frontiers | Frontiers in Sustainable Tourism

TYPE Original Research
PUBLISHED 03 June 2025
DOI 10.3389/frsut.2025.1553781

The evaluation system for the fishing harbor transition to sustainable sailing-yacht tourism

Cheng-Yu Hsu[1], Ye Shen[2]* and Josip Mikulić[3,4]

[1]Department of Recreational Sport, National Taiwan University of Sport, Taichung, Taiwan, [2]Experience Industry Management Department, California Polytechnic State University, San Luis Obispo, CA, United States, [3]Faculty of Economics and Business, University of Zagreb, Zagreb, Croatia, [4]Institute for Tourism, Zagreb, Croatia

Check for updates

OPEN ACCESS

EDITED BY
Leszek Butowski,
University of Łódz, Poland

REVIEWED BY
I. Gusti Bagus Rai Utama,
Dhyana Pura University, Indonesia
Gebeyaw Ambelu Degarege,
Lincoln University, New Zealand
Yenal Yağmur,
Siirt University, Türkiye
François Gravelle,
University of Ottawa, Canada

*CORRESPONDENCE
Ye Shen
yeshen@calpoly.edu

RECEIVED 31 December 2024
ACCEPTED 16 April 2025
PUBLISHED 03 June 2025

CITATION
Hsu C-Y, Shen Y and Mikulić J (2025) The evaluation system for the fishing harbor transition to sustainable sailing-yacht tourism. *Front. Sustain. Tour.* 4:1553781.
doi: 10.3389/frsut.2025.1553781

Introduction: Fishing harbor cities often face decline due to the depletion of fishing resources. In response, this study aims to develop an expert evaluation system to assist in transitioning these harbors toward sustainable sailing-yacht tourism. Such a transition aligns with the objectives of Sustainable Development Goals (SDGs) 14 (Life Below Water) and 11 (Sustainable Cities and Communities).

Methods: To construct the evaluation framework, the Analytical Network Process (ANP) was used to determine the interdependent relationships among criteria, while the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) was applied to rank and prioritize alternatives. This integrated approach facilitated a comprehensive evaluation model for sustainability transitions in harbor redevelopment.

Results: An empirical case study conducted in the Asia-Pacific region demonstrated the application of the expert system in selecting an ideal fishing harbor for redevelopment. The combined ANP-TOPSIS model effectively identified the most suitable harbor by systematically analyzing multiple dimensions related to sustainable tourism development.

Discussion: This research contributes to the planning and development of sustainable harbors, urban areas, and sailing-yacht tourism. It offers a comprehensive evaluation model grounded in expert decision-making methods. Furthermore, the findings suggest that fishing harbors, especially those in archipelagic regions, possess significant potential for transformation into sustainable sailing-yacht tourism destinations, supporting broader SDG implementation efforts.

KEYWORDS

sustainable development goals, sustainable ocean governance, marine management, sustainable harbor transition, boating tourism, sailing-yacht tourism

1 Introduction

Fishing harbors are facilities that support fishing activities and provide a sheltered body of water where ships and boats can dock. The main fishing harbors, such as the Port of Vigo in Spain and Chimbote in Peru, serve as economic pillars for their respective countries. However, these harbors face the challenge of unsustainable development. The unsustainability of fishing harbors stems from multiple factors related to resource depletion, environmental degradation, inefficient infrastructure management, and economic vulnerability. One of the most pressing concerns is the overexploitation of fishery resources. The same revenue cannot be maintained every year because fishery resources are limited and have declined. There is a need for the transitioning of traditional fishing harbors to multifunction harbors to facilitate economic development. From a sustainable development perspective, it is also an opportunity to achieve SDG (Sustainable

Development Goal) 14, *conserve and sustainably use the oceans, seas, and marine resources*. Furthermore, this transition can also achieve SDG 11, *making cities inclusive, safe, resilient, and sustainable*. Conservation can manage and sustain ocean and marine resources by altering industries from unsustainable to environmentally friendly ones.

The most common alternative business model for traditional fishery transition is recreational fisheries (Chen and Chang, 2017). In addition, sailing-yacht tourism is one option for a transition that uses fewer or no marine resources and creates more sustainable and livable cities (Abbott et al., 2022; McCarthy, 2003). Coastal countries have developed sailing-yacht tourism due to their environmental awareness and the need to boost economic growth. Cities that have reconstructed their fishing harbors with the potential for sailing-yacht tourism have transitioned to sailing-yacht harbors for more sustainable economic advantages (Bicak et al., 2006; Cariola, 2022). Harbor cities have promoted sailing-yacht tourism as a strategy for city development and regeneration due to the industry's financial benefits and sociocultural characteristics (Ioannidis, 2019; Yarovaya, 2013). However, while sailing-yacht tourism presents environmental and economic advantages, it also introduces potential ecological and sociocultural challenges. Increased yacht tourism can lead to seabed disturbances from anchoring, water pollution from waste discharge, and increased marine traffic, which may disrupt sensitive coastal ecosystems. Moreover, the shift from traditional fisheries to yacht tourism may create socio-economic tensions if local fishing communities are not adequately integrated into new tourism-based economies. Ensuring sustainability in this transition requires strategic planning, regulatory frameworks, and active engagement with local stakeholders to balance tourism development with environmental conservation and cultural preservation (Gedik and Mugan-Ertugral, 2019; Pásková et al., 2024).

Although many cities and countries desire to develop sailing-yacht tourism that can produce benefits for cities and the environment compared to original local fisheries, there are some limitations and bottlenecks. Emerging and developing sailing-yacht tourism cities have encountered problems such as limited navigable waters and a lack of public marinas and dedicated ports (Wang et al., 2017). In addition, sailing-yacht tourism destinations encounter competition from nearby countries or cities (Syafruddin et al., 2019), which results in wasted investments and damage to the natural and cultural environment without proper planning (Sevinç and Güzel, 2017). Therefore, it is necessary to sufficiently evaluate and plan for conditions from all aspects to prevent failure in substituting sailing-yacht tourism for fisheries. Rather than solely substituting fisheries with sailing-yacht tourism, a broad-based development strategy that integrates existing indigenous practices and local maritime traditions into new tourism plans could enhance long-term sustainability (Jugović et al., 2011). Many coastal and fishing communities have rich cultural and ecological knowledge that could contribute to responsible tourism development, such as sustainable seafood industries, eco-friendly boat-building techniques, and traditional navigation practices. Incorporating these elements into tourism initiatives, such as cultural sailing experiences, guided eco-tours, and locally led marine conservation programs, could diversify economic opportunities while preserving community identity and ecological balance.

Evaluating the conditions for the transition from fishing harbors to sailing-yacht harbors to develop sailing-yacht tourism needs multi-criteria decision-making (MCDM). The analytic hierarchy process (AHP) is an efficient method to solve MCDC problems (Pant et al., 2022) and has been applied to similar evaluation problems, such as selecting a cruise port (Wang et al., 2014), assessing resource-based tourism competitiveness (Horak et al., 2006), and evaluating sustainability in coastal lands (Luković, 2012). The AHP method assumes that all evaluation criteria are independent; however, criteria are often dependent in most actual situations. Saaty (2007) developed the analysis network process (ANP) method to consider the criteria relationships of dependence and feedback. The AHP and ANP are both based on experts' opinions to quantify the weights of each criterion. The main difference between these two methods is that AHP analyzes the decision problem based on a hierarchy considering goals, criteria, and alternatives, while the ANP structures the system as a network (Saaty, 2007).

The current study attempted to develop an expert evaluation system based on the ANP method integrated with the TOPSIS method to establish an evaluation framework for assessing fishing harbors' transition to develop sailing-yacht tourism for the emerging market in the Asian Pacific area. To further enhance decision-making accuracy, this study integrates the ANP method with the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). TOPSIS is a ranking method that evaluates multiple alternatives based on their relative closeness to an ideal solution (Fu et al., 2020; Tavana et al., 2020; Rezvani et al., 2022). Unlike ANP, which focuses on determining the relative importance of criteria, TOPSIS is used to rank alternatives based on their performance across multiple criteria. The core principle of TOPSIS is that the best alternative should have the shortest Euclidean distance from the ideal solution and the farthest distance from the worst solution. By applying TOPSIS, this study ensures a more objective evaluation of fishing harbors' potential for transition, balancing multiple interdependent factors such as geographic location, infrastructure readiness, environmental conditions, and economic feasibility.

This study applies the ANP-TOPSIS framework to assess the transition potential of fishing harbors in the Asia-Pacific region, where many fisheries are on the brink of collapse due to overfishing (DeRidder and Nindang, 2018; Weerawat, 2024). Given the pressing need for sustainable economic alternatives, sailing-yacht tourism has emerged as a viable industry for revitalizing coastal economies while mitigating environmental impacts. The study evaluates three fishing harbors in Taiwan as empirical cases to illustrate how the ANP-TOPSIS evaluation system can guide decision-making in harbor transitions. The results provide practical implications for harbor planners, policymakers, and tourism developers seeking to promote sustainable maritime tourism while ensuring environmental conservation and economic resilience.

By leveraging the ANP-TOPSIS framework, this study not only contributes to the theoretical development of multi-criteria decision-making in tourism planning but also offers practical insights for coastal cities aiming to transition toward sustainable maritime tourism. The findings serve as a decision-support tool for harbor authorities and destination management organizations (DMOs). The framework supports investment and planning decisions by incorporating a holistic assessment of economic, environmental, and infrastructural factors. As coastal tourism evolves, structured evaluation frameworks such as the one proposed in this study will be essential for achieving long-term sustainability in maritime tourism development.

2 Literature review

2.1 The emerging market and sustainability of sailing-yacht tourism in Asia

Sailing-yacht tourism is an essential aspect of marine tourism. It is a marine activity in which tourists can chart or take a sailing yacht for leisure to visit multiple seaside areas in destinations related to sailing (Galatsopoulou, 2022). In addition to several other activities at the marina or in the water, yacht tourism can include other activities to create a complete sailing-yacht experience together with or apart from sailing (Horak et al., 2006; Luković, 2012; Paker and Paker, 2024). Sailing-yacht tourism has been developing rapidly in coastal countries in recent years due to the desire of tourists for sailing-yacht and marine tourism. Alcover et al. (2011) noted that sailing-yacht charter tourism plays a crucial economic role in traditional Mediterranean areas. With the increased awareness of sustainability, many countries have included sailing-yacht tourism as an action for sustainable tourism practices to maintain the long-term economic advantage of sailing-yacht tourism (Sevinç and Güzel, 2017; Shen et al., 2021).

Comparably, there are more mature markets in Western European and Central American regions, such as the Mediterranean and Caribbean Sea regions, while there are emerging markets in Asia, such as the Andaman Sea and Strait of Malacca regions in Thailand and Malaysia. However, sailing-yacht tourism destinations encounter high competition in both mature markets and emerging markets. For instance, emerging destinations in East-South Asia, such as Sabang in Indonesia, compete with Langkawi in Malaysia and Phuket in Thailand to attract sailing-yacht tourists (Syafruddin et al., 2019). Although some yacht tourism investment and development projects are at a national level and policy (Sevinç and Güzel, 2017), evaluation of the conditions of the marina and region is necessary for the sustainability of sailing-yacht tourism.

There is also an emerging trend of sailing-yacht tourism in China. Sailing-yacht tourism for recreation and sport has become a novel type of maritime tourism in China and contributes to local and national development through important and emerging economic growth (Wang et al., 2018). For example, the growth of participants in sailing-yacht tourism brought considerable consumption to Xiamen, which is a coastal city with several marinas in southeast China (Wang et al., 2017). In addition, Hainan Island has developed marine tourism quickly, and sailing-yacht tourism is one of the strategies for developing a world-class yacht leisure community; Nine yacht harbors were completed on Hainan Island by the end of 2016 (Li et al., 2021; Luo, 2017).

2.2 Sailing-yacht tourism evaluation factors

2.2.1 Factors for sailing-yacht tourism

There are four factors that influence fishing harbors' transition to sailing-yacht tourism due to the characteristics of the sailing-yacht tourism industry and market: location (Castro, 2021), transport (Bieger and Wittmer, 2006; Nurhaeny et al., 2021), marine sports resources (Christensen et al., 2023; Shen et al., 2021), and tourism attractions (Mikulić et al., 2015; Goffi et al., 2019). First, it is necessary to consider the location of fishing harbors. The location determines the resources of the target market due to the area's industry characteristics and market scale. The location of the harbor is one of the crucial factors in attracting potential consumers with connections to nearby areas. Location is also a crucial factor in site selection for international hotels (Landauer et al., 2012). In the sports tourism context, Saveriades (2000) argued that sports tourism events bring different scale effects of economic benefits in different areas based on central place theory. Central place theory emphasizes that each central place has a surrounding complementary area, so the location of the central place, as well as the range of the complementary area, determines the impact of the economic benefits (Castro, 2021). Therefore, there are significantly different results even when events are hosted in nearby areas.

Second, transport is the lifeline of a tourism area and connects tourists with a destination. A lack of convenient transportation creates limitations for sailing-yacht tourism. Tourism is often the primary economic resource for an island, so transport services are vital for tourism development (Nurhaeny et al., 2021). Transport services not only provide tourist access to destinations but also are part of the travel experience (Simón et al., 2004). Transportation determines whether tourists visit a destination (Landauer et al., 2012; Simón et al., 2004).

Third, sailing-yacht tourism which involves sailing is a kind of marine sport that requires related sports and ocean environmental resources to support its development (Christensen et al., 2023). It is critical to the sailing-yacht tourism destination experience to establish sports resources in addition to attracting tourism (Flagestad and Hope, 2001). Lin and Juan (2009) noted that the potential for sailing-yacht tourism includes natural environments, such as suitable coastal and ocean environments, beautiful scenery, undestroyed marine environments and ecology, and quality accommodations. Sailing yachts are jibed by wind and powered by the climate. The climate is an important issue in tourism for resource development and risk management (Lin and Juan, 2009; Shen et al., 2021). It is essential to evaluate the quality and quantity of natural resources for the development of sailing-yacht tourism based on nature in coastal areas (Goossen and Langers, 2000). The appropriate usage and sustainable management of marine resources to develop sailing-yacht tourism is a way to sustain marine tourism (Chou et al., 2008).

Finally, sailing-yacht tourism is associated with tourism destination attractions as a main or minor route. Attraction is the pull that draws tourists to destinations (Mikulić et al., 2015; Goffi et al., 2019; Chou et al., 2008). Khadaroo and Seetanah (2008) indicated that researchers and DMOs (destination management organizations) should focus on attraction by examining the reasons why tourists travel to a destination. Attractions that effectively draw tourists include entertainment, culture, and sport, and investment in sports and entertainment in the tourism industry can produce economic benefits for locals.

These four factors—location, transport, marine sports resources, and tourism attractions—were identified based on their fundamental role in shaping the viability and success of sailing-yacht tourism. The selection of these factors was informed by a review of existing literature on maritime tourism, sports tourism, and sustainable tourism development, as well as case studies of successful harbor transitions. The distinction between essential and optional components was made by evaluating their direct impact on the feasibility of sailing-yacht tourism. Essential components, such as location and transport, are foundational prerequisites that determine whether a fishing harbor can effectively transition into a sailing-yacht hub. Without a strategic location and efficient transport connections, a harbor may struggle to attract tourists and sustain economic viability. Meanwhile, marine sports resources and tourism attractions serve as competitive advantages that enhance the appeal of a destination but are not always indispensable in the initial transition phase. These elements contribute to the overall experience and differentiation of a sailing-yacht tourism destination, making them significant but adaptable based on local conditions. The classification of these factors will be also influenced by expert consultations, ensuring that both theoretical and practical perspectives were incorporated into the analysis.

2.2.2 Criteria for each factor

The main framework includes four dimensions, namely, location, transport, marine sports resources, and tourism attractions. Each of these dimensions can be divided into several criteria based on previous literature. A total of 14 assessment criteria proposed for the evaluation framework are shown in Table 1. The proposed criteria for fishing harbor transition to sailing-yacht harbors in this study can assess whether fishing harbors are appropriate for the development of sustainable sailing-yacht tourism.

2.3 Expert evaluation system with ANP and TOPSIS

The current study adopted quantitative and qualitative methods to establish a framework of expert evaluation systems to assess and rank all the potential sites (Fu et al., 2020; Rezvani et al., 2022; Tavana et al., 2020). It aims to solve the MCDM problem of evaluating potential fishing harbors for the transition to sailing-yacht tourism. This research adopted three phases of analysis regarding the method. The first step is to determine multiple criteria and their relationships. The second step is to apply the ANP model to determine the weights of all criteria. The final step is to conduct the TOPSIS method to rank the sites.

TABLE 1 Criteria for fishing harbors' transition to sustainable sailing-yacht tourism.

Criteria	Description	Reference
Geographical location	The interaction of the harbor with the nearby areas and the physical distance between the harbor and the potential market.	Akdag and Öter, 2011; Jin et al., 2019; Fang et al., 2019
Marina conditions	The current harbor conditions for sailing-yacht activity and the budget needed for reconstruction.	Diedrich et al., 2011; Sariisik et al., 2011; Shen et al., 2021
Climate and hydrology	Are the climate and hydrology suitable for sailing and navigating?	Landauer et al., 2012; Shen et al., 2021
Carrying capacity	To satisfy tourism quality and avoid destroying the ecology and the environment within the carrying capacity.	Diedrich et al., 2011; Sariisik et al., 2011; Zhu et al., 2019
Accessibility	Is the harbor easily accessible by any kind of transport?	Davenport and Davenport, 2006; Khadaroo and Seetanah, 2008; Nurhaeny et al., 2021; Shen et al., 2021
Quality	The quality of the transportation to the harbor.	Graham, 2013; Khadaroo and Seetanah, 2008; Rigas, 2009; Papatheodorou, 2021
Costs	The costs for tourists traveling to the harbor.	Davenport and Davenport, 2006; Papatheodorou, 2021
Natural and environmental	Is the ocean suitable for marine sports (e.g., the ocean water, currents, water depth, water quality, coast, landscape, climate and other conditions).	Bowe and Marcouiller, 2007; Cooke et al., 2019; Needham and Szuster, 2011; Sariisik et al., 2011; Scott and Lemieux, 2010
Facilities	Are there sufficient facilities for sailing-yacht and marine sport activity and shops for equipment?	Christensen et al., 2023; Flagestad and Hope, 2001; Needham and Szuster, 2011; Rosentraub and Joo, 2009; Sariisik et al., 2011; Shen et al., 2021
Human resource	Is there a sailing-yacht club or organization, and is it easy to recruit staff locally to operate sailing-yacht activities and other marine recreation?	Christensen et al., 2023; Henriksen et al., 2010; Sariisik et al., 2011
Natural tourism attractions	There are unique and diverse geographical and coastal landscapes and ocean ecology.	Emekli and Baykal, 2011; Goffi et al., 2019; Mikulić et al., 2015
Cultural tourism attractions	There is a unique cultural landscape and heritage.	Emekli and Baykal, 2011; Goffi et al., 2019; Mikulić et al., 2015; Shen et al., 2021
Tourism venues	Is there a venue for tourism, such as theme parks or shopping malls?	Christensen et al., 2023; Goffi et al., 2019; Mikulić et al., 2015
Events and festivals	Hosting events and festivals to attract tourists.	Higham and Hinch, 2018; Hanna et al., 2021; Morgan et al., 2021

Saaty (2007) extended the ANP technique from AHP to allow more complicated interrelationships among evaluation models. Unlike other traditional MCDM methods based on the assumption of independence, ANP is a comparatively advanced MCDM method that can systematically process different kinds of dependent situations in a real context (Lim, 1997). Researchers have applied the ANP approach for selecting, evaluating, and prioritizing since interdependent relationships substantially affect the evaluation framework. Bowe and Marcouiller (2007) proposed an effective evaluation model based on ANP to improve the analysis of national park websites. Bull (2005) put forward a methodology based on ANP to evaluate strategies for sustainable tourism. Needham and Szuster (2011) used ANP to evaluate tourist development plans with a sustainable approach. Huang et al. (2022) adopted the ANP method to build the Sustainable Island Tourism Evaluation Model.

The technique for order preference by similarity to ideal solution (TOPSIS) is a common technique for dealing with multiobjective decision problems (Bowe and Marcouiller, 2007; Scott and Lemieux, 2010; Simón et al., 2004). TOPSIS was employed to select or rank one or more ideal fishing harbors from a series of accessible alternatives based on multiple evaluation criteria. The present study applied TOPSIS as a multi-objective methodology for fishing harbor comparisons due to its effective framework.

Many researchers have integrated multiple methods to increase the advantages and eliminate the limitations of the original method to solve particular issues. Fu et al. (2020) integrated NGT, TOPSIS and MCGP methods to develop a framework to select the airlines for their hotel and airline alliance. Henriksen et al. (2010) applied the hybrid MCDM approach based on ANP and TOPSIS techniques to evaluate smart and sustainable cities. Ozkaya and Erdin (2020) combined the AHP and TOPSIS methods to develop the evaluation frameworks and rank the sustainable city. Sahin and Cezlan (2022) analyzed the hospital selection of health tourists based on AHP and TOPSIS methods.

3 Methodology

3.1 Study procedure

In this study, the expert evaluation system was adopted as a method for assessing the potential of fishing harbor transitions to sustainable sailing-yacht tourism.

The process of constructing the system contains three steps and involves determining the relative importance of the sustainability of the transition from fishing harbor to sailing-yacht tourism. Here, three stages in the construction of the evaluation system are described: establishing a framework for the system and determining the factors and criteria and their relationships; determining the weights of all criteria; and ranking the alternatives by scoring each criterion. A diagrammatic sketch of the study procedures is shown in Figure 1, and details are described as follows.

3.1.1 Stage 1: identifying multiple criteria and determining their relationships

The purpose of this stage was to identify the main factors and criteria for evaluating the transition of fishing harbors to sustainable sailing-yacht tourism. First, this research evaluated the comprehensive literature on the concepts of sailing-yacht tourism, fishing harbor transition, and sustainable tourism and then proposed the primary framework. Second, the nominal group technique (NGT) method was employed to confirm the evaluation criteria and their interdependent and feedback attributes (Engen et al., 2024; Shyur, 2006).

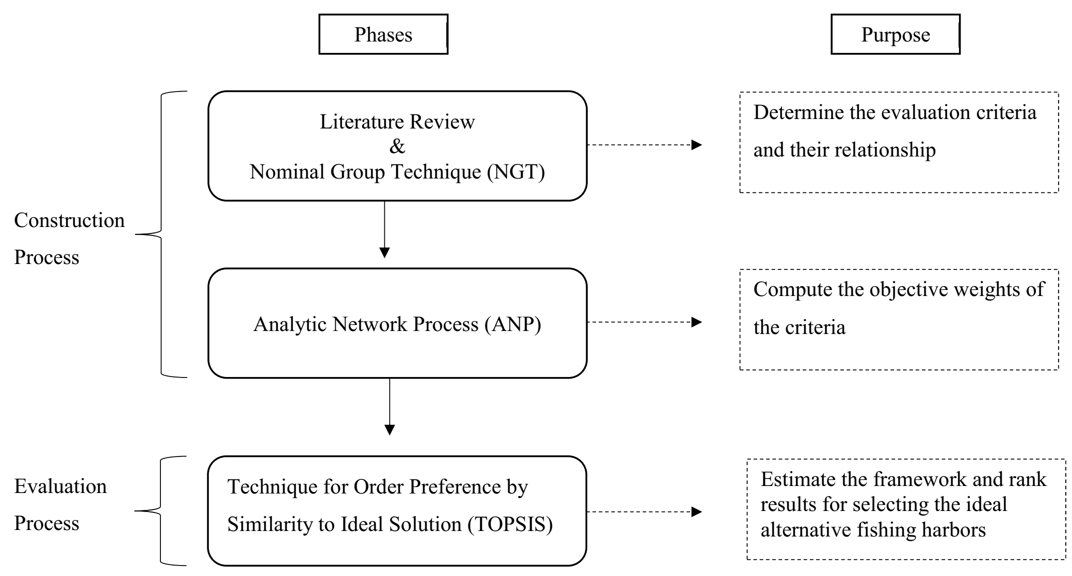

FIGURE 1
The procedure of forming the framework for sustainable sailing-yacht tourism harbors through an expert evaluation system.

3.1.2 Stage 2: adopting the ANP model to calculate the weights of criteria

The ANP processes are used to determine the weight of criteria using a survey of expert respondents. ANP utilizes the supermatrix approach to solve the dependence on feedback problems extending from AHP, which does not address these problems (Wu and Lee, 2007). The procedure for determining the criteria weights for ANP is described below (Cheng and Li, 2005; Saaty, 1996).

First, a survey was used to perform a pairwise comparison between factors and criteria with Saaty's 9-point scale, and the results were processed by the ANP process. The ANP uses an initial matrix derived from the average value of the survey results. Then, the consistencies of the pairwise comparison were examined by the CR (consistency ratio) value of the matrix. The final consistency can be accepted when the CR value is lower than 0.1. After consistency was confirmed, each ANP criterion weight for the evaluation of sustainable sailing-yacht tourism was determined by calculating the unlimited supermatrix in which the unweighted supermatrix was raised to limiting powers until the weights converged and remained stable. The values of the CR and weight calculation of factors and criteria in ANP were processed by the Super Decisions software version 2.8.0 (Aliani et al., 2017; Peng and Tzeng, 2019; Saaty, 2007).

3.1.3 Stage 3: conducting the TOPSIS techniques to rank the alternatives

In this stage, a case study was used to evaluate and rank three fishing harbors in Taiwan. After identifying the criteria weights, the TOPSIS approach was applied for the ranking evaluations.

TOPSIS was originally proposed by Hwang and Yoon (1981) based on the concept that the chosen alternative should have the shortest distance from the ideal solution and the farthest from the negative ideal solution. TOPSIS considers the distances to both the ideal and the negative-ideal solutions simultaneously by taking the relative closeness to the ideal solution. The calculation processes used in this method are presented below.

Establish a decision matrix for alternative performance.

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ \vdots \\ A_i \end{array} \begin{array}{c} \begin{array}{cccc} X_1 & X_2 & \cdots & X_j \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{j1} \\ x_{21} & x_{22} & \cdots & x_{j2} \\ \vdots & \vdots & \cdots & \vdots \\ x_{i1} & x_{i1} & \cdots & x_{ij} \end{bmatrix} \end{array} \tag{1}$$

A_i denotes the i^{th} program

X_{ij} denotes the performance of criteria-j for the program A_i

(a) Normalize the D matrix $R = (r_{ij})$

The normalized r_{ij} is calculated as

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2{}_{ij}}}, i = 1, 2, \ldots, m; j = 1, 2, \ldots, n \tag{2}$$

(b) Create the weighted normalized performance matrix.

TOPSIS defines the weighted normalized performance matrix as

$$V = (v_{ij}), \forall i, j$$
$$v_{ij} = w_j \times r_{ij}, \tag{3}$$

where w_j denotes the weight of the criteria of the framework.

(c) Identify the ideal solutions (A^*) and negative ideal solutions (A^-)

$$A^* = \left\{v_1^*, v_2^*, \cdots, v_j^*\right\} = \left\{\left(\max_i v_{ij} \left|j \in J\right.\right), \left(\min_i v_{ij} \left|j \in J'\right.\right)\right\}$$
$$A- = \left\{v_1^-, v_2^-, \cdots, v_j^-\right\} = \left\{\left(\min_i v_{ij} \left|j \in J\right.\right),\right.$$
$$\left.\left(\max_i v_{ij} \left|j \in J'\right.\right)\right\} \tag{4}$$

where J denotes the benefit criteria and J' represents the cost criteria.

(d) Calculate the Euclidean distance between the ideal solution (S_i^*) and the negative ideal solution (S_i^-) for each program

$$S_i^* = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^*\right)^2}, i = 1, 2, \ldots, m;\ j = 1, 2, \ldots, n$$
$$S_i^- = \sqrt{\sum_{j=1}^{n}\left(v_{ij} - v_j^-\right)^2}, i = 1, 2, \ldots, m; j = 1, 2, \ldots, n \tag{5}$$

(e) Calculate the relative closeness to the ideal solution of each program

$$C_i^* = \frac{S_i^-}{S_i^* + S_i^-}, i = 1, 2, \ldots, m \tag{6}$$

It is clear that $C_i^* = 1$ if $A_i = A^*$ and $C_i^* = 0$ if $A_i = A^-$. A_i is closer to A^*, C_i^* approaches to 1.

(f) Rank the preference order by C_i^*

A set of programs can be preferentially ranked in descending order of C_i^*. Larger index values indicate better performance of the programs.

3.2 Data collection

The data collection for this study included three stages. In the first stage, purposeful and snowball sampling was adopted. This study employed snowball sampling, as it is particularly suitable for recruiting experts in specialized fields. Given that the research required interviews with sailing experts from public administration, academia, and industry, this method was effective in identifying appropriate participants. Initially, the researchers used purposeful sampling to select the first group of participants based on their professional background and relevance to the study. And then, these experts recommended other qualified individuals, leading to a snowball effect that expanded the sample. In total twelve experts were successfully recruited. This approach not only ensured a high level of expertise among participants but also leveraged professional trust networks, enhancing the credibility of the study and the quality of the collected data. Twelve heterogeneous experts could satisfy the requirement of reliable evaluation suggested by decision-making research (Baker et al., 2006; Tang et al., 2017). All nominal experts have been engaged in sailing tourism for at least 10 years and have administrative, research, and industrial work experience. The four experts from the administration have been responsible for marina tourism planning and management. The four academic experts focus on marina tourism and recreation and publish related studies. The four industry experts have extensive experience in sailing boat and yacht tourism and sales, with a record of excellent performance. They hold key positions in sales, operations, or management within leading maritime companies or organizations. Therefore, the nominal group had substantial experience in sailing-yacht tourism to confirm the evaluation framework and its relationship.

The experts were invited to complete the NGT questionnaire to confirm the evaluation network factor and criteria and interdependent and feedback relationships. The Nominal Group Technique (NGT) questions were administered through a combination face-to-face meetings and online consultations. This hybrid approach ensured broader participation and accommodated experts' availability (Hindi et al., 2024; Oliver et al., 2024). Then, the ANP questionnaire employing the nine-point priority scale proposed by Saaty (1996) was distributed to experts to make a series of pairwise comparisons in which two elements were compared in their contribution to their specific upper-level criterion. Finally, after identifying the weights of the criteria using ANP, the TOPSIS questionnaire was delivered to the experts to assess the priorities of three alternative fishing harbors.

4 Results

4.1 Confirming the evaluation framework and relationships with NGT

After the NGT procedure, this study confirmed the four factors and 14 criteria of the evaluation framework for fishing harbors' transition to sustainable sailing-yacht tourism, as shown in Figure 2. In addition, 16 independent relationships of factors and criteria were verified.

4.2 Identifying the weights of criteria for the expert evaluation system

After the evaluation framework was established, the next procedure was to determine the weights of the criteria. In the

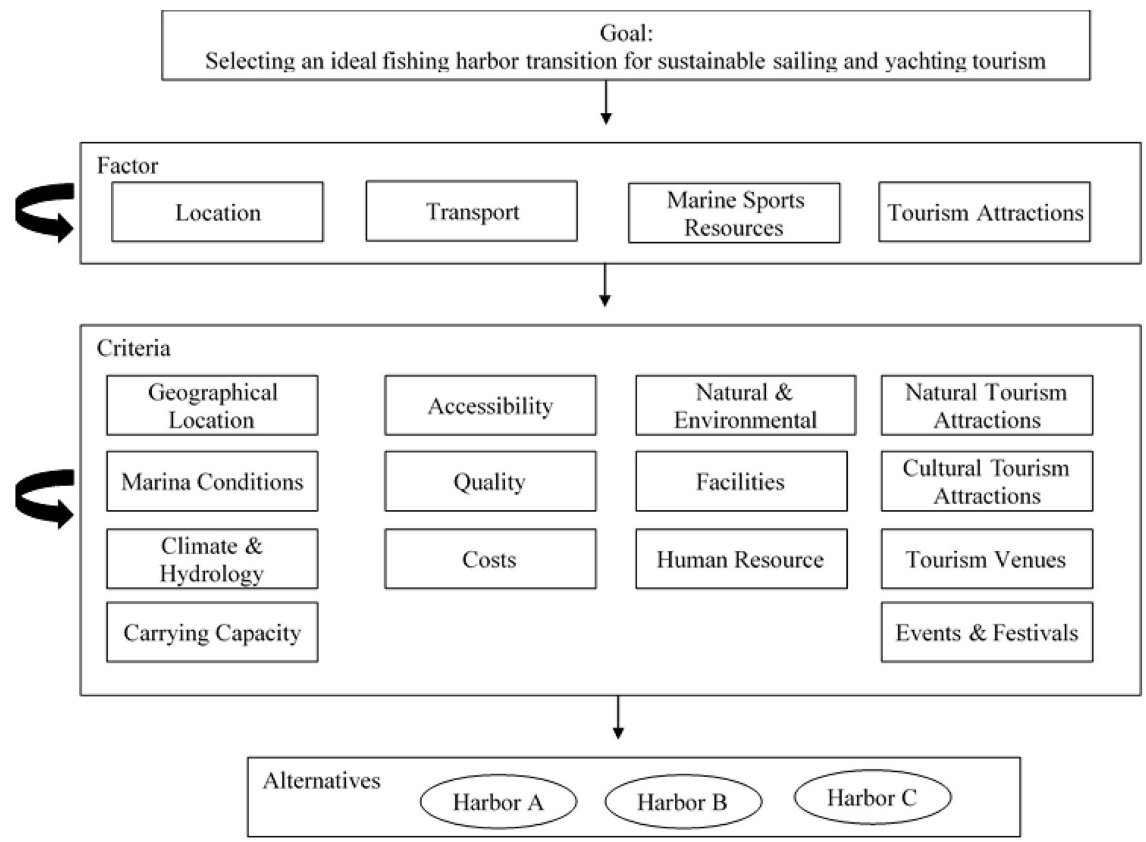

FIGURE 2
ANP framework of selecting an ideal fishing harbor transition for sustainable sailing-yacht tourism.

TABLE 2 The weights of expert systems for evaluating fishing harbor transitions for sustainable sailing-yacht tourism.

Goal	Factor	Total weights	Criteria	Weights
Fishing harbor transition for developing sustainable sailing-yacht tourism	Location	0.522	Geographical Location	0.196
			Marina Conditions	0.153
			Climate & Hydrology	0.127
			Carrying Capacity	0.046
	Transport	0.171	Accessibility	0.100
			Quality	0.037
			Costs	0.034
	Marine sports resources	0.171	Natural & Environmental	0.082
			Facilities	0.056
			Human Resource	0.033
	Tourism Attractions	0.136	Natural Tourism Attractions	0.049
			Cultural Tourism Attractions	0.025
			Tourism Venues	0.023
			Events & Festivals	0.039

ANP procedure computed by Super Decisions, the inconsistency validation is based on the value of the consistency ratio of the pairwise comparison result. For pairwise comparison of the performance perspectives, the value is from 0.000 to 0.044; when the values are under this level, the response by the experts is valid. The perspective criteria weights in the expert evaluation system are shown in Table 2.

4.3 Description of investment in fishing harbors

Three fishing harbors were evaluated as potential alternatives in this study. These three harbors were all traditional fishing harbors in Taiwan and have had thriving fishery production in the past. In recent years, due to the decline of the fishing industry, they have been planning to transform into tourism harbors under government policy. There are sail-yacht agents near all these three harbors, which offer tours, training, and sales. Besides, there are also regattas held that use them for the harbor of calls annually. Of the three alternatives, one is in the north of Taiwan, one is in the south, and the other one is in the off-seashore island. The chosen harbors represent different geographic regions in Taiwan (north, south, and an offshore island), each with unique characteristics affecting their potential for transitioning to sustainable sailing-yacht tourism. This selection ensures a comprehensive evaluation across diverse environmental and economic conditions. The location of the three fishing harbors is shown in Figure 3.

Alternate A is the Bisha fishing harbor, Keelung, situated in the northern part of Taiwan. It is in the north of the Tropic of Cancer and faces the Pacific Ocean. The harbor is connected with the largest metropolis, the commercial city of Taipei. Taipei is the most prosperous commercial area in Taiwan, and many potential consumers of sail yachts come from Taipei. It is easy and convenient to access the harbor from Taipei. An annual sailing regatta is held, starting from Keelung to Ishigaki Island or Miyako Island, Japan.

Alternate B is An-Ping Fishing Harbor, Tainan, situated in the southern part of Taiwan. It is in the south of the Tropic of Cancer and is connected with the southern largest city, the region of sailing-yacht manufacturing, and faces the Taiwan Strait. This fishing harbor is located in the southern part of Taiwan and is a well-known cultural city. The local government markets the area for its cultural attractions and traditional snacks for tourism. Due to its geographical location, this area is one of the few in Taiwan that is still suitable for navigation during the fall and winter seasons. Therefore, sailing races are held during these seasons.

Alternate C is the Makung fishing harbor, Penghu, situated in the western part of Taiwan. It is an archipelago within the Taiwan Strait and crosses the Tropic of Cancer. The fishing harbor is located on an island, so visitors need to take a boat or plane to get there. With its numerous islands and beautiful marine environment, it has become a well-known marine tourism destination, hosting popular festivals and events every year that attract a large number of tourists. There is more than one sailing regatta held every year, containing multi-leg races, one of the legs starting from Xiamen, China to Penghu, and a leg racing around the islands in the Penghu archipelago.

4.4 Ranking potential fishing harbors via the TOPSIS method

By using Equations 2, 3, the weighted normalized decision matrix of the programs, this research calculated the weighted normalized decision matrix (Table 3). It was the result of multiplying the normalized decision matrix and the weights.

After developing the weighted normalized decision matrix, the final ranking procedure should determine the ideal solution and negative-ideal solutions by using the Equation 4. Specifically,

10.3389/frsut.2025.1553781

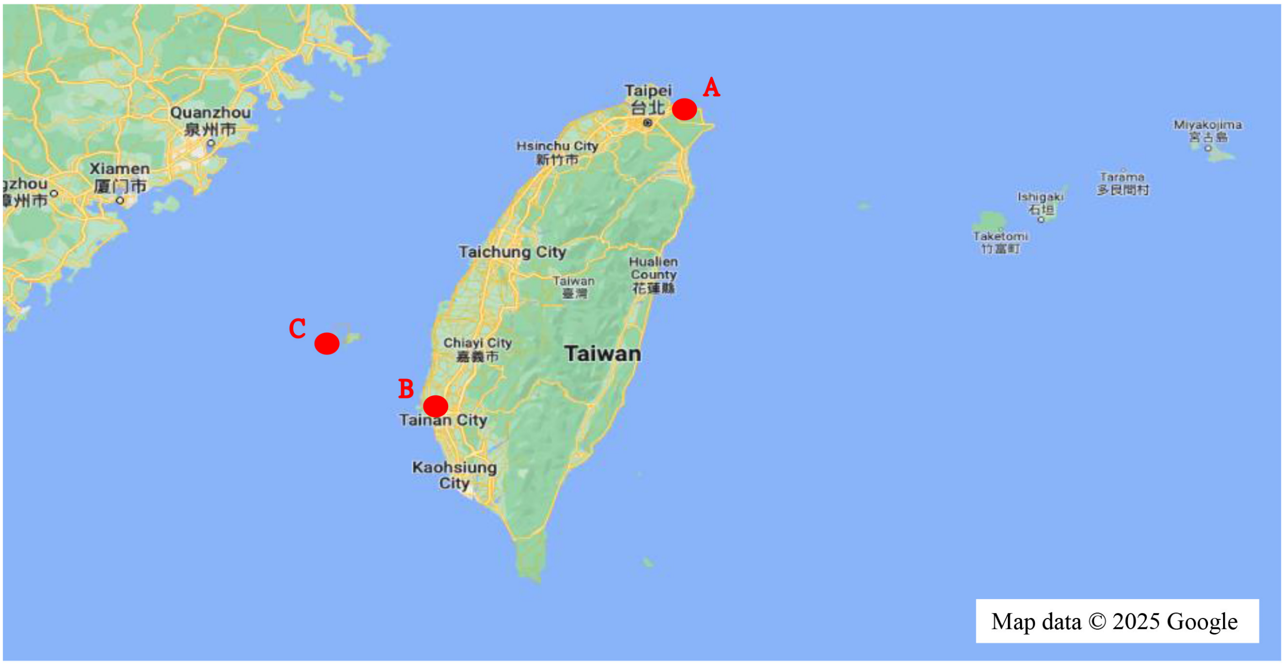

FIGURE 3
The location of alternatives. Source: Map data © 2025 Google.

TABLE 3 The weighted normalized decision matrix.

Criteria	Alternative A	Alternative B	Alternative C
Geographical Location	0.629	0.662	0.640
Marina Conditions	0.393	0.450	0.524
Climate & Hydrology	0.318	0.450	0.439
Carrying Capacity	0.120	0.141	0.162
Accessibility	0.345	0.333	0.246
Quality	0.118	0.126	0.087
Costs	0.095	0.116	0.078
Natural & Environmental	0.285	0.217	0.328
Facilities	0.140	0.164	0.173
Human Resource	0.122	0.106	0.104
Natural Tourism Attractions	0.153	0.159	0.197
Cultural Tourism Attractions	0.088	0.088	0.086
Tourism Venues	0.065	0.075	0.075
Events & Festivals	0.118	0.121	0.150

the ideal solution and negative-ideal solution are determined as follows:

$$A^* = \{0.662, 0.524, 0.450, 0.162, 0.345, 0.126, 0.116, 0.328, 0.173, 0.122, 0.197, 0.088, 0.075, 0.150\}$$

TABLE 4 Final ranking of alternatives.

Ranking	Alternatives	S_i^*	S_i^-	C_i^*
1	C	0.118	0.225	0.656
2	B	0.146	0.182	0.556
3	A	0.210	0.127	0.378

$$A- = \{0.629, 0.393, 0.318, 0.120, 0.246, 0.087, 0.078, 0.217, 0.140, 0.104, 0.153, 0.086, 0.065, 0.118\}$$

The ranking of the overall conditions of programs by using Equation 5, the computed distances of each program from the positive ideal solution (A*) and the negative ideal solution (A-) are presented in Table 4. Based on their relative closeness to the ideal solution obtained by using Equation 6, the final step of the TOPSIS method consists of ranking the programs. In this case, the results show that program C is the best choice among the programs, with a performance value of 0.656; program B and program A are ranked second and third, with performance values of 0.556 and 0.378, respectively.

5 Discussion and conclusion

This research developed a Multi-Criteria Decision-Making (MCDC) framework to guide the transition of fishing harbors into sustainable sailing-yacht tourism hubs. Using an expert evaluation system that integrates the Nominal Group Technique (NGT), Analytic Network Process (ANP), and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), the study systematically identified and weighted key factors influencing this transition. The findings highlight the significant role of geographical location, marina conditions, and climate and hydrology in determining the suitability of fishing harbors for transformation into sustainable sailing-yacht destinations.

A key finding of this study is that fishing harbors in archipelagos exhibit strong potential for sustainable sailing-yacht tourism development. This result aligns with prior research on coastal tourism (Zhu et al., 2019) and sustainable coastal land use planning (Pourebrahim et al., 2010), which emphasize the importance of natural and built environmental factors in tourism development. However, unlike research on cruise tourism (Wang et al., 2014), which often focuses on large-scale infrastructure investments and mass tourism, the current study suggests that small-scale, eco-friendly developments in fishing harbors can contribute significantly to both economic growth and environmental sustainability. By integrating the NGT-ANP approach, this study not only identified the most influential criteria but also assigned specific weights, providing a structured decision-making tool for stakeholders.

The study's results further reinforce the notion that a harbor's geographic and environmental conditions are fundamental to its suitability for sailing-yacht tourism. Geographical location (weight: 0.196) emerged as the most critical criterion, underscoring the necessity of strategic site selection for successful transitions. This is followed by marina conditions (0.153), which influence infrastructure readiness, and climate and hydrology (0.127), which affect the feasibility and attractiveness of sailing activities. These findings suggest that policymakers and urban planners must prioritize locations with favorable geographic and climatic conditions when developing strategies for sustainable maritime tourism. These findings are consistent with the insights presented by Gössling (2002) and Hall (2001) and underscores the importance of integrating geographic and climatic considerations into planning processes to achieve sustainable outcomes in maritime tourism development.

Beyond the three primary criteria, the study identified a total of 14 evaluation criteria that offer a systematic framework for harbor transition. These criteria serve as a guideline for destination management organizations (DMOs) and policymakers at both local and national levels, aiding them in balancing urban development with marine resource conservation. This structured approach provides clear directives for integrating sustainability into tourism planning, ensuring that economic benefits do not come at the expense of environmental degradation. It also extends the findings of Bramwell and Lane (2011) by emphasizing the importance of strategic and balanced development.

5. 1 Policy implications for destination management and sustainability

The research findings have several critical implications for DMOs and policymakers. First, the structured expert evaluation framework provides a clear roadmap for assessing the suitability of fishing harbors for sustainable sailing-yacht tourism. By applying this approach, policymakers can optimize resource allocation and prioritize harbors with the highest potential for development. Our findings align with Gari et al.'s (2015) insights into the application of the DPSIR framework. Ecological pressures and socio-economic drivers are interconnected within coastal systems. Consistent with their analysis, this research highlights the importance of systematic evaluation and monitoring. It informed decision-making that strategically addresses environmental and developmental priorities in harbor management. Moreover, the framework helps avoid the common pitfalls of overdevelopment and environmental degradation, which have plagued other forms of coastal tourism.

At the local level, the study highlights the need for infrastructure improvements tailored to sustainable sailing-yacht tourism. Upgrading marina facilities, ensuring proper waste management, and integrating renewable energy sources into harbor operations can enhance the sustainability of these destinations. These resonate closely with the findings of Dodds and Graci (2012), who emphasize that effective waste management, infrastructure improvement, and renewable energy integration are pivotal strategies for reducing the ecological footprint of tourism activities in islands. Local governments must also consider the socioeconomic impacts of this transition, such as the creation of new employment opportunities in tourism-related industries, the revitalization of local economies, and the preservation of cultural and maritime heritage. This perspective contributes to the insights provided by Moscardo (2008), who argues that tourism development should proactively build community capacity by fostering local participation, generating sustainable economic opportunities, and reinforcing cultural identity. This study highlighted the importance of socioeconomic impacts.

On a broader scale, the study contributes to the discourse on sustainable tourism policy by aligning with key United Nations Sustainable Development Goals (SDGs). Specifically, transitioning fishing harbors to sailing-yacht tourism supports SDG 14 (Life Below Water) by promoting sustainable marine resource use, reducing overreliance on fisheries, and fostering eco-friendly tourism alternatives. Additionally, this transition aligns with SDG 11 (Sustainable Cities and Communities) by encouraging sustainable urban and coastal planning, enhancing economic resilience, and improving the quality of life for local communities.

5. 2 Practical contributions

The findings provide several actionable insights for harbor planners, tourism developers, and policymakers seeking to promote sustainable sailing-yacht tourism. This framework helps guide decision-makers in pinpointing the fishing harbors best suited for transformation, which allows investments are made in locations with strong potential for success (Ritchie and Crouch, 2003). By prioritizing critical criteria such as geographical location, marina infrastructure, and climate suitability, urban planners can develop more effective strategies for transforming harbors into sustainable tourism destinations.

Moreover, this research highlights the importance of integrating sustainability into tourism development. The transition of fishing harbors to sailing-yacht tourism not only diversifies local economies but also promotes responsible tourism practices that align with global sustainability goals. Policymakers can leverage this framework to create regulations and incentives that encourage environmentally friendly marina designs, efficient resource management, and community engagement in tourism planning (Dodds and Graci, 2012).

Additionally, the findings emphasize the need for local governments to invest in infrastructure improvements tailored to sailing-yacht tourism. These investments should focus on enhancing marina facilities, implementing sustainable waste management practices, and ensuring that harbor operations align with ecological conservation efforts. Furthermore, as new business models emerge within the sailing-yacht tourism sector, local businesses can capitalize on opportunities related to hospitality, marine recreation, and nautical services, as it is suggested by Paker and Gok (2021).

5. 3 Theoretical implications

This study contributes to the literature on sustainable tourism development by introducing a systematic, multi-criteria decision-making approach for evaluating harbor transition potential. The integration of the NGT-ANP-TOPSIS framework enhances theoretical understanding of decision-making processes in sustainable maritime tourism by providing a structured methodology for assessing multiple criteria simultaneously.

The research also expands the scope of existing studies on coastal tourism by focusing on a niche yet rapidly growing segment—sailing-yacht tourism. Unlike previous studies that primarily address mass tourism or large-scale cruise infrastructure, this study provides insights into small-scale, high-value tourism development that emphasizes environmental conservation and community engagement. By doing so, it bridges gaps in the literature on sustainable destination management and offers a practical model for policymakers and planners seeking to balance tourism growth with ecological preservation. It bridged the literature gap as identified and discussed by Gari et al. (2015).

Furthermore, this study lays the groundwork for future research on sustainable harbor transitions. By establishing a comprehensive evaluation framework, it provides a foundation for comparative studies across different regions and economic contexts. Future research can build upon this model by incorporating emerging data analytics techniques, expanding stakeholder participation, and exploring the long-term impacts of harbor transformation on local economies and ecosystems (Leal Filho, 2018).

5.4 Conclusion

This study presents a comprehensive and structured approach to transitioning fishing harbors into sustainable sailing-yacht tourism hubs. By integrating expert evaluation methodologies, the research offers a robust decision-making framework that aligns with sustainability goals. The findings demonstrate the importance of geographic and environmental factors while providing actionable insights for policymakers, destination managers, and urban planners.

While the study has certain limitations, including its reliance on expert judgment and its geographic scope, it makes significant contributions by providing a systematic evaluation framework that can guide sustainable tourism planning. The study's practical implications highlight the need for targeted infrastructure investments, environmental conservation measures, and policy support for sustainable maritime tourism. From a theoretical perspective, the research advances decision-making methodologies in tourism planning and expands knowledge on sustainable coastal development.

As coastal and marine tourism continues to evolve, adopting structured, evidence-based approaches will be essential in ensuring a balance between economic development and environmental conservation. Future studies should explore how the proposed framework can be adapted to different geographical and regulatory contexts, integrating new data sources and emerging sustainability initiatives to further enhance the effectiveness of harbor transition strategies.

5.5 Research limitations

Despite its contributions, this study has certain limitations. First, the expert evaluation system, while rigorous, relies on subjective assessments from domain experts, which may introduce bias in the weighting of criteria. Although the use of the NGT-ANP-TOPSIS framework minimizes inconsistencies, future research could incorporate broader stakeholder perspectives, including local communities, policymakers, and tourists, to enhance the comprehensiveness of the evaluation.

Second, the study focuses primarily on fishing harbors with potential for sailing-yacht tourism development, particularly in archipelagos and coastal areas. However, the applicability of the framework to different geographical and socioeconomic contexts remains uncertain. Factors such as local governance structures, economic conditions, and environmental regulations could significantly influence the feasibility of such transitions. Future research should explore the adaptability of this framework in diverse coastal settings to validate its broader applicability.

Additionally, the study does not incorporate real-time environmental and economic data, which could provide a more dynamic assessment of harbor transition potential. Incorporating economic forecasting models would enhance the decision-making process by integrating more empirical and spatially relevant data.

Lastly, while the study aligns with sustainability principles, it does not explicitly quantify the long-term environmental and social impacts of transitioning fishing harbors to sailing-yacht tourism. Longitudinal studies are needed to assess the effectiveness of such transitions over time, considering factors such as economic sustainability, environmental conservation, and community acceptance. Future research should also explore how emerging policies and technologies, such as green port initiatives and carbon footprint reduction strategies, can further contribute to sustainable maritime tourism.

5.6 Future research directions

While this study provides a robust evaluation framework, future research should explore its applicability across diverse geographical and economic contexts. Different regions may exhibit unique challenges, such as varying regulatory environments, local stakeholder dynamics, and infrastructure constraints. Adapting the MCDC framework to different coastal settings can refine its effectiveness and expand its utility for broader applications in maritime and coastal tourism planning.

Additionally, further research should examine the long-term economic and environmental impacts of transitioning fishing harbors to sailing-yacht tourism. Longitudinal studies assessing the economic viability, environmental sustainability, and social acceptance of such transitions would provide valuable insights for policymakers and industry stakeholders. Integrating real-time data analytics and emerging technologies into the evaluation process could further enhance decision-making accuracy and predictive modeling.

Data availability statement

Due to anonymity and confidentiality agreements with the participants, the data is not publicly available. Interested parties may contact the author, Hsu, C-Y, for further information hsuchengyu@gm.ntus.edu.tw.

Ethics statement

Ethical approval was not required for this study in Taiwan. The research adhered to all established protocols and involved minimal risk. For more information, please feel free to contact the author: hsuchengyu@gm.ntus.edu.tw. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

C-YH: Conceptualization, Investigation, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Visualization, Writing – original draft. YS: Conceptualization, Methodology, Validation, Visualization, Writing – review & editing. JM: Conceptualization, Validation, Visualization, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for the research and/or publication of this article.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Abbott, J. K., Lew, D. K., Whitehead, J. C., and Woodward, R. T. (2022). The future of fishing for fun: the economics and sustainable management of recreational fisheries. *Rev. Environ. Econ. Policy*, 16, 262–281. doi: 10.1086/720987

Akdag, G., and Öter, Z. (2011). Assessment of world tourism from a geographical perspective and a comparative view of leading destinations in the market. *Proc. Soc. Behav. Sci.* 19, 216–224. doi: 10.1016/j.sbspro.2011.05.126

Alcover, A., Alemany, M., Jacob, M., Payeras, M., García, A., Martínez-Ribes, L., et al. (2011). The economic impact of yacht charter tourism on the Balearic economy. *Tour. Econ.* 17, 625–638. doi: 10.5367/te.2011.0045

Aliani, H. BabaieKafaky, S., Saffari, A., and Monavari, S. M. (2017). Land evaluation for ecotourism development-an integrated approach based on FUZZY, WLC, and ANP methods. *Int. J. Environ. Sci. Technol.* 14, 1999–2008. doi: 10.1007/s13762-017-1291-5

Baker, J., Lovell, K., and Harris, N. (2006). How expert are the experts? An exploration of the concept of expert within Delphi panel techniques. *Nurse Res.* 14, 59–70. doi: 10.7748/nr2006.10.14.1.59.c6010

Bicak, H., Altinay, M., Aksugür, E., Günyakti, A., and Katircioglu, S. (2006). Could yacht tourism be an alternative tourism potential in North Cyprus? *Tour. Marine Environ.* 3, 49–57. doi: 10.3727/154427306779380284

Bieger, T., and Wittmer, A. (2006). Air transport and tourism-perspectives and challenges for destinations, airlines and governments. *J. Air Trans. Manage.* 12, 40–46. doi: 10.1016/j.jairtraman.2005.09.007

Bowe, S. A., and Marcouiller, D. W. (2007). Alternative tourism-timber dependencies and the development of forested rural regions. *Forest Policy Econ.* 9, 653–670. doi: 10.1016/j.forpol.2006.05.005

Bramwell, B., and Lane, B. (2011). Critical research on the governance of tourism and sustainability. *J. Sustain. Tour.* 19, 411–421. doi: 10.1080/09669582.2011.580586

Bull, C. (2005). *Sport Tourism Destination Resource Analysis*. Oxford: Elsevier. doi: 10.1016/B978-0-7506-5937-6.50010-9

Cariola, M. (2022). "Transition strategies towards a more sustainable marine tourism: some proposals from a European project," in *CNR Case Histories in the Blue Planet Economy*, eds. G. Vitali, I. M. Zoppi (Quaderni IRCrES 16. Moncalieri, TO: CNR-IRCrES), Roma, 39–45.

Castro, H. U. (2021). Regional science, location and economic theory: thoughts and discussions about development. *Eur. J. Dev. Stud.* 2, 62–67. doi: 10.24018/ejdevelop.2022.2.4.124

Chen, C-. L., and Chang, Y-. C. (2017). A transition beyond traditional fisheries: Taiwan's experience with developing fishing tourism. *Marine Policy* 79, 84–91. doi: 10.1016/j.marpol.2017.02.011

Cheng, E. W. L., and Li, H. (2005). Analytic network process applied to project selection. *J. Constr. Eng. Manage.* 131, 459–466. doi: 10.1061/(ASCE)0733-9364(2005)131:4(459)

Chou, T-. Y., Hsu, C-. L., and Chen, M-. C. (2008). A fuzzy multi-criteria decision model for international tourist hotels location selection. *Int. J. Hospital. Manage.* 27, 293–301. doi: 10.1016/j.ijhm.2007.07.029

Christensen, C. P., Shen, Y., Kokkranikal, J., and Morrison, A. M. (2023). Understanding British and Danish sailing tourism markets: an analysis based on Kano's evaluation matrix. *Tour. Recreat. Res.* 48, 30–42. doi: 10.1080/02508281.2021.1891742

Cooke, S. J., Twardek, W. M., Reid, A. J., Lennox, R. J., Danylchuk, S. C., Brownscombe, J. W., et al. (2019). Searching for responsible and sustainable recreational fisheries in the anthropocene. *J. Fish Biol.* 94, 845–856. doi: 10.1111/jfb.13935

Davenport, J., and Davenport, J. L. (2006). The impact of tourism and personal leisure transport on coastal environments: a review. *Estuarine, Coast. Shelf Sci.* 67, 280–292. doi: 10.1016/j.ecss.2005.11.026

DeRidder, K. J., and Nindang, S. (2018). *Southeast Asia's Fisheries Near Collapse from Overfishing*. The Asia Foundation. Available online at: https://asiafoundation.org/2018/03/28/southeast-asias-fisheries-nearcollapse-overfishing/

Diedrich, A., Huguet, P. B., and Subirana, J. T. (2011). Methodology for applying the limits of acceptable change process to the management of recreational boating in the Balearic Islands, Spain (Western Mediterranean). *Ocean Coast. Manage.* 54, 341–351. doi: 10.1016/j.ocecoaman.2010.12.009

Dodds, R., and Graci, S. (2012). *Sustainable Tourism in Island Destinations*. London: Routledge. doi: 10.4324/9781849776660

Emekli, G., and Baykal, F. (2011). Opportunities of utilizing natural and cultural resources of Bornova (Izmir) through tourism. *Proc. Soc. Behav. Sci.* 19, 181–189. doi: 10.1016/j.sbspro.2011.05.122

Engen, S., Hausner, V. H., Mikkelsen, E., Gundersen, H., Christie, H., Falk-Andersson, J., et al. (2024). Co-creating coastal sustainability goals and indicators. *Sustain. Sci.* 19, 1327–1343. doi: 10.1007/s11625-024-01521-6

Fang, L., Li, H., and Li, M. (2019). Does hotel location tell a true story? Evidence from geographically weighted regression analysis of hotels in Hong Kong. *Tour. Manage.* 72, 78–91. doi: 10.1016/j.tourman.2018.11.010

Flagestad, A., and Hope, C. A. (2001). Strategic success in winter sports destinations: a sustainable value creation perspective. *Tour. Manage.* 22, 445–461. doi: 10.1016/S0261-5177(01)00010-3

Fu, Y. K., Huang, W., and Liao, C. N. (2020). The selection model for horizontal alliances between hotels and airlines: an integrated application of NGT, fuzzy TOPSIS and MCGP methods. *Tour. Rev.* 75, 681–698. doi: 10.1108/TR-06-2019-0214

Galatsopoulou, F. (2022). "Water sports tourism," in *Encyclopedia of Tourism Management and Marketing*, ed. D. Buhalis (UK: Edward Elgar Publishing), 727–730. doi: 10.4337/9781800377486.water.sports.tourism

Gari, S. R., Newton, A., and Icely, J. D. (2015). A review of the application and evolution of the DPSIR framework with an emphasis on coastal social-ecological systems. *Ocean Coast. Manage.* 103, 63–77. doi: 10.1016/j.ocecoaman.2014.11.013

Gedik, S., and Mugan-Ertugral, S. (2019). The effects of marine tourism on water pollution. *Fresenius Environ. Bull.* 28, 863–866.

Goffi, G., Cucculelli, M., and Masiero, L. (2019). Fostering tourism destination competitiveness in developing countries: the role of sustainability. *J. Clean. Prod.* 209, 101–115. doi: 10.1016/j.jclepro.2018.10.208

Goossen, M., and Langers, F. (2000). Assessing quality of rural areas in the Netherlands: finding the most important indicators for recreation. *Landscape Urban Plann.* 46, 241–251. doi: 10.1016/S0169-2046(99)00058-4

Gössling, S. (2002). Global environmental consequences of tourism. *Glob. Environ. Change* 12, 283–302. doi: 10.1016/S0959-3780(02)00044-4

Graham, A. (2013). Understanding the low cost carrier and airport relationship: a critical analysis of the salient issues. *Tour. Manage.* 36, 66–76. doi: 10.1016/j.tourman.2012.11.011

Hall, C. M. (2001). Trends in ocean and coastal tourism: the end of the last frontier? *Ocean Coast. Manage.* 44, 601–618. doi: 10.1016/S0964-5691(01)00071-0

Hanna, S., Rowley, J., and Keegan, B. (2021). Place and destination branding: a review and conceptual mapping of the domain. *Eur. Manage. Rev.* 18, 105–117. doi: 10.1111/emre.12433

Henriksen, K., Stambulova, N., and Roessler, K. K. (2010). Holistic approach to athletic talent development environments: a successful sailing milieu. *Psychol. Sport Exercise* 11, 212–222. doi: 10.1016/j.psychsport.2009.10.005

Higham, J., and Hinch, T. (2018). *Sport Tourism Development*. Channel View Publications. doi: 10.21832/HIGHAM6553

Hindi, A. M., Schafheutle, E. I., and Campbell, S. M. (2024). What are the priorities for improving quality for community pharmacy professional services? Nominal group technique discussions with multiple stakeholders. *BMC Health Serv. Res.* 24:1594. doi: 10.1186/s12913-024-11869-1

Horak, S., Marusic, Z., and Favro, S. (2006). Competitiveness of Croatian nautical tourism. *Tour. Marine Environ.* 3, 145–161. doi: 10.3727/154427306779435274

Huang, W., Chen, C-. Y., and Fu, Y-. K. (2022). The sustainable island tourism evaluation model using the FDM-DEMATEL-ANP method. *Sustainability* 14:7244. doi: 10.3390/su14127244

Hwang, C., and Yoon, K. (1981). *Multiple Attribute Decision Making: Methods and Application*. New York: Springer Publications. doi: 10.1007/978-3-642-48318-9

Ioannidis, S. (2019). An overview of yachting tourism and its role in the development of coastal areas of Croatia. *J. Hospital. Tour. Issues* 1, 30–43.

Jin, X., Xiang, Y., Weber, K., and Liu, Y. (2019). Motivation and involvement in adventure tourism activities: a Chinese tourists' perspective. *Asia Pac. J. Tour. Res.* 24, 1066–1078. doi: 10.1080/10941665.2019.1666152

Jugović, A., Kovačić, M., and Hadžić, A. (2011). Sustainable development model for nautical tourism ports. *Tour. Hospital. Manage.* 17, 175–186. doi: 10.20867/thm.17.2.1

Khadaroo, J., and Seetanah, B. (2008). The role of transport infrastructure in international tourism development: a gravity model approach. *Tour. Manage.* 29, 831–840. doi: 10.1016/j.tourman.2007.09.005

Landauer, M., Pröbstl, U., and Haider, W. (2012). Managing cross-country skiing destinations under the conditions of climate change-Scenarios for destinations in Austria and Finland. *Tour. Manage.* 33, 741–751. doi: 10.1016/j.tourman.2011.08.007

Leal Filho, W. (2018). *Handbook of Sustainability Science and Research*. Springer International Publishing. doi: 10.1007/978-3-319-63007-6

Li, Z., Xie, J., Yang, J., and Chang, D. (2021). Dynamic monitoring and analysis of ecological environment in the coastal tourist destinations of Sanya City, Hainan. *Proc. Second China Digit. Earth Conf.* 1004:012004. doi: 10.1088/1755-1315/1004/1/012004

Lim, C. (1997). Review of international tourism demand models. *Ann. Tour. Res.* 24, 835–849. doi: 10.1016/S0160-7383(97)00049-2

Lin, C-. T., and Juan, P-. J. (2009). Developing a hierarchy relation with an expert decision analysis process for selecting the optimal resort type for a Taiwanese international resort park. *Expert Syst. Appl.* 36, 1706–1719. doi: 10.1016/j.eswa.2007.11.044

Luković, T. (2012). "Nautical tourism and its function in the economic development of Europe," in *Visions for Global Tourism Industry-Creating and Sustaining Competitive Strategies* (Rijeka: InTech), 1304637622. doi: 10.5772/38058

Luo, X. (2017). "Study on Hainan tourism development strategy from the perspective of regional tourism," in *IOP Conference Series: Earth and Environmental Science, Vol. 100, No. 1* (Singapore: IOP Publishing), 012076. doi: 10.1088/1755-1315/100/1/012076

McCarthy, J. (2003). Spatial planning, tourism and regeneration in historic port cities. *disP-The Plann. Rev.* 39, 19–25. doi: 10.1080/02513625.2003.10556852

Mikulić, J., Krešić, D., and Kožić, I. (2015). Critical factors of the maritime yachting tourism experience: an impact-asymmetry analysis of principal components. *J. Travel Tour. Market.* 32, S30–S41. doi: 10.1080/10548408.2014.981628

Morgan, A., Wilk, V., Sibson, R., and Willson, G. (2021). Sport event and destination co-branding: analysis of social media sentiment in an international, professional sport event crisis. *Tour. Manage. Perspect.* 39:100848. doi: 10.1016/j.tmp.2021.100848

Moscardo, G. (2008). *Building Community Capacity for Tourism Development*. Wallingford: CABI. doi: 10.1079/9781845934477.0000

Needham, M. D., and Szuster, B. W. (2011). Situational influences on normative evaluations of coastal tourism and recreation management strategies in Hawai'i. *Tour. Manage.* 32, 732–740. doi: 10.1016/j.tourman.2010.06.005

Nurhaeny, A., Miharja, M., and Dirgahayani, P. (2021). Measuring accessibility and island development in Ambon City. *Island Stud. J.* 16, 373–387. doi: 10.24043/isj.157

Oliver, L. A., Manning-Stanley, A., and Bridge, P. (2024). Implementing gamification within interprofessional learning: perspectives of higher education staff and students. *Cogent. Educ.* 11:2423717. doi: 10.1080/2331186X.2024.2423717

Ozkaya, G., and Erdin, C. (2020). Evaluation of smart and sustainable cities through a hybrid MCDM approach based on ANP and TOPSIS technique. *Heliyon* 6:e05052. doi: 10.1016/j.heliyon.2020.e05052

Paker, N., and Gok, O. (2021). A comprehensive evaluation of yacht charter service concept: influence of voyager-to-voyager interaction on service satisfaction. *J. ETA Marit. Sci.* 9, 157–167. doi: 10.4274/jems.2021.94834

Paker, N., and Paker, S. (2024). The dual effects of health risks and crowd perception on marine traveller behaviour: the case of shared day cruise charter. *Eur. J. Tour. Res.* 36:3613. doi: 10.54055/ejtr.v36i.3227

Pant, S., Kumar, A., Ram, M., Klochkov, Y., and Sharma, H. K. (2022). Consistency indices in analytic hierarchy process: a review. *Mathematics* 10:1206. doi: 10.3390/math10081206

Papatheodorou, A. (2021). A review of research into air transport and tourism: launching the annals of tourism research curated collection on air transport and tourism. *Ann. Tour. Res.* 87:103151. doi: 10.1016/j.annals.2021.103151

Pásková, M., Štekerová, K., Zanker, M., Lasisi, T. T., and Zelenka, J. (2024). Water pollution generated by tourism: Review of system dynamics models. *Heliyon* 10.

Peng, K. H., and Tzeng, G. H. (2019). Exploring heritage tourism performance improvement for making sustainable development strategies using the hybrid-modified MADM model. *Curr. Issues Tour.* 22, 921–947. doi: 10.1080/13683500.2017.1306030

Pourebrahim, S., Hadipour, M., Mokhtar, M. B., and Mohamed, M. I. H. (2010). Analytic network process for criteria selection in sustainable coastal land use planning. *Ocean Coast. Manage.* 53, 544–551. doi: 10.1016/j.ocecoaman.2010.06.019

Rezvani, M., Nickravesh, F., Astaneh, A. D., and Kazemi, N. (2022). A risk-based decision-making approach for identifying natural-based tourism potential areas. *J. Outdoor Recreat. Tour.* 37:100485. doi: 10.1016/j.jort.2021.100485

Rigas, K. (2009). Boat or airplane? Passengers' perceptions of transport services to islands. The example of the Greek domestic leisure market. *J. Trans. Geogr.* 17, 396–401. doi: 10.1016/j.jtrangeo.2008.07.005

Ritchie, J. B., and Crouch, G. I. (2003). *The Competitive Destination: A Sustainable Tourism Perspective*. Loden: CABI. doi: 10.1079/9780851996646.0000

Rosentraub, M. S., and Joo, M. (2009). Tourism and economic development: Which investments produce gains for regions? *Tour. Manag.* 30, 759–770.

Saaty, T. L. (1996). *Decision Making with Dependence and Feedback: The Analytic Network Process*. Pittsburgh: RWS Publications.

Saaty, T. L. (2007). Time dependent decision-making; dynamic priorities in the AHP/ANP: generalizing from points to functions and from real to complex variables. *Math. Comp. Modell.* 46, 860–891. doi: 10.1016/j.mcm.2007.03.028

Sahin, K., and Cezlan, E. Ç. (2022). Hospital selection of health tourists: a study with AHP and TOPSIS methods. *OPUS J. Soc. Res.* 19, 327–339. doi: 10.26466/opusjsr.1091933

Sariisik, M., Turkay, O., and Akova, O. (2011). How to manage yacht tourism in Turkey: a swot analysis and related strategies. *Proc. Soc. Behav. Sci.* 24, 1014–1025. doi: 10.1016/j.sbspro.2011.09.041

Saveriades, A. (2000). Establishing the social tourism carrying capacity for the tourist resorts of the east coast of the Republic of Cyprus. *Tour. Manage.* 21, 147–156. doi: 10.1016/S0261-5177(99)00044-8

Scott, D., and Lemieux, C. (2010). Weather and climate information for tourism. *Proc. Environ. Sci.* 1, 146–183. doi: 10.1016/j.proenv.2010.09.011

Sevinç, F., and Güzel, T. (2017). Sustainable yacht tourism practices. *Manage. Market. J.* 15, 61–76.

Shen, Y., Kokkranikal, J., Christensen, C. P., and Morrison, A. M. (2021). Perceived importance of and satisfaction with marina attributes in sailing tourism experiences: a kano model approach. *J. Outdoor Recreat. Tour.* 35:100402. doi: 10.1016/j.jort.2021.100402

Shyur, H-. J. (2006). COTS evaluation using modified TOPSIS and ANP. *Appl. Mathe. Comput.* 177, 251–259. doi: 10.1016/j.amc.2005.11.006

Simón, F. J. G., Narangajavana, Y., and Marques, D. P. (2004). Carrying capacity in the tourism industry: a case study of Hengistbury Head. *Tour. Manage.* 25, 275–283. doi: 10.1016/S0261-5177(03)00089-X

Syafruddin, C., Aprilia, C., and Zainul, Z. R. (2019). Indonesian marine tourism: developing a favorable tourism destination to attract international sailing boats. *Expert J. Mark.* 7, 14–19.

Tang, H. W. V., Chang, K., Yin, M. S., and Sheu, R. S. (2017). Critical factors for implementing a programme for international MICE professionals: a hybrid MCDM model combining DEMATEL and ANP. *Curr. Issues Tour.* 20, 1527–1550. doi: 10.1080/13683500.2015.1053848

Tavana, M., Mousavi, S. M. H., Mina, H., and Salehian, F. (2020). A dynamic decision support system for evaluating peer-to-peer rental accommodations in the sharing economy. *Int. J. Hospital. Manage.* 91:102653. doi: 10.1016/j.ijhm.2020.102653

Wang, L-. F., Xiong, Y-. F., Chen, Q-. L., and Zheng, C-. Y. (2017). "The bottleneck of the development of yacht maritime leisure tourism in fujian and its countermeasures," in *Paper presented at the 3rd Annual International Conference on Management, Economics and Social Development (ICMESD 17)*, (Atlantis Press). doi: 10.2991/icmesd-17.2017.87

Wang, L. F., Zheng, C. Y., and Chen, W. (2018). "Status of yacht industry in China and its capital preservation and appreciation," in *4th Annual International Conference on Management, Economics and Social Development (ICMESD 2018)*, (Atlantis Press), 693–697. doi: 10.2991/icmesd-18.2018.121

Wang, Y., Jung, K-. A., Yeo, G-. T., and Chou, C-. C. (2014). Selecting a cruise port of call location using the fuzzy-AHP method: a case study in East Asia. *Tour. Manage.* 42, 262–270. doi: 10.1016/j.tourman.2013.11.005

Weerawat, P. (2024). Supporting small-scale fisheries in Southeast Asia: need, challenges, and recommendations. *Fish People* 22, 35–37.

Wu, W.-W., and Lee, Y.-T. (2007). Selecting knowledge management strategies by using the analytic network process. *Expert Syst. Appl.* 32, 841–847. doi: 10.1016/j.eswa.2006.01.029

Yarovaya, N. (2013). Perspectives of yacht tourism in Ukraine. *Modern Sci. Res Pract. Appl.* 21311, 88–95.

Zhu, J., Wang, E., and Sun, W. (2019). Application of Monte Carlo AHP in ranking coastal tourism environmental carrying capacity factors. *Asia Pac. J. Tourism Res.* 24, 644–657. doi: 10.1080/10941665.2019.1611610