hierarchy Process (AHP) as the primary research method.
- Design of Questionnaire and Expert Review: Develop the AHP questionnaire structure, which will be modified after discussions and pilot testing with experts.
- Questionnaire Implementation and Expert Consultation: Conduct surveys targeting personnel from relevant public departments, tourism industry practitioners, and university faculty in the Penghu region, and consult expert opinions.
- Data Integration and Analysis: Use software to perform consistency index (C.I. and C.R.) analysis, assessing the weight of each level and the overall weight.
- Discussion of Research Results: Compare overall weights across different background variables and discuss the reasons behind them.
- Conclusion and Recommendations: Based on the research findings, provide recommendations for relevant execution units and the industry, and offer reference materials for future researchers.

## **2. LITERATURE REVIEW**

This study establishes the theoretical foundation required for the research by collecting, organizing, analyzing, and summarizing relevant literature. The main content of the research includes "Current Status of Tourism Development in Penghu," "Key Factors for Tourism Development," and "Analytic Hierarchy Process (AHP)."

## **2.1. Current Status of Tourism Development in Penghu [2,3]**

Penghu is located in the Taiwan Strait and consists of 90 islands of varying sizes surrounded by the sea. Its geographical position makes the waters around Penghu a gathering place for ocean currents, resulting in rich natural ecological resources. The marine ecosystem of Penghu includes precious species such as green turtles, hawksbill turtles, and leatherback turtles, and the seabed is covered with extensive coral reefs. Additionally, Penghu boasts beautiful golden beaches, such as Aimen, Jiali, and Shawei, as well as unique coastal geological features. The Penghu archipelago not only has natural landscapes but also possesses rich cultural assets, basalt topography, and a long history and culture. During peak tourist seasons, these characteristics attract many visitors to enjoy the sea views, explore local culture, and taste local delicacies. In recent years, tourism-related units have increased their investment in scenic facilities, recreational resources, and tourism marketing, significantly enhancing the benefits of the tourism industry and attracting many visitors from outside. According to a survey by the Penghu National Scenic Area Administration [3], the number of tourists has stabilized at around 1 million in recent years, indicating that Penghu's tourist attractions have strong competitiveness and are rapidly developing, becoming one of the main economic activities in Penghu.

## **2.2. Key Important Factors for Tourism Development**

Key important factors for tourism development can be explored from multiple perspectives, including destination attractiveness, accessibility, infrastructure, service quality, and marketing strategy [4-9]. Destination attractiveness is the foundation of tourism development, encompassing natural landscapes, cultural resources, cultural activities, and historical sites, which can enhance the competitiveness of the tourism destination [7,10]. Furthermore, accessibility is an important prerequisite for attracting tourists, dependent on the convenience of transportation facilities such as air, rail, and road systems, and a good transport network can significantly increase the visitation rate to the tourism destination [6,11]. Infrastructure involves accommodations, dining, entertainment, and safety facilities at the tourism site, all of which can affect the overall travel experience of visitors [12]. Service quality also plays a critical role in tourism development, especially regarding the attitudes, professionalism, and service efficiency of service personnel. These factors directly influence tourist satisfaction and their willingness to revisit [9,13]. Marketing strategy is an important means to enhance the visibility and attractiveness of tourism destinations; through market segmentation, brand positioning, and digital marketing strategies, destinations can effectively enhance their competitive advantage and attract more potential tourists [14]. By effectively integrating various resources and strategically developing the aforementioned factors, tourism destinations can enhance the overall competitiveness and sustainable development of the tourism industry.

## **2.3. Analytic Hierarchy Process (AHP)**

The Analytic Hierarchy Process (AHP) is a simple yet practical theoretical tool that has been widely used in various studies since it was developed by Professor Thomas L. Saaty at the University of Pittsburgh in 1971 [15]. The main purpose of the AHP method is to systematize complex problems by decomposing issues into hierarchical structures and using quantitative methods for comprehensive evaluation, providing appropriate solutions for decision-makers. This method is particularly suitable for decision-making problems involving uncertainty and multiple evaluation criteria [16].

The development of AHP has gone through several applications and modifications until the theory matured in 1978. AHP breaks down complex problems into simpler factors through multi-objective and multi-evaluation indicator analysis, employing pairwise comparison for assessment.

These data are transformed into a pairwise comparison matrix, and after calculations, the eigenvalues of the matrix are obtained to assess the importance of each factor, providing reference information for decision-making [16-19]. The main steps of AHP [15-19] are as follows:

- **Problem Definition and Hierarchical Structure Construction:** Clearly define the research problem and establish a hierarchical structure based on the characteristics of the problem, including goal, criterion, and alternative levels.
- **Pairwise Comparison:** Based on expert opinions or relevant data, conduct pairwise comparisons of the various elements in the hierarchical structure to establish a comparison matrix. Use scales to evaluate the relative importance of different factors, typically employing a 1-to-9 scale system.
- **Consistency Check:** Examine the consistency of the pairwise comparison results to ensure the reliability of the assessments. The Consistency Ratio (CR) is primarily used for evaluation, with CR values less than 0.1 being acceptable.
- **Weight Calculation:** Calculate the weights of various factors based on the comparison matrix, usually using the eigenvalue method to obtain the importance weights of each criterion.
- **Comprehensive Assessment and Analysis:** Conduct a comprehensive assessment based on the calculated weights, analyze the influence of each factor on the overall decision-making, and propose corresponding recommendations based on the results.

### **3. RESEARCH METHODOLOGY**

This study employs the Analytic Hierarchy Process (AHP) to conduct the research, following these steps:

#### **3.1. Research Framework and Participants**

The research framework was developed based on expert opinions and a comprehensive review of relevant literature. To collect expert opinions, the Delphi Method [18,19], also known as the Expert Judgment Method, was utilized. The Delphi Method is a group decision-making tool used to manage expert group consensus. Experts provided their opinions through written responses, emails, or online questionnaires in an anonymous environment. The core of the Delphi Method lies in reducing differences in expert opinions through multiple rounds of feedback until a consensus is reached. Due to the time and effort required for repeated feedback loops in the traditional Delphi Method, this study adopted the Modified Delphi Method [19]. The Modified Delphi Method simplifies the questionnaire process while retaining the essence of the traditional approach. It often replaces the initial open-ended questionnaire with a review of literature or in-depth interviews with experts. In the end, nine experts with extensive knowledge of the tourism industries in Taiwan and Penghu were invited to participate in this study through expert interviews and questionnaire consultations (Table 1).

Table 1. Members of the Expert Interview and Consultation Questionnaire

Expert Representative	Affiliation
Expert 1	Deputy Director, Scenic Management Division, Tourism Bureau
Expert 2	Government Bureau Chief
Expert 3	Village Chief, Government Sector
Expert 4	Assistant Professor, University
Expert 5	Assistant Professor, Department of Tourism, University
Expert 6	Guesthouse Owner
Expert 7	Restaurant Manager
Expert 8	General Manager, Leisure and Entertainment Company
Expert 9	Manager, Beach Leisure Company

### 3.2. Research Tools and Data Analysis

To achieve the research objectives, a literature review and analysis were conducted to establish the theoretical foundation. First, relevant information from the Penghu National Scenic Area Administration and the Penghu County Government Tourism Office was collected, along with literature on AHP. This formed the initial draft of the “Hierarchical Structure and Indicator Evaluation List,” which served as the framework for subsequent research. This list was then refined through expert consultation, resulting in the “AHP Hierarchical Structure and Indicator Evaluation Expert Consultation Questionnaire.” The questionnaire design comprises four main dimensions and fifteen key evaluation items, which include:

#### A. Transportation:

- A-1 Air transport between Taiwan and Penghu
- A-2 Maritime transport between Taiwan and Penghu
- A-3 Inter-island transportation

#### B. Accommodation and Food:

- B-1 Hotels
- B-2 Specialty guesthouses
- B-3 Local cuisine

#### C. Tourism Resources:

- C-1 Ecological landscapes
- C-2 Traditional architecture in settlements
- C-3 Festivals and events
- C-4 Industrial tourism development
- C-5 Military heritage and facilities

#### D. Tour Guides and Facilities:

- D-1 Tour guide presentation skills

- D-2 Tour guide expertise
- D-3 Tour guide service attitude
- D-4 Tour guide facilities

These dimensions and evaluation items form the basis for establishing an evaluation model, which will be quantitatively analyzed using the AHP method. The questionnaire utilizes a five-point nominal scale to compare factors pairwise, allowing respondents to evaluate the relative importance of each factor.

During data processing and analysis, the consistency of the pairwise comparison matrix must be verified. Saaty [10] suggests using the Consistency Index (C.I.) and the Consistency Ratio (C.R.) to ensure consistency:

- C.I. measures the degree of consistency of the pairwise comparison matrix. Its formula is  $C.I. = (\lambda_{max} - n) / (n - 1)$ , where  $\lambda_{max}$  is the largest eigenvalue of the pairwise comparison matrix, and  $n$  is the order of the matrix.
- C.R. is used to assess the C.I. relative to a Random Index (R.I.). The formula is  $C.R. = C.I. / R.I.$ , where R.I. is the average Consistency Index based on random matrices, and its value varies according to the order of the matrix.

The screening criteria are as follows:

- The Consistency Index (C.I.) should be less than 0.1.
- The Consistency Ratio (C.R.) should be less than 0.1.

If all questionnaires meet these screening criteria, the pairwise comparison matrix is considered to have good internal consistency, allowing further analysis and evaluation to be carried out.

## 4. RESEARCH RESULTS AND DISCUSSION

### 4.1. Establishment of Hierarchical Structure

After confirming the preliminary research dimensions and evaluation items, this study, with revisions based on expert opinions, established a hierarchical structure. The final hierarchical structure includes four major dimensions and fifteen evaluation items:

- (1) Dimension A: Transportation
- (2) Dimension B: Accommodation
- (3) Dimension C: Tourist Resources
- (4) Dimension D: Tour Guides and Facilities

These four major dimensions and their respective items collectively constitute the main framework for evaluating the tourism development of Penghu.

### 4.2. Recovery of Hierarchical Analysis Questionnaires

- (1) Questionnaire Recovery Status: A total of 9 questionnaires were distributed to experts from various tourism-related sectors. Two questionnaires were excluded as invalid due to incomplete responses.
- (2) Consistency Testing: All valid questionnaire data underwent consistency indicator (C.I.) and consistency ratio (C.R.) testing. The C.I. values and C.R. values for the overall

dimensions and sub-dimensions were all less than 0.1, indicating good internal consistency in the perspectives and judgments of the experts. Table 2 displays the consistency indicators and ratios for each dimension, indicating the results of the tests.

Table 2. Consistency Testing Results

Dimension	Consistency Indicator (C.I.)	Consistency Ratio (C.R.)	Passed/Failed
Overall Dimension	0.0631	0.0747	Passed
Dimension A	0.0731	0.0918	Passed
Dimension B	0.0786	0.0951	Passed
Dimension C	0.0648	0.0389	Passed
Dimension D	0.0358	0.0689	Passed

### 4.3. Overall Analysis of Key Factors in Penghu Tourism Development

Based on the data obtained from the questionnaires, the weight values of each dimension and key factor items were calculated. Table 3 summarizes the overall weight values and rankings of the main dimensions and their key factor items, highlighting the relative importance between different dimensions and factors.

Table 3. Ranking of Key Factors in Penghu Tourism Development by Overall Weight of Dimensions and Evaluation Items

Main Dimension	Weight	Rank	Evaluation Item	Dimension Weight	Overall Weight	Overall Rank
A. Transportation	0.4628	1	A-1 Penghu Airlines	0.6638	0.3072	1
			A-2 Penghu Ferry	0.1795	0.0831	4
			A-3 Inter-Island Transport	0.1567	0.0725	5
B. Accommodation	0.1621	3	B-1 Hotels	0.5268	0.0854	3
			B-2 Featured B&Bs	0.3014	0.0489	9
			B-3 Local Cuisine	0.1718	0.0278	13
C. Tourist Resources	0.2897	2	C-1 Ecological Scenery	0.4387	0.1271	2
			C-2 Traditional Architecture	0.1782	0.0516	7
			C-3 Festival Activities	0.1687	0.0489	8
			C-4 Industrial Activities in Tourism	0.1387	0.0402	11
			C-5 Military Relics and Facilities	0.0757	0.0219	14
D. Tour Guides and Facilities	0.0854	4	D-1 Tour Guides' Explanation Skills	0.2147	0.0348	12
			D-2 Tour Guides' Professional Knowledge	0.2941	0.0477	10
			D-3 Tour Guides' Service Attitude	0.3674	0.0596	6
			D-4 Guiding Facilities	0.1238	0.0201	15

### 4.4. Overall Weight Ranking

- (1) Transportation: The highest importance, significantly affecting the convenience of island tourism.
- (2) Tourist Resources: Secondary importance, highlighting the key role of tourist resources in the development of Penghu tourism.

- (3) Accommodation: The importance of infrastructure cannot be overlooked.
- (4) Tour Guides and Facilities: Auxiliary factors that enhance the travel experience.

The above analysis provides practical guidance for Penghu tourism development, indicating that future strategies should be adjusted and optimized based on these key factors.

#### **4.5. Key Factor Ranking and Analysis**

- (1) Top 5 Key Factors is A-1 Penghu Airlines (0.3072), C-1 Ecological Scenery (0.1271), B-1 Hotels (0.0854), A-2 Penghu Ferry (0.0831), A-3 Inter-Island Transport (0.0725), The three transportation factors-Penghu Airlines, Penghu Ferry, and Inter-Island Transport-rank highest in overall weight, demonstrating the crucial importance of transportation convenience for Penghu tourism development. This reflects that good transportation connectivity can directly impact tourist flow and overall travel experience. The ecological scenery ranked second, indicating the significant role of natural scenery in attracting visitors. Penghu boasts rich natural landscapes and ecological resources, thus, tourism development should emphasize the protection and utilization of these natural resources to attract more visitors. The ranking of hotels third underscores the importance of the accommodation environment for the travel experience. High-quality lodging facilities can enhance visitor satisfaction and promote tourism industry development.
- (2) Key Factors Ranked 6 to 15: D-3 Tour Guides' Service Attitude (0.0596), C-2 Traditional Architecture (0.0516), C-3 Festival Activities (0.0489), B-2 Featured B&Bs (0.0489), D-2 Tour Guides' Professional Knowledge (0.0477), C-4 Industrial Activities in Tourism (0.0402), D-1 Tour Guides' Explanation Skills (0.0348), B-3 Local Cuisine (0.0278), C-5 Military Relics and Facilities (0.0219), D-4 Guiding Facilities (0.0201)
- (3) Cultural and activity factors such as festival activities and traditional architecture also have significant impacts on the travel experience, but their weights are slightly lower compared to transportation and ecological scenery. Featured B&Bs and local cuisine positively influence the travel experience, but they rank lower overall. The service attitude, professional knowledge, and explanation skills of tour guides also hold significant weight, indicating that good guiding services are vital for enhancing the travel experience. Guiding facilities ranked lowest, suggesting that in this study, the relative importance of guiding facilities was assessed as the lowest, possibly because other factors have a more significant impact on the travel experience.

Overall, the key factors for Penghu tourism development mainly focus on transportation convenience, protection of natural scenery, and accommodation quality. These factors directly influence the travel experience and development potential, thus should be prioritized in formulating tourism development strategies.

### **5. CONCLUSION AND RECOMMENDATIONS**

Based on the objectives of this study, which integrated literature to analyze the current state of tourism development in Penghu and explored the key factors for its tourism development while establishing a hierarchical structure, the findings indicate that the key factors for developing tourism in Penghu should focus on "transportation" while placing emphasis on "tourist resources" and "accommodation" in travel itinerary planning. The importance of "tour guides and facilities" was assessed to be relatively low



## 5.1. Conclusion

### (1) Weight Ranking Analysis of Four Major Dimensions

- The transportation dimension has the highest weight, indicating that addressing transportation issues is a priority for the development of tourism in Penghu.
- Tourist resources ranked second, highlighting the crucial role of natural scenery and cultural resources in attracting visitors.
- Accommodation ranked third, emphasizing the importance of high-quality lodging for the travel experience.
- The weight of tour guides and facilities was the lowest, suggesting that, while they have some impact, their importance is relatively insufficient compared to other dimensions.

### (2) Overall Item Evaluation by Weight Ranking and Distribution

- The top five key factors were "A-1 Penghu Airlines," "C-1 Ecological Scenery," "B-1 Hotels," "A-2 Penghu Ferry," and "A-3 Inter-Island Transport."
- The lowest weight was assigned to "D-4 Guiding Facilities," indicating that this factor is currently less important in tourism development.
- Overall results indicate that improving transportation convenience, enhancing the protection of tourist resources, and improving accommodation quality are the main directions for development.

## 5.2. Recommendations for Improving Key Factors in Penghu Tourism Development

### (1) Revitalizing Winter Tourism Highlights

- Promote winter tourism in Penghu by emphasizing the scenic beauty and religious activities, adding unique experiences such as intertidal ecology, traditional cuisine, and leisurely rural lifestyles to attract winter visitors.
- Innovate winter tourism products by integrating traditional cultural activities with modern travel experiences to expand the winter tourism market.

### (2) Optimizing Air Services

- Design more flexible flight scheduling options, such as early arrival and return or late arrival and return flights, along with discounted prices to reduce transportation pressure during peak periods.
- Encourage airlines to develop more flight options to enhance flexibility and convenience.

### (3) Improving Ferry Services

- Develop new routes connecting Chiayi's Budai Port with major offshore islands in Penghu (e.g., Dongji Island, Qimei Island) to shorten travel times and lower transportation costs for visitors.
- Collaborate with shipping operators to improve the comfort and efficiency of ferry services, enhancing the overall travel experience.

(4) Innovating Accommodation Experiences

- B&B operators can integrate local culture into accommodations by offering customizable ingredients and hands-on cooking experiences to enhance the entertainment value and local character of lodging.
- Encourage B&Bs to design experiences that reflect the unique characteristics of Penghu, improving overall visitor satisfaction.

(5) Protecting and Developing Unique Resources

- Focus on protecting and developing traditional fishing activities and military relics, uncovering their tourism potential and incorporating them into travel itineraries.
- Promote local unique tourist resources to increase the visibility of these special activities in the tourism market, enhancing the diversity and appeal of Penghu tourism.

The above recommendations aim to address the primary issues in Penghu tourism development by providing specific improvement measures, promoting the sustainable development of Penghu's tourism industry, and enhancing the overall visitor experience.

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