

Green economic model adapting to climate change and disaster prevention in Bach Long Vi island district, Hai Phong city

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Abstract:

In recent years, the economic model in Bach Long Vi island district has been maintained on a small scale, spontaneously, and heavily influenced by natural factors. Additionally, the impacts of climate change and the degradation of natural resources and the environment are increasing burdens on local socio-economic development. Therefore, this study aims to examine and build a compatible green economic model to help adapt to climate change and prevent natural disasters in the island district. The authors have researched and built a green economic model with three main activities (fishery logistics, tourism, and aquaculture), helping economic growth, improving people's quality of life, and minimising the negative impact on the ecological system. The effectiveness of the green economic model is evaluated through a set of criteria with many contents, such as economic efficiency, the ability to create jobs and improve people's living standards, and the level of renewable energy use, ecological and environmental conservation. In the end, groups of general and specific solutions are proposed to help strengthen the development and implementation of green economic models in the island district, ensuring adaptation to climate change, disaster prevention, and assurance of efficiency and sustainability for the environment, economy, and society.

Keywords: Bach Long Vi island district, climate change, green economy, models, natural disasters.

Classification numbers: 2.1, 5.2

1. Introduction

Bach Long Vi island is an island district in Hai Phong city, located at geographic coordinates 20°07'35'' to 20°08'36'' North latitude and 107°42'20''-107°44'5'' East longitude. Despite its modest size, covering just over 3 km², Bach Long Vi plays a significant role within the system of 2,376 coastal islands, serving as a fully-fledged administrative unit at the district level in the coastal island districts of Vietnam [1, 2]. Situated in the heart of the Gulf of Tonkin, Bach Long Vi island district is imbued with great potential for diverse economic sectors, including fisheries logistics, tourism, aquaculture, energy, oil and gas, and more [2, 3].

In recent years, Bach Long Vi's economic model has shown promising signs of growth. Nevertheless, it faces several challenges that hinder its full potential and advantages. Generally, the island

district's economic model is characterised by small-scale operations, spontaneity, susceptibility to various factors (such as weather conditions, environmental factors, and a small population), and lacks sustainable integration [4]. Moreover, due to its remote location from the mainland, the island's residents often encounter difficulties in securing suitable livelihoods and accessing quality healthcare, education, and social benefits [1]. Additionally, the island community grapples with serious issues such as resource depletion, environmental pollution, and increasing vulnerability to natural disasters. Consequently, many district residents experience a relatively low quality of life, regularly facing risks from natural disasters and health issues. These challenges contribute to the outmigration of people from the island to the mainland and deter individuals from relocating to Bach Long Vi island for residence and

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economic development. In light of these issues, there is a pressing need to establish a compatible economic model aimed at creating stable, long-term livelihoods, enhancing the material and spiritual well-being of the island's inhabitants, attracting individuals to migrate to and thrive on the island, and ultimately achieving the overall sustainability of the island district. This will enable Bach Long Vi to assume its strategic role on the map of Vietnam's sea and islands, serving as the country's maritime "gateway" for international and regional exchanges, especially in terms of national security and marine economy development.

Hence, this research will align with the development goals of Hai Phong city and the economic status of Bach Long Vi to develop a suitable green economic model for the region. This model will facilitate adaptation to climate change and effective responses to natural disasters, forming an essential foundation to ensure the balanced development of the three key factors-economy, society, and the environment-towards sustainable development in the foreseeable future.

2. Methodology

2.1. Methods for data collection and documentation

Data collection and synthesis methods will involve reviewing previous documents, research works (primarily focusing on the outcomes of socio-economic initiatives in Bach Long Vi island district from 2020 to 2022), and other ecological and environmental data [2-7].

Seminars, interviews, and expert consultations will be employed to analyse and evaluate data, establish information systems, and consolidate data.

2.2. Methods for environmental and biological resource assessment

This category encompasses techniques for assessing the current environment, natural assets, and challenges impacting the development of a green economic model in Bach Long Vi.

Investigation, survey, and laboratory analysis of samples (air quality, water quality, and organisms) in accordance with Vietnamese standards and regulations or widely recognised methods [8, 9].

Utilisation of GIS (Geographic information system) methods to create a comprehensive map of the fisheries, aquaculture, and tourism logistics

service centre, scaled at 1:10,000, to support the development of the green economic model in Bach Long Vi district.

2.3. SWOT analysis

SWOT analysis stands as the central method for researching and devising an appropriate green economic model for Bach Long Vi island district. SWOT is an acronym derived from the initial letters of English terms: Strengths, Weaknesses, Opportunities, and Threats. This analysis will provide an improved understanding of the context in Bach Long Vi island district, enabling the formulation of development objectives and strategies based on the equilibrium between strengths, weaknesses, opportunities, and challenges.

2.4. Methods for establishing a set of criteria to evaluate green economic models

The expert approach is employed to create a set of criteria for evaluating green economic models concerning three economic components: fishery logistics, experiential tourism, and high-tech aquaculture.

Personnel involved in the development of the set of criteria: Experts from government agencies, research organisations, and other relevant stakeholders participated in the development of criteria for assessing the green economic model of Bach Long Vi island district, along with determining the weights for each component criterion. These experts possess extensive experience in various fields, including green economy, environmental technology, human geography, biology, and tourism, among others.

Weight determination criteria: In this study, the authors applied the following method to evaluate the development level of the green economic model for a specific area based on the general index presented in previous studies [10, 11]:

$$GEI = \sum_{i=1}^n K_{Bi} K_i$$

where GEI stands for the general index of green economic development, K_{Bi} denotes the weight of the criterion i , and K_i denotes the score achieved by criterion i , n : constant.

K_{Bi} is divided into three levels, denoted 1, 2, 3, corresponding to increasing importance (low,

moderate, and high). For K_i , the study proposes rating points as 0, 2.5, 5, 7.5, and 10, aligning with 5 rating levels (Unsatisfactory, L1, L2, L3, and Exceeded L3). Based on the results of the assessment of criterion weights (K_{Bi}) and criterion scores (K_i) evaluated by experts with extensive experience in the field of green economy and a deep understanding of Bach Long Vi, the overall green economic development index (GEI) is categorised into different levels to evaluate the development stage of the green economic model, including (i) Unsatisfactory (M1: $0 \leq GEI \leq 70$); (ii) Oriented towards green economic

development (M2: $71 \leq GEI \leq 135$); (iii) In progress (M3: $136 \leq GEI \leq 200$); (iv) Green and sustainable (M4: $GEI > 200$) [10, 11].

3. Results

3.1. SWOT analysis of strengths, weaknesses, opportunities and challenges in building a green economic model in Bach Long Vi island district

Utilising SWOT analysis, an assessment of the strengths, weaknesses, opportunities, and threats in establishing a green economic model in Bach Long Vi island district has been conducted, as shown in Table 1 [1, 2, 12-14].

Table 1. Summary of strengths, weaknesses, opportunities, and threats to building a green economic model in Bach Long Vi island district.

Ordinal number	Component	Characteristic
1	Strengths	- Bach Long Vi occupies a crucial strategic position in national defence and security, making it conducive to the development of various economic sectors. - It is one of Vietnam's eight largest fishing grounds. - Abundant natural resources and stunning natural scenery are present. - The coral reef ecosystem exhibits a rich biodiversity. - There is substantial potential for renewable energy sources, including solar energy, wind, waves, and tides. - The local population is known for their friendliness and amicability. - Both Hai Phong city and Bach Long Vi district are inclined towards the development of green and sustainable economic models, offering specific preferential and supportive policies for businesses aiming to establish green economic models.
2	Weaknesses	- Infrastructure faces numerous limitations, including transportation systems, water supply, electricity, and telecommunications. - There are limited transportation options between the mainland and the island, resulting in relatively lengthy travel times (averaging 6-8 hours) that are heavily dependent on weather conditions. - Logistics services supporting fisheries, tourism, aquaculture, and other sectors remain underdeveloped. - Various environmental challenges persist, including oil pollution in ports and solid waste pollution in residential areas and ports. - The shortage of qualified and experienced human resources in green economy, sustainable tourism, high-tech aquaculture, and related fields is notable. - Insufficient availability of young, healthy, and enthusiastic human resources to participate in the development of green economic models is a concern. - The economic development in the region remains modest and straightforward, primarily centred around fishing and initial forays into tourism.
3	Opportunities	- In the future, several large-scale economic development projects will be implemented in Bach Long Vi, offering significant opportunities to transform the island district. - Vietnam consistently promotes international cooperation in green economic development within the tourism and aquaculture sectors. - Numerous opportunities exist to access support programmes from both the Government and non-governmental organisations for the development of green economic models. - Nature tourism is among the top tourism priorities for Vietnamese tourists in the post-COVID-19 period.
4	Threats	- Bach Long Vi's geographical remoteness from the mainland makes it susceptible to isolation during natural disasters. - The effects of climate change are becoming increasingly apparent, potentially impacting Bach Long Vi's economy, society, and environment. - Environmental pollution, particularly solid waste pollution, originates from external sources, primarily international ships. - Competition with neighbouring tourist destinations (Do Son, Cat Ba, Co To, etc.) is on the rise. - There is a significant reliance on external resources, including essential goods (such as food and beverages) and raw materials for construction and production. - Foreign tourists are currently not accepted.

Based on the internal and external components matrix within the SWOT model as presented in Table 1, we will propose an appropriate green economic model for the Bach Long Vi island district. This model will leverage its strengths, address weaknesses, capitalise on opportunities, and mitigate threats, all with the ultimate aim of promoting sustainable development. Specifically, by identifying and comprehending the local strengths and weaknesses, the proposed green economic model will fully exploit its advantages while effectively overcoming its disadvantages. Additionally, identifying both current and future opportunities and challenges for the locality will enable proactive solutions to be found in order to realise those opportunities and minimise threats to the socio-economic development and environment of the island district.

3.2. Orientation for building a green economic model in Bach Long Vi island district

Drawing from the synthesis of previous research conducted in Vietnam and globally, the orientation for building a green economic model in the Bach Long Vi island district will adhere to the following principles: "A green economic model with a suitable scale for the island district administrative unit with an appropriate economic structure to improve living standards, improve social equity, increase people's connection to the island, and significantly reduce environmental risks and ecological degradation". Consequently, the development of green economic models in Bach Long Vi should target the following key directions:

1. The island district's economy aims to improve the living standards of the local people (selecting an appropriate and sustainable economic structure).

2. Reducing environmental risks (applying environmental techniques in livelihood models, reducing carbon emissions, using renewable energy sources).

3. Conservation of ecosystems on the island and marine ecosystems.

4. Ensuring security, affirming, and maintaining national sovereignty over the country's seas and islands (local people do not migrate to the mainland, attracting labour forces from the mainland to the island to work, enhancing island-land connectivity).

3.3. Proposal for a green economic model in Bach Long Vi island district

Based on the legal foundations, practical needs of Bach Long Vi, and the

authors' experience in researching and implementing green economic models on islands in three regions of Vietnam [12], the orientation towards green economic development in Bach Long Vi is a promising choice. According to this approach, Bach Long Vi's economic model will encompass three main economic activities (namely, fishery logistics, experiential tourism, and high-tech aquaculture) closely interconnected, serving as the core components to establish a green economic model in Vietnam. The constructed green economic model must maintain a balance between economic, social, and environmental factors while being rooted in the input sources of the model.

The model consists of the following elements: (i) Assessment and identification of inputs to build a green economic model for Bach Long Vi; (ii) Development of an integrated green economic model suitable for Bach Long Vi; and (iii) The output of the economic model must meet specific criteria (Fig. 1). The assessment of inputs for constructing a green economic model encompasses various components, including geographical location, natural conditions, the policy framework guiding green economic model development, infrastructure and energy sources, island-land connectivity, social status, natural capital, environmental status, and economic status.

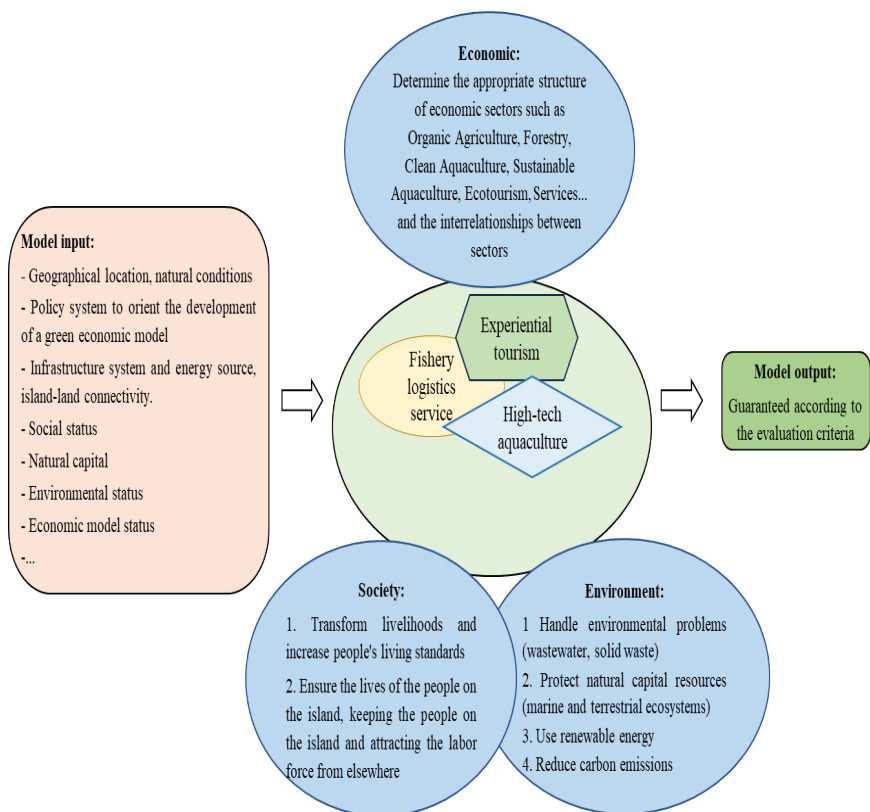


Fig. 1. Diagram of the proposed green economic model for Bach Long Vi island district.

Development of an Integrated Green Economic Model: Based on the assessment of input factors and the development orientation of Hai Phong city, where the success of green economic models applied to the sea and islands has been previously demonstrated, the core of the model should focus on building and developing three green economy-oriented economic activities in descending order of priority as follows: (1) Establishment of a fisheries logistics centre: Assessing the required supply scale for the number of ships as per regulations, while providing effective environmental protection solutions. (2) Promotion of experiential tourism: Tourism oriented towards experiential and ecological tours, encompassing exploration of the island's topography, such as rocky tidal flats, coral viewing through glass-bottom boats, fishing tours, and photography, in addition to traditional tourism activities. Tourism development should be closely linked to environmental protection and the conservation of Bach Long Vi's ecological values. (3) Development of a high-tech aquaculture centre: Evaluating natural and human conditions and material resources to guide the application of appropriate scientific and technological advancements in aquaculture for practical production. High-tech aquaculture will significantly reduce pollutant emissions into the environment, mitigating the negative impacts of extreme weather conditions in Bach Long Vi.

Output of the model: The model's effectiveness will undergo a thorough review and evaluation based on specific economic, social, and environmental criteria.

3.3.1. Establishment of a fisheries logistics service centre

The aim of fisheries logistics is to foster the development of seafood harvesting in the waters surrounding Bach Long Vi and its vicinity. This involves ensuring safety and enhancing production efficiency throughout the entire process, from the capture of seafood to the purchase and processing of fishermen's products. Fisheries logistics activities are geared towards sustainable economic development, minimising adverse impacts on the ecological environment, and reinforcing environmental protection in Bach Long Vi to enhance the well-being of its residents. The primary directions for developing fisheries logistics activities

in Bach Long Vi within a "green" framework need to address three main aspects: vessels, onboard crew, and harvested seafood.

More specifically, for vessels, the focus should be on improving their capacity to serve fishing vessels, encompassing areas for anchoring and providing services such as refuelling, oiling, repairs, and replacements. Regarding onboard crew members, solutions should be devised for essential needs such as dining, accommodation, bathing, sanitation, health, and entertainment. For harvested seafood, it is imperative to formulate a process plan that encompasses three dimensions: (i) The application of RAS (Recirculation aquaculture system) technology for recirculating culture; (ii) Investment in ice production technology to ensure a stable ice supply for freezing seafood; (iii) Investment in a drying system capable of handling large quantities of seafood, complemented by vacuum technology to create branded dried products.

Utilising GIS technology, the development space for fisheries logistics activities in Bach Long Vi is designed with a focus on green economic principles (Fig. 2). This plan comprises three key components: (1) The fisheries logistics service area; (2) Port facilities; and (3) Ship anchorage areas. Proposed scale and development type: 2023-2030: Provision of services and storm shelters for 500-600 ships, with the capacity of anchored ships at 500 HP (horsepower); 2030-2050: Provision of services and storm shelters for 600-800 ships, with the capacity of anchored ships at 1.000 HP.

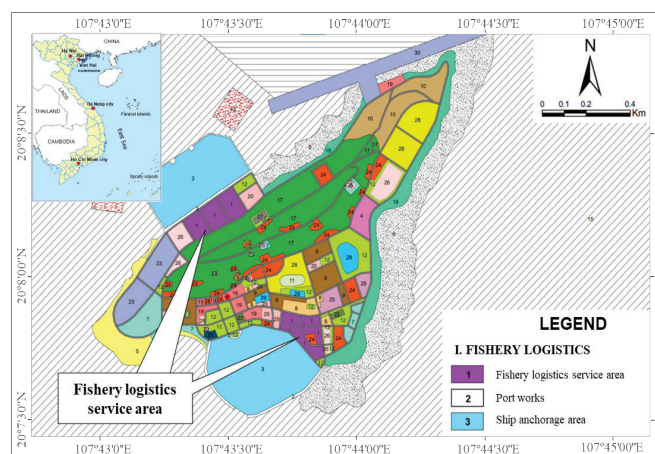


Fig. 2. Spatial zoning model for the development of fisheries logistics activities in Bach Long Vi island district [4].

In comparison to the set of evaluation criteria, as of May 2023, fisheries logistics activities in Bach Long Vi island district have scored 110 points, currently categorised as “M2: Being oriented towards green economic development” (Table 2).

Table 2. Results of assessment of fisheries logistics activities of Bach Long Vi island district according to the set of green criteria (as of May 2023).

No	Criteria	Evaluation method ($K_{Bi} \times K_i$) K_{Bi} : weight of criterion i K_i : score of criterion i achieved	Scores
1	Criterion 01: criteria for the island's road system, locks, and ports	3x5.0	15.0
2	Criterion 02: criteria for the electrical system	3x5.0	15.0
3	Criterion 03: criteria for clean water treatment stations and water storage	3x7.5	22.5
4	Criterion 04: criteria for the connection between the island and mainland	2x5.0	10.0
5	Criterion 05: criteria for seafood resources	3x5.0	15.0
6	Criterion 06: criteria for waste control from high-tech activities (mainly solid waste) and the use of environmentally friendly materials.	2x2.5	5.0
7	Criterion 07: criteria for promoting offshore fishing and prohibiting destructive fishing	2x7.5	15.0
8	Criterion 08: income criteria for individuals involved in fisheries logistics	2x2.5	5.0
9	Criterion 09: criteria for government propaganda activities involving all participants in the model	2x0	0.0
10	Criterion 10: criteria for green elements in advanced technology models and TCKN	3x2.5	7.5
Total GEI score			110.0

Source: Calculation results performed by the research team.

3.3.2. Developing experiential tourism

The orientation for developing experiential tourism activities in Bach Long Vi, within the context of a green economy, includes the following key aspects:

Adherence to city and island district policies: This involves aligning with the tourism development plans of Hai Phong city and tailoring tourism establishments and services to focus on key tourism products such as sports tourism, marine ecology, cultural and sports events related to the sea and islands.

Local community involvement: Encouraging local households to participate in experiential tourism activities, with a focus on making tourism a primary industry in Bach Long Vi. These activities should include offerings such as homestays, restaurants, transportation services, bicycle rentals, food delivery, and souvenirs.

Sustainability measures: Implementing technical measures to reduce carbon emissions and increase the use of renewable energy sources in experiential tourism activities.

Environmental management: Implementing environmental management and technical solutions to reduce waste discharge into the environment, with the aim of transitioning to a model that prohibits single-use plastic utensils on Bach Long Vi.

Ecosystem protection: Utilising solutions to protect the island's ecosystems through sustainable exploitation, emphasising indirect values over the exhaustion of direct ones.

Island migration: Ensuring that the migration rate from the island district to the mainland gradually approaches “0” by attracting mainland labour to the island for business, production, and long-term residence.

Using GIS technology, the development space for experiential tourism in Bach Long Vi is designed with a green economy focus (Fig. 3). The sightseeing experience route is designed to enable visitors to fully explore the island district, with key stops including beaches, rocky tidal flats, coral reef areas, and the

lighthouse. Notably, the areas for visiting coral reefs (near the North-West port) via glass-bottomed boats have become a significant tourist attraction in Bach Long Vi, contributing to the conservation of natural ecosystems. In addition, homestay development areas (with mobile prefab houses) and tourism service facilities are strategically distributed based on the island district's development orientation, thereby enhancing the ability to provide essential services to visitors during their stay. This is a highlight of the experiential tourism model, which also enhances climate change adaptation and disaster prevention.

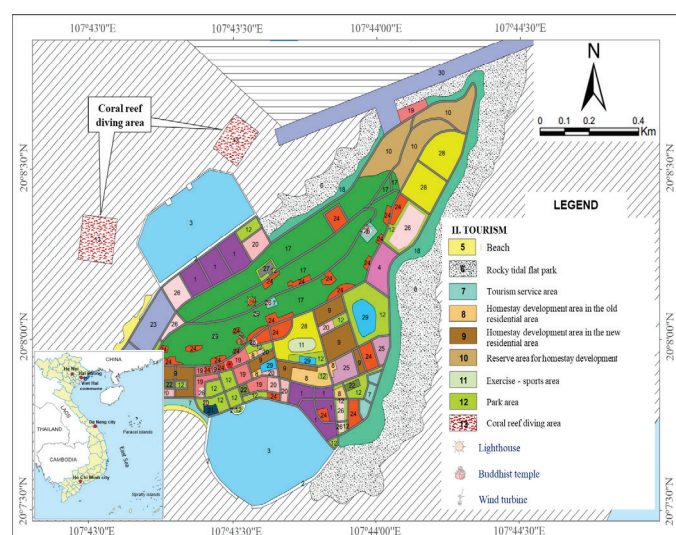


Fig. 3. Spatial zoning model for the development of experiential tourism in Bach Long Vi island district [4].

Compared with the set of evaluation criteria, as of May 2023, experiential tourism activities in Bach Long Vi island district have scored 110 points, currently categorised as “M2: Being oriented towards green economic development” (Table 3).

3.3.3. Developing high-tech aquaculture

Concerning high-tech aquaculture, two potential types are proposed for Bach Long Vi island district, meeting high technology criteria and climate change adaptation. These types include offshore seabass farming and onshore aquaculture using RAS technology. These activities are expected to promote economic development in Bach Long Vi due to the decline in fishing activities in recent years owing to the decrease in resources. Using GIS technology, the space for developing high-tech aquaculture

Table 3. Evaluation results of experiential tourism activities in Bach Long Vi island district according to the set of green criteria (as of May 2023).

No	Criteria	Evaluation method ($K_{Bi} \times K_i$) K_{Bi} : weight of criterion i K_i : score of criterion i achieved	Scores
1	Criterion 01: criteria for the island's road system, locks, and ports	3×5.0	15.0
2	Criterion 02: criteria for the electrical system	3×7.5	22.5
3	Criterion 03: criteria for clean water treatment stations and water storage	2×5.0	10.0
4	Criterion 04: criteria for the connection between the island and mainland	3×7.5	22.5
5	Criterion 05: criteria for seafood resources	2×5.0	10.0
6	Criterion 06: criteria for waste control from high-tech activities (mainly solid waste) and the use of environmentally friendly materials.	2×2.5	5.0
7	Criterion 07: criteria for promoting offshore fishing and prohibiting destructive fishing	2×2.5	5.0
8	Criterion 08: income criteria for individuals involved in fisheries logistics	2×5.0	10.0
9	Criterion 09: criteria for government propaganda activities involving all participants in the model	2×2.5	5.0
10	Criterion 10: criteria for green elements in advanced technology models and TCKN	2×2.5	5.0
Total GEI score			110.0

Source: Calculation results performed by the research team.

activities in Bach Long Vi is designed with a focus on a green economy (Fig. 4). The aquaculture area, covering approximately 3.02 hectares, is the central area for developing high-tech aquaculture activities in the locality. Additionally, there are ecological restoration areas designated as marine protected areas and zones for the development of marine protected areas.

Firstly, the aquaculture area of approximately 3.02 hectares will be utilised for the abalone hatchery and industrial farming. This area will concentrate on scientific and technological advancements to produce high-quality aquatic seed, particularly abalone, ensuring a stable supply of high-quality aquatic seed for sustainable operation. Currently, a project is underway to establish a wildlife rescue station and produce seafood to support the restoration of aquatic resources in the Bach Long Vi marine protected area, further promoting high-tech aquaculture activities in the future. Next is the abalone ecological farming area, a substantial marine space extending from the sea with a depth of 5 meters in the northeast to the sea with a depth of 5 meters in the southwest. This area will provide a favourable ecological environment for the development of aquaculture species, with priority given to abalone, followed by seaweed, sea snails, sea cucumbers, and more. Meanwhile, the marine protected area development zone is a space that can be considered, researched, and implemented in the future for barramundi (sea bass) farming.

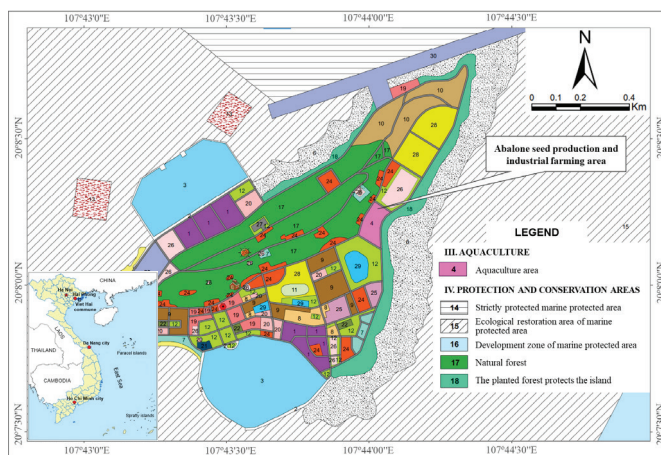


Fig. 4. Spatial zoning model for the development of hi-tech aquaculture in Bach Long Vi island district [4].

In comparison with the set of evaluation criteria, high-tech aquaculture service activities in Bach

Long Vi island district (as of May 2023) scored 75 points, categorised as “M2: Being oriented towards green economic development” (Table 4).

Table 4. Results of evaluation of high-tech aquaculture activities of Bach Long Vi island district, according to the set of green criteria (as of May 2023).

No	Criteria	Evaluation method ($K_{Bi} \times K_i$) K_{Bi} : weight of criterion i K_i : score of criterion i achieved	Scores
1	Criterion 01: criteria for the island's road system, locks, and ports	2×5.0	10.0
2	Criterion 02: criteria for the electrical system	3×5.0	15.0
3	Criterion 03: criteria for clean water treatment stations and water storage	3×2.5	7.5
4	Criterion 04: criteria for the connection between the island and mainland	2×2.5	5.0
5	Criterion 05: criteria for seafood resources	2×5.0	10.0
6	Criterion 06: criteria for waste control from high-tech activities (mainly solid waste) and the use of environmentally friendly materials.	3×2.5	7.5
7	Criterion 07: criteria for promoting offshore fishing and prohibiting destructive fishing	2×2.5	5.0
8	Criterion 08: income criteria for individuals involved in fisheries logistics	2×2.5	5.0
9	Criterion 09: criteria for government propaganda activities involving all participants in the model	2×2.5	5.0
10	Criterion 10: criteria for green elements in advanced technology models and TCKN	2×2.5	5.0
Total GEI score			75.0

Source: Calculation results performed by the research team.

3.4. Proposed solutions to build a green economic model in Bach Long Vi island district to adapt to climate change and disaster prevention

3.4.1. Integrated solutions to build a green economic model

Mechanisms and policies: Implement mechanisms and policies that promote green economic development in Bach Long Vi, with a focus on those associated with national defence and security, telecommunications, banking, and health services. Additionally, invest in passenger and cargo transportation infrastructure.

Management solutions: Enhance the role of government organisations in green economic development, implement community-based or co-management models, and adopt ecosystem-based management approaches.

Environmental solutions: Increase the use of renewable energy sources, promote environmental education and awareness, and implement environmental engineering solutions. Address wastewater and solid waste management issues in Bach Long Vi.

Human resource solutions: Attract and improve the quality of human resources to support the three main economic activities (fishery logistics, tourism, and aquaculture).

Capital mobilisation solutions: Mobilise financial investment from both the government and businesses to ensure sufficient resources for building a green economic model in Bach Long Vi.

3.4.2. Specific solutions to develop fisheries logistics activities

Several specific solutions are proposed to achieve green economic goals in the field of fisheries logistics, including: (i) Improving productivity and product quality, especially for rare and high-value seafood species in Bach Long Vi; (ii) Incorporate renewable energy sources into fisheries production and logistics; (iii) Implement intelligent and automated technology in seafood production, transportation, and preservation; (iv) Provide training, coaching, and professional development for workers in the

fisheries logistics industry; (v) Strengthen coordination among government organisations, security forces, businesses, and residential communities to promote comprehensive development of the fisheries logistics sector.

3.4.3. Specific solutions to develop tourism activities

Several particular solutions to develop green economy-oriented experiential tourism include:

(i) Integrating experiential tourism with traditional Tourism: It is crucial to conduct a comprehensive study and propose suitable preferential mechanisms and policies to the Government and city authorities. This approach aims to attract investment and enhance the quality of local tourism services. Developing tourist routes that showcase Bach Long Vi's unique tourism products linked to the homeland's sea and islands, while also emphasising territorial sovereignty and marine ecology experiences, should be a priority.

(ii) Enhancing tourism services: Experiential tourism activities like squid fishing, fishing, and coral diving should receive investment in essential equipment to ensure safety and create distinctive features for Bach Long Vi tourism. Moreover, there is a need to invest in and construct vehicles for transporting tourists between the island and the mainland, prioritising safety during operation. Utilising existing ships, such as the Hoa Phuong Do ship and Bach Long ship, to meet tourist demands is advisable.

(iii) Strengthening brand management: To boost tourism development, it is vital to focus on managing and promoting Bach Long Vi's brand values. This includes geological values, such as rocky tidal flats, and cultural values. Proper management of these unique features can significantly enhance the attractiveness of the destination for tourists.

3.4.4. Specific solutions for developing aquaculture activities

Brand value management: Prioritise the management of brand values for Bach Long Vi, especially highlighting the typical seafood species for the region, such as abalone, squid, and sea cucumber.

Abalone raising process: Develop a process for raising abalone using recirculating aquaculture system technology, combining natural culture at the adult stage with abalone.

Sea bass farming: Establish a process for raising sea bass to create new livelihoods for the island's residents, replacing traditional fishing activities. Improve management efficiency by implementing conservation measures and banning destructive fishing, while promoting high-tech aquaculture practices to increase the production of specialist species in Bach Long Vi.

4. Conclusions

Based on theoretical research, analysis, and practical assessment, it is evident that green economic development is a suitable direction for the economic growth of Bach Long Vi island district in the near future. The orientation for building a green economic model for the island district relies on natural capital (both on the island and within marine ecosystems), local and external resources (human and material), and development strategies aligned with conservation efforts. This approach aims to enhance climate change adaptation and disaster prevention.

The proposed green economic model for Bach Long Vi island district aligns with Hai Phong city's development goals and focuses on three primary activities: fisheries logistics, experiential tourism, and high-tech aquaculture.

(i) For fisheries logistics: The goal is to provide comprehensive fisheries logistics services while implementing optimal solutions for environmental protection, hygiene, and crew health. Infrastructure for anchoring ships, fuel supply, and a 12.43-hectare distribution area for crew facilities, including dining, cleaning, rest, and medical services, are essential components. Addressing waste disposal into the two docks, ensuring a pleasant landscape environment, and enhancing labour safety are immediate challenges.

(ii) For experiential tourism activities: Identified tourism products and associated challenges, particularly solid waste management, have been recognised. To meet future visitor needs, there is

a focus on increasing the quantity and quality of accommodation options (including mobile prefab models and upgrades to existing rooms). Experiential tourism products primarily utilise natural capital sources like rocky tidal flats and coral reefs, closely tied to ecological conservation activities.

(iii) For high-tech aquaculture: Two feasible types meeting high-tech criteria have been identified, namely, seabass farming and onshore farming using RAS technology. These activities aim to drive economic development in the island district as traditional fishing activities have been declining due to resource depletion.

Integrated solutions have been proposed to build a green economic model that aids climate change adaptation and natural disaster prevention in Bach Long Vi island district, encompassing policies, management, environmental considerations, human resources, and capital mobilisation. Specific solutions for individual economic activities (fishery logistics, experiential tourism, and high-tech aquaculture) have been presented, offering creative and viable strategies to address current socio-economic development challenges in Bach Long Vi island district and promote green, sustainable economic growth for the local community.

CRedit author statement

Xuan Sinh Le: Conceptualisation, Methodology, Supervision, Writing, Reviewing and Editing; Van Bach Nguyen: Qualitative data collection and Analysis; Thi Minh Hien Bui: Developing fisheries logistics activities; Manh Hao Do: Developing fisheries logistics activities; Van Thao Nguyen: Building thematic maps; Thi Thu Ha Nguyen: Building thematic maps; Van Tung Pham: Developing experiential tourism; Truong Huynh Nguyen: Developing a set of criteria.

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COMPETING INTERESTS

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