

Public administration for green port development strategy

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Abstract:

The maritime sector is crucial for socioeconomic development and safeguarding the internal security and defense of the country. Ecosystems may be harmed by dredging and ship activities at ports. Services at seaports for transporting passengers and cargo are believed to be responsible for releasing approximately 20% of worldwide waste into the sea. Increased port activities heighten the risk of pollution, leading to a substantial adverse effect on the ecosystem. Thus, the goal is to prevent environmental contamination and construct sustainable seaports to balance environmental conservation and economic growth. However, there is no universal approach for constructing green ports globally, as it varies based on the specific circumstances of each seaport. A comprehensive set of documents and legislation aimed at reducing pollution in permeable ecosystems in Vietnam has been assembled, especially the Green Port Development Project and recommendations have been provided following a comparison with worldwide case studies. Additional improvements are needed in green concession policies, minimizing ship and inland transport idling and terminal waiting times, and carbon capture and storage.

Keywords: Port pollution; Environmental protection; Green port; Legislation; Public administration.

1. Introduction

Greening seaports is a vital objective for sustainable development, particularly in Vietnam, because it is a global trend. Decreasing emissions at seaports has the dual advantage of benefiting the environment and enhancing the economic efficiency of maritime operations. Currently, seaports globally are adopting social and environmental responsibilities by shifting to “green” solutions to reduce negative effects on the environment. This not only fulfills the growing need for environmental conservation but also creates new business opportunities. Reducing emissions at seaports has the major benefit of fostering a business-friendly environment for port operators. They can upgrade from obsolete, energy-inefficient extraction methods to advanced technologies, improving operation, and reducing greenhouse gas emissions. Moreover, implementing eco-friendly practices

at seaports creates a conducive environment for investments in cutting-edge projects and technologies. Businesses can take advantage of incentives and government support to facilitate this transformation. This not only aids organizations in conserving energy and cutting operational expenses but also plays a role in safeguarding the marine ecosystem.

The Vietnam Maritime Administration, under the Ministry of Transport, released a plan to carry out the Green Port Development Project in Vietnam. The concept of “Green port” in sustainable port development involves integrating the economic advantages of seaports with environmental protection following international standards and community benefits. Between 2021 and 2025, research has focused on developing frameworks and policies to assist businesses in adopting ecologically sustainable practices in port growth. This includes studying,

implementing, and sharing clean and eco-friendly technologies for port activities [1].

From 2021 to 2022, the authorities concentrated on establishing and promoting fundamental norms and requirements for “green ports” as outlined in the project’s roadmap. Starting in 2023, several Vietnamese seaports initiated a pilot program for the “green port” model, followed by an evaluation of its outcomes. During 2023-2025, conduct research and suggest revisions and additions to regulations concerning planning management, investment, seaport building, and seaport business and operational requirements to align with standards. Vietnam will likewise carry out the “green ports” concept.

Therefore, guiding the implementation strategy and accurately pinpointing obstacles and problems in green port development can assist port operators and policymakers in making informed decisions. This study examined global literature on green port development to identify successful strategies, which were then compared to the suggestions outlined in the Green Port Development Project in Vietnam, hence, the suggestion is put forward.

2. Legal basis in Vietnam

2.1. Guidelines and policies of the Communist Party of Vietnam (CPV) and the Government

Environmental protection has been a significant focus of the CPV and the Government since the early 2010s. Central Executive Committee Resolution No. 24-NQ/TW, issued on June 3, 2013, established the objectives of effectively addressing climate change, enhancing resource management, and protecting the environment by 2050 [2].

The National Strategy on Green Growth outlined in Decision No. 1393/QĐ-TTg on September 25, 2012, by the Prime Minister, emphasizes the shift towards a low-carbon economy as a key aspect of sustainable

economic development. Decreasing emissions and enhancing the capacity to capture greenhouse gases are essential and significant objectives in socioeconomic progress [3]. Ten years later, the Prime Minister adopted the new National Strategy on Green Growth for the period 2021-2030, with a vision extending to 2050, as well as the National Action Plan for Green Growth for the period 2021-2030 via Decision No. 1658/QĐ-TTg on October 1, 2021, and Decision No. 882/QĐ-TTg on July 22, 2022, to fulfill Vietnam's obligations to the international community regarding sustainable development and climate change. This includes the commitment to achieve net zero emissions by 2050, as agreed upon at the COP26 Conference [4], [5]. The National Environmental Protection Strategy aims to control and limit increases in environmental pollution, resource degradation, and biodiversity loss. It also seeks to enhance the quality of the living environment and strengthen the ability to respond to climate change in pursuit of the country's sustainable development [6]. The 12th Party Central Committee's Resolution 36-NQ/TW from October 22, 2018, outlines the strategy for Vietnam's marine economy development until 2030, aiming to establish Vietnam as a robust maritime nation. The resolution focuses on achieving sustainable development criteria for the marine economy, fostering a marine ecological culture, proactively addressing climate change and sea level rise, combating pollution, marine environmental degradation, coastal erosion, and sea erosion, and restoring and conserving crucial marine ecosystems. Recent cutting-edge scientific advancements have directly contributed to the promotion of sustainable development in the marine sector [7]. The Government's Resolution 120/NQ-CP, issued on November 17, 2017, aimed to develop the Mekong Delta region to address climate change, elevating its degree of development above that of other regions. Crucial natural ecosystems have been

conserved and enhanced. The socioeconomic infrastructure network was constructed in a synchronized and contemporary manner. The contemporary urban system is constructed and dispersed logically throughout the sub-regions. Road and canal transportation systems are constructed simultaneously to connect regions and inter-regions, ensuring a harmonious combination, unity, complementarity, and no conflict with irrigation and dike systems [8].

In the Green Port Development Project in Vietnam, it is expected that after 2030, the “green port” criteria will be obligatory for planning, investing in constructing, and operating seaports in Vietnam. Green ports in Vietnam will be developed based on six primary criteria, emphasizing general ports and container ports. These criteria include awareness of green ports (maximum score of 5 points), resource utilization (maximum score of 15 points), environmental quality management (maximum score of 50 points), energy consumption (maximum score of 15 points), utilization of information technology (maximum score of 5 points), and efforts to reduce emissions, address climate change, and mitigate rising sea levels (maximum score of 10 points). A seaport must score a minimum of 60 out of 100 points to be eligible for certification as a green port. Port operators must provide documentation demonstrating the fulfillment of each condition [1].

2.2. International environmental accords in the maritime sector that Vietnam has ratified

The United Nations Convention on the Law of the Sea (UNCLOS) is a global convention created in 1982 to provide a thorough structure for regulating the utilization of Earth's oceans and seas. It sets regulations for territorial waters, exclusive economic zones (EEZs), and continental shelves. The treaty guarantees unrestricted movement at sea, deals with safeguarding the environment, and establishes the International Seabed Authority to oversee

resources in areas outside national boundaries. UNCLOS includes procedures for resolving disputes and has been ratified worldwide, encouraging collaboration, sustainable growth, and peaceful oceanic activities [9].

The International Convention for the Prevention of Pollution from Ships (MARPOL) was designed to combat marine pollution caused by ships. MARPOL was implemented in 1973 and has since been revised with annexes. It addresses ship-generated pollutants, such as oil, chemicals, sewage, rubbish, and air emissions. The agreement sets rules on how ships should be designed, built, and operated to reduce their negative effects on the marine environment. MARPOL consists of annexes that focus on different types of pollution and establish a system for ensuring adherence and enforcement through the International Maritime Organization (IMO). MARPOL aims to encourage sustainable maritime practices and minimize the environmental consequences of shipping operations [10].

The International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS) is an international treaty that regulates the use of dangerous antifouling technologies with organotin chemicals on ships. The International Maritime Organization (IMO) adopted it in 2001 and became effective in 2008. The primary objective of the AFS Convention is to mitigate the environmental harm resulting from the application of toxic antifouling coatings, especially those containing hazardous compounds such as tributyltin (TBT). This convention bans the use of organotin compounds as biocides in anti-fouling systems on ships. It also sets guidelines for managing ship's hulls to avoid releasing dangerous substances into the maritime environment [11].

3. Literature review in green port development

Green port development involves implementing initiatives to enhance

environmental sustainability. Port locations produce significant amounts of greenhouse gases (GHG) in the atmosphere, primarily as a result of industrial and transportation operations. Various strategies related to the creation and operation of environmentally friendly ports are available:

- Create green concession policies by integrating sustainable components into terminal concession processes and agreements [12];

- Create green zones and buffers inside the port vicinity to act as a barrier between intense port operations and residential zones [13];

- Investing in shore power/cold ironing involves ports installing infrastructure that enables moored ships to connect to shore power for electricity, eliminating the need to use diesel auxiliary engines for refrigeration and lighting... by using renewable energy sources like hydroelectric, wind, solar, and wave energy, and integrating them with Port Energy Management [14];

- Utilize zero- or low-emission cargo handling equipment at the quayside and yardside of terminals [15,16];

- Minimize ship and inland transport idling and terminal waiting times by sharing information along the supply chain via a data platform, vessel-specific time window, and truck appointment management solutions [17-19];

- Integrate Carbon Capture and Storage (CCS) with fume return systems. The CCS process involves capturing, transporting, and storing carbon emissions [20];

- Implement eco-friendly warehousing and distribution practices at ports by selecting optimal locations, designing efficient distribution systems, and creating sustainable warehouses with features such as solar panels, EV charging infrastructure, LED lighting, and intelligent cooling/heating systems. Additionally, the focus should be placed on energy and material recycling [21].

Currently, several ports worldwide are effectively implementing these strategies to make their ports more environmentally friendly.

Table 1. Green strategies with case studies.

Green strategies	Examples
Green concession policies	Port of Los Angeles (USA), Port of Amsterdam (Netherlands), Port of Long Beach (USA), Port of Rotterdam (Netherlands), Port of Antwerp (Belgium)
Green zones	Port of Antwerp (Belgium), Port of Los Angeles (USA)
Shore power/ cold ironing with renewable energy sources	Port of Los Angeles (USA), Port of Los Angeles (USA), Port of Seattle (USA), Port of Vancouver (Canada), Port of Barcelona (Spain)
Zero or low-emission terminal equipment	Port of Los Angeles (USA), Port of Los Angeles (USA), Port of Seattle (USA), Port of Vancouver (Canada), Port of Shanghai (China)
Minimize ship and inland transport idling and terminal waiting times	Port of Singapore, Port of Antwerp (Belgium), Port of Miami Tunnel (USA), Port of Long Beach (USA), Port of Rotterdam (Netherlands)

Green strategies	Examples
Carbon capture and storage	Port of Rotterdam (Netherlands), Port of Antwerp (Belgium), Port of Los Angeles (USA), Port of Gävle (Sweden), Port Kembla (Australia)
Eco-friendly warehousing and distribution practices	Port of Amsterdam (Netherlands), Port of Tauranga (New Zealand), Port of Helsinki (Finland), Port of Long Beach (USA), Port Klang (Malaysia)

4. Comparison and discussion

Using the above-analyzed table, the study compared the list of criteria outlined in the Green Port Development Project to identify areas that require additional improvements.

4.1. Green concession policies

The Green Port Development Project does not properly specify green concession policies. We would like a comprehensive list of incentives, such as reduced fees and priority access, together with specific conditions related to fuels, technology, and equipment, to enhance the environmental efficiency of ships and port activities. For example, the Port of Los Angeles provides the Environmental Ship Index Incentive Program, offering reduced dockage costs to ships that exceed pollution standards [22]. The Port of Amsterdam offers a Green Award discount program that provides a port charge discount of up to 6% for seagoing boats that are Green Award certified [23]. The Port of Rotterdam offers reductions ranging from 0.5% to 10% in port dues for seagoing vessels, based on their Environmental Ship Index ratings that assess air pollutants and CO₂ emissions [24]. Seagoing and inland vessels that use LNG as fuel are eligible for a 30% reduction in port infrastructure fees under the Port of Antwerp's LNG concession policy implemented in 2016 [25]. To establish effective green concession policies, it is necessary to first create an emissions inventory for ports. Subsequently, specific standards can be formulated to qualify as green incentives.

4.2. Minimize ship and inland transport idling and terminal waiting times.

The Green Port Development Project does not address strategies to reduce idle ship and inland transport or terminal waiting times. Tools with automation algorithms for operating port equipment have received significant research attention, utilizing both accurate and heuristic methods. These algorithms provide automated integration of the operational terminal equipment, resulting in time and energy savings, reduced emissions, and task balancing. Leading ports utilize data systems, virtual arrival technology, new infrastructure, and operational coordination to enhance efficiency and reduce waiting time for ships, vehicles, and cargo handling equipment. Singapore's port authority created a Vessel Traffic Information System (VTIS) to watch ship movements in real-time and offer data-driven analysis on port congestion and waiting times. This enables the optimization of ship timetables and berthing slots [25]. The Port of Long Beach has implemented systems such as OffPeak to lengthen gate hours and redirect more truck traffic to non-peak periods. The system also introduced an appointment system that arranges truck arrivals in advance depending on labor and cargo availability to minimize terminal waiting times [26].

4.3. Carbon capture and storage

Multiple international ports are developing substantial CCS initiatives to reduce industrial emissions in response to the increasing demand

for ports and shipping to transition to a carbon-neutral state. These initiatives offer blueprints for extensive emission capture from factories, ships, or handling equipment and storage technologies. In 2019, the Port of Rotterdam initiated the Porthos Project to trap carbon (CO₂) emissions from factories and refineries in the port region. The captured emissions are sent by a pipeline to an empty offshore gas field in the North Sea for permanent storage. It plans to sequester 2.5 million tonnes of CO₂ annually upon completion [27]. The Port of Rotterdam is taking the initial steps to implement CO₂ capture and storage technology to reduce greenhouse gas emissions from port operations. Towards this goal, the port is building infrastructure to collect, transport, and store CO₂ from factories and logistics activities in the port area by utilizing depleted offshore oil and gas fields under the North Sea [28].

5. Conclusion

Ports significantly contribute to environmental contamination, mainly because of maritime operations and related industrial activities. Implementing green port projects is crucial for sustainable development in Vietnam, as it corresponds to government policies on environmental protection and climate change responses.

This study analyzed Vietnam's Green Port Development Project and pinpointed areas requiring further enhancements through comparison with international best practices. The project provides a detailed structure; however, there is room for improvement in green concession policies by implementing varied port fees, giving priority berthing to eco-friendly ships, and requiring the use of clean fuels and technologies. Vietnam can implement data-driven vessel traffic management, appointment systems, and virtual arrival infrastructure from top ports to reduce idling and waiting periods. A significant opportunity exists for implementing large-scale carbon

capture and storage facilities in ports and industrial areas to address emissions.

Vietnam can lead the way in developing innovative sustainability models and promoting the adoption of green technology and solutions by incorporating these improvement areas into its Green Port Development Plan. This will provide substantial environmental and public health benefits to the nearby areas. This promotes a forward-thinking company atmosphere that supports investment in cutting-edge solutions. Vietnam seeks to become a strong maritime nation, and the adoption of green port initiatives is crucial in achieving this goal. This research also offers precise advice to assist policymakers and port operators in making informed decisions during project execution. Future research can expand these discoveries by creating specific frameworks customized to local circumstances, performing feasibility evaluations, and testing solutions on a small scale. Vietnam will take the lead in smart, sustainable, and inclusive growth in its marine industry by focusing on developing next-generation green seaports through collaborative efforts.

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