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Multi-Criteria Model to Assess the Potentials of Cat Ba National Park to Develop Tourism Tied to Conservation

For a sustainable tourist destination, a multi-criteria assessment is essential. The assessment results are the basis for managers to make optimal development decisions for the destination. In particular, for the nature-based tourist sites (protected areas, national parks), the assessment of tourism potentials will establish the basis for protecting, monitoring ecosystems, and managing the tourism sustainable development calendar. The Multi-Criteria Method and additional methods were applied to assess tourism potentials as well as to propose conservation measures for Cat Ba National Park in Vietnam. Through the assessment of six criteria (location/accessibility, attractiveness, tourist capacity, environmental sustainability, travel duration, and tourism infrastructure/tourism technology), the results indicate that Cat Ba National Park (Vietnam) is an attractive tourist destination with a good tourist capacity, a convenient location for tourists to move, and a long tourism time of the year. However, Cat Ba National Park is a place where environmental sustainability is still limited; its exploitation needs to be considered along with its conservation, degradation prevention, and ecosystem monitoring.

Keywords: *Cat Ba National Park, Tourism, Conservation, Multi-Criteria.*

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Багатокритеріальна модель оцінювання потенціалу національного парку «Кат Ба» (В'єтнам) для потреб розвитку туризму

Для сталої туристичної дестинації багатокритеріальне оцінювання є важливим. Результати оцінювання є основою для прийняття менеджерами оптимальних рішень щодо розвитку дестинації. Зокрема для природних туристичних об'єктів (заповідних територій, національних парків) оцінка туристичного потенціалу створює основу для заповідання, моніторингу екосистем та управління календарем сталого розвитку туризму. Багатокритеріальний метод та додаткові методи було застосовано для оцінювання туристичного потенціалу, а також для формування пропозицій заходів щодо збереження національного парку «Кат Ба» у В'єтнамі за допомогою оцінювання 6 критеріїв (розташування/доступність, привабливість, туристична спроможність, екологічна стійкість, тривалість подорожі, туристична інфраструктура/туристичні технології). Результати свідчать, що національний парк «Кат Ба» (В'єтнам) є привабливою туристичною дестинацією з достатньою туристичною спроможністю, зручним місцем для пересування туристів і тривалим туристичним сезоном. Проте національний парк «Кат Ба» є місцем, де сталість навколишнього середовища все ще є обмеженою, його експлуатацію необхідно розглядати разом зі збереженням, запобіганням деградації та моніторингом екосистеми.

Ключові слова: *національний парк «Кат Ба», туризм, охорона природи, багатокритеріальність.*

1. Introduction

Tourist potential is defined as "a set of possibilities for using the tourist resources of the territory to form tourist products with unique needs that attract the maximum number of tourists" ***[1]***. Quantifying the tourism potential of a destination requires careful and comprehensive research, as the characteristics of the tourism industry include many diverse and heterogeneous components ***[2]***. However, if the tourism potential is clearly defined, it will create a basis for the development of the tourism industry in the future, for example, by defining product promotion campaigns, adopting urgent strategies, establishing principles of sustainable development, and prioritizing urgent measures ***[3]***.

The assessment of tourism potentials should be based on the visitors' behaviors and interests, but more importantly, it is necessary to view the destination as an object that needs to be protected and respected. All tourism resources, both natural and man-made, should be protected and properly utilized, but with the national parks and nature reserves, development cannot be separated from conservation. The World Tourism Organization has highlighted this significance using the slogan "Tourism — Enjoy — Respect" ***[4]***. Tourism in the national parks has many implications, including connecting with visitors and improving their understanding of the values of the protected area. And the benefits of the tourism industry in the reserves depend on the natural areas, the beauty of nature, the diverse nature and wildlife, and the authentic cultures ***[5, 6]***. However, the conservation factor has been considered by the UNWTO as the most important principle of sustainable tourism: "Optimal use of environmental resources is a key factor in the development of sustainable tourism, sustaining essential ecological processes and helping to preserve the natural heritage and biodiversity."

In addition, Agenda 21 on tourism pointed out the role of tourism (especially ecotourism) as a good tool for the preservation of natural values, ecological conservation, and biodiversity for sustainable development ***[7]***.

A national park is a place that is organized to preserve biodiversity and provide cultural services through tourism. In the context of the rapidly developing global tourism industry, in particular nature tourism (ecotourism, visiting national parks, and nature reserves), the mentioned national park presented numerous development prospects and challenges for reserves ***[8]***. The modern requirement is to create an economic balance and protect the ecological environment, that is, to ensure both the development of tourism and conservation goals ***[9]***. There are many research projects and initiatives on the practice of sustainable tourism in nature reserves, national parks, and biosphere reserves ***[8, 10, 11]***, but the most typical is the multidimensional system of research and assessment of protected areas of the IUCN and WTO on tourism in protected areas ***[8, 12, 13, 14]***. Research has confirmed that tourism should be considered in the creation and management of conservation areas, as well as in tourism-conservation decisions to establish mutual relationships. Recognizing the role of tourism development in nature conservation efforts and preserving biodiversity values, many studies have been conducted in Vietnam ***[15, 16]***.

Recently, Bui Thanh Huong et al. have conducted two important studies on tourism in Hoang Lien protected areas of Vietnam and protected areas in mountainous areas in general ***[17, 18]***. n particular, Le Thanh An et al. assessed the attractiveness of Vietnam's protected areas based on 13 different criteria ***[19, 20]***. Such research has shown many aspects of the above relationship between ecotourism development and conservation. Cat Ba National Park, with its great geological and biological values, is the focal point of the Cat Ba Archipelago World Biosphere Reserve. The park represents typical tropical and subtropical marine-island ecosystems in Asia, creating wealthy landscapes and habitats. Due to the influence of the sea breeze all year round, it has created a unique flora and fauna community that is adapted to harsh environmental conditions. Particularly, this is the only conservation area in Vietnam and the world where the small population of Cat Ba langur (*Trachypithecus poliocephalus*) exists; its number has now increased to 75–78 individuals, and pythons (*Python molurus*).

Cat Ba National Park is also the place to store ancient species that have existed for ten million years without any change in their body structure, the living evidence for the development of organisms such as amphibians (Amphioxus bencheri), cephalopods (Lingula anatina), etc.

The national park has a system of beaches in the middle of the sea, such as Ang Vem, Tung Bear Cave, and Cat Dua Beach. There is a relatively good coral reef range located in the southeast of Cat Ba and in the enclosed spaces of Long Chau island ***[21, 22, 23, 24, 25]***. Thanks to these values, Cat Ba National Park has been researched by many scientists, and it has formed an attractive destination for both domestic and foreign tourists. However, the tourism potential of Cat Ba National Park has not been exploited

Table 1: **Criteria and levels of assessing tourism potentials for tourism development and conservation purposes in Cat Ba National Park (Vietnam)**

Traffic accessibility				
Level of convenience	**Point**	**Accessability (km)**	**Reach time (hours)**	**Means of access**
Very convenient	4	10–100	< 2	3
Convenient	3	100–200	2–3	3
Average convenient	2	200–300	4–5	2
Less convenient	1	< 300	> 5	1
Attractiveness				
Level of attractiveness	**Point**	**Number of beautiful scenery**	**Number of unique scenery**	**Number of types of tourism**
Very attractive	4	5	3	4
Attractive	3	3–5	2	3–4
Average attractive	2	1–2	0	1–2
Less attractive	1	0	0	1
Time of tourism activities				
Level of convenience	**Point**	**Number of days in a year with favorable weather conditions to well deploy tourism activities, suitable for tourists' health to participate in outdoor tourism activities (days)**		
Very convenient	4	180–200		
Convenient	3	120–180		
Average convenient	2	90–120		
Less convenient	1	90		
Facilities and techniques for tourism				
Level of convenience	**Point**	**Infrastructure quality**		
Very convenient	4	The facilities are synchronous and comfortable, meeting international standards		
Convenient	3	The facilities are synchronous and comfortable, meeting national standards		
Average convenient	2	The facilities are synchronous, comfortable, meeting local standards		
Less convenient	1	The facilities have not been inconsistent, low quality, temporary or lacked		
Tourism capacity				
Level of convenience	**Point**	**Tourism capacity**		
Very convenient	4	Tour routes with actual capacity > 1000 people/time/day		
Convenient	3	Tour routes with the actual capacity of 500–1000 people/time/day		
Average convenient	2	Tour routes with the actual capacity of 100–500 people/time/day		
Less convenient	1	Tour route with the actual capacity of 100 people/time/day		
Level of sustainability				
Level of sustainability	**Point**	**Number and damaged degree of natural factors**	**Renewability**	**The ability to organize tourism activities**
Very sustainable	4	0	Still primitive	Continuously
Sustainable	3	1–2 factors with minor damaged	Can self-healing	Frequently
Average sustainable	2	1–2 factors with significantly damaged	Human-assisted recovery	Limited
Less sustainable	1	1–2 factors with badly damaged	Slow and difficult recovery	Hard

effectively. Specific tourism potential assessments are few and only limited to description, qualitative, small scope, no tourism bookings, and conservation in a unified relationship. ***[22, 26, 27]***. In this study, we assessed Vietnam's Cat Ba National Park against both development and conservation criteria, to optimize the tourism benefits while also contributing to minimizing the negative impacts on the national park. We hope that the research will contribute to a harmonious solution between natural ecosystem conservation and tourism development for this precious national park.

2. Materials and methods

The research team used data on the natural conditions and resources, socio-economic resources, and ecological resources of Cat Ba National Park, described and analyzed in: reports on the general plan of economic development; reports on the socio-economic status of the Cat Hai district; Cat Ba National Park conservation planning reports; the reports of the park board; and published journal articles. In addition, tourism statistics from the Hai Phong Department of Culture, Sports, and Tourism for 5 years (2018–2022) and questionnaire data provided by tourists in Cat Ba (103 votes) through direct and online forms were also used to verify or generalize the results. According to the results of the study, a multi-criteria model was used to assess the potential of Cat Ba National Park for the development of tourism related to nature conservation.

The multi-criteria model is to assess all the criteria to reflect the relationship between one subject and its assessed objects. Cat Ba National Park is a tourist destination, so the assessment subject is carefully considered and selected from the characteristics of the natural conditions, natural and socio-economic resources, and humanities. The object is a tourist object related to conservation to determine the favorable level (good, average, poor) of the assessment. Specifically, this method consists of two steps:

Step 1: *Choosing the assessment criteria*

We selected the assessment criteria to satisfy two goals: development and conservation. The assessment criteria were selected based on the visitors' needs and comfort while considering the criteria of respecting and preserving values at Cat Ba National Park (Vietnam). The selection of assessment factors by comparing the potentials of Cat Ba National Park with the ecological needs of tourism was based on collected documents related to the research problem, combined with the results of a field survey in March 2023. The six selected criteria are:

(1) location and accessibility;
(2) attractiveness;
(3) tourism activity time;
(4) tourism infrastructure and facilities;
(5) tourist capacity; and
(6) environmental sustainability;

among which, the first four criteria are for development purposes and the last two criteria are for conservation purposes ***(Table 1, see p. 21)***.

Step 2: Create a favorable rating scale for each factor and criterion

Factors were evaluated on a scale of 4 levels of convenience (very favorable, favorable, moderately favorable, and less favorable), with an estimate of 4, 3, 2, and 1 points, respectively. Since tourism resources were chosen among the common ones, no factor will be rated as unfavorable, but only at a more or less favorable level, as shown in ***Table 1.***

The selected factors for assessment have unequal properties, levels, and values. Therefore, to ensure the accuracy and objectivity of the results, the research team determined additional coefficients for important factors (also known as weights) by using AHP techniques combined with expert opinions.

Therefore, to develop tourism tied to conservation in a national park in the coastal island districts, the location/accessibility, duration of tourism activities, capacity, and environmental sustainability play an important role together. The research team consulted and respected the opinions of experts, to ensure harmonization between development and conservation goals.

Table 2: **Weights of assessment criteria**

No.	Assessment criteria	Weight
1	Location/Accessability	0.2
2	Attractiveness	0.1
3	Time of tourrism activities	0.2
4	Facilities and infrastructure for tourism	0.1
5	Tourism capacity	0.2
6	Sustainability of environment	0.2

Consistency Index $CI = 0.003 < 0.1$(satisfactory)

Step 3: Conducting an assessment

The assessment process was intended to determine the assessment score. The assessment scores include the individual assessment score for each factor and the total rating score.

The individual assessment of each factor. The individual assessment score of each factor is the score

of the rating levels multiplied by the coefficient and weight of that factor.

$$S = \sum_{l}^{n} W_i X_i$$

where: S is the composite assessment index, W_i is the i-th indicator weight, X_i is the assessment index of the i-th indicator.

Composite assessing. The composite assessment is the sum of the individual ratings for each element. Numerous assessment works take the aggregate rating as the product of the individual rating score. The method of adding scores to assess the overall results is still widely used in many assessment fields today. To determine the gap between the assessment levels, the random break technique (Natural Break) was used. Based on the maximum number of scores determined by the assessment scale and the specific assessment results for each assessed object, the results were synthesized by the percentage of the achieved score compared with the maximum number of scores.

3. Results and discussion

3.1 Results of the assessment of traffic accessibility in Cat Ba National Park

Cat Ba National Park is both a World Biosphere Reserve and a protected marine area, so it has favorable potentials for tourism development. Visitors can travel on different roads and by many types of common means of transport. With the above analysis, it can be concluded that Cat Ba National Park has a favorable location / accessibility for tourism development (4 scores). Although the geographical distance between Cat Ba National Park and tourist supply centers is not far, in the rainy season, this tourist destination is quite difficult to access due to limited means of transportation. During this time, speedboats / ferries in Got Wharf are banned; visitors can choose the Tuan Chau-Gia Luan route instead because the ferry runs in an airtight bay.

Table 3: **Criteria for assessing the accessibility of Cat Ba National Park**

Traffic accessability			
Departure	**Road (km)**	**Means of transport**	**Time of travelling (min)**
Hai Phong	70	Car/Motorbike, ferry (Got – Cai Vieng wharf)	70–90
		Car, Canoe (Got – Cai Vieng wharf)	70–90
	64	Car, cable car (Sunworld Cat Hai cable car)	65
Ha Long	30	Car/motorcycle, ferry (Tuan Chau – Gia Luan wharf)	90
Hanoi	150–160	Car/motorcycle, ferry (Got – Cai Vieng wharf)	120–150
		Car, Canoe (Got – Cai Vieng wharf)	120–150
	150–160	Car, cable car (Sunworld Cat Hai cable car)	100–120
	150–160	Train, Car, Motorbike, ferry (Got – Cai Vieng wharf)	180–240
Assessment	4 score — Very convenient		

3.2. Results of the assessment of the attractiveness of Cat Ba National Park

The attractiveness shown by the values of Cat Ba National Park can be exploited for tourism development and for attracting tourists to experience. The unspoiled natural landscape is one of the attractions that tourists visit at Cat Ba National Park, and the number of visitors has been increasing rapidly in recent years. Cat Ba National Park is located in the archipelago of Cat Ba Long Chau, with a system of karst fields invaded by seawater and a full range of terrain types, such as surviving mountains, karst funnels, karst valleys, karst caves, and karst terrains.

Large and small limestone islands floating in the sea are a rare and spectacular sight; each island is a wonder, constantly changing its shape and the views of visitors as the boat glides smoothly through the bay. From above, the mountains, and islands look like people and things you might see in everyday life.

Unlike in the karst regions on the mainland, the limestone islands here all have small spines — the result of the chemical corrosion of seawater and the mechanical action of waves and tides. When the tide recedes, hundreds of islands like a

series of "toes" on the water create a unique and spectacular landscape. At the same time, the flora on the islands in Cat Ba National Park develops and is preserved relatively well, making the rocky islands more alive and lively each day and in different weather modes. The sea and islands change their colors.

The primary forest on the island has rich flora and fauna, stratified characteristics of the typical tropical forest carpet, and an interlaced root system. It is also an ideal habitat for rare animals such as monkeys, langurs, birds, etc., which stimulates curiosity and the desire to immerse oneself in nature.

In Cat Ba National Park, there are many beautiful caves associated with revolutionary feats, forming attractive tourist attractions. The unique small bays with unique caves are also attractive destinations for tourists to visit and relax on the beaches in the middle of the sea. The attractiveness of Cat Ba National Park for tourism is also reflected in the increasing number of tourists coming here to experience it.

Despite being greatly affected by the COVID-19 pandemic (from 2019 to 2021), Cat Ba National Park is still an ideal choice for tourists, while many tourist destinations in the world fell into the "frozen state." Numerous tourist destinations with similar conditions in the Northeastern Sea and islands of Vietnam experienced stagnant tourism activities, such as Co To Island and Quan Lan Island.

In particular, Cat Ba National Park was a tourist destination with a forceful and impressive recovery after the COVID-19 years.

According to the survey results, most first-time visitors to Cat Ba National Park are impressed and attracted by the magnificent landscape and diverse ecosystems. Up to 62.5% of the interviewed tourists said they agree to return or recommend this tourist destination to their relatives and friends; 29.8% fully agree; the cases of doubt and disagreement account for a minimal percentage. With the characteristics analyzed above, it is possible to rank the attractiveness of Cat Ba National Park at a very attractive level, with a score of 4.

3.3. Results of the assessment of infrastructure, materials and technical services for tourism in Cat Ba National Park

According to the field survey results in March 2023, in general, not much investment was put into the infrastructure, materials, and technical services for tourism in Cat Ba National Park. At the administrative and service subdivision, only one marine scientific research project by the National Park Management Board has been put into use as a tourist center; there has been no investment in building an ecological museum for tourism; tourist routes lack rest stops; and signposts were not yet updated with 4.0 technology. Currently, the National Park has 16 staff members engaged in tourism activities (narrators, guides, services, etc.), mainly part-time staff. With this result, it is possible to classify infrastructure, materials, and technology for tourism development in Cat Ba National Park as a favorable category with a score of 2.

3.4. Results of the capacity assessment of Cat Ba National Park

Tourist capacity: Cat Ba National Park has 15 different sightseeing routes, of which 9 are forest routes and 6 are sea and island routes. Depending on the characteristics of each route, the physical capacity of Cat Ba National Park tourist routes is around 26,629 people per day. However, when organizing tourism activities in ecological areas, specifically Cat Ba National Park, it is necessary to pay attention to limiting factors. Limiting factors in Cat Ba National Park include weather factors (sunshine, storms), ecosystem effects (animal foraging time), and difficult roads (high slope). These factors are determined to contribute to calculating the actual carrying capacity in Cat Ba National Park for tourism development, conservation, and protection of natural resources and the environment. Therefore, the actual carrying capacity in Cat Ba National Park is 5,018 people.

Table 4: **The evaluation result of tourism capacity of Cat Ba National Park**

Tourism capacity		
Assessment criteria	**Result**	**Assessment**
Physical capacity	26,629 visitors per day	**4 score Very convenient**
Capacity in reality	5,018 visitors	
Percentages of tourist in reality	40%	

According to the statistics of the authorities, in the period 2017–2021, tourists to Cat Ba National Park were the highest in 2019, with 719,988 visitors. In 2020, and 2021, due to the COVID-19 pandemic, the number of domestic and international visitors both decreased compared to 2019. Therefore, to calculate the maximum value, participants used the data from 2019: 1,973 tourists visit Cat Ba National Park per day. Cat Ba National Park. Thus, it can be seen that the actual value of the number of tourists per day compared to the potential

$$U = \frac{1{,}973}{5{,}018} = 0.4,$$

(equivalent to 40%). With the above results, it is possible to classify the tourist capacity in Cat Ba National Park into a very favorable category with a score of 4.

3.5. Environmental sustainability assessment results

Economic development and conservation are two opposites and have a symbiotic relationship with each other. Especially, since economic development took place in highly sensitive areas such as NPs, NRs, etc. Economic activities that have been taking place in Cat Ba National Park very early (especially exploitation of forest resources, farming, and aquaculture in Lan Ha Bay) have had certain impacts on the natural environment here. With the collected data, the research team conducted a general analysis of the environmental situation caused by the many economic development activities taking place in Cat Ba National Park in particular and Cat Ba Island in general, where development activities were carried out. Tourism development is one of the factors that increases those impacts.

According to the research results of Tran Duc Thanh et al. (2015), Le Van Nam et al. (2021), and the Ministry of Natural Resources and Environment (2021), it is shown that in 2015, Cat Ba received about 809 tons of BOD, 1,381 tons of COD, 304 tons of Nts, 115 tons of Pts, 4,693 tons of suspended solids, 584 tons of grease, 702 tons of organic matter from leftovers and fertilizers, 460 tons of inorganic fertilizers, and 1.5 tons of chemicals for plant protection. By 2021, the values of physicochemical parameters such as temperature, pH, and dissolved oxygen in seawater (DO) will not change much, but the values of suspended solids (TSS), organic matter, grease minerals, coliform, and Fe tend to increase, exceeding the standards QCVN10-MT:21015/BTNMT, directly affecting the water quality in the NP. The value of water quality parameters in the rainy season is often higher than in the dry season, during the low tide phase (low water), and in the high tide phase (high water) ***[25, 28]***.

In addition, Cat Ba Island in general, and the National Park in particular are facing a large source of waste, with an amount of waste generated of about 80,000 kg per day and night, of which only about 72% is collected. The ecosystem and environment of Cat Ba National Park are suffering from a large amount of waste, especially during the holidays and peak tourist season (from May to September every year). Along with that, to serve tourism development, people have exploited more and more aquatic resources. The process of building infrastructure for development and tourism is also taking place increasingly strongly. Many resorts, restaurants, and hotels have sprung up close to the coast. The construction of docks disrupts the landscape, occupying natural ecosystems. These activities also have a negative impact on wildlife.

Recognizing the potential hazards posed by economic development activities to the environment in Cat Ba National Park, specifically, and Cat Ba Island in general, the management agencies have taken specific measures. Cat Ba National Park has been divided into four functional zones to ensure tourism development associated with conservation: a strict protection zone, an ecological restoration subdivision, an administrative subdivision, and a buffer zone. Combined with that is the relocation of households living in the core area and households doing aquaculture in the Lan Ha Bay Area of Cat Ba National Park, propagandizing for local people and tourists to join hands in environmental protection.

According to the data from the Management Board, currently, Cat Ba National Park manages and preserves 5,811.2 hectares of natural forest and 193.77 hectares of planted forest. The above carpet types are the storage places of many valuable and rare species of forest animals and plants. Of the total 1,595 plant species recorded in Cat Ba National Park, there are 70 endangered plant species protected by Vietnamese and international laws. Of these, 54 species are ranked from vulnerable (VU) to critically endangered (CR) in the Vietnam Red Book. 13 species are classified on the IUCN Red List, including Aquilaria crassma which is classified as CR (very endangered) ***[29]***. Cat Ba National Park has recorded and preserved 357 species of terrestrial vertebrates, of which the fauna has recorded 63 species of mammals, belonging to 44 genera and 20 families in Cat

Ba National Park (updated and added 3 new ones). Mammals naturally distributed in Cat Ba National Park include the tall-eared bat (*Myotis siligorensis*), the long-winged bat (*Miniopterus fuliginosus*), Civet civet (*Herpestes javanicus*).

The fauna in Cat Ba National Park is typical of the fauna of the Northeast region of Vietnam and has high conservation value. Cat Ba National Park has recorded and preserved 16 endangered species of mammals protected by Vietnamese and international laws (accounting for 25.4%); 26 threatened bird species, rated and protected under national and international law; 13 endangered rare reptile species (accounting for 22.4%) assessed and protected by domestic and international law; and 3 endangered rare and precious amphibians (accounting for 9.4%) are assessed as threatened and protected by domestic law ***[29]***.

As noted by the study, the majority of tourists appreciate the environment in Cat Ba National Park and are satisfied with their experiences here. However, under the influence of natural factors (climate change) as well as social factors, especially the increasingly rapid and strong development of tourism, environmental sustainability in Cat Ba National Park will have unpredictable fluctuations. With this result, it is possible to rank the sustainability of the natural environment in Cat Ba National Park into the medium sustainable category with a score of 2.

3.6. Results of assessing the time of exploitation of tourism activities in Cat Ba National Park

The results indicate that Cat Ba National Park has a relatively high number of days favorable for tourism activities per year, with a total of 245 days rated as "good" or "excellent" (245/365, corresponding to 68%). In terms of the months of the year, these days are distributed as follows: 26 days rated as "exceptional" fall in the period from January to March; 94 days rated at the "excellent" level fall in the period from December to March; 125 days rated at the "good" level fall in the period from April to November; and finally, 11 days rated at the "unfavorable" level fall in August and September.

Thus, Cat Ba National Park has a long time of tourist activity throughout the year and this happens regularly. Thanks to this result, tourism activities in Cat Ba National Park can be classified as very favorable with a score of 4.

3.7. Overall assessment results

The combined assessment results are performed with the principle of taking the number after the decimal point (.) as a number, so the largest weight is 0.5 and the smallest is 0.1. Then the highest score is:

$$(1 \times 4 \times 0.5) + (5 \times 4 \times 0.1) = 4,$$

and the lowest score is

$$6 \times 1 \times 0.1 = 0.6.$$

By the method of random break (Natural Break), the interval between favorable levels is 0.85 score ***(Table 5)***.

The combined assessment results ***(Table 6)*** show that Cat Ba National Park has very favorable conditions for tourism development associated with conservation (the assessment score is 85 % compared to the highest value).

The most important contribution in the multi-criteria model to assess the potential of Cat Ba National Park for tourism development associated with conservation is the 03 criteria of accessibility, time to exploit tourism activities, and capacity (each criterion, even contributed up to 24%). Compared to other islands in the northeastern coastal island system with similar conditions, Cat Ba National Park, located on Cat Ba Island, has a large capacity; tourists come to experience it by many means. Meanwhile, with its location near the mainland, the outside is surrounded by many small islands lying alternately, which is the "green lung" not only of Vietnam but also of the world, so this is an area with a low temperature. Humidity is suitable for human health. This is the objective advantage that nature has favored for the study area.

The second important contribution in the multi-criteria model to assess the potential of Cat Ba National Park for tourism development associated with conservation is 02 natural environmental sustainability and attractiveness (each criterion contributes to 12%). These are the criteria that have the most variation because they are both subjective and objective, depending a lot on the method of exploitation, management, and potential use for development purposes. These are also two criteria that clearly show the close link between tourism development and conservation in Cat Ba National Park.

Finally, the contribution of the criteria of infrastructure, material, and technical services for tour-

Table 5: **Hierarchy of convenience**

No.	Level of assessment	Score	Ratio to max score (%)
1	Very convenient	≥ 2.55	≥ 64
2	Convenient	≥ 1.7 – 2,55	≥ 43 – 63
3	Average convenient	≥ 0.85 – 1.7	≥ 22 – 42
4	Less convenient	< 0.85	< 22

Table 6: **Results of general assessment of resources for tourism development associated with conservation of Cat Ba National Park**

No	Criteria of assessment	Score	General score	Level of ranking	Ratio to maximum score
1	Location/accessibility	0.8	3.4	Very convenient	85%
2	Time of tourism activities	0.8			
3	Tourism capacity	0.8			
4	Sustainability of the natural environment	0.4			
5	Attractiveness	0.4			
6	Facilities and infrastructure for tourism	0.2			

ism in the multi-criteria model of assessing the potential of Cat Ba National Park for tourism development associated with conservation (a contribution of 6%). This is also a subjective cause leading to the limitation of tourism development associated with conservation in Cat Ba National Park. The above assessment results are the scientific basis to confirm that Cat Ba National Park is an attractive tourist destination. However, to achieve sustainable development in the future, it is necessary to:

Infrastructure upgrade: To meet the growth and tourist capacity, it is necessary to invest in infrastructure such as roads, wharves, and other tourist facilities. This upgrade helps to increase accessibility and attract visitors. Researching and calculating in detail the environmental capacity and tourist capacity at tourist spots and tourist routes to invest in developing a reasonable infrastructure system, both meeting the needs of tourists, but not causing overload on the national park environment; investing in a system of guide boards and signboards attached with QR codes.

Environmental conservation and sustainability: Cat Ba National Park needs to maintain environmental conservation and sustainability to protect the natural landscape and biodiversity. Environmental management needs to be strengthened to ensure tourism does not negatively affect the ecosystem here. It is necessary to develop a strategy for tourism development associated with conservation in Cat Ba National Park that sets out a set of indicators to assess the situation and monitor the change of surrounding environmental factors to prevent the risks of deterioration. Recession due to tourism activities: comply with all regulations for functional subdivisions of strictly protected areas, ecological restoration zones, and administrative-service zones to organize appropriate tourism activities, and at the same time supervise and manage activities. Effective forest environment leasing: regularly organize training courses to improve tourism professionals and at the same time propagate and educate the community to clearly see the benefits of protecting natural resources and the environment; regularly organize environmental education programs for students of Cat Ba as well as Hai Phong city, to raise awareness of environmental protection and nature conservation for them from an early age; encourage voluntary associations to collect garbage on the sea and islands.

Diversification of tourism activities: To attract and maintain the attractiveness of Cat Ba National Park, it is necessary to diversify tourism activities and experiences. Besides exploiting natural resources, it is possible to develop more activities such as trekking, visiting the sea, caving, or visiting traditional fishing villages. And it designs educational tourism programs, practical research on the natural, cultural, and historical environment, marine biodiversity, and

conservation work for students of schools in the region and abroad, especially tourists.

Promotion and market access: Promotion and market access activities should be stimulated to raise awareness and interest among tourists. Building a brand image for Cat Ba National Park and creating links with international tourism partners can help attract a larger number of visitors. Tourism promotion should be diversified on various channels, such as the media and social networks, and at the same time convey messages about tourism associated with conservation in Cat Ba National Park. Development of diversified tour packages: to provide diverse and flexible tour packages for visitors to choose from. This makes it easy for travelers to find suitable tour packages and extend their travel time.

Training and improving service quality: To meet the requirements of tourists, it is necessary to invest in training and improve the quality of tourism services. Providing professional guides, friendly staff, and rich entertainment activities will bring out better experiences for visitors. It is necessary to link the universities and research institutions with training activities in tourism to increase the personnel resources with professional qualifications in tourism management and service for the National Park, v.v.

Conclusion

Tourism development and conservation are two sides of development; conservation will support tourism development, and tourism development can enhance the role and awareness of conservation. This is especially true for an area with special conditions like Cat Ba National Park because it is located in an open natural system, formed by a combination of coastal, island, and sea elements, with specific ecosystems that are independent of each other; however, the factors forming them are always related and have mutual effects on each other. Based on the resources of Cat Ba National Park and a multi-criteria model to evaluate the potential for tourism development associated with conservation, Cat Ba National Park has very favorable conditions for tourism development and conservation. The overall assessment score is 3.4/4, equivalent to 85%. The research results give an overview of the role of each factor, as well as the relationship between them in tourism development associated with conservation in the study area. On that basis, there are sustainable development orientations for Cat Ba National Park. In the future, this will be an ideal destination for tourists, not just for weekend trips. However, to harmonize tourism development and conservation, it is necessary to have specific orientations and plans; therefore, therefore the ranking result is only one of the reference factors. It is therefore necessary to pay attention to the overall assessment score and the separate assessment score for each criterion to have a comprehensive perspective, thereby offering appropriate development solutions to ensure conservation.

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