HO CHI MINH NATIONAL ACADEMY OF POLITICS

NGUYỄN THỊ THANH VÂN

MANAGEMENT OF MARINE AQUACULTURE BY THE KHANH HOA PROVINCIAL GOVERNMENT

DOCTORAL DISSERTATION ABSTRACT

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Academic supervisors: **1. Assoc. Prof. Dr. Đinh Thị Nga**

2. Assoc. Prof. Dr. Đinh Công Hoàng

Reviewer 1: .....

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Reviewer 2: .....

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Reviewer 3: .....

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INTRODUCTION

1. Rationale for the study

Marine aquaculture is a priority sector in Vietnam's marine economy. Resolution No. 36-NQ/TW of 22 October 2018 on the Strategy for the Sustainable Development of Vietnam's Marine Economy to 2030, with a Vision to 2045, calls for a gradual shift from capture fisheries to modern, environmentally friendly, industrial-scale marine aquaculture. This direction is elaborated in the Scheme for Marine Aquaculture Development to 2030, with a Vision to 2045, the National Programme for Aquaculture Development, and the National Marine Spatial Plan. These policies require a transition from small-scale production heavily dependent on natural conditions to organised production using technology, controlling environmental impacts, adapting to climate change, and meeting market standards.

While this transition necessitates technological upgrades and capital investment, it is fundamentally an issue of management. Provincial governments translate central legislation and policies into locally appropriate plans and programmes. They allocate sea areas, administer registration and licensing, coordinate sectors sharing marine space, provide guidance and support, monitor environmental conditions, prevent and control disease, conduct inspections, and address emerging issues. Provincial management quality therefore directly affects the conversion of marine potential into sustainable development outcomes.

Theoretically, marine aquaculture occupies marine space with common-pool resource characteristics. Use boundaries are harder to identify and control than on land; aquatic environments are interconnected; and waste, uneaten feed, and pathogens can spread from one farm throughout a farming area. Aquaculture shares this space with capture fisheries, tourism, transport, conservation, national defence, security, and other marine economic activities. Individual farms may benefit from expansion, while the wider community bears the costs of declining water quality, increasing disease, and exceeded carrying capacity. Without effective allocation rules, monitoring, and coordination, individually rational behaviour may harm the farming area and ecosystem.

In practice, Khanh Hoa's bays, inlets, and marine waters favour cage and raft aquaculture, particularly lobster, marine fish, and molluscs. The merger with Ninh Thuan expanded its marine aquaculture space and diversified ecological conditions, farming systems, and commodity composition. In 2025, provincial aquaculture production reached 41,751 tonnes, including 41,341 tonnes from marine and brackish waters. Cage culture volume exceeded 5.19 million m^3; lobster output was approximately 12,749 tonnes, and marine fish output from cages and rafts approximately 7,371 tonnes. Around 548 hatchery and nursery establishments produced an estimated combined 51,755.8 million individuals. This scale confirms Khanh Hoa's position in the national marine aquaculture value chain and requires corresponding management capacity in aquatic seed production, biosecurity, disease control, environmental management, and traceability.

Despite these achievements, marine aquaculture remains fragmented and dominated by smallholder households. Farming outside designated areas and excessive cage and raft densities persist in some areas. Registration, licensing, and sea-area allocation are slow; farming-area infrastructure and services lack integration; environmental monitoring is mainly periodic; and data on farms, cage and raft coordinates, production scale, environmental conditions, disease, and compliance histories remain fragmented. Linkages among households, cooperatives, and enterprises are unstable; sales depend on traders; and traceability and sustainability certification remain limited. Consequently, the disparity between policy intent and implementation capacity necessitates critical attention.

Expanded administrative boundaries and two-tier local government, introduced on 1 July 2025, have changed management's geographical scope and methods. The coastline, water surface, farms, and farming areas under provincial management have increased, while natural conditions, technological capabilities, infrastructure, and legal status differ across locations. The elimination of the district administrative tier necessitates the reallocation of provincial and commune responsibilities, the designation of a lead agency, the restructuring of locally deployed personnel, the handover of administrative records, the standardization of procedures, and the integration of data. Consequently, proposed policy measures must meticulously reflect this emergent context.

Digital transformation and green development are changing management assessment criteria. Decision-making requires a unified database of farming areas and operators; digitised coordinates, boundaries, licences, and establishment codes; automated monitoring; early warning; electronic traceability; and inter-agency data sharing. Performance should be assessed through output and high-tech cage numbers, alongside resource-use efficiency, waste control, biosecurity, compliance, resilience, and the balance of economic, social, and environmental interests.

Grounded in these theoretical and practical imperatives, the doctoral candidate selected "Management of Marine Aquaculture by the Khanh Hoa Provincial Government" as the topic for this dissertation in Economic Management. Conceptualizing marine aquaculture as an economic activity predicated on common-pool resources, the study examines provincial governance in relation to marine spatial planning, sustainable development, implementation capacity, multi-stakeholder coordination, and data-driven governance.

2. Research aims and objectives

Research aims

Theoretically, the dissertation develops and extends the analytical framework for provincial government management of marine aquaculture, clarifying concepts, objectives, principles, management functions, assessment criteria, and influencing factors. Empirically, it assesses management by the Khanh Hoa provincial government and the relative importance of influencing factors through expert

assessments, then proposes measures and recommendations for improvement to 2030, with a vision to 2045.

Research objectives

The dissertation has six objectives: review Vietnamese and international studies; systematise and extend theoretical foundations and construct an analytical framework; examine selected localities' experience and draw lessons for Khanh Hoa; collect and process data to assess three management functions; identify five groups of influencing factors and their relative priorities, accounting for new management requirements; and propose directions, measures, and recommendations consistent with provincial government functions and authority.

3. Research questions

The dissertation addresses five questions: (1) What theoretical foundations underpin provincial government management of marine aquaculture, and how should its functions, assessment criteria, and influencing factors be defined? (2) During 2014–2025, particularly 2020–2025, how did the Khanh Hoa provincial government plan, issue regulatory instruments, organise implementation, inspect, monitor, and address violations, and what were its achievements, limitations, and their causes? (3) What factors influence management, and how do experts rank their relative priorities? (4) What requirements arise from expanded administrative boundaries, two-tier local government, digital transformation, green development, and high-tech marine aquaculture? (5) What measures are required to enhance provincial management toward 2030, with a vision to 2045?

4. Research subject and scope

Research subject

The dissertation examines the Khanh Hoa provincial government's management of marine aquaculture from the disciplinary perspective of Economic Management.

Research scope

The governing bodies studied are the Khanh Hoa Provincial People's Council, Provincial People's Committee, and relevant specialised agencies. The study covers provincial authority within the central government's unified management framework, focusing on planning and regulatory instruments; organising implementation; and inspections, monitoring, and handling violations. Geographically, it focuses on pre-merger Khanh Hoa and considers areas incorporated from Ninh Thuan after 1 July 2025 to identify new management requirements. The empirical assessment spans the 2014–2025 period, with a primary focus on 2020–2025, whereas the proposed measures are formulated for 2026–2030, with a vision to 2045.

5. Original contributions of the dissertation

Theoretical contributions

First, the dissertation advances an approach to marine aquaculture management based on economic management and local governance of marine space,

extending beyond farming techniques, environmental biology, or sectoral policy alone.

Second, it develops and systematises an integrated theoretical framework for provincial government management of marine aquaculture, clarifying its concept, characteristics, functions, assessment criteria, and groups of influencing factors.

Third, it develops and successfully applies a procedure combining the Delphi method and the Analytic Hierarchy Process (AHP) within an integrated analytical framework, thereby contributing to approaches for studying the factors influencing the effectiveness of provincial government management of marine aquaculture.

Practical contributions

First, the dissertation systematically analyses the Khanh Hoa provincial government's marine aquaculture management during 2020–2025, clarifying achievements, limitations, and causes in the specific context following the Khanh Hoa–Ninh Thuan merger.

Second, based on expert assessments, the dissertation identifies five factor groups with 29 component criteria and establishes the weights and priority ranking of factors influencing marine aquaculture management in Khanh Hoa. The group "State institutions and policies" holds the highest weight, followed by "Natural conditions, the environment, and marine space".

Third, the current management assessment, analytical framework of influencing factors, and proposed measures provide a reference for coastal localities with similar conditions seeking to improve marine aquaculture management.

6. Theoretical and practical significance

Theoretical significance

The dissertation clarifies provincial governments' role in marine aquaculture and marine-space management for sustainability and climate adaptation. It advances an interdisciplinary approach linking economic management, resource governance, and marine environmental science within an expanded post-merger jurisdiction.

Practical significance

The findings provide a reference for Khanh Hoa and similar coastal localities to improve planning, implementation, monitoring, databases, support for technological transition, and sustainable marine aquaculture. They also support research and teaching in marine economic management and local governance.

7. Structure of the dissertation

In addition to the introduction, conclusion, references, and appendices, the dissertation comprises five chapters.

Chapter 1
REVIEW OF LITERATURE RELATED TO THE DISSERTATION TOPIC

1.1. Research strands relevant to the dissertation

1.1.1. Studies on marine spatial planning and management

International marine spatial planning studies view the sea as a multi-objective system, considering aquaculture alongside conservation, capture fisheries, shipping, tourism, energy, and national defence. Ehler and Douvere describe a cycle of setting objectives, analysing conditions, selecting options, implementation, monitoring, and adaptation. Geographic Information Systems (GIS), multi-criteria analysis, spatial risk assessment, and carrying-capacity models inform farming locations, scales, and densities. Findings show that effective planning requires boundaries delineated on site, licensing linked to carrying capacity, and post-licensing monitoring. However, most studies emphasise zoning techniques or national planning without fully tracing how provincial governments translate plans into sea-area allocation, licensing, infrastructure investment, density control, and data-informed adjustments.

1.1.2. Studies on institutions governing marine aquaculture

Institutional studies link effective marine aquaculture management to clear, coherent, feasible regulations; decentralisation; intersectoral coordination; and participation by enterprises, fisheries associations, and communities. North, Scott, Ostrom, Jentoft, and Kooiman show that individual licences cannot replace institutions governing a farming area through defined boundaries, rights, responsibilities, monitoring, sanctions, and conflict resolution. Studies in Japan, Europe, and Vietnam find that private standards, certification, and cooperatives can complement public management, subject to organisational capacity and linkages across levels. In-depth analysis of provincial institutions across spatial allocation, licensing, implementation, and compliance assurance remains limited.

1.1.3. Studies on support policies for marine aquaculture

Anderson and colleagues, Belton and Little, Lester and colleagues, Zhou and colleagues, and Food and Agriculture Organization of the United Nations (FAO) reports agree that sustainable marine aquaculture needs support for science and technology, infrastructure, credit, insurance, training, the environment, and markets. Vietnamese studies add requirements for aquatic seed, feed, farming procedures, fisheries extension, disease prevention, spatial organisation, and value-chain linkages. Lasting support benefits require eligibility conditions, counterpart funding, compliance with spatial plans and environmental requirements, sustained technology use, and market linkages. Poorly targeted support may raise output but increase environmental and public-budget pressures. Studies mainly establish support needs or propose policies from production conditions, without fully assessing provincial roles in localising central policies, mobilising resources, implementing them, or measuring access and behavioural change across stakeholder groups.

1.1.4. Studies on factors influencing provincial government management of marine aquaculture

The literature identifies five groups of conditions shaping marine aquaculture management: institutions and legislation; government organisational and implementation capacity; local socioeconomic conditions; the capacity of aquaculture

establishments; and natural conditions, the environment, and marine space. Institutional theory explains the influence of rules, norms, and cognition. Governance capacity theory emphasises organisational structures, personnel, resources, data, and coordination. Common-pool resource and co-management theories clarify the roles of boundaries, participation, community monitoring, and accountability. The ecosystem approach places carrying capacity, water quality, disease, and resilience at the centre of analysis. These studies provide a relatively comprehensive basis for identifying mechanisms of influence, but measurement criteria remain fragmented and analysis is predominantly qualitative. A unified set of criteria and a method for quantifying the relative importance of factor groups in provincial management are therefore still lacking.

1.1.5. Studies on inspection, monitoring, and legal compliance in fisheries and marine aquaculture management

Research on monitoring and compliance draws on FAO's monitoring, control and surveillance (MCS) framework, Ostrom's principles of monitoring and graduated sanctions, Ayres and Braithwaite's responsive regulation, and economic approaches to detection probabilities and sanction severity. The findings show that effective management requires a combination of activity monitoring, documentation and licensing controls, follow-up inspections, field patrols, location data, environmental monitoring, self-reporting, and community feedback, alongside follow-up on corrective action after enforcement. Vietnamese studies on nutrient loading, water-quality indices, sediments, carrying capacity, and biological indicators provide scientific tools for identifying environmental degradation. However, these studies largely focus on monitoring techniques and do not fully connect data with warning thresholds, risk-based inspection plans, responsibility for remedial action, or provincial decisions to adjust farming density, production seasons, or spatial plans.

1.1.6. Studies on criteria and indicators for assessing public management of marine aquaculture

Existing governance assessment frameworks distinguish between resource inputs, process quality, outputs, outcomes, and impacts, while emphasising government effectiveness, regulatory quality, the rule of law, and accountability. For planning, studies distinguish between conformity with plan provisions and the extent to which plans produce change in practice. For policy implementation, criteria commonly include clarity of objectives, resources, implementing-agency capacity, intersectoral coordination, and acceptance among target groups. However, indicator sets remain general or assess individual functions separately, without integrating the distinctive characteristics of marine space and the three provincial management functions. This provides the basis for developing a set of criteria aligned with the functions, authority, and scope for action of provincial governments.

1.2. Established research findings

1.2.1. Theoretical findings

First, previous studies have progressively established important theoretical foundations for multi-level governance, ecosystem approaches to management, and marine spatial planning. These findings clarify how management is organised, farming space allocated, environmental impacts controlled, and marine economic

activities coordinated. They provide an important theoretical basis for the dissertation's analysis of provincial management of marine aquaculture space.

Second, theories of common-pool resource governance and fisheries governance have established foundational propositions for identifying factors that influence management effectiveness. These provide the direct theoretical basis for identifying the groups of factors affecting marine aquaculture management.

Third, research on modern management tools has advanced data-informed governance and clarified how GIS can support site selection and aquaculture zoning. This provides a basis for incorporating technology into the analytical framework for provincial management capacity.

Fourth, many studies have established theoretical foundations for the role of government policy in marine aquaculture development. Public policy is therefore recognised as an important component of the theoretical framework for assessing the effectiveness of public management of marine aquaculture.

1.2.2. Practical findings

First, international studies have reviewed numerous marine aquaculture management models and confirmed the importance of local governments' organisational capacity, coordination mechanisms, and support policies.

Second, Vietnamese studies have clarified current conditions and limitations in marine aquaculture planning, implementation, resources, data, and monitoring.

Third, studies have demonstrated the need to strengthen multi-stakeholder coordination, promote community participation, and apply co-management models to improve the effectiveness and sustainability of marine aquaculture.

1.3. Research gaps requiring further investigation

1.3.1. Theoretical gaps

First, institutional, common-pool resource, interactive governance, ecosystem, and data-related theories have not been fully integrated into a provincial management framework. *Second*, most studies identify influencing factors without quantifying their relative importance. *Third*, evidence on co-management primarily concerns small communities and does not adequately reflect high-density marine aquaculture contexts such as Khanh Hoa.

1.3.2. Practical gaps

First, most studies focus on freshwater or brackish-water aquaculture, while in-depth research on marine aquaculture, particularly from the perspective of provincial government management, remains relatively limited.

Second, Khanh Hoa has favourable natural conditions, with numerous bays, lagoons, and sheltered waters, densely concentrated farming areas, and a position as one of Vietnam's major marine aquaculture centres. However, within the literature reviewed, few studies comprehensively examine management mechanisms, institutional characteristics, provincial organisational and management capacity, and the specific socioeconomic and environmental factors influencing marine aquaculture management effectiveness in this locality.

Third, previous studies have not adequately clarified mechanisms for organising and coordinating marine aquaculture management across sectors and administrative levels within a province in response to climate change, environmental pressures, and international integration.

1.4. Issues selected for investigation in the dissertation

First, the dissertation clarifies the concept, substance, scope, and specific features of provincial marine aquaculture management. *Second*, it integrates institutional theory, governance capacity, common-pool resources, and the ecosystem approach into a theoretical framework. *Third*, an integrated Delphi and AHP procedure is employed to validate the assessment criteria, quantify the relative influence of factors, and establish priority weights. *Fourth*, it assesses management in Khanh Hoa, identifies achievements, limitations, and causes, and proposes measures for Khanh Hoa and similar localities.

Chapter 2
THEORETICAL AND PRACTICAL FOUNDATIONS OF PROVINCIAL GOVERNMENT MANAGEMENT OF MARINE AQUACULTURE

2.1. Overview of marine aquaculture

2.1.1. The concept of marine aquaculture

Aquaculture involves human intervention and control in farming aquatic organisms for economic, ecological, or social outputs. In natural saline waters, the environment is more open and strongly affected by currents, weather, disease, and other sea uses. Combining technical, biological, economic, and institutional dimensions, the dissertation defines marine aquaculture as controlled farming and harvesting of marine organisms with economic and ecological value in natural saline waters, using specialised technical systems in marine areas under coastal local authorities' jurisdiction. Public institutions must coordinate production development with rational spatial use and environmental protection.

2.1.2. Forms of marine aquaculture

Marine aquaculture can be classified by location as nearshore, in intermediate waters, or offshore; by production category as marine fish, crustaceans, molluscs, seaweeds and algae, or aquatic seed production; and by technological level as traditional, semi-industrial, or industrial and high-tech. Each form has different requirements for capital, cage and mooring structures, logistical infrastructure, structural safety, environmental control, monitoring, and markets.

2.1.3. The role of marine aquaculture

Marine aquaculture supplies food and raw materials for processing, creates employment and income for coastal communities, supports livelihood transitions, reduces pressure on capture fisheries, and promotes science and technology, support services, and fisheries value chains. When organised in accordance with spatial plans, appropriate technologies, and sustainability standards, it also contributes to green growth, exports, and local marine economic development.

2.1.4. Characteristics of marine aquaculture

Marine aquaculture operates in an open environment and is highly dependent on currents, weather, water quality, and disease conditions. It uses marine space that

serves multiple purposes, where boundaries are difficult to delineate and environmental externalities and conflicts of interest can readily arise. The activity involves long investment cycles, high risks, and substantial capital, technical, and infrastructure requirements; its products face demanding food safety, traceability, and market standards. These characteristics require management at the farming-area and ecosystem levels, rather than a focus solely on individual establishments.

2.2. Provincial government management of marine aquaculture

2.2.1. Defining provincial government management of marine aquaculture

2.2.1.1. The concept of public management

Public management is the exercise of public power by competent authorities through enacting and implementing legislation, using legal, administrative, economic, financial, and organisational instruments to guide, coordinate, regulate, and support actors. It seeks efficient resource use, protection of the public interest, and development objectives. The concept incorporates legality and discipline from traditional public administration; effectiveness, efficiency, and results-based management from New Public Management; and coordination, transparency, accountability, and participation from contemporary governance.

2.2.1.2. The concept of provincial government management

Provincial government management involves provincial administrative authorities organising, directing, inspecting, and adjusting development activities within their jurisdiction to implement central policies through legal, organisational, technical, and financial instruments suited to local conditions.

2.2.1.3. The concept of provincial government management of marine aquaculture

Drawing on sustainable development, marine spatial planning, common-pool resource governance, co-management, and ecosystem-based management, the dissertation defines provincial government management of marine aquaculture as provincial action, within authorised powers and unified central management, combining legal, administrative, economic, financial, technical, and information instruments to plan, implement, inspect, monitor, and adjust aquaculture activities. It allocates and promotes rational use of space and resources, controls environmental impacts and risks, supports production, and ensures effectiveness, efficiency, transparency, accountability, and sustainable development.

This definition distinguishes provincial management from sectoral development policy. Policy sets objectives, directions, and incentives; management translates them into local measures, implementation, oversight, and adjustment. Management directly concerns production volumes and farming composition, as well as actors' use of space and resources. Assessment must therefore consider legality, feasibility, coordination, compliance, and protection of the public interest.

2.2.2. Objectives of provincial government management of marine aquaculture

The objectives are to ensure the sustainable development of marine aquaculture; optimise its economic and technical efficiency; safeguard social welfare and livelihoods in coastal communities; and protect and restore the marine environment.

2.2.3. Principles of provincial government management of marine aquaculture

Management must comply with legislation and the allocation of authority; maintain consistency between planning and implementation; respect ecosystem limits, carrying capacity, and the precautionary principle; prioritise prevention and risk management; ensure openness, transparency, and accountability; promote community participation and intersectoral coordination; combine administrative, economic, technical, and data-based instruments appropriately; and provide continuous monitoring, feedback, and adjustment in response to changing conditions.

2.2.4. Functions of provincial government management of marine aquaculture

2.2.4.1. Planning and issuing regulatory instruments for marine aquaculture

Provincial governments translate marine spatial plans, provincial plans, and sectoral orientations into designated farming areas, species, densities, infrastructure, safety corridors, and implementation schedules. Planning must be grounded in hydrological conditions, ecosystems, carrying capacity, and interactions with tourism, shipping, conservation, and national defence. Local regulatory instruments guide registration, licensing, sea-area allocation, establishment requirements, environmental protection, and coordination mechanisms without imposing additional conditions beyond provincial authority.

2.2.4.2. Organising the implementation of marine aquaculture management

Implementation comprises issuing policy guidance; implementing support policies; investing in and developing infrastructure; providing education, training, and science and technology transfer; promoting value-chain linkages and traceability; monitoring and managing environmental conditions; preventing and controlling disease; and protecting marine ecosystems.

2.2.4.3. Inspection, monitoring, and the handling of violations in marine aquaculture

Provincial governments develop risk-based plans and inspect farm locations, densities, licences, farming conditions, seed stock, feed, veterinary medicines, environmental conditions, and food safety. They combine on-site monitoring with coordinate data, environmental observations, and community feedback. Violations must be detected and addressed within the relevant authority, fairly and transparently; compliance with corrective requirements must be followed up and re-inspected. Monitoring results also provide feedback for adjusting plans, policies, and resource allocation.

2.2.5. Criteria for assessing provincial government management functions in marine aquaculture

The assessment criteria correspond to the three groups of management functions. For planning and regulatory instruments, they address completeness, coherence, clarity, suitability to local conditions, capacity to reduce conflicts, incorporation of carrying capacity, and implementation. For organising implementation, they cover support policies, infrastructure, training, monitoring, coordination, and value-chain linkages. For oversight, they address inspection

planning, frequency and coverage, information coordination, timeliness of enforcement, follow-up on corrective action, and the digitisation of records.

2.2.6. Factors influencing provincial government management of marine aquaculture

2.2.6.1. State institutions and policies

This group reflects the completeness, clarity, transparency, coherence, and stability of legislation; the fit between central regulations and local conditions; coordination mechanisms; decentralisation; implementation roadmaps; and the scope for adopting tailored policies. Institutions determine the structure of rights and obligations, compliance costs, and the scope for action of provincial governments and aquaculture establishments.

2.2.6.2. Local government capacity

Government capacity comprises organisational structures, personnel quality, plan and policy formulation and implementation, inspection and monitoring, intersectoral coordination, and data and technology use. Authority requires resources, skills, clear procedures, and accountability to deliver results. A sound, rational organisational structure directly underpins management continuity and consistency.

2.2.6.3. Local socioeconomic conditions

The size of the local economy, budgetary resources, infrastructure, scientific and technological capabilities, livelihood characteristics, markets, and social participation influence resource mobilisation and management implementation. Localities with strong infrastructure, services, and research networks are better placed to support technological transition, environmental monitoring, and value-chain development. Conversely, high livelihood dependence on aquaculture increases the social costs of reorganising farming areas.

2.2.6.4. Capacity of marine aquaculture establishments

The financial capacity, technical and technological capabilities, production organisation, and market access of households, cooperatives, and enterprises, together with their legal knowledge and ability to comply, determine policy uptake and management effectiveness. Small-scale establishments often face constraints in legal documentation, capital, record-keeping, and traceability. Policies therefore need to differentiate among target groups, expand support services, and link benefits to compliance responsibilities.

2.2.6.5. Natural conditions, the environment, and marine space

Water quality, currents, depth, ecosystem resilience, natural hazards, climate change, disease, carrying capacity, and spatial conflicts create opportunities while also imposing limits on management. These are not passive background conditions; they are integral to decisions on planning, density, production seasons, technology, licensing, monitoring, and response measures. They must therefore be continually assessed using spatial and temporal data.

2.3. Provincial experience in marine aquaculture management internationally and in Vietnam and lessons for Khanh Hoa

2.3.1. Marine aquaculture management experience in selected localities

2.3.1.1. Experience of Troms og Finnmark County in Norway

Troms og Finnmark's approach to marine aquaculture management is based on spatial planning, site-specific licences, biomass limits, environmental standards, and traceability data systems. Local government coordinates with specialised agencies in site assessment and monitoring, while enterprises are responsible for monitoring, reporting, and corrective action. The central lesson is to link spatial-use rights to environmental obligations, transparent data, and independent oversight.

2.3.1.2. Experience of Fujian Province in China

Fujian emphasises functional zoning of aquaculture areas, the reorganisation of smallholder production, density control, offshore aquaculture development, and support for upgrading cages, seed stock, feed, and technology. Government combines infrastructure investment, demonstration-area development, cooperative organisation, and value-chain linkages. This experience shows that technological transition must be accompanied by the reorganisation of space and production actors, rather than support for individual pieces of equipment alone.

2.3.1.3. Experience of Quang Ninh Province

Quang Ninh has reorganised cages and rafts, promoted the adoption of new materials, designated farming areas, allocated sea areas, and regulated activities in line with provincial planning, tourism, and bay conservation. Key lessons include publicly announcing transition roadmaps, organising dialogue, classifying establishments, engaging material-supply enterprises, and intensifying inspections during the transition.

2.3.1.4. Experience of Phu Yen Province now part of Dak Lak Province

Phu Yen offers experience in managing cage aquaculture in densely farmed bays, reorganising farming areas, replacing materials, monitoring environmental conditions, and coordinating disaster prevention and response. Its experience demonstrates the need to link warnings to plans for reducing density, relocation, and mooring, while reconciling environmental protection with the livelihoods of farming communities.

2.3.2. Lessons for Khanh Hoa Province

Key lessons are to link planning with carrying capacity and boundaries delineated on site; clarify the legal basis for sea-area use; unify licensing, monitoring, and traceability data; make support for technological transition conditional; emphasise environmental prevention; designate a coordination lead; and integrate export and sustainability certification requirements at farming-area level.

Chapter 3
RESEARCH METHODOLOGY

3.1. Research design

3.1.1. Research approach

The dissertation examines its subject from an economic management perspective, combining systems, institutional, and local governance approaches with integrated coastal zone management, marine spatial planning, ecosystem-based management, and sustainable development. Management is examined as a cycle extending from planning and the issuance of regulatory instruments through

implementation to inspection, monitoring, and adjustment. It is also situated within the interactions among government, aquaculture establishments, communities, markets, and the natural environment.

3.1.2. Research process

The dissertation adopts a mixed-methods design comprising six steps: a literature review to develop a preliminary model; a first Delphi round with 20 experts, using the Content Validity Ratio (CVR) to refine the criteria; a second Delphi round to assess consensus and finalise five groups comprising 29 criteria; a survey of current conditions; AHP with 10 experts and consistency testing; and, finally, the synthesis of secondary data, survey results, AHP findings, and qualitative information to identify priority issues and propose measures.

3.2. Research model

3.2.1. Structure of the final research model

The final research model, established after two Delphi rounds, comprises five groups of factors and 29 criteria. State institutions and policies comprise seven criteria; local government capacity, six; the capacity of marine aquaculture establishments, five; local socioeconomic conditions, six; and natural conditions, the environment, and marine space, five. The model provides the basis for applying AHP to determine the weights and relative influence of each factor group and criterion on provincial government management of marine aquaculture.

3.3. Research methods

3.3.1. Data collection methods

3.3.1.1. Secondary data collection

Secondary data were collected from legislation, strategies, spatial and development plans, statistical yearbooks, official reports, and Vietnamese and international scholarly publications indexed in Web of Science, Scopus, and national databases. Data were checked and cross-verified for publication source, reference period, administrative boundaries, units of measurement, and consistency.

3.3.1.2. Primary data collection

Primary data were collected through two Delphi rounds involving 20 experts, a questionnaire survey, and AHP involving 10 experts. The questionnaire contained 54 items measured on a five-point Likert scale. Of the 290 questionnaires distributed across five clusters, 276 were returned and 265 valid responses were retained, comprising 205 aquaculture establishments, 30 officials, and 30 supply establishments. The achieved sample corresponded to 4.91 observations per variable, appropriate for the objectives of descriptive and comparative analysis.

3.4. Data processing and analysis methods

3.4.1. Assessment using the Content Validity Ratio

Lawshe’s CVR was used to assess the essentiality of each criterion. With 20 experts, the minimum threshold was 0.42. Criteria meeting or exceeding this threshold were retained; those below it were considered for removal or merger with similar criteria. CVR was used to assess content validity and did not replace an assessment of convergence in expert opinions.

3.4.2. Calculation of means, consensus rates, and interquartile ranges

The second Delphi round jointly used the mean, consensus rate, and interquartile range. On a scale from 1—Very important to 5—Very unimportant, a criterion was accepted only when all three conditions were met: a mean ≤ 2.0; at least 70% agreement at ratings 1–2; and an interquartile range (IQR) ≤ 1. Combining these indicators controlled for both central tendency and dispersion in expert judgements.

3.4.3. Descriptive and comparative analysis of survey data

The 265 valid questionnaires were processed in Excel using frequencies, percentages, and means. Each item was calculated using the number of valid responses to that item. Results were compared descriptively across groups of criteria, locations, and respondent groups, then cross-checked against secondary data and expert information to identify implementation levels, constraints, and underlying causes.

3.4.4. The Analytic Hierarchy Process

AHP involved 10 experts with 15–28 years of experience: nine held postgraduate qualifications, and one had 15 years of practical experience in marine aquaculture. Each expert completed six matrices containing 81 pairwise comparisons. Weights were calculated by normalising each column by its sum and then averaging across rows; the matrices were reciprocal, with diagonal entries equal to 1. Only matrices with a consistency ratio (CR) < 0.1 were accepted. The weights represent relative priorities based on expert judgements, not causal coefficients. Each expert's priority vector was calculated independently; the vectors were then combined using Aggregation of Individual Priorities (AIP), with arithmetic averaging and normalisation to a sum of 1. Each criterion's global weight was obtained by multiplying its group weight by its local weight.

Chapter 4
CURRENT STATE OF MARINE AQUACULTURE MANAGEMENT BY THE KHANH HOA PROVINCIAL GOVERNMENT

4.1. Natural and socioeconomic conditions affecting marine aquaculture in Khanh Hoa

4.1.1. Favourable conditions

Khanh Hoa has a long coastline, numerous bays, lagoons and sheltered waters, and temperatures, salinity, currents and depths suitable for lobster, marine fish, molluscs and aquatic seed production. Van Phong, Nha Phu, Nha Trang, Cam Ranh and the area incorporated from former Ninh Thuan Province offer opportunities for nearshore, intermediate-water, offshore and high-tech aquaculture. Its relatively developed network of research institutes, universities, enterprises and fisheries services facilitates technology transfer, workforce training and value-chain development.

4.1.2. Constraints

Sheltered bays, uneven water exchange and high farming densities increase risks of exceeding carrying capacity, localised pollution and disease. Storms, large waves, extreme rainfall, reduced salinity and climate change threaten cages and rafts. Marine aquaculture also overlaps spatially with tourism, shipping, conservation and

national defence. Farming communities mainly comprise smallholders with unequal financial capacity and ability to meet legal requirements. Infrastructure, data and support services lag behind expansion, increasing demands on government coordination and monitoring.

4.2. Overview of marine aquaculture in Khanh Hoa

4.2.1. Scale, structure, and distribution of marine aquaculture in Khanh Hoa

During 2021–2024, farming households increased from 2,285 to 3,300, cooperatives from five to eight, and enterprises from seven to eight; households remained overwhelmingly predominant. Activities concentrated in Van Ninh–Van Phong, Ninh Hoa–Nha Phu, Nha Trang and Cam Ranh. After the administrative merger, the southern area added potential for intermediate-water and offshore aquaculture. The rapid proliferation of smallholder households and cages has outpaced the development of cooperatives, enterprises, infrastructure, and management capacity, underscoring the needs to reorganise production by designated zones and value chains.

4.2.2. Species composition and degree of specialisation

Lobster and marine fish are the two principal production groups. Lobster cage numbers increased from 60,647 in 2020 to 99,790 in 2024, while production rose from 1,540.4 to 3,300.9 tonnes. Marine fish production fluctuated between approximately 8,200 and 9,800 tonnes, while spotted babylon snail production varied markedly. Some businesses and cooperatives have developed relatively integrated chains, including Australis for cobia, Phuong Minh for pompano, and Van Thanh Cooperative for lobster. However, most households continue to purchase inputs and sell their products through traders; standardisation, record-keeping, traceability, and contractual linkages remain limited.

4.2.3. Aquatic hatchery and nursery production

Khanh Hoa plays an important role in marine aquatic hatchery and nursery production. However, during 2020–2023, establishments fell from 252 to 227, and average output per establishment from 24.92 million to 17.00 million individuals. In 2025, the newly merged province had approximately 548 seed-production establishments, producing an estimated 51,755.8 million individuals. Changes in establishment numbers and seed quality, broodstock sourcing issues and dependence on wild-caught seed for some species require stronger controls over establishment conditions, quarantine and traceability, and closer links between research and seed production.

4.3. Organisational structure for marine aquaculture management in Khanh Hoa

The management structure comprises the Provincial People’s Council, Provincial People’s Committee, Department of Agriculture and Environment, Sub-Department of Fisheries, Seas and Islands, other relevant departments and agencies, and commune-level authorities. Specialised fisheries, seas and islands units were reorganised in March 2025 and merged with the corresponding unit of former Ninh Thuan Province in August 2025. This streamlining facilitates integrated fisheries, marine and environmental management, but requires records transfer, reassignment of geographical responsibilities, standardised procedures and integrated data.

4.4. Current state of marine aquaculture management by the Khanh Hoa provincial government

4.4.1. Planning and issuing regulatory instruments for marine aquaculture

Provincial authorities have progressively integrated aquaculture areas into provincial planning, reviewed priority areas, and issued plans for high-tech marine aquaculture, cage-material replacement, environmental management and farming reorganisation. Most survey respondents assessed planning completeness and suitability relatively positively: 64.1% agreed or strongly agreed that farming-area plans were clearly formulated, and 64.6% considered them consistent with national and provincial plans. These developments provide an important basis for guiding spatial use and reorganising production.

However, plans have not been fully translated into boundaries delineated on site, sea-area allocation plans, infrastructure, and density-control mechanisms. Only 45.3% of respondents positively assessed the application of GIS and digitisation in plan preparation and management, while 51.7% positively assessed the granting of sea-area use rights in accordance with plans. With the establishment of the newly merged province, the total marine aquaculture area was estimated to increase from 1,025 ha in the former Khanh Hoa to around 1,645 ha, with marine aquaculture production of approximately 20,050 tonnes. Integrating areas with different ecological conditions and legal status has therefore become an urgent requirement.

Guidance documents are relatively diverse, but implementation remains governed by multiple laws and procedures. In the survey, 74.7% positively assessed document completeness and 68.3% the clarity of registration and licensing procedures. Yet implementation remained limited: of 3,582 establishments required to register for cage and raft aquaculture identification codes across the merged province, only 72 had received codes, approximately 3%; 49 marine aquaculture licences had been issued. This reveals a substantial gap between regulations and the capacity to establish legal compliance for numerous farming households.

This implementation gap reflects intersectoral procedures and uneven availability of initial documentation. Legal operation requires compliance with spatial plans, sea-area use rights, registration of key farmed species, establishment conditions, environmental requirements and safety. Yet many households began farming before plans and procedures were finalised; cage and raft locations change seasonally; and documents and coordinates are incomplete. Emphasising farmers' obligations without guidance, application classification, surveys and transitional arrangements is unlikely to improve compliance. Conversely, unconditional relaxation would undermine planning discipline.

4.4.2. Organising the implementation of marine aquaculture management

– Issuing policy guidance**:** The province has elaborated regulations on registration, licensing, sea-area allocation, density management, seed stock, inputs, environmental management, and high-tech marine aquaculture development. However, progress in issuing identification codes and licences and reorganising farming areas remains slow.

– Implementing support policies**:** Support for cage upgrading, accident insurance, and access to credit has begun to reduce risks, improve safety, and

promote technological innovation. Access among smallholder farmers remains constrained by counterpart-funding requirements, procedures, and legal documentation for farming areas.

– Investing in infrastructure**:** The province has begun reorganising cages and rafts, determining coordinates, and installing marker buoys. However, technical infrastructure, monitoring systems, support and logistics services, storm shelters, waste collection, and digital databases remain insufficiently integrated.

– Education and training**:** Programmes on farming techniques, environmental management, disease prevention and control, the operation of high-density polyethylene (HDPE) cages, and traceability have expanded, but are not yet sufficiently differentiated according to the needs of each target group.

– Coordination and cooperation**:** Responsibilities have been assigned among agencies, but intersectoral coordination and the resolution of conflicts over marine-space use are not sufficiently proactive or regular.

– Promoting value-chain linkages: Some safe-production chains have emerged, but cooperatives' organisational capacity remains limited. Most farming households still depend on traders, and traceability data are not yet interoperable.

– Environmental management and ecosystem protection**:** Monitoring has been maintained in priority farming areas, but automated monitoring, waste control, and management based on environmental carrying capacity have not met requirements.

4.4.3. Inspection, monitoring, and the handling of violations in marine aquaculture

First, inspections cover production and business conditions and marine aquaculture operations. Inspection, certification, registration, and licensing have been implemented, but coverage remains low, and farming outside authorised areas has not been fully resolved.

Second, disease surveillance and biological risk control involve annual sampling, testing, and warnings. However, disease data have not been fully integrated with environmental monitoring to support early warning.

Third, food safety inspection and monitoring in marine aquaculture involve the issuance of certificates and the signing of compliance commitments for relevant groups of establishments. However, follow-up inspection, maintenance of required conditions, and monitoring of corrective action remain limited.

Fourth, inspection and monitoring of veterinary medicines aim to ensure quality suitable for marine aquaculture. Inspections focus on trading conditions, product origins, and medicine use, but sampling, detection of violations, and follow-up on enforcement are not conducted regularly.

4.5. AHP analysis of factors influencing marine aquaculture management by the Khanh Hoa provincial government

4.5.1. Comparison of the relative influence of factor groups

All matrices completed by the 10 experts had CR < 0.1. The aggregated results indicate the following order of priority according to expert assessments: state institutions and policies (TC), 0.3659; natural conditions, the environment, and marine space (TN), 0.1786; local government capacity (CQ), 0.1697; local socioeconomic conditions (ĐP), 0.1530; and the capacity of marine aquaculture

establishments (CS), 0.1328. These results reflect relative importance within the criteria system, rather than causal effect sizes or statistically representative conclusions about the entire population.

4.5.2. Comparison of the relative influence of criteria within each factor group

The criteria with the highest local weights within their respective groups were TC7—tailored mechanisms and policies (0.1997); CQ1—a sound, rational organisational structure (0.2454); CS1—financial capacity of aquaculture establishments (0.3524); ĐP2—integrated infrastructure (0.3364); and TN1—water quality (0.3395). TC7 had the highest global weight (0.0731), followed by TC6—guidance and implementation roadmaps (0.0666), TC3—legislative coherence (0.0647), TC1 (0.0637), and TN1 (0.0606). This indicates that institutional priorities must be accompanied by environmental management, organisational improvements, and infrastructure development.

4.5.3. Synthesis of results

The global results indicate that management priorities should first focus on improving institutions and policies and addressing constraints associated with natural conditions, the environment, and marine space. These should be followed by strengthening local government capacity and improving local socioeconomic conditions and the capacity of aquaculture establishments.

4.6. Assessment of marine aquaculture management by the Khanh Hoa provincial government

4.6.1. Achievements in marine aquaculture management

First, marine aquaculture institutions, plans and regulatory instruments have progressively improved. *Second*, marine aquaculture space has been reviewed, zoned and integrated into planning, reducing sea-use conflicts. *Third*, policies supporting technological transition, education, training and high-tech marine aquaculture have been implemented. *Fourth*, attention has been given to research, science and technology transfer, and technical advances. *Fifth*, environmental monitoring, early warning and disease prevention and control have gradually strengthened. *Sixth*, production, processing, marketing and traceability linkages have emerged. *Seventh*, continued inspection and monitoring have increased farmers' awareness of legal compliance.

4.6.2. Limitations and shortcomings in marine aquaculture management

First, plan implementation has limited effectiveness; farming outside designated areas, excessive densities and marine-space encroachment persist. *Second*, sea-area allocation, leasing and establishing a legal basis for farms remain slow. *Third*, credit, insurance and farming-transition support are insufficient and poorly accessible. *Fourth*, farming-area infrastructure, support services, logistics and waste treatment are inadequate and fragmented. *Fifth*, pollution and disease risks persist; monitoring cannot meet real-time early-warning needs. *Sixth*, value-chain linkages are weak, markets unstable and cooperatives' role unclear. *Seventh*, management personnel are insufficient; inspection and monitoring data and digital technologies remain underdeveloped.

4.6.3. Causes of limitations in marine aquaculture management

Five main causes explain these limitations. *First*, marine aquaculture institutions and policies lack coherence and lag behind industrial-scale, high-tech aquaculture requirements. *Second*, farming environments are deteriorating, while natural-hazard, climate-change and marine-space conflict risks increase. *Third*, organisational structures remain unstable; post-restructuring staffing, procedural standardisation and data integration are inadequate. *Fourth*, infrastructure, finance and socioeconomic conditions fall short of modern marine aquaculture requirements. *Fifth*, most establishments are small, with limited financial and technological capacity and ability to meet technical and environmental requirements.

Chapter 5
MEASURES TO IMPROVE MARINE AQUACULTURE MANAGEMENT BY THE KHANH HOA PROVINCIAL GOVERNMENT

5.1. International and domestic contexts affecting marine aquaculture management by the Khanh Hoa provincial government

5.1.1. International context

Rising demand for aquatic products and limits on capture fisheries encourage industrial-scale and offshore marine aquaculture. Environmental, food safety, traceability, social responsibility and emissions-reduction standards are tightening; digital technologies, automation and real-time data are changing management. Climate change, transboundary diseases and market volatility increase risks, requiring management based on ecosystems, carrying capacity, value chains and resilience.

5.1.2. Domestic context

Vietnam promotes a green marine economy, marine spatial planning, industrial-scale and high-tech aquaculture, decentralisation and digital transformation. However, fisheries, marine resources, environmental, investment and shipping laws still overlap; infrastructure, credit and insurance resources remain inadequate. Khanh Hoa's administrative merger expands potential and management scale but increases diversity in farming areas, documentation and technology. Two-tier local government requires redefined functions, locally deployed personnel, full records transfer, standardised procedures and integrated data.

5.2. Directions for improving marine aquaculture management by the Khanh Hoa provincial government

Directions include: ensuring coherent planning, regulatory instruments, implementation and monitoring suited to Khanh Hoa; shifting from fragmented to integrated management based on marine spatial planning and environmental carrying capacity; enabling development centred on establishments and value chains; modernising management through science, technology, digital data and risk management; and linking industrial-scale, high-tech marine aquaculture with environmental protection, climate adaptation and secure community livelihoods.

5.3. Measures to improve marine aquaculture management by the Khanh Hoa provincial government during 2026–2030 with a vision to 2045

5.3.1. Removing constraints in state mechanisms and policies for marine aquaculture development in Khanh Hoa

The province should review all marine aquaculture documents and procedures for overlaps among fisheries, marine resources, the environment, investment, planning, shipping and national defence. Within its authority, it should standardise integrated procedures and publish deadlines and responsibilities. Issues beyond its authority require consolidated, evidence-based recommendations. Provincial documents should clarify registration, identification-code issuance, licensing, sea-area allocation, establishment-condition inspection, monitoring and enforcement procedures without creating additional permits or business conditions.

5.3.2. Improving the effectiveness of marine aquaculture plan implementation

The province should translate plans into digital maps of coordinates, boundaries, carrying capacity, density, species, safety corridors and infrastructure, accessible to the public and marine sectors. Implementation phases must link to sea-area allocation, investment in marker buoys, moorings and monitoring, and relocation and transition roadmaps. In overloaded or overlapping areas, classify establishments by legal status, compliance and transition capacity to devise suitable measures that protect livelihoods without legitimising activities contrary to spatial plans.

5.3.3. Strengthening marine environmental management and adaptation to natural hazards and climate change in marine aquaculture

Environmental management must reflect each area’s carrying capacity. The province should assess physical, ecological and production capacities, setting warning thresholds and rules for adjusting density, seasons, species and feed inputs. Monitoring should combine fixed stations, automated sensors, periodic sampling and community information, linked to hydrometeorological forecasts, disease information and farming-area databases. Agencies must have procedures to issue warnings, suspend stocking, reduce density, harvest early or relocate farms when thresholds are exceeded.

5.3.4. Strengthening organisational structures and public management capacity for marine aquaculture

After restructuring, the province should designate a single lead agency, delineate specialised agencies’ and commune-level responsibilities, and establish coordination procedures with environmental, maritime, tourism, defence, and science and technology agencies. Records, personnel and data must be fully transferred and procedures standardised province-wide. Staffing must reflect job functions and geographical workloads, not merely staffing quotas or qualifications.

5.3.5. Mobilising financial resources and continuing to develop and implement marine aquaculture support policies

Investment should combine central and local budgets with non-state resources. Public funding should prioritise shared management infrastructure: boundary demarcation, common moorings, monitoring, early warning and data systems. Enterprises, cooperatives and households should invest in cages, equipment, service vessels, cold storage and processing. Public–private partnerships require legal

eligibility and clear investment, operation, maintenance and risk-sharing responsibilities.

5.3.6. Investing in integrated essential infrastructure for marine aquaculture development

Priorities include marker buoys, warning lights, boundary markers and farming-area identification equipment; standardised mooring clusters and shelters; monitoring stations and warning platforms; service ports, loading and unloading points, waste collection, cold storage and logistics. Infrastructure must accompany spatial planning, ensuring maritime safety, inspection access and value-chain connectivity. Each project must specify its service area, capacity, operator, charges, maintenance funding and performance indicators.

5.3.7. Promoting research, innovation, and technology transfer for industrial-scale, modern, and sustainable marine aquaculture

The province should mobilise institutes, universities and enterprises for research and technology transfer in seed production, feed, cages and moorings, offshore aquaculture, waste treatment and monitoring. A database with unified identifiers should link operators, coordinates, licences, environmental conditions, disease, inspections and traceability. Data-updating and sharing procedures and responsibilities should also be standardised, alongside deploying GIS, the Internet of Things (IoT), and data analytics for early warning, density monitoring, and decision support.

5.3.8. Promoting trade, developing markets, and increasing value in marine aquaculture product chains

The province should help enterprises, cooperatives and households diversify markets and access value-added processing, cold chains, modern distribution and digital commerce; develop brands, geographical indications and appropriate VietGAP, GLOBALG.A.P. and ASC standards. Batch traceability must link establishment and farming-area codes, recording seed, feed, medicines, monitoring, harvests and buyers. Smallholders may keep electronic records through cooperatives, with verified data and clear responsibilities. Cooperatives should coordinate technical, data and market services; enterprises should lead contracting, standards and processing.

5.4. Recommendations

5.4.1. Recommendations to the National Assembly

Harmonise fisheries, sea-area use, environmental, planning and investment laws; ensure decentralisation comes with resources and accountability.

5.4.2. Recommendations to the Government

Improve coordinated sea-area allocation and licensing, shared infrastructure investment, credit, risk insurance and high-tech marine aquaculture pilot mechanisms.

5.4.3. Recommendations to the Ministry of Agriculture and Environment

Issue establishment, farming-cluster, cage and mooring, carrying-capacity, environmental, disease and traceability standards; develop data standards, monitoring and warning systems, and risk-based management.

5.4.4. Recommendations to the Ministry of Finance

Guide incentives, capital mobilisation and funding for infrastructure, data and monitoring; improve credit and insurance suited to marine aquaculture risks.

5.4.5. Recommendations to the Ministry of Science and Technology

Prioritise research, standardisation and technology transfer in seed, feed, cages and moorings, offshore aquaculture, sensors, GIS, data and waste treatment.

5.4.6. Recommendations to the Ministry of Industry and Trade

Support market information, trade promotion, branding, value-added processing, cold chains, digital commerce and links among farming areas, processing and distribution.

CONCLUSION

Marine aquaculture is an important development direction for realising Khanh Hoa's marine potential and advantages, supporting livelihood transitions, and promoting a sustainable marine economy. The dissertation systematises theoretical foundations and practical experience, clarifying the objectives, principles, functions, assessment criteria, and factors influencing provincial government management of marine aquaculture. On this basis, it identifies three core management functions: planning and issuing regulatory instruments; organising implementation; and inspections, monitoring, and the handling of violations.

The findings show that the Khanh Hoa provincial government has made progress in improving plans and regulatory instruments, reorganising farming areas, supporting production, applying science and technology, monitoring environmental conditions, and raising awareness of legal compliance. However, management remains constrained by shortcomings in plan implementation; sea-area allocation and leasing and licensing; the coherence of guidance documents; farming-area infrastructure; credit and insurance policies; value-chain linkages; monitoring and early warning; intersectoral coordination; data digitisation; and risk-based oversight.

Using Delphi and AHP, the dissertation identifies five groups of influencing factors in order of priority: state institutions and policies; natural conditions, the environment, and marine space; local government capacity; local socioeconomic conditions; and the capacity of aquaculture establishments. These findings help explain management limitations and provide a scientific basis for prioritising proposed measures.

The dissertation makes three distinct contributions. Theoretically, it specifies an analytical framework for provincial government management of marine aquaculture, linking economic management to the governance of resources, the environment, and marine space. Methodologically, it combines Delphi and AHP to validate the criteria system and quantify the relative influence of factors. Empirically, it provides a relatively comprehensive assessment of management in Khanh Hoa and proposes measures consistent with provincial authority. These focus on digitising licensing; developing databases and traceability systems; managing according to environmental carrying capacity and risk; and strengthening monitoring, early warning, and intersectoral coordination.

The dissertation has limitations concerning survey coverage, the generalisability of its findings to other localities, and dependence on administrative data. It also does not fully quantify environmental carrying capacity, climate risks, or the impacts of individual proposed measures. Future research should therefore extend comparisons across localities, quantify carrying capacity and risks, analyse conflicts over marine-space use, and assess the effectiveness of digital management tools and multi-stakeholder coordination models.

THE AUTHOR'S PUBLISHED SCIENTIFIC WORKS RELATED TO THE DISSERTATION TOPIC

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2. Nguyễn Thị Thanh Vân (2024), "Strengthening the Khanh Hoa provincial government's management of high-tech marine aquaculture", *Tạp chí Kinh tế và Dự báo [Economy and Forecast Review]*, special issue, June 2024, pp. 195–198.

3. Nguyễn Thị Thanh Vân (2025), "Supporting the transition to industrial-scale cages in marine aquaculture in Khanh Hoa: Current situation and solutions", *Tạp chí Kinh tế và Dự báo [Economy and Forecast Review]*, No. 15, August 2025, pp. 193–196.

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