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Importance–Performance Analysis of the Sustainability of South Penghu Marine National Park, Taiwan

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Abstract: Despite the growing global focus on marine protected areas, there is a dearth of research addressing the comprehensive sustainability of such areas. This study fills the gap by evaluating the sustainability of South Penghu Marine National Park (SPMNP) using importance–performance analysis (IPA) across 18 sustainability indicators, encompassing environmental, economic, and social dimensions. The results reveal that environmental sustainability was rated as the most critical, with top indicators including protecting ecological habitats and marine wildlife. Performance scores were generally satisfactory, though disparities between importance and performance were noted, suggesting areas for improvement. Notably, all sustainability indicators are significantly below the threshold performance target of 75%, indicating significant gaps in meeting public expectations. The analysis also highlights strong public support for both on-site and off-site management measures as key strategies to enhance park sustainability. This study provides valuable insights for policymakers and park managers aiming to improve the sustainability of marine protected areas.

Keywords: gap analysis; protected areas; public support; quadrant analysis; sustainable development; threshold performance targets

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1. Introduction

A national park is a designated area of natural, cultural, or scenic significance protected by the national government. The inception of Yellowstone National Park in the United States in 1872 established the idea of national parks and served as a model for creating protected places worldwide [1]. As conservation gained traction globally, countries began establishing their own national parks, primarily focusing on terrestrial ecosystems [2].

National parks serve three purposes. First, national parks aim to conserve biodiversity and protect the natural environment from human activities that could cause irreversible damage. National parks serve as sanctuaries for endangered species, safeguarding habitats critical for survival [3]. By maintaining the ecological integrity of these areas, national parks help preserve the genetic diversity of flora and fauna, which is essential for the resilience of ecosystems in facing the challenges of climate change [2]. Second, national parks are set up to provide spaces for public recreation and environmental education. They offer visitors the opportunity to experience and appreciate the beauty of nature through outdoor activities such as hiking, wildlife watching, and camping. These recreational opportunities enhance public health and well-being and foster a deeper connection with the natural world, promoting environmental stewardship [4,5]. Third, national parks also play a vital role in supporting local and national economies through sustainable tourism. By attracting visitors worldwide, national parks generate revenue that can be reinvested into conservation efforts and provide economic opportunities for nearby communities [6].

As the understanding of ecological systems evolved, it became clear that marine environments deserved equal protection. Making up over 70% of the Earth's surface, oceans are home to a wide variety of biodiversity and provide various ecological services that

benefit local and global populations [7]. However, marine environments are increasingly threatened by overfishing, pollution, and climate change [8]. There is a need to extend the initiatives of terrestrial national parks to marine areas [9,10]. Recognizing the importance of oceans, the first marine national park, Great Barrier Reef Marine Park in Australia, was designated in 1975 [11]. The transition from terrestrial to marine parks marked a shift in conservation philosophy, embracing a more holistic understanding of environmental protection, including land and sea [12].

While significant progress has been made, the coverage of marine national parks still lags behind that of terrestrial parks. Globally, less than 10% of oceans currently are under certain forms of protection, with even fewer areas designated as strictly protected marine reserves [13]. This underscores the need for marine protected areas as part of global initiatives to achieve sustainable development goals (SDGs), particularly SDG 14, which aims at the sustainable use of the oceans, seas, and marine resources [14].

From a sustainable development perspective, marine national parks are crucial to the well-being of local communities. They also play a key role in supporting sustainable fisheries and promoting eco-tourism [15,16]. Effective management of marine national parks is essential to ensure that these benefits are sustained and preserve the ecological integrity of marine environments [12]. By analyzing the ecological, social, and economic sustainability of the park, administrators can identify key challenges and opportunities [17]. The strategic analysis can inform park managers to develop strategies that balance conservation, recreation, and community needs, ultimately securing the park's long-term vitality [18].

Several approaches to strategic analysis have direct relevance to the management of protected areas [19]. One simple but effective approach is importance–performance analysis (IPA), which involves measures of a variety of importance and performance indicators [20]. The scores of these indicators are fitted in an importance–satisfaction grid to provide a graphic visualization of the sustainability situation of the national park [20]. The importance and performance scores can be further examined by gap analysis and threshold performance targets. While the former assesses the distinction between importance and performance, the latter ascertains whether or not the satisfaction score was statistically lower than the benchmark [21]. Although the methodology of IPA has been successfully applied to investigate terrestrial protected areas, there has been very limited application in marine national parks [22].

Therefore, this study applies the methodology of IPA to evaluate the environmental, economic, and social sustainability of South Penghu Marine National Park (SPMNP). The objectives were fourfold: (1) to investigate how the public perceives the respective importance–performance levels of the environmental, economic, and social sustainability of SPMNP; (2) to identify key achievements and challenges of SPMNP through importance–satisfaction quadrant analysis, gap analysis, and threshold performance targets; (3) to explore possible factors that affect the sustainability of SPMNP; and (4) to suggest recommendations for the sustainable management of SPMNP.

The novelty of this paper lies in its pioneering application of IPA to a marine national park, addressing a significant research gap in the field of environmental assessments that the application of IPA has been extremely limited to marine environments. This study breaks new ground by applying IPA to the marine context and integrating gap analysis and threshold performance targets, offering a comprehensive analysis of the environmental, economic, and social dimensions of sustainability. By evaluating public perceptions and management strategies through this novel approach, this study supplements the existing literature on marine protected areas. It also provides valuable insights into the sustainable management of marine protected areas worldwide.

This paper is structured as follows: Next to the introduction is the literature review, which discusses relevant theories and applications of IPA and related analyses. The research methods, such as the questionnaire, data collection, and statistical analysis, are described in detail in Section 3. The findings are systematically presented in Section 4, and the

interpretations are included in Section 5, respectively. Key discoveries and closing thoughts are finally discussed in Section 6.

2. Literature Review and Theoretical Foundation

2.1. Importance–Performance Analysis

IPA is a strategic management tool developed in the 1970s [23]. While only two constructs, namely importance and performance, are considered, the IPA methodology represents a straightforward means of identifying critical areas where an organization's performance does not meet stakeholder expectations.

Specifically, a grid is set up with the gradient of importance as the y-axis and the gradient of performance as the x-axis, respectively. Each item is then positioned in the grid based on its importance and performance scores, typically the means [24]. Four quadrants are created by placing crosshairs (i.e., vertical and horizontal lines) on the grid (Figure 1). The placement of crosshairs is usually at the grand means of importance and performance scores [20]. Otherwise, some researchers may place the crosshairs at the midpoint of the measurement scale (e.g., 3 on a 5-point scale, 3.5 on a 6-point scale, etc.) or even a particular point, dependent upon the research purposes [19,22].

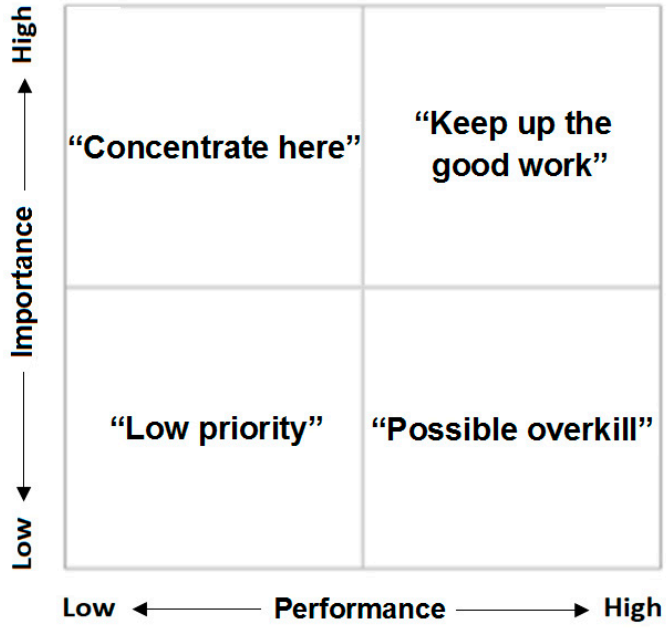


Figure 1. Importance–performance grid and four quadrants.

Each quadrant is labeled to provide managers with actionable insights:

- Right upper quadrant (i.e., both the levels of importance and performance are high): "keep up the good work";
- Left upper quadrant (i.e., the level of importance is high but the level of performance is low): "concentrate here";
- Right lower quadrant (i.e., the level of importance is low but the level of performance is high): "possible overkill";
- Left lower quadrant (i.e., both the levels of importance and performance are low): "low priority".

Data representation effectively tells how a company or organization can address the key concerns and challenges while offering direction for future resource allocation [20]. From the management perspective, the quadrants of "keep up the good work" and "low priority" indicate that resources and efforts are properly allocated according to the importance of the areas. In contrast, "concentrate management here" and "possible overkill"

quadrants deserve more attention because they suggest the need for management action or resource relocation.

The simplicity and ease of interpretation make IPA appealing to organizations seeking to streamline their strategic planning processes [25]. The applications of IPA can be widely found in various research fields and areas, including tourism and the management of protected areas. For instance, Wade and Eagles [22] applied IPA to investigate the satisfaction of visitors to Tanzania's national parks. Similarly, Taplin [26] used it to assess visitor satisfaction and management priorities in the Walpole-Nornalup National Park in Australia.

Despite the popularity of IPA, there are a few criticisms. First, IPA oversimplifies complex relationships between importance and performance. As Slack [27] pointed out, the method assumes a linear relationship between these two dimensions, which may not always reflect the reality of customer perceptions or organizational performance. Second, the placement of crosshairs on the IPA grid can significantly influence the results and subsequent decisions. This has led to debates on the most appropriate method for setting these crosshairs [28].

In recent years, researchers have sought to address some of the limitations of traditional IPA by introducing modifications and extensions. For example, Tonge and Moore [21] reconceptualized IPA as importance–satisfaction analysis (ISA). They saw that the terms "performance" and "satisfaction" are identical, so they decided to focus on the latter as it pays attention to the consequences of desired leisure experiences and recreation. Deng [29] proposed a revised IPA that accounts for the dynamic nature of customer expectations and the relative importance of attributes. This approach acknowledges that the importance of certain attributes may change over time or in different contexts. Another significant development in the application of IPA is the integration of other techniques, e.g., gap analysis and threshold performance targets. Wong et al. [30] indicated that incorporating gap analysis into IPA enhanced the diagnostic power by not only identifying which attributes need improvement but also quantifying how much improvement is necessary. The above initiatives have expanded the applicability and effectiveness of IPA in both academic research and practical applications.

2.2. Gap Analysis

The importance–performance results can be further evaluated by gap analysis. The gap is defined as the difference in value between the mean performance score and the mean importance score. A negative gap occurs when the level of importance is lower than the level of performance, urging for performance improvement, similar to the message of "concentrate here". Conversely, a positive gap occurs when the level of importance is lower than the level of performance, suggesting that resources can be re-located to other needed areas, probably because of "possible kill" [31]. A paired-sample *t*-test can be used to determine the significance of the gap. Significant gaps, whether negative or positive, may imply the need for management actions.

One way to think of gap analysis is as the one-dimensional scaling of a two-dimensional quadrant diagram. This can be done by drawing a diagonal line from the lower left to the upper right in the quadrant diagram, where importance and performance are equal. The distance between the object and the diagonal line can visually represent the gap. Two triangles are essentially used in place of the four rectangular quadrants by the diagonal line. The left triangle represents positive gaps, and the right triangle represents negative gaps.

Gap analysis can be used for benchmarking performance, taking the reference of importance. However, importance and performance are measured on different scales [21]. The satisfaction scale often ranges from "low" to "high", but the importance scale typically goes from "not at all important" to "extremely important". Furthermore, it is often assumed that high performance is desirable for highly important traits. Therefore, relative measurements rather than absolute ones may be a better way to understand gaps [32]. Given the limitations of gap analysis, Bacon [33] indicated that gap analysis was deemed superior to

quadrant analysis because the gap measurement is simple and gap scores are available for statistical analysis. In practice, gap analysis often accompanies quadrant analysis [21].

2.3. Threshold Performance Targets

Another key extension of IPA is the incorporation of threshold performance targets. This method is another type of benchmarking. Different from gap analysis, threshold performance targets focus only on performance. Threshold performance targets refer to a priori percentage of respondents who rate an attribute above a predefined level of performance. The selection of the target level of performance is typically guided by strategic goals, industry standards, and stakeholder expectations [34]. The percentage is often chosen based on benchmarks from similar studies, organizational objectives, or regulatory requirements, with common thresholds being 75%, 80%, or 85% [35]. The implications of setting these targets are significant, as higher thresholds demand stronger performance and can highlight areas requiring urgent improvement. In comparison, lower thresholds might indicate a more lenient performance standard but overlook critical deficiencies.

If the sample proportion of an item fails to meet the threshold performance target, management attention is warranted. A one-sample z-test can be used to determine the significance of the failure. To enhance the interpretability of threshold performance targets, three levels of importance, i.e., low, medium, and high, are identified under the importance–performance framework [36].

Threshold performance targets provide a nuanced understanding of whether specific attributes meet predefined standards of performance. The findings allow organizations to set clear benchmarks for performance to ensure that critical attributes meet the desired standards. Martilla and James [23], who originally developed IPA, emphasized the importance of focusing on attributes that fall below performance expectations, laying the groundwork for later applications of threshold performance targets.

Threshold performance targets have been successfully applied to studies in the context of protected areas. For example, Archer and Griffin [36] and Tonge et al. [31] used threshold performance targets to evaluate the performance of two national parks in Australia, respectively.

3. Methods

3.1. Study Area

SPMNP (23°14′–23°17′ N and 119°30′–119°40′ E) is situated in the southern region of the Penghu archipelago. Four islets—Dongjiyu, Xijiyu, Dongyuping, and Xiyuping—and the seas that encircle them are covered by SPMNP (Figure 2). SPMNP comprises 35,473 hectares of surrounding sea and roughly 370 hectares of total land area, accounting for approximately 1% of Taiwan's claimed exclusive economic zone.

Penghu archipelago is a hotspot for island tourism because of its rich marine biodiversity and beautiful scenery. To protect the marine ecosystem and regulate tourism activities, SPMNP was designated as the second marine national park in Taiwan in 2014, based on the National Park Law of Taiwan in 2010 [37]. According to the official statistics, SPMNP harbors more than 250 fish species and 150 coral reef species [38,39]. While about 50% of SPMNP is covered by coral reefs, an exceptionally high concentration of coral can be found in the shallow waters around the four islets [40].

SPMNP is also Taiwan's first multiple-purpose marine protected area, aiming at conservation, recreation, and education [38]. Taiwan's approach to SPMNP is guided by the principles of sustainable development, which highlight the importance of balancing environmental conservation, economic opportunities, and community benefits [41,42]. While SPMNP is protected by the legal framework and enforced by the park authority [35], ecotourism was strategically promoted as a tool for environmental conservation and, at the same time, a vehicle to generate revenue and benefit the local communities. According to government statistics, Penghu annually receives more than 1 million tourists. While tourism effectively generates revenue, it may cause damage to marine ecosystems and

conflicts between visitors and local people. Therefore, a systematic and comprehensive evaluation of the sustainability of SPMNP is necessary and timely.



Figure 2. The map of South Penghu Marine National Park (SPMNP).

Using the three spheres of sustainability as a framework for evaluating the performance of SPMNP ensures that all aspects of sustainability are addressed, promoting a holistic and inclusive approach to park management. This framework helps not only assess the current status of SPMNP but also formulate a management plan for its future. Through careful and deliberate management strategies, it is hoped that SPMNP will exemplify how sustainable development can be achieved and continue to serve its purposes for future generations.

3.2. Questionnaire

The development of the questionnaire began with a critical review of documents and reports from the Taiwanese government and the existing literature on assessments of protected areas to select an appropriate analytical framework for this study. Among a few popular frameworks such as sustainable development [43], Millennium Ecosystem Assessment [44], the capital-based framework [45], etc., the framework of sustainable development was selected for its comprehensiveness, which encompasses environmental,

economic, and social dimensions essential for evaluating the park's sustainability. This choice also aligns well with the management goals of the Taiwanese government, ensuring coherence with national conservation strategies [38]. Moreover, the public is familiar with the concepts of sustainable development, which facilitates effective communication and dissemination of the results, an important aspect for gaining stakeholder support and understanding.

Following the framework selection, a series of in-depth interviews was conducted with scholars, government officials, and local residents to finalize the assessment items for the questionnaire. These interviews were crucial in gathering diverse perspectives and ensuring that the questionnaire reflected the interests and insights of key stakeholders. This collaborative approach helped identify relevant and context-specific items that would accurately assess the environmental, economic, and social impacts on the marine national park. The resulting questionnaire thus integrates expert knowledge and local input, creating a robust tool for evaluating the sustainability of SPMNP in line with the chosen framework.

Two independent experts in the field were invited to review the draft questionnaire, and some revisions were made based on their comments. A pilot study was performed on 15 local Penghu residents in July 2022. A few ambiguous wordings were revised to confirm the face validity and reliability of the measurement. The questionnaire was initially prepared in English and then translated into Chinese. The Chinese questionnaire was translated back into English for an accuracy check. Respondents were free to select either an English or Chinese questionnaire to answer.

The questionnaire consisted of three sections. In the first section, 18 items were used to measure the environmental, economic, and social sustainability of SPMNP. Each sphere of sustainability had six items. These question items were adopted from previous studies on sustainable development and sustainability, including Andereck and Nyaupane [46], Lee et al. [47], and Senlier et al. [48], with some wording modified to fit the research context of this study. Respondents were first asked to rate the importance of these 18 items on a Likert scale of 1 to 5 (1 being not at all important to 5 being very important). They were then asked to assign a 5-point rating to the performance (1 being extremely awful and 5 being great). In the second section, respondents were asked to rate their support for 5 on-site and 5 off-site management measures on a 5-point scale (1 being strongly opposed to 5 being strong support). In the third section, five questions were asked to collect the respondents' demographic information, including their gender, age, education, income, and place of residence. All constructs of the questionnaire achieved a satisfactory level of reliability, as the values of Cronbach's alpha were higher than the required threshold of 0.7 (Table 1).

Table 1. Reliability test for the constructs of the questionnaire.

Constructs	Cronbach's Alpha
Importance of environmental sustainability (n = 6)	0.810
Importance of economic sustainability (n = 6)	0.911
Importance of social sustainability (n = 6)	0.910
Performance of environmental sustainability (n = 6)	0.946
Performance of economic sustainability (n = 6)	0.944
Performance of social sustainability (n = 6)	0.955
On-site management measure (n = 5)	0.715
Off-site management measure (n = 5)	0.841

3.3. Data Collection

An online questionnaire survey was conducted to collect data from the public in August 2022. There are two advantages of using an online platform for data collection. First, a wide and diverse number of respondents can be reached by online surveys, which is crucial for obtaining a representative sample. Second, online surveys are more cost-effective than face-to-face methods because the former requires less administrative costs and physical materials involved in data collection and entry than the latter.

Snowball sampling was used to ensure the penetration and distribution of the questionnaire and to reach suitable samples. Initially, participants from various backgrounds were chosen to provide a varied starting point for the snowball process and to reduce selection bias. Anonymity and confidentiality were maintained during the survey, so respondents were expected to provide truthful and accurate answers.

A total of 388 respondents completed the questionnaire. Table 2 summarizes the demographic characteristics of the respondents. The number of females (50.5%) was slightly more than males (49.5%). Respondents were over-represented by middle-aged or seniors, with the largest groups being those aged 61 or above (34.4%) and 51–60 years old (33.3%). Other age groups are less than 15% each. Respondents were well educated. Most respondents have a college degree (45.8%), while a significant portion holds a graduate degree (18.4%). More than half of respondents (52.2%) earned more than TWD 45,001 monthly. Lower-income categories are less represented. Geographically, the majority of respondents reside in Northern Taiwan (74.5%), followed by Southern Taiwan (9.3%), Eastern Taiwan (7.7%), Central Taiwan (7.5%), and the Outlying Islands (1.0%).

Table 2. Demographic characteristics of the respondents (n = 388).

Sociodemographic		Number	%
Gender	Male	191	49.5
	Female	195	50.5
Age	30 or below	56	14.5
	31–40	29	7.5
	41–50	40	10.3
	51–60	129	33.3
	61 or above	133	34.4
Education	Junior secondary or below	11	3.1
	Senior secondary	55	15.5
	Post-secondary	61	17.2
	University	162	45.8
	Postgraduate	65	18.4
Monthly income *	TWD 30,000 or below	53	14.5
	TWD 30,001–TWD 35,000	34	9.9
	TWD 35,001–TWD 39,000	39	8.2
	TWD 39,001–TWD 42,000	22	5.0
	TWD 42,001–TWD 45,000	34	8.2
	TWD 45,001 or above	206	52.2
Place of residence	Northern Taiwan	289	74.5
	Central Taiwan	29	7.5
	Southern Taiwan	36	9.3
	Eastern Taiwan	30	7.7
	Outlying islands	40	1.0

* US Dollar (USD)/Taiwan New Dollar (TWD) exchange rate = 32.

3.4. Data Analysis

Three analyses were performed on the data. First, indicators were plotted to the quadrant diagram in the importance–satisfaction quadrant analysis based on their mean importance and satisfaction scores. To account for the positive skew frequently observed in social surveys, the crosshairs were positioned at the grand means for importance and satisfaction because of the skewness of the data [31]. The placement of indicators (i.e., the quadrants) provided actionable insights for park management. The standard errors were also calculated to show the accuracy of the mean scores.

Second, in the gap analysis, gap scores were calculated by subtracting the mean scores of importance from the mean scores of performance. The significance of the gaps was then assessed using a paired-sample t-test [21]. A significant gap prompts required management actions, or vice versa.

The third is the threshold performance target analysis. In this survey, the criterion of 75% of respondents indicating they were "satisfied" or "very satisfied" with the items was employed. The one-sample z-statistic was computed for each item that failed to reach the target in order to assess if the sample proportion was statistically lower than 75%. A significant difference between sample proportion and a priori percentage prompts required management actions, or vice versa. The importance rating of the indicator was assigned based on its mean score of importance (high being above the grand mean, moderate being between the grand mean and the scale midpoint, and low being below the scale midpoint) [36].

4. Results

4.1. Importance–Performance Quadrant Analysis

Table 3 presents the mean importance and performance scores of 18 indicators and Figure 3 shows the quadrant in which they fall. The grand means of importance and performance were 4.52 and 3.60, respectively, which defined the placement of the crosshairs.

Table 3. Importance and performance scores of 18 sustainability indicators of SPMNP.

Indicators	Importance		Performance	
	Mean	**SE**	**Mean**	**SE**
Grand Mean	4.52	0.027	3.60	0.034
Environmental indicators:				
(A1) Protect natural landscape	4.91	0.018	3.68	0.036
(A2) Protect ecological habitat	4.93	0.017	3.65	0.041
(A3) Protect marine wildlife	4.91	0.021	3.63	0.042
(A4) Facilitate sustainable use of resources	4.90	0.020	3.63	0.042
(A5) Arise environmental awareness of people	4.83	0.024	3.63	0.042
(A6) Provide education and research opportunities	4.73	0.030	3.66	0.039
(A_m) Mean of environmental indicators	4.87	0.013	3.65	0.036
Economic indicators:				
(B1) Stimulate local economy	4.23	0.050	3.63	0.039
(B2) Promote local prosperity	4.10	0.056	3.51	0.039
(B3) Increase local residents' income	4.04	0.053	3.49	0.041
(B4) Create jobs	4.12	0.049	3.43	0.040
(B5) Help attract tourists to come to Penghu	4.29	0.049	3.76	0.039
(B6) Enhance Taiwan's international image	4.68	0.037	3.64	0.046
(B_m) Mean of economic indicators	4.24	0.041	3.58	0.036
Social indicators:				
(C1) Strengthen neighborhood relationships in local communities	4.22	0.049	3.54	0.040
(C2) Let the public identify with local culture	4.51	0.040	3.57	0.042
(C3) Give local communities a sense of belonging	4.47	0.041	3.52	0.040
(C4) Preserve local culture	4.63	0.036	3.63	0.042
(C5) Improve the quality of life in local communities	4.32	0.046	3.51	0.040
(C6) Increase local visibility	4.47	0.042	3.69	0.040
(C_m) Mean of social indicators	4.44	0.035	3.58	0.037

The results indicated that the importance of environmental sustainability (4.87 $\pm$ 0.013) of SPMNP was rated higher than the importance of social (4.44 $\pm$ 0.035) and economic sustainability (4.24 $\pm$ 0.041). The three most important attributes of SPMNP were "protect ecological habitat" (4.93), "protect natural landscape" (4.91), and "protect marine wildlife" (4.91). The three least important attributes were "increase local residents' income" (4.04), "promote local prosperity" (4.10), and "create jobs" (4.12). The differences in the importance scores reflected the priority of objectives of the marine national park.

The mean scores of performance were more or less the same for environmental (3.65 $\pm$ 0.036), social (3.58 $\pm$ 0.037), and economic (3.58 $\pm$ 0.036) sustainability. The three best-performing attributes of SPMNP were "help attract tourists to come to Penghu" (3.76), "increase local visibility" (3.69), and "protect natural landscape" (3.68). The four worst-performing attributes were "create jobs" (3.43), "increase local residents' income"

(3.49), "promote local prosperity" (3.51), and "improve the quality of life in local communities" (3.51).

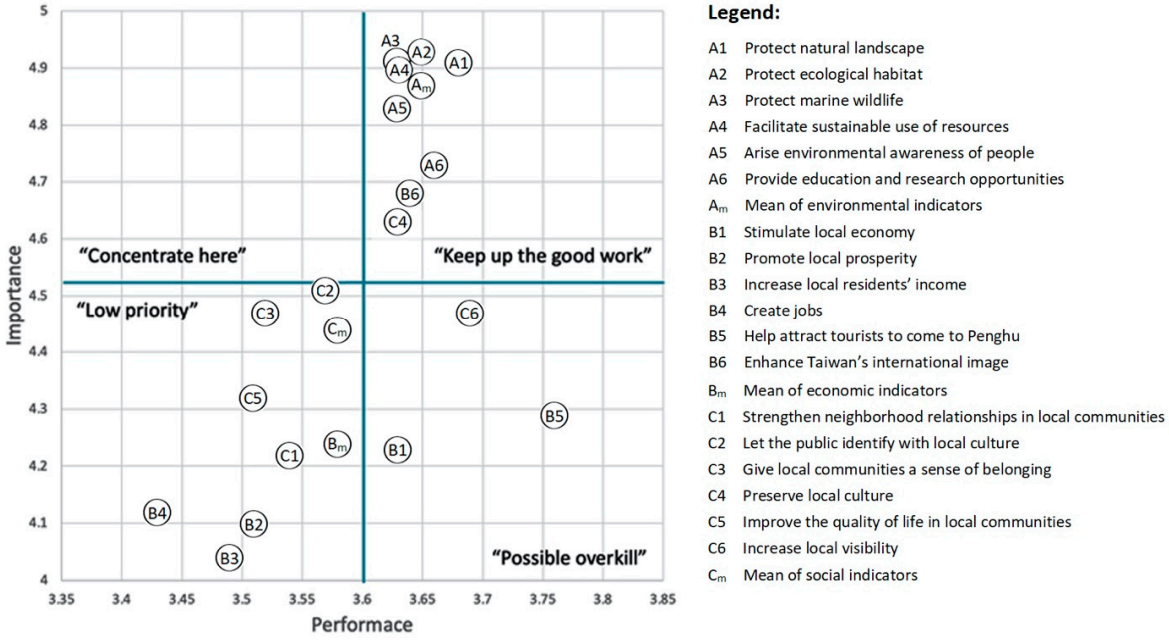


Figure 3. Importance–satisfaction grid analysis for 18 sustainability indicators of SPMNP.

Importance–satisfaction quadrant analysis (Figure 3) showed that the majority of sustainability indicators fell in the quadrant of "keep up the good work" or "low priority". There were no indicators in the quadrant of "concentrate here".

Eight indicators, namely all six environmental indicators, "enhance Taiwan's international image", and "preserve local culture", were found in the quadrant of "keep up the good work", indicating that the current level of attention and resources should be maintained in these areas.

Three economic indicators, namely "promote local prosperity", "increase local residents' income", and "create jobs", and four social indicators, namely "strengthen neighborhood relationships in local communities", "let the public identify with local culture", "give local communities a sense of belonging", and "improve the quality of life in local communities", fell in the quadrant of "low priority", indicating that these areas require less immediate attention. Resources could be reallocated to more critical areas.

There were three indicators, namely "increase local visibility", "help attract tourists to come to Penghu", and "stimulate local economy", in the quadrant of "possible overkill", indicating that SPMNP might allocate excessive resources in promoting itself as a vehicle for economic and tourism development. Resources devoted to these areas could be better used elsewhere, though performance should still be maintained.

4.2. Gap Analysis

Table 4 presents the results of the gap analysis for 18 sustainable indicators. It is interesting that all 18 sustainability indicators had negative gap scores, which were statistically significant, indicating discrepancies between the importance and performance. All indicators' performance scores were above the "pass" level, or three on a five-point scale. The discrepancies might be interpreted as room for improvement or calling for better management of the marine national park.

Table 4. Gap analysis for 18 sustainability indicators of SPMNP.

Indicators	Importance		t
	Mean	SE	
Grand Mean	−0.916	0.036	−25.623 ***
Environmental indicators:			
(A1) Protect natural landscape	−1.227	0.039	−31.343 ***
(A2) Protect ecological habitat	−1.278	0.043	−29.821 ***
(A3) Protect marine wildlife	−1.273	0.045	−28.435 ***
(A4) Facilitate sustainable use of resources	−1.276	0.046	−27.745 ***
(A5) Arise environmental awareness of people	−1.201	0.048	−24.937 ***
(A6) Provide education and research opportunities	−1.067	0.041	−25.829 ***
(A_m) Mean of environmental indicators	−1.220	0.037	−33.031 ***
Economic indicators:			
(B1) Stimulate local economy	−0.593	0.055	−10.761 ***
(B2) Promote local prosperity	−0.588	0.059	−9.928 ***
(B3) Increase local residents' income	−0.546	0.059	−9.230 ***
(B4) Create jobs	−0.691	0.055	−12.467 ***
(B5) Help attract tourists to come to Penghu	−0.528	0.056	−9.518 ***
(B6) Enhance Taiwan's international image	−1.034	0.053	−19.391 ***
(B_m) Mean of economic indicators	−0.663	0.046	−14.396 ***
Social indicators:			
(C1) Strengthen neighborhood relationships in local communities	−0.683	0.051	−13.266 ***
(C2) Let the public identify with local culture	−0.941	0.050	−18.859 ***
(C3) Give local communities a sense of belonging	−0.956	0.048	−19.970 ***
(C4) Preserve local culture	−0.997	0.050	−19.853 ***
(C5) Improve the quality of life in local communities	−0.814	0.049	−16.618 ***
(C6) Increase local visibility	−0.786	0.050	−15.767 ***
(C_m) Mean of social indicators	−0.863	0.041	−20.924 ***

*** denote gaps significantly different to 0 at the level of 0.001.

4.3. Threshold Performance Targets

In terms of threshold performance targets, all 18 sustainability indicators fell below the threshold performance target of 75% (Table 5). The differences are statistically significant at the level of 0.001. The importance ratings provide an additional layer of interpretation.

Table 5. Threshold performance target analysis for 18 sustainability indicators of SPMNP.

Indicators	Satisfaction Score (%)	z	Importance Rating
Environmental indicators:			
(A1) Protect natural landscape	60.6	−6.55 ***	High
(A2) Protect ecological habitat	59.0	−7.28 ***	High
(A3) Protect marine wildlife	57.7	−7.87 ***	High
(A4) Facilitate sustainable use of resources	55.9	−8.69 ***	High
(A5) Arise environmental awareness of people	55.2	−9.01 ***	High
(A6) Provide education and research opportunities	57.7	−7.87 ***	High
Economic indicators:			
(B1) Stimulate local economy	53.6	−9.73 ***	Moderate
(B2) Promote local prosperity	46.1	−13.15 ***	Moderate
(B3) Increase local residents' income	44.3	−13.97 ***	Moderate
(B4) Create jobs	41.8	−15.10 ***	Moderate
(B5) Help attract tourists to come to Penghu	62.1	−5.87 ***	Moderate
(B6) Enhance Taiwan's international image	54.9	−9.14 ***	High

Table 5. *Cont.*

Indicators	Satisfaction Score (%)	z	Importance Rating
Social indicators:			
(C1) Strengthen neighborhood relationships in local communities	47.7	−12.42 ***	Moderate
(C2) Let the public identify with local culture	51.5	−10.69 ***	Moderate
(C3) Give local communities a sense of belonging	49.2	−11.74 ***	Moderate
(C4) Preserve local culture	56.7	−8.32 ***	High
(C5) Improve the quality of life in local communities	46.6	−12.92 ***	Moderate
(C6) Increase local visibility	56.2	−8.55 ***	Moderate

*** denote gaps significantly different to 0 at the level of 0.001.

4.4. Management Measures

In responding to the challenges, respondents supported all management measures (Table 6), but they seemed to prefer off-site options (4.65 ± 0.024) to on-site options (4.53 ± 0.027). The two most popular measures were "education" (4.77 ± 0.026) and "ecological restoration" (4.70 ± 0.033), but the two least popular measures were "entrance ticket" (4.18 ± 0.053) and "attract residents to return to Penghu for life" (4.40 ± 0.041).

Table 6. Level of support (% of respondents) for management measures of SPMNP.

Management Measures	Mean	SE
On-site measures:		
Entrance ticket	4.18	0.053
Patrolling	4.57	0.038
Law enforcement and penalty	4.63	0.034
Upgrading infrastructures	4.57	0.035
Ecological restoration	4.70	0.033
Mean of on-site measures	4.53	0.027
Off-site measures:		
Education	4.77	0.026
Training for tourism operators	4.67	0.030
Ecotourism accreditation	4.67	0.029
Attract residents to return to Penghu for life	4.44	0.041
Coordination among government, industry, and local people	4.70	0.028
Mean of off-site measures	4.65	0.024

5. Discussion

5.1. Sustainability of SPMNP

The results of the IPA provide essential insights into the sustainability of SPMNP. Overall, the importance scores (grand mean of importance = 4.52) were higher than performance (grand mean of performance = 3.60), prompting the disparities between expectations and satisfaction. Nevertheless, the performance scores of all indicators were 3.0, indicating that the public was generally satisfied with the performance of SPMNP. This notion is supported by the results of quadrant analysis. The lack of indicators in the "concentrate here" quadrant suggests that while no critical issues are immediately pressing, the overall performance could still be enhanced to better align with the importance ratings [49].

The environmental sustainability indicators consistently ranked highest in importance, with attributes such as "protect ecological habitat", "protect natural landscape", and "protect marine wildlife" receiving the highest importance ratings. These results align with the primary objectives of marine national parks, which emphasize the protection of natural environments and biodiversity [9]. The corresponding performance ratings, although positive, suggest areas where improvements can be made to fully meet public expectations.

In contrast, despite being rated as important, the economic and social sustainability indicators generally received lower importance scores than environmental indicators. This

reflects a common challenge in balancing conservation with socio-economic development in protected areas. The lower performance ratings for economic indicators such as "create jobs", "increase local residents' income", and "promote local prosperity" suggest that while the park contributes to environmental protection, its impact on local economies may be perceived as insufficient. These findings are consistent with other studies, highlighting the difficulties of marine national parks in delivering socio-economic benefits without compromising environmental goals [50]. While the park's primary mandate is to protect biodiversity, which may limit its ability to generate immediate economic returns or promote large-scale social initiatives. Furthermore, the remote location and the limited economic opportunities typically associated with marine conservation areas could also contribute to the perceived inadequacies in economic outcomes [51].

Social sustainability also shows mixed performance, with indicators like "strengthen neighborhood relationships" and "improve the quality of life" falling into the "low priority" quadrant. This could indicate that while these social goals are important, they may not receive adequate attention in the park's current management practices [52].

5.2. Importance–Performance Gap

There are consistent negative gap scores across all 18 sustainability indicators. Despite all indicators exceeding the midpoint of the measurement scale where the "pass" level is achieved, the significant discrepancies between perceived importance and actual performance highlight a crucial need for improvement and strategic reallocation of resources [53].

The threshold performance targets further support these findings. While current efforts maintain a baseline level of sustainability, SPMNP's management may not adequately address the priorities identified by stakeholders. The consistently lower performance scores, compared to the high importance ratings, indicate that greater emphasis should be placed on addressing the areas highlighted in the "low priority" quadrant, particularly those related to economic and social sustainability, such as increasing local residents' income and improving the quality of life in local communities. Failing to address these discrepancies risks undermining public support and potentially hindering the long-term ecological and socio-economic well-being of the park and the surrounding communities. This finding underscores the importance of a revised management strategy that prioritizes areas deemed crucial by stakeholders, ensuring a more balanced approach to environmental protection, economic development, and social equity within the SPMNP. Further research could investigate the specific factors hindering performance in these critical areas and identify actionable strategies to bridge the gap between perceived importance and actual performance.

5.3. Public Support

The public support for on-site and off-site management measures provides essential insights into community engagement and the perceived effectiveness of various strategies in enhancing the sustainability of SPMNP. The survey results indicate a strong preference for off-site management measures (mean score of 4.65) over on-site measures (mean score of 4.53), aligning with studies that suggest the broader impact of off-site initiatives can significantly enhance protected area sustainability [42].

Among the off-site measures, "education" and "ecological restoration" were the most supported. Their mean scores were 4.77 and 4.70, respectively. These findings underline the public's recognition of the importance of raising awareness and restoring ecosystems as critical components of sustainability, as supported by previous research emphasizing the role of education in conservation [54] and the effectiveness of ecological restoration in improving ecosystem resilience [55]. Educational initiatives can foster a greater understanding of marine conservation, leading to more responsible behavior among visitors and the local community [56]. Ecological restoration projects can enhance the resilience of marine ecosystems, helping to mitigate the adverse effects of human activities and environmental changes [57].

On-site measures, while slightly less favored, still received strong support, indicating that respondents also value direct actions within the park. However, the lower support for measures like "entrance ticket" and "attracting residents to return to Penghu for life" suggests some hesitancy toward strategies that might impose restrictions or have complex socio-economic implications. The introduction of an entrance fee, for example, could be seen as a barrier to accessibility or a potential burden on local residents, echoing concerns raised in studies on user fees in protected areas [58]. Conversely, such fees could provide a sustainable funding source for park management if implemented thoughtfully [59].

These management measures, both on-site and off-site, are crucial for enhancing the sustainability of SPMNP. Off-site measures like education and restoration can have long-term benefits by addressing the root causes of environmental degradation and promoting sustainable practices beyond the park's immediate area [60]. On-site measures, when carefully managed, can help maintain the park's ecological integrity while ensuring that the local community benefits from its existence [61].

In conclusion, the public's support for these management measures highlights the importance of integrating both local community needs and broader environmental goals in the sustainability strategy for SPMNP [62]. By aligning management efforts with public preferences, park authorities can enhance the effectiveness of their sustainability initiatives, ensuring that SPMNP continues to fulfill its role as a model of marine conservation.

5.4. Theoretical Implications

The findings of this study contribute to the broader understanding of sustainability in marine national parks by emphasizing the need for a balanced approach that equally prioritizes environmental, economic, and social dimensions [63]. The consistency of these findings with the broader literature suggests that marine parks often face similar challenges globally, where environmental goals are met at the expense of socio-economic objectives [64]. This study highlights the importance of taking community needs and local settings into account when managing marine parks, which has implications for developing more inclusive conservation strategies.

The theoretical implications of this study extend to the concept of sustainable development in the context of marine protected areas. The three spheres of sustainability—environmental, economic, and social—are often treated separately in theoretical models, but this study demonstrates the interdependence of these dimensions in practice. For instance, the perceived inadequacies in economic and social outcomes suggest that achieving sustainability in marine parks requires a more holistic approach, where environmental protection is not seen in isolation but in conjunction with human well-being [65].

This study also contributes to the theoretical discourse on the effectiveness of marine protected areas by challenging the notion that environmental success alone is sufficient for sustainability. It highlights the need for theoretical models that incorporate socio-economic factors as integral components of sustainability. The findings suggest that the existing frameworks may need to be expanded to better account for the complex trade-offs and synergies between different sustainability goals in marine national parks [66,67].

5.5. Practical Implications

From a practical standpoint, the results suggest that while SPMNP is performing adequately in terms of environmental sustainability, there is room for improvement in how it supports local economic and social development. The management could consider reallocating resources from areas identified as "possible overkill" to those in the "low priority" quadrant, particularly focusing on enhancing local community benefits and addressing economic challenges [68,69]. This reallocation of resources could involve investing in community-based tourism initiatives or local enterprise development, which could simultaneously promote economic prosperity and strengthen social cohesion within the community [70].

Moreover, incorporating more community engagement and participation in decision-making processes could help align the park's objectives with the expectations of the local population, leading to better outcomes across all sustainability dimensions [71]. Engaging local communities in conservation efforts not only enhances social sustainability but also ensures that economic benefits are more equitably distributed, thereby reducing potential conflicts between conservation and development goals [72].

In terms of environmental management, maintaining the high performance of environmental sustainability indicators will require ongoing monitoring and adaptive management strategies. This could include implementing more stringent conservation measures, enhancing habitat restoration efforts, and improving ecological monitoring to ensure that the park's biodiversity remains protected in the long term [73]. There is a need for a more integrated management approach that considers the interrelated nature of environmental, economic, and social sustainability [74].

5.6. Limitations and Recommendations

While this study provides valuable insights into the sustainability of SPMNP, several limitations should be acknowledged. First, using self-reported data through surveys may introduce biases. The sampling protocol is believed to effectively reduce bias, but it is impossible to eliminate bias completely. In this study, respondents might overstate the importance of environmental sustainability indicators due to perceived social expectations (i.e., social desirability bias) [75]. Future studies could incorporate observational methods or objective performance metrics to complement survey data and provide a more balanced assessment of sustainability.

Second, the cross-sectional design of this study limits its capability of inferring the causality between the importance and performance of sustainability indicators. Longitudinal studies are recommended to examine how these perceptions evolve over time and how they may be influenced by specific management actions or external factors, such as changes in policy or environmental conditions [76].

Third, the sample used in this study may not represent the general population. Although efforts were made to gather a diverse sample, middle-aged people, seniors, and residents in northern Taiwan were over-represented. To improve the representativeness of the results, it is recommended that future studies should expand the sample to include more respondents from different regions, age groups, and socio-economic backgrounds [77]. Fourth, the study focused on a specific marine national park in Taiwan, namely SPMNP, which may limit the applicability of the findings to other marine national parks with different environmental, economic, and social contexts. Comparative studies involving multiple marine national parks across different regions would better understand how sustainability indicators vary and what factors contribute to these differences [4].

Lastly, the IPA methodology does not account for the relative weight or trade-offs between different sustainability indicators, which could be critical in decision-making processes. Future research might explore more sophisticated analytical techniques, such as multi-criteria decision analysis (MCDA), to address these limitations and provide a more nuanced understanding of sustainability performance [78]. For example, the Analytic Hierarchy Process (AHP) is a valuable method if prioritizing or weighing these indicators by their perceived importance is necessary, as it structures them in a hierarchy and uses pairwise comparisons to derive priority scales [79]. The Analytic Network Process (ANP) offers a way to account for complex interdependencies among the indicators, making it suitable for scenarios where factors are interconnected and influence each other, thus providing a more comprehensive analysis of the sustainability criteria [80].

6. Conclusions

This study conducted a comprehensive assessment of the sustainability of SPMNP by employing importance–performance analysis (IPA) and gap analysis. The results reveal that while the environmental sustainability indicators of SPMNP are well-aligned with

public expectations, there are notable gaps in the performance of social and economic indicators, particularly in areas related to local community benefits. This study contributes to the literature by highlighting marine national parks' nuanced challenges in balancing ecological preservation with socio-economic development. By identifying areas where resources may be misallocated or underutilized, this research offers practical insights for park management to enhance the overall sustainability of SPMNP. Furthermore, the methodological approach adopted here, including the application of threshold performance targets, provides a valuable framework for assessing and improving sustainability in other protected areas, thereby contributing to the broader discourse on sustainable management practices in marine conservation.

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