Journal of Infrastructure, Policy and Development 2025, 9(1), 7640.
https://doi.org/10.24294/jipd7640

Article

Stakeholder dynamics on green port transformation: A socio-technical regime approach

Goldie Melinda Wijayanti[1,2,*], Puspita Dirgahayani[1], Pradono Pradono[1], Muhammad Zainal Ibad[2]

[1] School of Architecture, Planning, and Policy Development, Bandung Institute of Technology, Bandung 40132, Indonesia
[2] Faculty of Infrastructure and Regional Engineering, Department of Urban and Regional Planning, Sumatera Institute of Technology, South Lampung 35365, Indonesia
*** Corresponding author:** Goldie Melinda Wijayanti, goldie.wijayanti@pwk.itera.ac.id

CITATION

Wijayanti GM, Dirgahayani P, Pradono P, Ibad MZ. (2025). Stakeholder dynamics on green port transformation: A socio-technical regime approach. Journal of Infrastructure, Policy and Development. 9(1): 7640. https://doi.org/10.24294/jipd7640

ARTICLE INFO

Received: 30 June 2024
Accepted: 20 August 2024
Available online: 13 January 2025

Abstract: The green port concept offers a sustainable approach to port management aimed at reducing environmental damage while maintaining efficient operations. This study examines the transformation of Teluk Lamong Terminal in Indonesia into a green port using a socio-technical regime approach. Employing stakeholder analysis and content analysis, the research identifies key actors involved and assesses their roles and influences in the transformation process. The study concludes that effective collaboration among government agencies, port authorities, and local communities is essential to achieving sustainable port development. The insights provided can guide policymakers and practitioners in enhancing the green port initiatives in Indonesia and similar contexts.

Keywords: green port; socio-technical regime; stakeholder dynamics; transformation

1. Introduction

Ports are critical nodes in global supply chains and play an important role in regional economic development. However, they also contribute significantly to environmental pollution, particularly through emissions from marine transportation and port operations. As global awareness of environmental issues grows, the concept of "green ports" has emerged as a sustainable solution to mitigate the negative impacts of port activities. Green ports aim to enhance environmental protection, energy efficiency, and ecological sustainability while maintaining operational efficiency (Canbulat, 2017; Darbra et al., 2005).

Emissions from the shipping sector are around 2% of the world's total greenhouse gas and are expected to continue to increase (Faber et al., 2021). Ports as part of the transportation system are required to have sustainable characteristics. The theory of sustainable development in planning theory emerged in the 1960s. Mitigation and adaptation are two climate approaches to reduce risks and prepare for hazards caused by climate change. The development of low-carbon resilient cities must integrate mitigation and adaptation, which have great potential in decarbonization and prevention of natural disasters (Rodrigue, 2020).

Indonesia, as the fifth largest contributor to CO_2 emissions globally, faces substantial challenges in balancing economic growth with environmental sustainability. The marine transportation sector, responsible for a significant portion of these emissions, necessitates urgent intervention. Approximately 70% of marine emissions occur in coastal areas, and 60%–90% of these emissions are generated while ships are docked at ports (Chen et al., 2019). In this context, transforming traditional

ports into green ports is not only desirable but essential for Indonesia's sustainable development goals.

The involvement of actors in the transformation towards green ports is one of the success factors towards green ports. Establishing green port organizations (Badurina, 2017) and collaborating with private sector or business partners (Marschlich, 2022) can optimize the development of green port concepts. The most significant gap in the literature is the absence of empirical evaluation of collaborative planning practices, particularly in natural resource management contexts. There is limited information to determine whether communicative planning theory is appropriate to guide the implementation of local natural resource management. While limited evaluations have been conducted of places, case study descriptions of collaborative approaches to natural resource management provide in-depth information on the opportunities and limitations presented by such approaches (Rodrigue, 2020).

Teluk Lamong Terminal in East Java Province stands as a pioneering example of green port implementation in Indonesia. Since its transformation began in 2015, it has aimed to reduce carbon emissions and enhance environmental sustainability through various initiatives. However, the success of such transformations relies heavily on the effective collaboration and engagement of multiple stakeholders, including government agencies, port authorities, private sector entities, and local communities.

This paper aims to address the research problem of understanding the roles and interactions of stakeholders in the green port transformation process at Teluk Lamong Terminal. By employing a socio-technical regime approach, this research seeks to map the actors involved, analyze their roles and influences, and provide insights into the governance and coordination required for successful green port initiatives. The research question focuses on understanding the dynamics of stakeholders involved in the transformation process of green ports.

The specific objectives of this study are: (1). To identify and categorize the stakeholders involved in the transformation of Teluk Lamong Terminal into a green port. (2). To analyze the roles, interests, and influences of these stakeholders in the transformation process. The paper aims to offer practical recommendations for policymakers and port authorities to enhance the implementation and management of green ports in Indonesia, thereby contributing to the broader goals of environmental sustainability and economic resilience.

2. Review of literature

2.1. Sustainable transportation

Sustainable transportation is critical to mitigating the adverse environmental impacts of the transport sector. According to the Organization for Economic Co-operation and Development (Rodrigue, 2020), sustainable transport must minimize harmful effects on public health and ecosystems while meeting current mobility needs. The use of renewable resources below regeneration levels and the development of alternative renewable resources are fundamental principles. Sustainable transportation encompasses environmental, social, and economic dimensions, aiming to meet present transportation needs without compromising future requirements (Tamin, 2007).

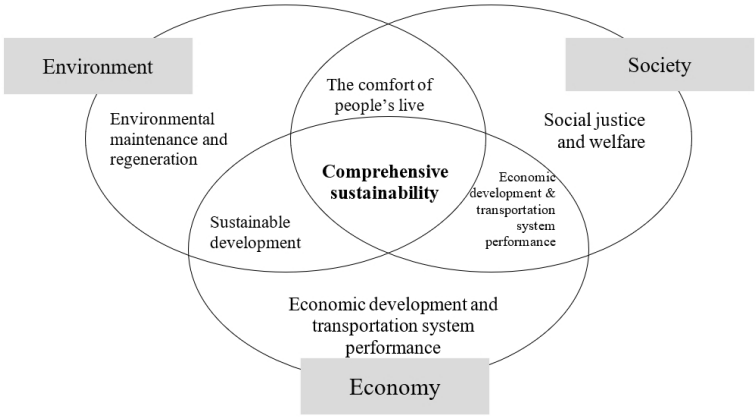

Figure 1. Aspects of sustainable transportation.

Source: Tamin (2007).

2.2. Green port concept

Ports are essential nodes in global supply chains, connecting maritime and land transportation networks (Lu et al., 2016). The green port concept focuses on integrating sustainability into port planning, development, and operations, addressing energy efficiency, environmental protection, and ecological sustainability (Darbra et al., 2005). Recent studies emphasize the importance of minimizing the environmental footprint of port activities through technology adoption and infrastructure renewal.

The European Sea Ports Organisation (ESPO) issued the "Green Guide" in 2003, outlining key indicators for green ports, including resource consumption, environmental equality, and energy management (ESPO, 2003). Successful green port initiatives, such as those in Rotterdam and Los Angeles, demonstrate significant reductions in emissions and operational costs through the adoption of renewable energy sources, advanced waste management systems, and stringent environmental regulations (Markard, 2012).

2.3. Socio-technical regime

Socio-technical regimes are complex systems comprising artifacts, institutions, and agents that sustain existing development trajectories. These regimes involve interdependencies between technology, regulations, infrastructure, user practices, and maintenance networks, making them resistant to change (Kemp et al., 1998). The transformation towards sustainability often begins at the margins of these regimes, driven by pioneering organizations and innovative practices (Schot, 1994).

In the context of green ports, the socio-technical regime approach helps to understand the dynamic interactions between various stakeholders and the systemic changes required for sustainable port operations. This approach highlights the need for coordinated governance and multi-disciplinary involvement to overcome the resistance to change inherent in existing port systems (Smith, 2007).

2.4. Stakeholder analysis in green port development

Stakeholders in port development include internal actors such as port employes and managers, public sector entities, market players, and community groups (Lam et al., 2019). Each stakeholder group has distinct roles and responsibilities, influencing

the implementation of green port initiatives. Another studies, such as those by Darbra et al. (2005) and Lam and Notteboom (2014), also broadly highlighted the importance of stakeholder engagement in green port initiatives. This article focuses on the specific roles, challenges, and complex governance faced by stakeholders within the Indoensian context, particulary at Teluk Lamong Terminal. Unlike the general framworks and strategies discussed in earlier research, this paper delves into the localized socio-economic and regulatory factors that uniquely influence stakeholder interactions and decision-making processes in Indonesia. It examines how these specific roles, challenges, and complex governance shape the green port transformation at Teluk Lamong and explores contextually relevant strategies that can enhance the effectiveness of stakeholder engagement in a developing country setting. This paper, therefore, contributes new insights by contextualizing global green port strategies within the distinct socio-technical landscape of Indonesia, offering tailored solutions that address the obstacles and opportunities present in this environment.

Stakeholder analysis methods, categorized into identifying, distinguishing, and investigating stakeholder relationships, provide insights into the power dynamics and interests that shape port governance (Freeman, 1994). Studies indicate that collaborative planning and the establishment of green port organizations are critical for optimizing sustainable port development (Badurina et al., 2017).

By reviewing research articles in the ScienceDirect database from 1990 to 2018, this review article categorizes stakeholder analysis methods into three groups: (1) identifying stakeholders, (2) distinguishing and categorizing stakeholders, and (3) investigating the relationships among stakeholders. Generally, the institutional system in each issue varies according to the planning objectives that have been set. One example is the institutional system in green ports where stakeholders and also the role of each stakeholder adjust to the indicators of green port realization. Lam and Yap (2019) said that the ideal stakeholders to manage a sustainable port are as follows.

Table 1. Stakeholder standards in port institutions.

Internal	Port employees, port manager minority shareholders, port owner board members e.g., government/port operator; and port regulators.
Public Sector	National government, ministry of transportation, ministry of finance, ministry of environment, legislators, and urban development authorities.
Market players / corporate bodies	Logistics companies, shipping and transportation companies.
Community; interest groups	Local residents living near the port Consumers and taxpayers Non-profit organizations (NGOs) e.g., environmental groups media, and press

Source: Lam et al. (2019).

Based on the stakeholders in the **Table 1** above, each stakeholder has their respective roles in the fulfillment or development of green port indicators such as air pollution management, noise pollution management, solid waste pollution management, and management. In general, the institutional work mechanism in carrying out planning will have a focus or priority indicator that will be prioritized. Based on Port Economics, Management, and Policy, governance carried out by actors/stakeholders in green ports is divided into 4 things, including (Notteboom et al.,

2022): a) Environmental management system; b) Monitoring and reporting of environmental conditions; c) Community consultation; d) Land use strategy.

In addition, the book also explains that green port stakeholders act as landlords, regulators, and operators where a more detailed explanation is as follows:

- Stakeholders as landlords

Stakeholders as landlords means that stakeholders play a role in managing port assets such as providing facilities and infrastructure and providing land;

- Stakeholders as regulators

Stakeholders as regulators in green ports are stakeholders as determinants of planning frameworks such as planning for financing, services, safety, enforcement of national regulations related to ports, and so on;

- Stakeholder as operator

Stakeholders as operators in a green port are stakeholders who provide daily services for ships such as cranes and also trade goods for loading and unloading activities.

2.5. Comparative analysis with relevant studies

The green port transformation at Teluk Lamong Terminal can be effectively compared to similar initiatives in other parts of the world to highlight both the common challenges and unique aspects of the Indonesian context. For instance, the Port of Rotterdam, a pioneer in green port development, has successfully implemented a range of measures, including shore power supply, waste heat recovery systems, and extensive environmental monitoring programs (Fenton, 2020). Similarly, the Port of Los Angeles has adopted zero-emission technologies and stringent air quality standards, resulting in significant reductions in greenhouse gas emissions (Lam and Li, 2019).

When compared to these international examples, the transformation at Teluk Lamong Terminal shares similar goals of reducing emissions and enhancing sustainability but faces different socio-economic and regulatory challenges. While ports like Rotterdam and Los Angeles benefit from strong institutional frameworks and substantial financial resources, Teluk Lamong Terminal operates within a developing economy where resource constraints and fragmented governance pose significant challenges (Du et al., 2019). Additionally, the emphasis on stakeholder engagement at Teluk Lamong Terminal, particularly the involvement of local communities, contrasts with the more centralized approaches seen in ports like Rotterdam, where community involvement is often less emphasized.

The socio-technical regime approach applied in this study aligns with the frameworks used in studies of other green ports, such as those in Asia and Europe. For example, Lam and Notteboom (2014) discuss the importance of coordinated governance and multi-disciplinary involvement in green port initiatives across leading ports in Asia and Europe. The findings at Teluk Lamong Terminal corroborate the importance of these factors but also underscore the need for more localized solutions tailored to the specific socio-economic and political context of Indonesia. This comparison illustrates that while the green port transformation at Teluk Lamong

Terminal follows global trends, it also requires context-specific strategies that address the unique challenges of the Indonesian maritime sector.

3. Methodology

This research is descriptive-qualitative, which seeks to describe or describe the phenomenon under study systematically and accurately. The research location was determined based on the purpose of the port.

3.1. Research operationalization and analysis

In this study, the informants were stakeholders from the central and local governments as well as companies running port operations. After making observations and transcribing interviews, the researcher further analyzed each transcript by conducting thematic content analysis to identify themes/categories that might emerge from the data in the transcripts by coding all data. The categories found will then be used to group the existing data so that it is easier to draw conclusions from the research analysis. Data coding was done iteratively during the data analysis process. Improvements and revisions to the codes found can continue to be made to find categories that best fit the research context and are able to help answer research questions.

Table 2. Field operationalization.

	Sub-goals	Data requirements	Data collection technique	Data source	Analysis method	Output
a.	- Reviewing the actors involved in the planning process of green port transformation at Teluk Lamong Terminal.	- Actors directly on indirectly involved in Teluk Lamong Terminal	- Literature study; - Observation; - In-depth Interview.	- PT. Teluk Lamong Terminal; - Ministry of Transportation; Ministry of Environment and Forestry; - Coordinating Ministry for Maritime Affairs and Investment; - Provincial Environment Agency; - Provincial Departement of Transportation.	- Content analysis;	- Known actors who are directly or indirectly involved
b.	- Reviewing the roles of actors involved in the planning process of green port transformation at Teluk Lamong Terminal.	- Roles and functions of actors directly or indirectly involved in Teluk Lamong Terminal	- Literature study; - In-depth Interview.	- PT. Teluk Lamong Terminal; - Ministry of Transportation; Ministry of Environment and Forestry; - Coordinating Ministry for Maritime Affairs and Investment; - Provincial Environment Agency; - Provincial Departement of Transportation.	- Stakeholders analysis	- The roles and functions of actors involved directly or indirectly are known
c.	- Reviewing the influence and interests of actors on the implementation of the transformation of the green port concept in Teluk Lamong.	- Level if influence and importance of actors involved in the green port transformation process - Mapping the hierarchy / position in the transformation towards green port at Teluk Lamong Terminal	- Literature study; - In-depth Interview.	- PT. Teluk Lamong Terminal;	- Stakeholders analysis	- The level of influence and importance of actors in Teluk Lamong Terminal;Known hierarchy / position of each actor.

Source: Authors' own work, 2024.

On the targets set, an analysis will be carried out using actor analysis to find out the main and key actors in the development of Teluk Lamong Terminal. Through this actor analysis will be analyzed the level of interest and influence of each actor who intervenes. This analysis is carried out by presenting a matrix of interests and

influences using primary data in the form of interview results and secondary data in the form of planning documents, policies and so on that have been collected. The steps in conducting actor analysis are as follows.

a) Identification of key actors can be done by assessing several things, including: Who are the actors who have the potential to benefit; How is the relationship between actors involved?;
b) Identify the influence and interests of actors. Influence assessment, including: Power (rules and policy establishment) and status (politically, socially, or economically); Organizational level (role). The strength of the relationship with other actors. Interests assessment, including: The involvement of actors in the development of Teluk Lamong Terminal; Priority in the development of Teluk Lamong Terminal (operations, infrastructure, environment).

PT. Teluk Lamong Terminal, which is located in the border area between the city of Surabaya and Gresik District, is a multipurpose terminal flanked by 2 (two) ports owned by PT. Pelabuhan Indonesia III, namely the western part is Gresik Port while the eastern part is Tanjung Perak Port.

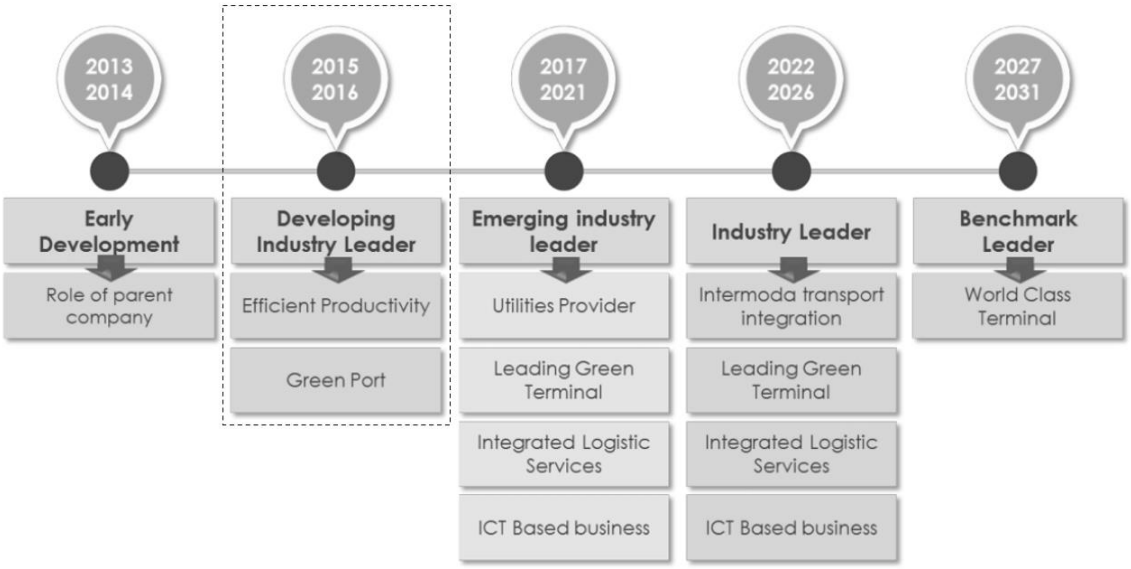

Figure 2. Long-term development plan of Teluk Lamong Terminal.
Source: PT. Teluk Lamong Terminal, 2021.

3.2. Materials and study area

3.2.1. Materials

This study aims to explain the relationship or relationship between actors in the transformation of Teluk Lamong Terminal to a green port. Several objectives to achieve the objectives include: (a) explaining the actors in Teluk Lamong Terminal; and (b) describe the influence and level of interest of actors in Teluk Lamong Terminal. According to Spradley (1980) there are three components, which are the scope of substance, namely place, actor and activity. The following is the scope of substance in this study:

a. Place, or a place where interaction in a social situation is taking place. In this research will be carried out at the Teluk Lamong Terminal;

b. Actor, performer or person who is carrying out a certain role. In this research, the actors involved were the ministries and institutions;
c. Activities or activities carried out by the organization in the ongoing social situation. In this research, the activities or activities that will be used as research objects are all activities related to the success of port planning process towards a green port.

3.2.2. Study area

Teluk Lamong Terminal, which was located in the border areas of Surabaya and Gresik Regency, is a multipurpose terminal in between two ports from PT Pelabuhan Indonesia III (Persero), which was Gresik Port in the west and Main Port Tanjung Perak in the east. Project planning of Teluk Lamong Terminal based on the study until 2010 that the container, liquid bulk, dry bulk, and general cargo in Tanjung Perak Port will be overcapacity, From the result of a pre-feasibility study from Community Service Institution (LPM) of Institut Teknologi Sepuluh Nopember Surabaya, it is recommended that Tambak Osowilangun, Kecamatan Benowo area is the most decent location the President of Indonesia, inaugurated Teluk Lamong Terminal and Surabaya West Sailing Chanel (APBS) revitalization after a concession agreement between the Ministry of Transportation and PT. Pelindo Ill (Persero).

Figure 3. Existing location of Teluk Lamong Terminal.
Source: Modification from KM 22 master plan tanjung perak port, 2021.

4. Result and discussion

Teluk Lamong Terminal has the potential to reduce carbon from port poreationalization activities, this can be seen from the environmental dimension. The following is the decarbonization potential of Teluk Lamong Terminal:

a) Management energy at Teluk Lamong Terminal was carried out by establishing the first subsidiary named PT. Lamong Energi Indonesia (LEI) engaged in Gas Engine Power Plant (PLTMG). PT. LEI was built to fulfill the electricity supply of Teluk Lamong Terminal. Currently it has 2 PLTMG engines with a capacity of 3.3 MW each.

b) Teluk Lamong Terminal is equipped with unmanned semi-automatic technology and is divided into nine sections for containers and one section for vehicles for purposes other than containers. The auto gate system not only reduces the potential for 'cheating' between officers and goods owners, but is also able to reduce the length of container stacking time (dwelling time) at the port.

c) A number of blocks in the container ship area have been equipped with several reefer plugs that have been functioning effectively since 2015. Reefer plug is useful as a conductor or electrical conductor from the ship to the reefer container which is useful for flowing electricity so that the temperature in the reefer container is maintained.

d) Grab Ship unloader is one of the transport equipment technologies that plays an important role in the coal handling system, which functions to move coal from the ship to the conveyor using a grab. Teluk Lamong Terminal already has 2 units of grab ship unloader and 2 units of conveyor in dry bulk storage.

Teluk Lamong Terminal went through several phases of development: Phase 1 took place between 2010–2014. In this phase, the placement and construction of main infrastructure such as docks (domestic/international), stacking yards, and interchange land were carried out. In addition, loading and unloading equipment such as ship to shore (STS), ship unloaders, and automated stacking cranes (ASC) were procured. Phase 2 This phase took place from 2014 to 2016. The development entered the process of increasing the number of loading and unloading equipment, expanding the stacking area, building a dry bulk dock area along with a stacking field and building a power plant area. Phase 3 Phase III was carried out in 2016–2023. In this phase, the construction of a distribution area and consolidation of container depots using monorail were added. In addition, there are additional port facilities such as container crane, chip unloader, automated atacking crane, etc. Phase 4 Phase IV is planned to be implemented in 2023–2030. At this stage it is planned to expand the location of the pier and stacking field and add port facility equipment. Here is the layout design of lamong bay reclamation.

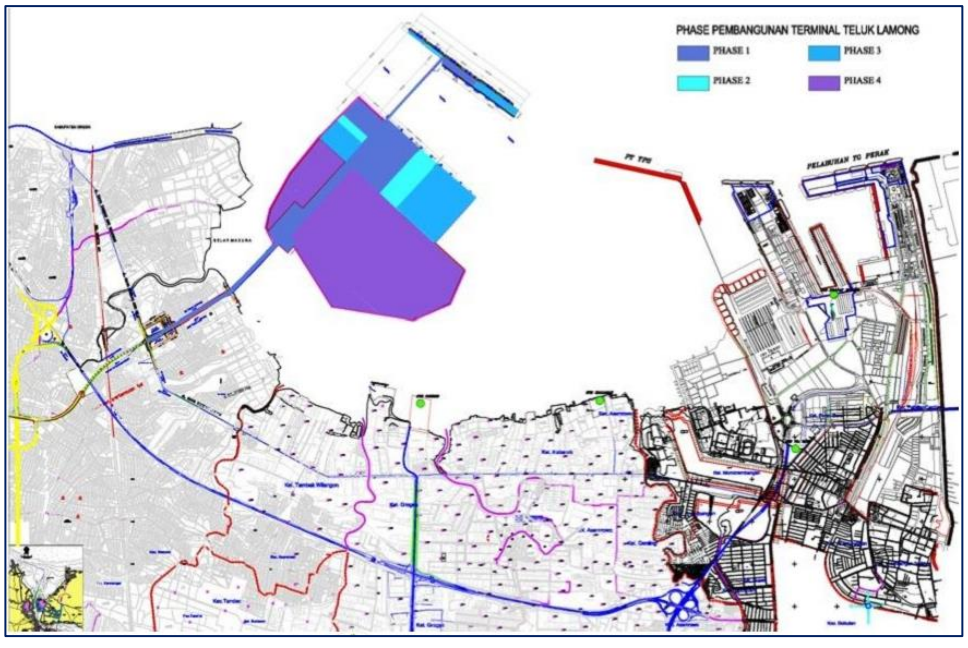

Figure 4. Stages of Teluk Lamong Terminal layout design.
Source: Modification from Pratikto et al. (2022).

According to Lam and Yap (2019), the ideal stakeholders to be owned by a sustainable port such as a green port are internal stakeholders, the public sector, the private sector (corporate bodies), and the community/community. The following is the role of stakeholders at Panjang Port based on the classification according to Lam and Yap. The following is a classification of stakeholders involved in the management and development of the Teluk Lamong Terminal into a Green Port based on the Lam and Yap classification standards.

4.1. Mapping the actors

In classifying stakeholders, it is often based on the level and form of influence of the company's stakeholder group (Freeman, 1994), namely "the principle of who or what really counts." The roles and actors involved in green port development are divided into two classifications: internal actors and external actors (Huse, 2007). Based on the results of the interview, it was revealed that the actors directly involved in port transformation are:

> *"...on the government side, we have to follow a lot, from the city government, coordinator for maritime, ministry of transport, ministry of environment and forestry, and each stakeholder." (Interview with HSSQE division staff of Teluk Lamong Terminal, on September 4, 2023).*

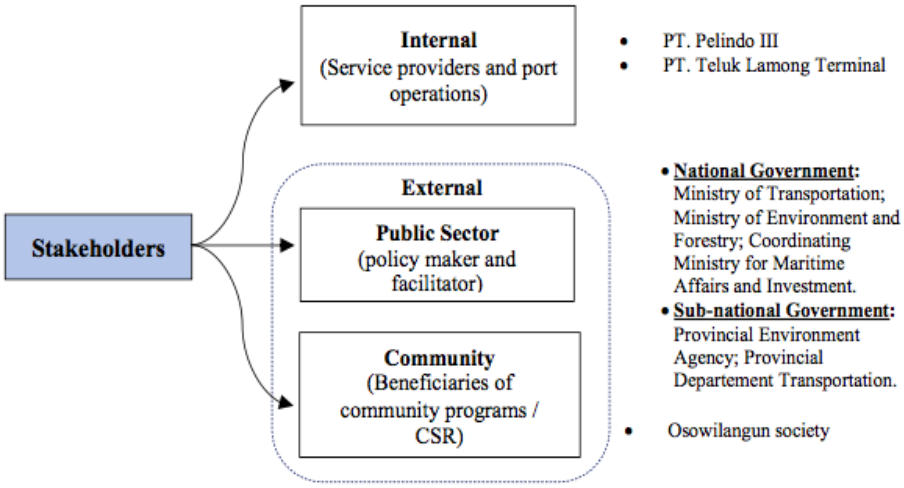

Figure 5. Classification of stakeholders in green port planning and development at Teluk Lamong Terminal.
Source: Modification from Lam and Yap (2019).

The internal group is made up of shareholders and employees who have responsibilities such as (a) always putting increased efficiency and productivity first and optimizing company performance, (b) creating a work environment that complies with good corporate governance (GCG) rules, and norms, (c) creating a digital transformation and increasing information technology optimization in developing systems and procedures, including improving infrastructure and superstructure capabilities, (d) cultivating the idea of development and maintenance in a planned,

productive, efficient, and sensitive to the advancement of port technology, (e) raising awareness of the necessity of supervision to support management success, (f) raising employee competence in line with business developments.

The community category is accountable for the following: (a) engaging in community activities within the port environment; (b) maintaining environmental integrity throughout all port operations; and (c) taking the lead in partnership and environmental development initiatives for the local community. User groups have the right to: (a) dependable port facilities; (b) prompt service, real-time information systems, and affordable port service charges; and (c) high-quality port services that go above and beyond what is required.

CSR programs for villages directly affected by the company's operations and villages in the vicinity of the company and villages around the company that are not directly affected, villages affected or passed by the company's facilities or equipment and villages affected by the company's expansion plans/programs are The target of CSR program distribution is the community around the company's working area with the nature of assistance that can create a harmonious relationship between the community and the company and a conducive climate for the continuity of business activities and the security of company assets.

> *"... the CSR program includes: assistance for victims of natural disasters; education and/or training assistance; health improvement assistance; assistance in developing public facilities and infrastructure; assistance for worship facilities; nature conservation assistance; community social assistance in the context of poverty alleviation; assistance in education, training, apprenticeship, marketing, promotion of fostered partners; social assistance." (Interview with HSSQE division staff of Teluk Lamong Terminal, on September 4, 2023).*

Based on the literature provided by Mitchell (1997) that notes from all definitions they propose a normative theory of stakeholders identified based on three variables, namely:

- Power (P), stakeholders who influence the company;
- Legitimacy (L), stakeholders who have a relationship with the company;
- Urgency (U), stakeholders who demand attention from the company.

Then the variable levels are grouped into low (L), medium (M), high (H) and no effect (X).

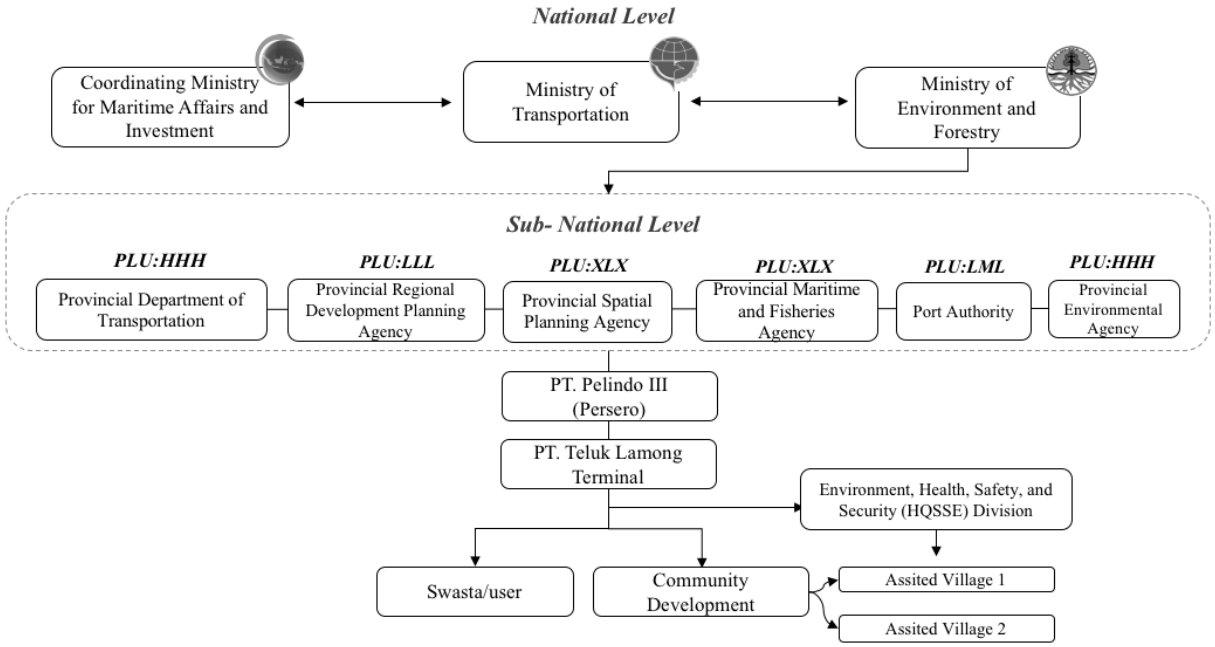

Figure 6. Actors and their roles in green port development at Teluk Lamong Terminal.
Sorce: Authors' own work, 2024.

So, referring to **Figure 6**, it is known that there are three ministerial institutions that are responsible for receiving reports on progress and evaluating green ports at each port company. There is the Coordinating Ministry for Maritime Affairs and Investment, the Ministry of Transportation, and the Ministry of Environment and Forestry. Then at the sub-national level there is the Provincial Department of Transportation, the Provincial Regional Development Planning Agency, the Provincial Spatial Planning Agency, the Provincial Maritime and Fisheries Agency, the Port Authority, and the Provincial Environmental Agency.

Stakeholders at the sub-national level have their respective roles such as monitoring activities at port companies with green port standards and then reporting directly to the ministry. However, there are findings that stakeholders between sub-national levels do not coordinate well or run independently. It is known that to be a successful green port, there needs to be coordination and involvement of a multi-disciplinary team (Antao et al., 2016; Lam et al., 2014) and establishing a green port organization (Badurina et al., 2017).

Figure 6 describes how horizontal relationships occur, based on Mitchell (1997), there are three levels: six sub-national levels with power (P): stakeholders who influence the company; legitimacy (L): stakeholders who have a relationship with the company; and urgency (U): stakeholders who demand attention from the company. Each institution at the sub-national level has a different value in the field.

Ideally, Provincial Department of Transportation should have high power, legitimacy and urgency towards other institutions. However, this is not implemented in practice, as the implementation is directly to the Ministry of Transportation. The Provincial Regional Development Planning Agency has low power, legitimacy and urgency towards other sub-national institutions. The Provincial Spatial Planning Agency and the Provincial Department of Marine Affairs and Fisheries share weak legitimacy and lack power and urgency in green port development. The Port Authority

has weak power and urgency towards green port development and moderate legitimacy. Power, legitimacy, and urgency all play essential parts in the Provincial Environmental Agency.

The revealed transformation in the socio-technical regime aspect that has an impact on the developed space, such as: *"... this condition changed when there was a change in the Job Creation Law and its derivative, Government Regulation No. 22 of 2021. The changes are such as initially taking care of the hazardous and toxic waste permit must be in Surabaya City because our environmental impact assessment or AMDAL authority is from the center, so taking care of it is now at the Ministry of Environment and Forestry, and there does not require a building permit or IMB but with changes in environmental approval." (Interview with HSSQE division staff of Teluk Lamong Terminal, on September 4, 2023).*

The stakeholder approach is closer to the strategic management process (Freeman, 2001). Strategic management actively plans a new direction for the company and considers how the company can influence the environment as well as how the environment can influence the company (Freeman, 2001).

4.2. Stakeholder roles and influence

4.2.1. Government agencies

The green port transformation at Teluk Lamong Terminal involves various stakeholders whose roles and influences are crucial to the success of this initiative. Government agencies, including the Ministry of Transportation, the Ministry of Environment and Forestry, and the Coordinating Ministry for Maritime Affairs and Investment, play a pivotal role in setting regulatory frameworks and ensuring compliance. The study revealed that these agencies hold significant power and legitimacy, directly impacting the green port transformation process. However, the lack of coordination among these agencies can lead to inefficiencies and delays in implementing green port initiatives. For effective transformation, a streamlined governance structure with clear roles and responsibilities is essential. Improved inter-agency coordination can enhance policy implementation and enforcement, leading to more effective and timely realization of green port objectives. Establishing a dedicated task force or committee comprising representatives from all relevant agencies could facilitate better communication and collaboration.

4.2.2. Port authorities and operators

Port authorities, particularly PT. Pelindo III and PT. Teluk Lamong Terminal, are instrumental in operationalizing green port initiatives. Their responsibilities include managing port infrastructure, implementing sustainable practices, and ensuring compliance with environmental regulations. The study found that port authorities have been proactive in adopting green technologies, such as automated systems and energy-efficient equipment. However, their efforts are sometimes hindered by bureaucratic red tape and limited financial resources. To sustain and expand green initiatives, port authorities need greater financial and administrative support. Public-private partnerships (PPPs) can be an effective strategy to leverage private sector investment and expertise, thereby enhancing the port's sustainability efforts.

4.2.3. Private sector and market players

The private sector, including logistics companies, shipping lines, and other market players, is essential in implementing sustainable practices through adopting green technologies and complying with environmental regulations. The study highlighted that while some market players are highly committed to sustainability, others lack the necessary incentives or awareness. This variation in commitment levels poses a challenge to achieving uniform green practices across port operations. Incentivizing market players through subsidies, tax breaks, or recognition programs can encourage broader adoption of green practices. Additionally, awareness campaigns and training programs can educate market players about the benefits and requirements of green port initiatives.

4.2.4. Local communities

Local communities around Teluk Lamong Terminal are both stakeholders and beneficiaries of the green port transformation. Their involvement is crucial in ensuring social acceptance and support for sustainable practices. The study found that local communities have been engaged through corporate social responsibility (CSR) programs and community development initiatives. However, their involvement has primarily been passive, with limited opportunities for active participation in decision-making processes. Empowering local communities through participatory planning and decision-making processes can enhance their support and cooperation. Establishing community advisory panels and regular stakeholder meetings can provide a platform for local voices to be heard and considered in the port's development plans.

The transformation of Teluk Lamong Terminal has been accompanied by significant socio-economic and demographic changes. These changes include shifts in employment patterns, economic activities, and population dynamics in the surrounding areas. The adoption of automated technologies has reduced the demand for manual labor, impacting local employment. While this shift has improved operational efficiency, it has also necessitated workforce retraining and capacity building to equip local workers with new skills. To mitigate the socio-economic impacts, comprehensive retraining and capacity-building programs are needed. These programs should focus on equipping the local workforce with the skills required for new, green jobs. Additionally, economic diversification strategies can help reduce the community's reliance on port-related employment.

The implementation of green port initiatives at Teluk Lamong Terminal has led to notable environmental improvements, including reductions in emissions, energy consumption, and waste generation. The study found that using energy-efficient equipment, renewable energy sources, and advanced waste management systems has significantly mitigated the port's environmental footprint. However, challenges remain in scaling up these initiatives and ensuring long-term sustainability. Continuous investment in green technologies and infrastructure is essential for maintaining and enhancing environmental sustainability. Regular environmental monitoring and reporting can help track progress and identify areas for improvement. Collaborations with research institutions and environmental organizations can also provide valuable insights and innovations.

The green port transformation at Teluk Lamong Terminal demonstrates the importance of coordinated stakeholder engagement, financial and administrative

support, and community involvement in achieving sustainable port operations. By addressing the challenges identified and leveraging the opportunities presented, Teluk Lamong Terminal can serve as a model for green port development in Indonesia and beyond. Future research should focus on longitudinal studies to assess the long-term impacts of green port initiatives and explore innovative solutions for sustainable port management.

5. Conclusion

The transformation of Teluk Lamong Terminal into a green port underscores the critical importance of stakeholder engagement, coordinated governance, and innovative solutions in achieving sustainable port operations. This paper investigated the roles and influences of stakeholders in the green port transformation at Teluk Lamong Terminal, revealing that while government agencies and port authorities hold significant power, the lack of coordination among these entities hampers progress. Socio-economic challenges, such as workforce retraining and regulatory fragmentation, further complicate the implementation of green initiatives. Strategies such as improved inter-agency coordination, capacity building, and tailored stakeholder engagement programs are needed to overcome these obstacles. It is recommended that a dedicated task force comprising representatives from all relevant agencies be established to streamline governance and improve collaboration. Public-private partnerships (PPPs) should be fostered to leverage private sector investment and expertise, thereby enhancing the port's capacity to implement sustainable practices and infrastructure. These findings contribute to the broader understanding of sustainable port operations in developing countries and offer a model for similar initiatives.

Future research should focus on longitudinal studies to assess the long-term impacts of green port initiatives on environmental sustainability, economic performance, and social well-being. Exploring innovative technologies and best practices from successful green port case studies worldwide can provide valuable insights for further improvements. Research on the effectiveness of public-private partnerships in financing and implementing green port initiatives can contribute to more robust and sustainable port management strategies. The transformation of Teluk Lamong Terminal into a green port presents a valuable model for other ports in Indonesia and beyond. By implementing the recommendations and focusing on continuous improvement, Teluk Lamong Terminal can achieve its sustainability goals and contribute to broader environmental protection and economic resilience.

Author contributions: Conceptualization, methodology, GMW; data analysis, MZI; writing and editing, GMW; supervision, PD; review, revisions, approved, PP. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: Thanks are conveyed to the Sumatra Institute of Technology (ITERA) for helping fund this research. This research is part of a dissertation which was submitted as partial fulfillment to meet the requirements for the degree of Doctor of Philosophy at Bandung of Institute Technology.

Funding: xx

Conflict of interest: The authors declare no conflict of interest.

References

Antão, P., Calderón, M., Puig, M., et al. (2016). Identification of Occupational Health, Safety, Security (OHSS) and Environmental Performance Indicators in port areas. Safety Science, 85, 266–275. https://doi.org/10.1016/j.ssci.2015.12.031

Badurina, P., Cukrov, M., & Dundović, Č. (2017). Contribution to the implementation of "Green Port" concept in Croatian seaports. Pomorstvo, 31(1), 10–17. https://doi.org/10.31217/p.31.1.3

Canbulat, O. (2017). Sustainable port operation management: Green performance criteria for container terminals. MSc Dissertation; Brunel University.

Carpenter, A., & Lozano, R. (2020). European Port Cities in Transition. In: Strategies for Sustainability. Springer International Publishing. https://doi.org/10.1007/978-3-030-36464-9

Chen, J., Huang, T., Xie, X., et al. (2019). Constructing Governance Framework of a Green and Smart Port. Journal of Marine Science and Engineering, 7(4), 83. https://doi.org/10.3390/jmse7040083

Darbra, R. M., Ronza, A., Stojanovic, T. A., et al. (2005). A procedure for identifying significant environmental aspects in sea ports. Marine Pollution Bulletin, 50(8), 866–874. https://doi.org/10.1016/j.marpolbul.2005.04.037

ESPO Green Guide. (2021). Towards excellence in port environmental management and sustainability. Available online: https://www.espo.be/media/espopublications/espo_green%20guide_october%202012_final.pdf. (accessed on 13 December 2023).

Faber, J., et al. (2021). The Fourth IMO GHG Study 2020. Available online: https://www.imo.org/en/OurWork/Environment/Pages/Fourth-IMO-Greenhouse-Gas-Study-2020.aspx (accessed on 6 December 2023).

Freeman, R. E. (1994). The Politics of Stakeholder Theory: Some Future Directions. Business Ethics Quarterly, 4(4), 409–421. https://doi.org/10.2307/3857340

Freeman, R. E. E., & McVea, J. (2001). A Stakeholder Approach to Strategic Management. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.263511

Huse, M. (2007). Boards, Governance and Value Creation. Available online: https://doi.org/10.1017/cbo9780511611070 (accessed on 6 December 2023).

Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. Technology Analysis & Strategic Management, 10(2), 175–198. https://doi.org/10.1080/09537329808524310

Lam, J. S. L., & Li, K. X. (2019). Green port marketing for sustainable growth and development. Transport Policy, 84, 73–81. https://doi.org/10.1016/j.tranpol.2019.04.011

Lam, J. S. L., & Notteboom, T. (2014). The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe. Transport Reviews, 34(2), 169–189. https://doi.org/10.1080/01441647.2014.891162

Lam, J. S. L., & Yap, W. Y. (2019). A Stakeholder Perspective of Port City Sustainable Development. Sustainability, 11(2), 447. https://doi.org/10.3390/su11020447

Lu, C. -S., Shang, K. -C., & Lin, C. -C. (2016). Examining sustainability performance at ports: port managers' perspectives on developing sustainable supply chains. Maritime Policy & Management, 43(8), 909–927. https://doi.org/10.1080/03088839.2016.1199918

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. Research Policy, 41(6), 955–967. https://doi.org/10.1016/j.respol.2012.02.013

Marschlich, S., & Ingenhoff, D. (2022). Public-private partnerships: How institutional linkages help to build organizational legitimacy in an international environment. Public Relations Review, 48(1), 102124. https://doi.org/10.1016/j.pubrev.2021.102124

Ministry of Transporttaion of the Republic Indonesia. (2021). Minister of Transportation Regulation Number KM 22 of 2021 Concerning the Integrated Master Plan for Tanjung Perak Port and its Surroundings in East Java Province. Jakarta.

Mitchell, R. K., Agle, B. R., & Wood, D. J. (1997). Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. The Academy of Management Review, 22(4), 853. https://doi.org/10.2307/259247

Notteboom, T., Pallis, A., & Rodrigue, J.-P. (2021). Port Economics, Management and Policy. Routledge. https://doi.org/10.4324/9780429318184

Pratikto, W. A., Suntoyo, Sholihin. (2022). Analysis of Teluk Lamong Reclamation Implementation Based on Implementation UU No. 27 of 2007. Sewagati, 3(3), 97-99.

Rodrigue, J. P. (2020). The Geography of Transport Systems New York. Routledge, 456.

Saldaña, J. (2014). Coding and Analysis Strategies. In: The Oxford Handbook of Qualitative Research. Oxford University Press, 580–598. https://doi.org/10.1093/oxfordhb/9780199811755.013.001

Schot. J., Hoogma, R., et al. (1994). Strategies for shifting technological systems: the case of the automobile. System Futures, 26(10), 1060-1076.

Smith, A. (2007). Translating Sustainabilities between Green Niches and Socio-Technical Regimes. Technology Analysis & Strategic Management, 19(4), 427–450. https://doi.org/10.1080/09537320701403334

Spradley, James P. (1980). Participant Obsevation. USA: Holt, Rinehart and Winston.

Spradley, James, P. (1980). Participant Obsevation. USA: Holt, Rinehart and Winston.

Tamin, O. Z. (2007). Towards the Creation of a Sustainable Transportation System in Big Cities in Indonesia. Transportation Journal, 7(2), 87-104.