

Mitigation Implementation of PERMENHUB No. 58/2013 and its amendment No. 39/2021 on Maritime Pollution Control at Panjang Port: Stakeholder Coordination and Environmental Protection

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ABSTRACT : This study examines the implementation of Transportation Minister Regulation No. 58/2013 and its amendment No. 39/2021 concerning pollution prevention at Panjang Port, Bandar Lampung, Indonesia. Using qualitative methods and the Van Horn and Van Meter implementation model, the research analyzes policy implementation effectiveness, supporting and hindering factors, and proposes an enhanced implementation framework. Data was collected through interviews with key stakeholders from five institutions: Port Authority (KSOP), Naval Base (LANAL), Maritime Police (POLAIRUD), Ministry of Environment (KLHK), and Port Corporation (PELINDO). The findings reveal significant improvements in environmental compliance, with vessel compliance rates increasing from 65% to 87% between 2014-2023. Key success factors include strong inter-agency coordination, technological advancement, and community engagement. However, challenges persist in budget constraints, organizational culture differences, and technical capacity limitations. The study proposes an integrated implementation model incorporating transparency, accountability, and stakeholder participation principles. This research contributes to understanding maritime environmental policy implementation in developing nations while providing practical recommendations for enhancing pollution control measures at ports. The experience at Panjang Port demonstrates that successful environmental regulation implementation requires balancing economic, social, and environmental factors while maintaining strong stakeholder engagement and operational efficiency.

KEYWORDS : Maritime pollution, policy implementation, environmental compliance, port management, stakeholder coordination

I. INTRODUCTION

The global maritime domain demonstrates unprecedented interconnectivity among nations, societies, and governance systems, particularly evident in environmental management frameworks (Braunbeck et al., 2009; Burkhardt-Holm et al., 2005). This interconnectedness manifests through international agreements like the Sustainable Development Goals (SDGs) and Paris Climate Agreement, reflecting shared global environmental objectives and interlinked national interests (Hossain, 2020; Zheng et al., 2020). The trajectory of maritime environmental consciousness has evolved significantly since the 1970s, leading to increasingly complex challenges that transcend national boundaries. Maritime pollution control has become increasingly critical as ports face growing environmental challenge (Keiter et al., 2009; Triebkorn et al., 2019). Port Panjang, as a major Indonesian port, exemplifies these challenges through its struggle to balance operational efficiency with environmental protection requirements under Minister of Transportation Regulation No. 58/2013. The urgency stems from rising maritime traffic increasing pollution risks, growing environmental impacts affecting marine ecosystems, regulatory compliance challenges facing port operators, and significant economic implications of environmental degradation (Alamouh et al., 2022; Maragkogianni et al., 2016; Primorac, 2018); Zanne dan Twrdy, 2021; Zheng dkk., 2020). The implementation of maritime pollution control policies serves multiple crucial functions, including protecting marine ecosystems from operational impacts, ensuring sustainable port operations, maintaining compliance with international standards, and safeguarding community health and livelihoods (Hossain, 2020; Zheng et al., 2020). While extensive research exists on maritime environmental management, significant gaps remain in understanding policy implementation dynamics in developing nation contexts. Previous studies by Sari (2017), and Ramadhan (2019) examined environmental policy implementation but failed to address specific challenges in maritime pollution control implementation, integration of stakeholder interests in policy execution, resource allocation effectiveness, and coordination

mechanisms among multiple agencies. Current implementation of Regulation No. 58/2013 at Port Panjang reveals several critical gaps between operational reality and policy requirements, stakeholder coordination challenges, and limitations in monitoring and enforcement capabilities. The research identifies concerning disconnects between prescribed procedures and practical implementation, resource constraints affecting compliance capabilities, and technical capacity limitations. Additionally, fragmented responsibility distribution and communication challenges among agencies have hampered effective policy implementation (Alamouh et al., 2022; Gössling et al., 2021; Nunes et al., 2019). These gaps are further complicated by inadequate pollution detection systems and limited enforcement capabilities, highlighting the need for comprehensive analysis and improvement of current implementation frameworks.

To address these challenges, this research examines implementation pathways, institutional dynamics, and operational integration at Port Panjang. The study investigates policy interpretation and execution processes, resource allocation mechanisms, stakeholder engagement strategies, and technical capability development. This analysis incorporates insights from international research by Okoli et al. (2020), da Silva Leite & De Lócco (2020), and others to develop a comprehensive understanding of implementation challenges and opportunities. The research addresses three primary questions: how effective is the implementation of Minister of Transportation Regulation No. 58/2013 regarding pollution control at Port Panjang; what supporting and hindering factors influence the implementation of pollution control measures; and what modifications to the Van Meter and Van Horn implementation model are needed to enhance policy effectiveness. These questions guide the examination of policy interpretation mechanisms, resource allocation processes, stakeholder engagement strategies, and implementation outcomes.

Building upon studies by Hastuti et al. (2021), Tampubolon (2018), and Febryanti&Suryaningsih (2018), this research aims to analyze implementation effectiveness, identify factors influencing policy implementation success, and develop an enhanced implementation model incorporating context-specific modifications to Van Meter and Van Horn's framework. The study employs a qualitative approach, utilizing document analysis, stakeholder interviews, and field observations to gather data on implementation processes and outcomes. Expected contributions include enhanced understanding of maritime pollution control implementation challenges, practical recommendations for improved policy execution, a modified implementation model reflecting local context, and a strategic framework for stakeholder coordination. Through systematic examination of implementation pathways and institutional dynamics, this study aims to enhance understanding of effective pollution control measures while supporting sustainable port operations. The research outcomes will benefit port operators, regulatory agencies, and environmental protection efforts while contributing to broader maritime environmental governance knowledge.

The research particularly focuses on Port Panjang's implementation of pollution control measures as mandated by Regulation No. 58/2013, examining both structural and operational dimensions of policy execution. The port's strategic location and economic importance make it an ideal case study for understanding the complexities of maritime environmental policy implementation in developing nations. Current challenges at Port Panjang reflect broader issues in maritime environmental governance, including resource constraints, coordination difficulties, and technical limitations that impact policy effectiveness. The implementation framework at Port Panjang reveals significant variations in effectiveness across different operational areas. Studies by Jerin et al. (2022) and Kumar (2017) have highlighted similar implementation challenges in other developing nation contexts, emphasizing the need for adaptive approaches that consider local capabilities and constraints. The research examines how these variables interact within Port Panjang's specific operational environment, providing insights into effective policy implementation strategies.

Environmental monitoring capabilities represent a critical aspect of policy implementation that requires careful evaluation. The current state of monitoring systems at Port Panjang, including pollution detection mechanisms and data analysis frameworks, must be assessed against both regulatory requirements and practical operational needs. This evaluation encompasses technical capabilities, human resource competencies, and system integration effectiveness, considering insights from research by Setyawati&Purnaweni (2018) and Novaldi et al. (2022) on environmental monitoring systems. Stakeholder engagement emerges as a crucial factor influencing implementation success. The research examines how Port Panjang integrates various stakeholder interests, including port operators, shipping companies, local communities, and environmental agencies. Previous studies by Tan et al. (2021) and Yang et al. (2018) have demonstrated the importance of effective stakeholder coordination in environmental policy implementation, providing valuable frameworks for analyzing Port Panjang's stakeholder engagement strategies.

Resource allocation and utilization patterns significantly impact implementation effectiveness. The research investigates how Port Panjang manages and deploys resources for pollution control, considering both financial and technical aspects. This analysis builds upon work by Oliveira (2021) examining resource optimization in environmental policy implementation, while considering the specific constraints and opportunities present in Port Panjang's operational context. The study employs the Van Meter and Van Horn implementation model as its theoretical foundation, while incorporating modifications to address specific

maritime environmental management challenges. This adapted framework enables comprehensive analysis of implementation pathways while considering the unique characteristics of port operations and environmental protection requirements. The research extends current theoretical understanding by examining how implementation models can be effectively adapted to maritime contexts in developing nations.

Through this comprehensive examination, the research aims to contribute both theoretical insights and practical recommendations for improving maritime pollution control implementation. This comprehensive analysis addresses critical gaps in current understanding while providing practical insights for improving maritime pollution control implementation. The findings will contribute to both theoretical knowledge and practical applications in maritime environmental management, supporting the development of more effective and sustainable approaches to port pollution control.

II. METHODOLOGY

This study employs a qualitative case study design to examine the implementation of pollution control policies at Port Panjang, Indonesia, focusing specifically on Minister of Transportation Regulation No. 58/2013 and its amendment No. 39/2021. The research adopts a comprehensive methodological framework that emphasizes personal interpretation, holistic approaches, and constructivist perspectives towards policy implementation phenomena, aligning with established qualitative research principles in academic and professional fields. The research site centers on Port Panjang, a crucial maritime hub in Lampung Province, Indonesia. Data collection involves both primary and secondary sources. Primary data is gathered through in-depth interviews with key informants from five critical institutions: the Port Authority (KSOP), Environmental Agency (KLHK), state-owned port operator (Pelindo), Maritime Police (Polairud), and Naval Base (Lanal). These interviews are designed to uncover implementation processes, challenges, strategies, and inter-agency dynamics. Secondary data includes policy documents, implementation reports, statistical records, and relevant previous studies.

The study implements a rigorous data verification process utilizing both observation extension and triangulation methods. The observation period extends over three months, divided into three phases: relationship building, intensive data collection, and findings verification. Triangulation encompasses three dimensions: source triangulation (comparing data from five different institutions), technique triangulation (combining interviews, direct observation, and document analysis), and time triangulation (collecting data at various times and conditions). Data analysis follows the interactive model proposed by Miles, Huberman, and Saldana (2014), comprising four interconnected steps: data collection, data condensation, data display, and conclusion drawing/verification. This analytical framework enables systematic examination of implementation pathways while considering the complex interplay of various stakeholders and institutional dynamics in maritime environmental governance.

III. RESULTS

The results of interviews with several informants from several stakeholders in the Panjang Port area, still refer to the variables determined by the Van Meter and Van Horn models with 2 concepts that will be included in the refinement of the model, including:

KSOP :Implementation of Minister of Transportation Regulation No. 58/2013 and its amendment No. 39/2021 has shown significant progress at Port Panjang. Our real-time monitoring system has successfully detected and prevented several potential pollution incidents in the past 18 months. Compliance rates have increased from 75% to 88%. We've implemented an Integrated Safety Management System that combines safety, occupational health, and environmental protection aspects. Our port personnel undergo intensive training and certification programs. Port operational efficiency has improved by 15%, with reduced vessel waiting times and a 10% increase in trade volume over the past year.

This is in line with the opinions of other informants with their opinions as follows

POLAIRUD : "Our role focuses on law enforcement and security. Through our integrated patrol system, we've achieved a 30% reduction in shipping safety violations over the past two years. Compliance with safety standards has reached 82%, up from 68%. We operate an Integrated Maritime Security Command System utilizing AIS and VMS for real-time vessel monitoring. Our teams are equipped with surveillance drones and portable pollution detection devices. We've recorded a 40% decrease in piracy and illegal fishing incidents over three years. Key challenges include monitoring vast maritime territories with limited resources." This is in line with the opinions of other informants with their opinions as follows

LANAL : "As a naval base, we've enhanced maritime security through our integrated surveillance system, achieving a 35% increase in illegal activity detection. Vessel safety compliance in our jurisdiction has reached 87%, up from 73%. Our Integrated Maritime Command and Control System combines coastal radar, AIS, and satellite data for comprehensive monitoring. We've recorded a 45% reduction in territorial violations and illegal activities over two years. Our personnel receive specialized training in SAR operations and oil spill response. Main challenges include evolving maritime threats and cross-border pollution issues." This is in line with the opinions of other informants with their opinions as follows

KLHK : "Environmental monitoring has shown significant improvements, with a 40% reduction in pollution incidents over two years. Environmental regulatory compliance has increased to 83% from 70%. Our Integrated Marine Environmental Monitoring Information System combines data from monitoring stations, satellite imagery, and community reports. Water quality index has improved by 25% at major ports, positively impacting fisheries and marine tourism. Key challenges include managing complex pollution sources, including transboundary pollution and microplastics. We're implementing machine learning-based pollution prediction systems and enhancing coastal ecosystem rehabilitation programs."

This is in line with the opinions of other informants with their opinions as follows

PELINDO : "As port operators, we've achieved a 25% increase in port throughput while maintaining high safety and environmental standards. Safety compliance has reached 92%, up from 80%. Our technology-based Port Safety Management System integrates CCTV monitoring, IoT sensors, and mobile incident reporting. We've reduced vessel waiting time by 40% and increased cargo handling productivity by 30%. We're implementing Smart Port concepts integrating AI, blockchain, and 5G technology. Major challenges include infrastructure modernization needs and maintaining balance between growth and environmental protection. Future plans include port electrification and renewable energy facility development."

Common themes across all responses include:

- a) Significant improvements in compliance rates (ranging from 82-92%)
- b) Integration of advanced technology for monitoring and enforcement
- c) Focus on personnel training and capacity building
- d) Challenges in resource allocation and vast area coverage
- e) Emphasis on inter-agency coordination
- f) Balance between operational efficiency and environmental protection
- g) Implementation of data-driven decision-making systems
- h) Investment in modern equipment and infrastructure
- i) Development of preventive rather than reactive approaches
- j) Commitment to continuous improvement in safety and environmental standards

These responses demonstrate a coordinated effort across agencies to implement the regulation effectively, while highlighting specific challenges and achievements within each organization's mandate.

IV DISCUSSION

The implementation of Transportation Minister Regulation No. 58 of 2013 and its amendment No. 39 of 2021 concerning pollution prevention at Panjang Port, Bandar Lampung, represents a significant milestone in Indonesia's efforts to protect its maritime environment while maintaining efficient port operations. This comprehensive regulatory framework involves multiple stakeholders, including the Port Authority (KSOP), Naval Base (LANAL), Maritime Police (POLAIRUD), Ministry of Environment and Forestry (KLHK), and Indonesia Port Corporation (PELINDO), each playing crucial roles in ensuring effective policy implementation. The Port Authority (KSOP) serves as the primary coordinator for implementing these regulations at Panjang Port. Since 2014, KSOP has achieved remarkable progress in improving vessel compliance with pollution prevention standards, increasing from 65% to 87% by 2023. This improvement was accomplished through enhanced monitoring systems and regular training programs. KSOP has implemented technology-based compliance monitoring that enables more efficient vessel inspections, including digital document verification and automated water quality sensors around vessels.

The Naval Base (LANAL) contributes significantly to maritime security and environmental protection around Panjang Port. Through regular patrols and surveillance operations, LANAL helps detect potential pollution incidents early and supports enforcement actions against violations. Their role extends beyond security to include participation in joint pollution response exercises and providing logistical support during major pollution incidents. The integration of LANAL's maritime domain awareness capabilities with other stakeholders' systems has strengthened the port's overall environmental monitoring capacity. The Maritime Police (POLAIRUD) focuses on law enforcement aspects of environmental regulations at Panjang Port. Their investigation unit has successfully handled numerous cases of illegal waste disposal and environmental violations, creating a deterrent effect that has contributed to improved compliance levels. POLAIRUD's community engagement programs have also helped raise awareness about maritime environmental protection among coastal communities and port users.

The Ministry of Environment and Forestry (KLHK) provides crucial technical expertise and regulatory oversight. Their implementation of real-time environmental monitoring systems at strategic locations around Panjang Port has enabled early detection of potential pollution incidents. KLHK has also led efforts to develop green port initiatives, promoting renewable energy use and improved waste management practices. Their technical guidelines and environmental standards have become benchmarks for port operations nationwide. Indonesia Port Corporation (PELINDO), as the port operator, has made substantial investments in environmental infrastructure and management systems. Between 2014 and 2023, PELINDO invested approximately 150 billion rupiah in modernizing waste management facilities, acquiring specialized vessels for waste collection, and developing integrated environmental monitoring systems. These investments have significantly improved operational efficiency while reducing environmental impacts.

The coordination among these agencies has been facilitated through the Pollution Prevention Coordination Team (TKPP), which conducts monthly meetings to evaluate policy implementation and plan improvements. This coordinated approach has resulted in dramatic improvements in pollution incident response times, reducing average response time from 6 hours in 2014 to less than 2 hours by 2023. The development of an integrated reporting system has enabled faster information sharing and more effective incident response coordination.

Significant improvements have been observed in maritime services at Panjang Port following the implementation of these regulations. The standardization of ship waste handling procedures has reduced vessel waiting times for waste disposal services from 12 hours to 4 hours. Modern waste treatment facilities now process 1,000 cubic meters of waste daily, a substantial increase from the previous capacity of 300 cubic meters. Customer satisfaction surveys indicate an increase in satisfaction rates from 62% in 2014 to 85% in 2023.

The economic impact of implementing these regulations has been positive, despite initial concerns about increased operational costs. Cost-benefit analysis conducted by PELINDO in 2023 revealed annual operational cost savings of approximately 25 billion rupiah through improved energy efficiency, reduced environmental penalties, and enhanced port competitiveness. The local fishing industry has particularly benefited, with traditional fishermen reporting a 30% increase in catch volumes between 2014 and 2023, attributed to improved water quality around the port. Public health impacts have been equally significant. An epidemiological study conducted by the Bandar Lampung Health Department in 2022 showed a 40% reduction in acute respiratory diseases among residents living within 5 kilometers of the port. Regular health monitoring programs have documented a 60% decrease in work-related illnesses associated with waste handling among port workers between 2014 and 2023. The implementation has also created new employment opportunities in the environmental management sector. PELINDO has added 120 new positions related to waste management operations and environmental monitoring since 2014. Training programs developed in collaboration with local educational institutions have enhanced the skills and competitiveness of the local workforce in environmental technology fields.

The education sector has benefited through partnerships between PELINDO and local universities for research and development in waste management technologies. Several universities in Lampung now offer specializations in maritime environmental management, responding to growing demand for expertise in this field. Internship and research programs have enriched higher education curricula in environmental engineering and port management. Tourism development around Panjang Port has seen positive growth due to improved environmental conditions. Local tour operators now offer educational tours showcasing environmentally friendly port practices, attracting tourists interested in sustainable tourism. The Lampung Provincial Tourism Office has reported a 25% increase in tourist visits to coastal areas around the port in recent years.

Despite these successes, several challenges remain in implementing the regulations. Overlapping authority among agencies occasionally hampers quick decision-making processes. The rapid pace of technological development requires continuous infrastructure updates, demanding significant ongoing investment. Some port users continue to resist stricter standards, particularly regarding additional costs. To address these challenges, several recommendations have been proposed. These include strengthening inter-agency coordination through integrated information systems, developing innovative funding schemes such as public-private partnerships, implementing more comprehensive incentive systems for compliant port users, and enhancing education and outreach programs to increase stakeholder support.

The implementation of environmental monitoring systems has been particularly successful. Real-time water quality monitoring using sensor networks connected to a control center enables continuous monitoring of various parameters including pH levels, dissolved oxygen content, and pollutant presence. This data not only supports environmental protection efforts but also helps optimize waste management operations and improve service efficiency. The development of emergency response capabilities has been another significant achievement. The port now maintains specialized teams trained in handling various types of pollution incidents, supported by modern equipment and clear standard operating procedures. Regular drills and simulations ensure readiness for potential environmental emergencies, while cooperation agreements with neighboring ports enable mutual assistance during major incidents.

Community engagement has played a crucial role in successful implementation. Regular stakeholder consultations, public awareness campaigns, and community participation in environmental monitoring have helped build support for environmental protection measures. Local communities now actively participate in reporting potential violations and supporting conservation efforts around the port area. Innovation in environmental technology has been encouraged through research partnerships and pilot projects. The port has become a testing ground for new environmental technologies, including automated waste sorting systems, renewable energy applications, and advanced water treatment methods. These innovations not only improve environmental performance but also contribute to operational efficiency and cost reduction.

The implementation of these regulations has positioned Panjang Port as a model for environmental management in Indonesia's maritime sector. The successful integration of environmental protection with efficient port operations demonstrates that economic development and environmental conservation can be mutually supportive goals. The experience gained through implementing these regulations provides valuable lessons for other ports seeking to enhance their environmental performance while maintaining operational efficiency. Looking forward, continued success will require sustained commitment from all stakeholders, ongoing investment in infrastructure and technology, and adaptability to address emerging challenges. The model developed at Panjang Port shows that comprehensive environmental regulations, when properly implemented with strong stakeholder coordination and adequate resources, can achieve significant positive impacts across multiple sectors while supporting sustainable port development. The implementation of digital technologies has emerged as a crucial factor in supporting environmental compliance at Panjang Port. The development of a port-wide environmental management information system has enabled better tracking of waste streams, more efficient resource allocation, and improved reporting capabilities. This digital transformation has not only enhanced environmental performance but also improved operational transparency and accountability.

The port's waste management system has evolved into a comprehensive circular economy approach. Waste materials are increasingly viewed as potential resources, with recycling and recovery programs generating additional revenue streams while reducing environmental impact. The port has established partnerships with recycling facilities and waste-to-energy plants, creating a sustainable waste management ecosystem that serves as a model for other ports in the region. International cooperation has also played an important role in implementing these regulations. Panjang Port has established partnerships with several international ports to share best practices in environmental management. These relationships have facilitated knowledge transfer, technical assistance, and joint research projects, helping the port stay current with global trends in sustainable port operations.

The success of environmental initiatives at Panjang Port has attracted attention from international environmental organizations and shipping companies. The port's commitment to environmental protection has enhanced its reputation in the global maritime community, potentially attracting environmentally conscious shipping lines and cargo owners who prioritize sustainable supply chains. The experience at Panjang Port demonstrates that successful environmental regulation implementation requires a balanced approach that considers economic, social, and environmental factors while maintaining strong stakeholder engagement and

operational efficiency. This model of integrated environmental management could serve as a blueprint for other ports seeking to enhance their environmental performance while maintaining competitive operations in the global maritime sector. These findings underscore the importance of continued investment in environmental protection infrastructure, stakeholder coordination, and innovative technologies to ensure sustainable port development while protecting valuable marine ecosystems for future generations.

V. CONCLUSION

The implementation of Minister of Transportation Regulation No. 58/2013 and its amendment No. 39/2021 concerning disaster mitigation at Panjang Port in Lampung Bay adopts a top-down approach based on Van Horn and Van Meter's theory. The policy implementation emphasizes transparency through widespread information dissemination, accountability through regular reporting and performance evaluation, and community participation in planning and executing mitigation programs.

The implementation faces several key challenges, including inter-agency coordination, resource limitations, and public awareness levels. The mitigation theory is applied through prevention measures, preparedness initiatives, and risk reduction steps. Critical variables include policy standards, resources, inter-organizational communication, implementing agency characteristics, socio-economic-political conditions, and implementer attitudes. Implementation success depends heavily on government commitment, active community involvement, and continuous monitoring for policy improvement.

Supporting factors for implementing the regulation include clear policy standards, resource allocation, technological advancement, organizational characteristics, and inter-agency communication. Other important factors encompass socio-economic-political support, personnel training, continuous evaluation, and community engagement. Effective coordination between agencies remains key to successful disaster mitigation policy implementation at Panjang Port. However, the implementation faces various challenges: complex standards, budget constraints, differing organizational cultures, and sectoral ego between agencies. Additional hindering factors include balancing security with operational efficiency, regulatory harmonization, and climate change adaptation.

The effective disaster mitigation policy implementation model at Panjang Port integrates Van Horn's theory with Input-Process-Output-Outcome analysis, considering mitigation variables. This model evaluates policy standards, resources, inter-organizational communication, implementing agency characteristics, socio-economic-political conditions, and implementer disposition. Transparency is achieved through open information about standards and implementation processes. Accountability is strengthened through agency performance evaluation and results reporting. Community participation is involved in implementation planning and monitoring. This comprehensive model produces a holistic approach to pollution mitigation, considering collective impacts on maritime services and related sectors. The resulting public policy performance potentially influences port operational efficiency, environmental quality, and local economy. This holistic approach aims to enhance mitigation effectiveness while ensuring transparency, accountability, auditability, and active community involvement in policy implementation and evaluation processes.

VI IMPLICATION

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