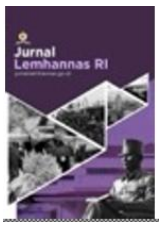

Jurnal Lemhannas RI (JLRI)
e-ISSN: 2830-5728
Vol. 3 No. 1, March 2025: 118-132
DOI: 10.55960/jlri.v13i1.1067
https://jurnal.lemhannas.go.id/index.php/jkl

Ship Recycling in Indonesia: Regulatory Gaps and Environmental Impacts

Wanda Rulita Sari[1], Amira Jasmine Salsabila Darojat[2]
[1] Faculty of Engineering, Universitas Indonesia, Depok 16424, Indonesia
[2] Faculty of National Security, Indonesia Defense University, Jakarta 10440, Indonesia

Corresponding Author: wanda.rulita@ui.ac.id

Article Info:

Keywords:
Environmental Impact,
International Standard,
National Regulations,
Ship Recycling,
Sustainable Practices.

Article History:
Received: 24-11-2024
Revised: 25-02-2025
Accepted: 30-03-2025

Article DOI:
10.55960/jlri.v13i1.1067

Abstract

Purpose: This study examines Indonesia's challenges in establishing safe and environmentally sound ship recycling practices aligned with national regulations and the Hong Kong Convention. It identifies discrepancies between existing regulations and current industry practices, proposing actionable recommendations for improvement.

Study Design/Methodology/Approach: This study used a a qualitative approach, conducting a comprehensive literature review. This involved analysing national and international ship recycling regulations and evaluating Indonesian ship recycling practices for compliance with safety and environmental standards.

Findings: Significant regulatory gaps persist in Indonesia's ship recycling industry, leading to widespread non-compliance with international standards. Prevalent hazardous practices, including beaching and inadequate waste management, pose substantial risks to both workers and the environment. Furthermore, deficient infrastructure and weak enforcement exacerbate these issues, underscoring an urgent need for regulatory reform.

Originality/Value: This study emphasises the urgency of ship recycling modernisation as part of strengthening Indonesia's National Resilience through the *Astagatra* framework, including Geography (maritime territorial protection), Demography (safety of shipyard workers), Natural Resources (hazardous waste and material reuse), as well as the *Pancagatra* dimensions of ideology, politics, economy, socio-culture, defence, and security. This research offers original insights into Indonesia's ship recycling sector, highlighting the critical need for facility modernisation, enhanced enforcement, and regulatory alignment with international standards. Future research should investigate the feasibility of green ship recycling technologies and public-private partnerships to advance industry sustainability.

How to cite: Sari, W.R.S., Darojat, A.J.S. (2025). Ship Recycling in Indonesia: Regulatory Gaps and Environmental Impacts. Jurnal Lemhannas RI, 13 (1),118-132. https://doi.org/10.55960/jlri.v13i1.1067

e-ISSN: 2830-5728

INTRODUCTION

Indonesia, the world's largest archipelago (Sarjito, 2023), relies heavily on its extensive maritime fleet, comprising over 25,000 registered ships (Buchary *et al.*, 2006; Supriyanto, 2015; Pulungan, 2024; Sari *et al.*, 2024; Sari *et al.*, 2025). A substantial number of these vessels, exceeding 25 years in age, are nearing the end of their operational lives (Fariya *et al.*, 2020). Responsible ship recycling is essential for phasing out these ageing vessels, not only mitigating environmental damage but also recovering valuable materials and promoting maritime industry sustainability (Mannan *et al.*, 2024). Properly managed ship recycling offers significant benefits, including enhanced worker safety, reduced hazardous waste, and the recovery of critical materials like steel and aluminium for other industries (Mannan *et al.*, 2023). However, the condition of ship recycling in Indonesia shows a different reality, as most activities still take place informally and are poorly regulated, especially in areas such as Cilincing (North Jakarta) and Madura, where implementation often ignores basic safety and environmental protection procedures (Akriananta and Suastika, 2017).

While Indonesia possesses some legal and institutional frameworks, primarily from the Ministry of Transportation, these laws often fail to achieve comprehensive implementation. Fundamentally, they do not yet align with international agreements like the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (HKC) (Oktaviany, 2019; Prabowo, 2019). This misalignment creates a substantial regulatory gap, compromising both environmental standards and worker safety within the industry. The dominant ship dismantling method in Indonesia, beaching, involves driving vessels ashore for dismantling on tidal flats. Although cost-effective and widely adopted, this method is notoriously hazardous, exposing workers to toxic materials and unpredictable sea conditions (Fariya *et al.*, 2016; Mannan *et al.*, 2024). This informal approach also leads to significant marine pollution, with hazardous substances including oil, heavy metals, and asbestos contaminating coastal ecosystems. To mitigate these emerging problems, experts advocate for establishing "green" ship recycling yards equipped with modern technology and environmentally responsible procedures. Experts have proposed safer, cleaner methods for future operations, such as dry ice blasting for de-coating and oxy-acetylene cutting for dismantling (Sornn-Friese *et al.*, 2021; ElMenshawy *et al.*, 2024).

This initiative aligns with broader regional environmental objectives, including ASEAN's transition towards a circular economy, which emphasises resource efficiency and sustainable waste management (Munabari and Sellita, 2025). Ship recycling plays a vital role in this transformation by reducing material waste and bolstering economic resilience through reuse (Ramli and Michelle, 2023). Despite this potential, progress in Indonesia has been limited due to bureaucratic fragmentation and inadequate coordination among key stakeholders. Recent global studies indicate growing awareness of regulated, eco-friendly ship recycling. Countries like Bangladesh and India are already investing in upgraded recycling infrastructure (Abdullah *et al.*, 2023; Günes *et al.*, 2024). Indonesia, facing similar challenges, is well-positioned to follow suit, provided there is sufficient political will and strategic investment (Hartanto, 2024; Mannan *et al.*, 2024). This paper aims to examine Indonesia’s ship recycling landscape by critically analysing its regulatory framework, evaluating its alignment with international standards (particularly the HKC), and proposing actionable recommendations. Through this research, authors aspire to advance developing safer, more sustainable ship recycling practices that meet

e-ISSN: 2830-5728

both national needs and global expectations. Within Indonesia's framework of National Resilience, the practice is closely linked to the *Astagatra*, which integrates natural and societal dimensions. Unsustainable methods pollute marine ecosystems (Geography and Natural Resources), endanger workers and coastal populations (Demography and Socio-cultural), erode competitiveness and governance (Economy and Politics), and compromise maritime security (Defence and Security). Therefore, modernising ship recycling in line with the *Astagatra* is essential to strengthen national resilience.

LITERATURE REVIEW

Ship Recycling

Ship recycling, the process of dismantling end-of-life vessels to recover valuable materials, contributes significantly to reducing environmental impacts through material recovery (Choi *et al.*, 2016; Golbabaei *et al.*, 2024). However, this industry also raises concerns regarding worker safety and environmental degradation, particularly in developing nations where practices often fall short. The majority of ship recycling activities occur in South Asia, including India, Bangladesh, and Pakistan, where lower labour costs sometimes compromise environmental and worker safety standards (Sarraf *et al.*, 2010; Mathew, 2021). Nevertheless, the European Union (EU) mandates through regulations such as the European Ship Recycling Regulation (SRR) that EU-flagged vessels can only be recycled in certified facilities that adhere to stringent safety and environmental guidelines (Hadjiyianni and Pouikli, 2024b).

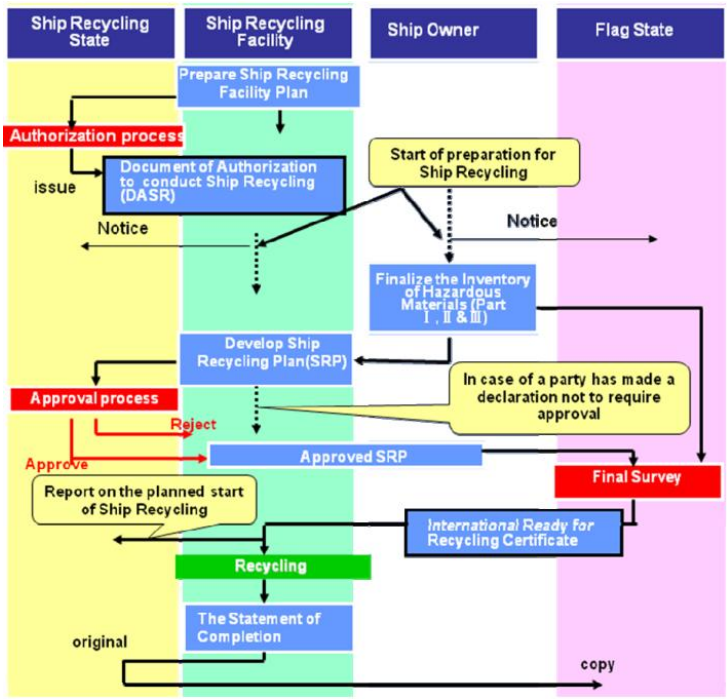

Figure 1. Ship Recycling Workflow
Source: IMO (2012a)

The typical ship recycling workflow, as illustrated in Figure 1, commences with the sale of end-of-life ships, which are then transported to recycling facilities. At these yards, workers dismantle the ships, carefully removing hazardous materials like asbestos, oils,

e-ISSN: 2830-5728

and heavy metals. The sorted materials include recyclables and waste, aiming to minimise environmental pollution. For example, the EU's SRR requires recycling to occur in facilities listed on the European List, ensuring high environmental standards (Solakivi *et al.*, 2021). To enhance industry practices, international agreements, for example, the HKC for the Safe and Environmentally Sound Recycling of Ships, establish legal obligations for ship recycling, focusing on safety, hazardous material handling, and proper waste disposal (IMO, 2012a). However, the HKC faces implementation challenges, particularly as countries like Bangladesh and India express reluctance to meet all requirements due to high costs (Chang *et al.*, 2010). Consequently, the EU has adopted stricter regulations, compelling recycling yards to meet specific environmental and safety standards, which has led to measures including impermeable floors and robust waste management systems. While economically beneficial, the ship recycling process necessitates continuous regulatory oversight to balance economic development with environmental protection and worker safety (Mikelis, 2019). Despite notable progress through regulations like the SRR and HKC, compliance, safety, and environmental impacts remain significant challenges, especially in less developed nations where most recycling activities occur (Mikelis, 2008).

The Statutory and Regulation for Ship Recycling

The statutory and regulatory landscape for ship recycling establishes foundational legal frameworks and guidelines to ensure safe and environmentally sound practices. The International Maritime Organization (IMO) and other bodies have set stringent regulations governing hazardous materials, worker safety, and environmental impacts. A fundamental requirement is the Inventory of Hazardous Materials (IHM), a document essential for ships throughout their operational life and during recycling, ensuring the proper accounting and safe management of substances like asbestos and heavy metals (Celik *et al.*, 2024). Another key regulation is the Ship Recycling Plan (SRP), which mandates that shipowners develop detailed plans for safe and environmentally sound dismantling, including hazardous materials management, worker safety, and environmental impact minimisation (Hiremath *et al.*, 2016). The IMO regulations further require facilities to be authorised to handle hazardous materials, and all ships must undergo surveys to verify compliance before the recycling phase (Jain *et al.*, 2014; Turk Loydu, 2014). The HKC provides specific guidelines for authorising ship recycling facilities and certifying them for recycling. Surveys and certifications under the HKC are vital to ensure ships are ready for environmentally responsible dismantling (Hadjiyianni and Pouikli, 2024a). Table 1 below summarises important IMO regulations and their descriptions regarding ship recycling.

Table 1. IMO Regulations and Requirements for Ship Recycling

IMO Rule	Description
Development of the Inventory of Hazardous Materials (IMO, 2023)	Ships must maintain an IHM (e.g., asbestos, lead), which must be verified and regularly updated.
Development of the Ship Recycling Plan (IMO, 2011)	A specific plan for ship recycling must be developed, covering the dismantling sequence and management of hazardous materials.
Safe and Environmentally Sound Ship Recycling (IMO, 2012a)	Ship recycling facilities must have an operational plan to ensure worker safety, environmental protection, and management of hazardous materials.
Survey and Certification of Ships under the HKC (IMO, 2012c)	Ships must undergo surveys to obtain the International Certificate on IHM before recycling.
Authorization of Ship Recycling Facilities (IMO, 2012b)	Facilities must be authorized by competent authorities and comply with hazardous materials management, safety, and environmental standards.

e-ISSN: 2830-5728

IMO Rule	Description
Inspection of Ships under the HKC (IMO, 2012d)	Ships must be inspected by port state control officers to verify compliance with hazardous materials management and ensure required certificates are on board.

Source: data processed by the author (2025)

Proper regulations significantly support the development of a more sustainable and safe ship recycling industry. Recent studies, by Alcaide *et al.* (2017), highlight the instrumental role of the EU Ship Recycling Regulation in shaping the global industry by pushing for stricter adherence to safety and environmental standards. In Indonesia, despite existing national frameworks, several studies consistently reveal substantial gaps between regulatory intent and actual practices. Table 2 summarises key findings from various research efforts on ship recycling practices in Indonesia, explicitly identifying the referenced regulations and the observed regulation-practice gap.

Table 2. Study of Ship Recycling Practices in Indonesia

Ref. Nr.	Author	Regulations Referenced	Regulation–Practice Gap
1	Sunaryo et al. (2020)	a. Presidential Instruction Nr. 5/2005 b. Ministry of Transportation Regulation Nr. 29/2014 c. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Ship recycling activities in Indonesia often neglect environmental and safety regulations. b. Many shipyards are not in compliance with the HKC. c. Hazardous waste (including asbestos and PCBs) is frequently mismanaged.
2	Sunaryo and Indianto (2024)	a. Government Regulation Nr. 101/2014 b. Ministry of Transportation Regulation Nr. 29/2014 c. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Ship dismantling often does not meet safety and environmental standards. b. The proposed design ensures compliance with both international (HKC) and national regulations.
3	Sunaryo *et al.* (2021)	a. National Law Nr. 17/2008 b. Government Regulation Nr. 21/2010 c. Ministry of Transport Regulation Nr. PM 29/2014 d. Ministry of Transportation Regulation Nr. 29/2014 e. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Conventional yards do not follow regulations. b. Even modern yards do not comply fully, particularly regarding waste handling and IHM. c. Regulatory compliance is seen as costly and complicated.
4	Fariya *et al.* (2021)	a. IMO 2011 Development of the Ship Recycling Plan b. IMO 2012 Safe and Environmentally Sound Recycling of Ships c. IMO 2012 Inspection of Ships under the HKC	a. Indonesian yards often lack planning and awareness, leading to unsafe practices. b. Structured risk assessment tools like the one proposed aim to bridge this gap.
5	Agung and Afriansyah (2021)	a. National Law Nr. 17/2008 b. Government Regulation Nr. 31/2021 c. Ministry of Transportation Regulation Nr. 29/2014 d. Circular Letter Nr. 19/PK/DK/2019	a. Regulations only partially cover ship types (mainly ≥100 GT, but not clearly ≥500 GT). b. No enforcement clarity. c. Absence of prohibitions on harmful methods like beaching. d. Lack of compliance frameworks, leading to environmental risks and legal vulnerabilities.
6	Sunaryo and Tjitrosoemarto (2022)	a. Government Regulation Nr. 142/2015 b. Minister of Industry Regulation Nr. 40/2016 c. Ministry of Transportation Regulation Nr. 29/2014 d. Government Regulation Nr. 101/2014 e. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. No yard meets the complete national or international standards, b. The methods used are unsafe and harmful to the environment.

e-ISSN: 2830-5728

Ref. Nr.	Author	Regulations Referenced	Regulation–Practice Gap
7	Sunaryo and Aidane (2022)	a. National Law Nr. 17/2008 b. Government Regulation Nr. 21/2010 c. Ministry of Transportation Regulation Nr. 29/2014 d. Government Regulation Nr. 101/2014 e. Government Regulation Nr. 142/2015 f. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. No facility meets both national and international standards. b. A major disconnects between regulation content and on-ground practice.
8	Jamaluddin *et al.* (2022)	IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Many yards do not meet basic safety and environmental standards. b. The average compliance (maturity) level is 2.1 out of 4. c. 55% of assessed items fall into the category of "non-existent or untreated."
9	Hariyanto *et al.* (2023)	a. National Law Nr. 17/2008 b. Government Regulation Nr. 31/2020 and Nr. 31/2021 c. Government Regulation Nr. 21/2010 d. Ministry of Transportation Regulation Nr. 29/2014 e. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Shipbreaking facilities are traditional, under-regulated, and use basic tech b. Lack of compliance with environmental safety and occupational standards c. There is a mismatch between IMO's HKC principles and actual field practices
10	Mutmainnah *et al.* (2024)	a. National Law Nr. 32/2009 b. Government Regulation Nr. 101/2014 c. IMO 2012 Safe and Environmentally Sound Recycling of Ships	a. Many shipbreaking yards operate with insufficient oversight, lack of B3 (hazardous waste) handling procedures, and non-compliance with safety standards.
11	Elizabeth *et al.* (2024)	a. National Law Nr. 17/2008 b. Presidential Instruction Nr. 5/2005 c. Minister of Transportation Regulation Nr. PM 29/2014, amended by Nr. PM 24/2022	a. Indonesian facilities often lack the infrastructure, training, and regulatory compliance needed to meet international standards.

Source: data processed by the author (2025)

Table 2 highlights Indonesia's recurring problem in ship recycling: the consistent failure to fully enforce regulations. Studies from Sunaryo *et al.* (2020), Sunaryo *et al.* (2021), and Agung and Afriansyah (2021) show that many shipyards, even modern ones, neglect national and international safety and environmental standards because compliance is considered costly and complicated. Regulations only partially cover ship types and lack clear enforcement, creating a gap between policy and practice (Sunaryo and Aidane, 2022; Sunaryo and Tjitrosoemarto, 2022). The average compliance level is low (2.1 out of 4), with 55% of aspects rated as "non-existent or untreated" (Jamaluddin *et al.*, 2022). Oversight is weak, especially for hazardous waste (Mutmainnah *et al.*, 2024), and facilities often lack infrastructure, training, and planning (Fariya et al., 2021; Elizabeth et al., 2024) ; prior attempts at compliance have been fragmented and largely ineffective. The literature consistently identifies a widespread lack of planning and awareness(Fariya *et al.*, 2021), indicating an urgent need for a stronger, integrated, and consistently enforced regulatory framework to close the gap between regulation and actual practice.

METHODS

This research adopts a structured framework for analysing and implementing ship recycling in Indonesia in accordance with national regulations and international standards. Figure 2 illustrates this framework, which specifically focuses on the gaps between regulatory frameworks and actual practices. The framework begins with a comprehensive literature review that explores the global and local context of ship

e-ISSN: 2830-5728

recycling, followed by an examination of international ship recycling regulations. The focus then shifts to methods, where the state of ship recycling in Indonesia is assessed, emphasising the regulatory and practical challenges local shipyards face. The results section identifies key national regulations and analyses their implementation in Indonesia's ship recycling yards. This study further evaluates the regulatory-practice gap, proposing recommendations for aligning national practices with international standards. The gap analysis also informs the identification of existing barriers, including non-compliance, lack of awareness, and insufficient infrastructure, all of which hinder the proper implementation of ship recycling regulations in Indonesia.

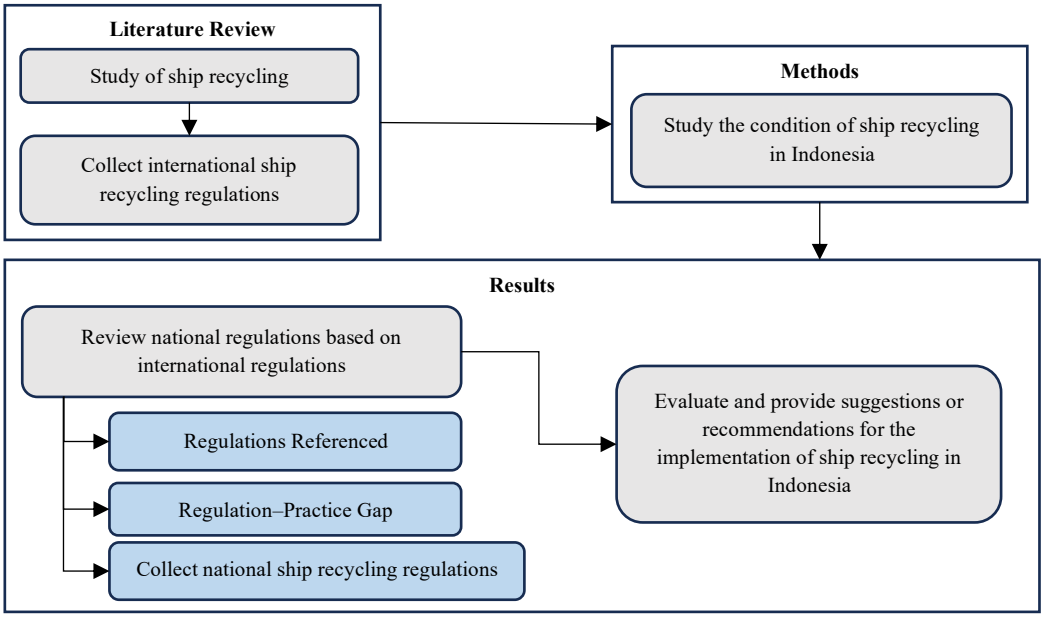

Figure 2. Research Framework

RESULT AND DISCUSSION

Result

The review of Indonesia's national regulations, particularly those concerning ship recycling, reveals significant gaps between domestic practices and international standards, the IMO 2012 Safe and Environmentally Sound Recycling of Ships guidelines. This section further elaborates on the regulation–practice gaps, which Table 2 highlights based on various authors' evaluations of ship recycling yards across Indonesia. The findings consistently reveal gaps between regulatory frameworks and on-site practices, non-compliance with safety and environmental rules, deficient hazardous-waste management, and inadequate infrastructure to satisfy international standards. These gaps highlight the significant challenges Indonesian ship-recycling yards encounter in achieving full compliance with national and international regulations. Table 3 presents Indonesia's national ship-recycling regulations, reflecting the sector's shifting regulatory framework. The Minister of Transportation specifically governs ship-recycling procedures, certification, and oversight through Regulation Number PM 29/2014, which Number PM 24/2022 amended. However, it lacks comprehensive guidelines for

e-ISSN: 2830-5728

hazardous material handling (Menteri Perhubungan RI, 2022). Concurrently, Government Regulation Number 31/2021 promotes the development of recycling facilities, but its alignment with international standards, notably the HKC, remains insufficient (Republik Indonesia, 2021). Other regulations, including Government Regulation Number 101/2014 on Hazardous Waste Management, aim to ensure proper waste disposal but still encounter enforcement challenges (Republik Indonesia, 2014). Despite these efforts, Indonesia's regulatory framework for ship recycling appears fragmented, characterised by weak enforcement and persistent gaps in aligning national practices with global environmental and safety norms.

Table 3. National Regulations Governing Ship Recycling in Indonesia

Regulation	Details
Minister of Transportation Regulation Nr. PM 29/2014, amended by Nr. PM 24/2022 on Maritime Environmental Pollution Prevention	Regulates ship recycling procedures, certifications, and supervision for ships flagged in Indonesia or foreign ships being recycled in Indonesia.
Government Regulation Nr. 31/2021 on Implementation of the Shipping Sector	Supports the development of ship recycling facilities in Indonesia by ensuring compliance with international standards for environmental and safety regulations in the shipping sector.
Government Regulation Nr. 31/2020 on the Addition of State Capital Participation of the Republic of Indonesia into the Share Capital of the Limited Liability Company (Persero) PT Permodalan Nasional Madani	Facilitates the growth of related industries by providing financial support to PT Permodalan Nasional Madani, encouraging investment in eco-friendly ship recycling technologies.
Circular Letter Nr. 19/PK/DK/2019	Provides guidelines for safe ship recycling practices, ensuring compliance with environmental and safety standards for ships under recycling.
Minister of Industry Regulation Nr. 40/2016 on Industrial Estate Guidance	Provides provisions for maritime security and ship operations, relevant to the processes of ship recycling and safety during decommissioning.
Government Regulation Nr. 142/2015 on Industrial Estates	Focuses on the supervision of ship recycling facilities, including certification and operational guidelines for decommissioning ships.
Ministry of Transportation Regulation Nr. 29/2014 on Prevention of Maritime Environmental Pollution	Sets standards for the prevention of maritime pollution, which must be adhered to by ships undergoing recycling.
Government Regulation Nr. 101/2014 on the Management of Hazardous and Toxic Waste	Establishes guidelines on managing hazardous and toxic waste, including waste generated from maritime operations.
Government Regulation Nr. 21/2010 on Maritime Environmental Protection	Covers the prevention and management of maritime pollution, including pollution resulting from ship operations and port activities.
National Law Nr. 32/2009 on Environmental Protection and Management (Republik Indonesia, 2009)	The topic pertains to the protection and management of the environment, specifically the management of ship-related pollution risks, including those arising from ship recycling activities.
National Law Nr. 17/2008 on Shipping (Republik Indonesia, 2008)	Covers maritime operations, including pollution control, safety, and ship management, applicable to ship recycling.
Presidential Instruction Nr. 5/2005 on Cabotage Principle	Presidential Instruction that includes support for Indonesia's commitment to international standards, including those relevant to ship recycling.

Source: data processed by the author (2025)

Discussion

The Indonesian ship recycling industry faces significant challenges related to environmental management, occupational health and safety (OHS), and regulatory

e-ISSN: 2830-5728

compliance. The current state of ship recycling in Indonesia, as highlighted in numerous studies, reveals a profound gap between existing practices and international standards. This section provides a comprehensive discussion of the environmental issues identified in the literature, their corresponding recommendations, and the necessary steps to align Indonesia's ship recycling industry with global best practices, as Table 4 illustrates.

Table 4. Environmental Issues and Recommendations in Ship Recycling Practices

Ref. Nr	Environmental Issues	Recommendations
1	Pollution from hazardous materials (asbestos, PCBs).	a. Promote the service provider model to enhance financial viability. b. Involve the Ministry of Industry, Transportation, and Environment in regulatory efforts. c. Construct shipyards in strategic locations (e.g., Bojonegara, Banten) with access to ports and steel plants. d. Partner with hazardous waste treatment facilities.
2	Risks include hazardous waste spills (e.g., asbestos, PCBs) and marine contamination.	a. Construct dedicated on-land ship recycling yards. b. Strict adherence to the HKC. c. Integrate hazardous waste management into yard design. d. Collaborate with waste management entities. e. Equip yards with necessary mechanical tools and safety systems.
3	Impacts include toxic waste in coastal areas and heavy metal pollution (e.g., Pb, Hg, Cd) in sediments.	a. Disseminate regulations widely to stakeholders. b. Offer government incentives. c. Simplify registration procedures. d. Promote training on OHS and environmental management. e. Integrate and synchronize existing regulations.
4	Environmental concerns including toxic fumes, residual fuels, and noise pollution.	a. Broader adoption of the Three Step Online Tool. b. Strengthening interdisciplinary expert collaboration. c. Further training and awareness programs. d. Encourage governmental policy alignment with risk management standards.
5	Impacting marine pollution (oil, heavy metals, asbestos) and risk of transboundary pollution.	a. Ratify the HKC and align national law accordingly. b. Establish comprehensive regulations covering ≥500 GT ships. c. Ban harmful methods (e.g., beaching) d. Develop technical guidelines and inspection systems. e. Strengthen inter-agency coordination and enforcement.
6	Environmental impacts include pollution and poor hazardous waste (B3) management.	a. Design and build an integrated ship recycling estate. b. Include all required industries and facilities. c. Align the estate with regulatory requirements. d. Use Bloc Plan programming to optimize layout.
7	a. Pollution is similar to heavy industries, including toxic metals and hazardous materials. b. Waste management is insufficient and poorly regulated.	a. Build eco-industrial parks following international norms. b. Implement mixed public-private management. c. Prioritize infrastructure and regulatory compliance. d. Enhance training and safety infrastructure.
8	Exposure to hazardous materials, lack of clear waste handling systems.	a. Upgrade existing yards to comply with the HKC. b. Implement structured OHS management systems. c. Improve training programs and PPE usage. d. Encourage regulatory support and monitoring mechanisms. e. Develop SOPs for high-risk tasks.
9	Limited waste (B3/hazardous waste) management.	a. Establish SRF clusters in Kamal and Bojonegara. b. Strengthen regulation aligned with the HKC. c. Encourage investment through government incentives. d. Improve inter-industry coordination (e.g., with steel and waste sectors).
10	a. Soil and water contamination from oil, paint, and asbestos. b. Improper handling of B3 waste (hazardous materials).	a. Align national regulations with the HKC. b. Invest in infrastructure and training. c. Strengthen inter-agency coordination. d. Develop a centralized database for ship dismantling statistics. e. Promote public-private partnerships to improve recycling yards.
11	Soil and water pollution, air pollution from burning toxic materials, worker health risks.	a. Establishment of comprehensive waste handling protocols. b. Regulatory strengthening and enforcement c. Training and capacity building. d. Investment in facility modernization.

Source: data processed by the author (2025)

e-ISSN: 2830-5728

Pollution from hazardous materials remains a serious concern in Indonesia's ship recycling industry, as dismantled ships often contain asbestos, PCBs, and other toxic substances, yet many shipyards do not have the necessary infrastructure to handle these safely (Agung and Afriansyah, 2021). Poor handling practices contaminate soil and water, aggravating environmental degradation and directly threatening the health and livelihoods of coastal communities that rely on these resources (Sunaryo *et al.*, 2020; Mutmainnah *et al.*, 2024). Without proper waste management systems, toxic fumes, residual fuels, and excessive noise further damage local air and water quality (Fariya *et al.*, 2021). The widespread use of the beaching method, which runs ships aground on beaches without adequate containment, adds to the problem by releasing oil, heavy metals, and asbestos that pollute surrounding waters, harm marine biodiversity, and reduce fish stocks, which in turn diminishes the income and food security of local fishing communities (Hariyanto *et al.*, 2023). Occupational health and safety (OHS) remain a major concern, with workers routinely exposed to hazardous substances without adequate personal protective equipment (PPE) and operating under weakly enforced safety protocols, which heightens accident risks, fosters chronic health conditions, and imposes broader healthcare costs on society (Jamaluddin *et al.*, 2022). Although regulations specifically Law Nr. 17/2008 on Shipping, Government Regulation Nr. 101/2014 on Hazardous Waste Management, and Ministry of Transportation Regulation Number PM 29/2014, establish a legal framework for safer practices, poor coordination and weak enforcement mean many shipyards do not comply, which undermines the industry's credibility and discourages international investment in greener technologies (Sunaryo *et al.*, 2021).

To tackle these problems, experts recommend building dedicated on-land ship recycling yards equipped with modern waste management systems that meet international standards, which would reduce marine contamination and prevent hazardous leaks (Sunaryo and Tjitrosoemarto, 2022; Sunaryo and Indianto, 2024). The findings also support the adoption of the service provider model as a sustainable funding approach that spreads financial risk and attracts investment in cleaner technologies and proper waste handling (Sunaryo *et al.*, 2020; Mutmainnah *et al.*, 2024). Strengthening OHS management by enforcing mandatory PPE use and clear Standard Operating Procedures for high-risk tasks would protect workers and improve the industry's image. A more coordinated and structured regulatory framework that aligns national rules with international standards, the HKC, would improve governance, ensure consistent monitoring, and close enforcement gaps. Establishing Ship Recycling Facility (SRF) clusters in key locations such as Kamal and Bojonegara would enhance safety and efficiency in recycling operations, strengthen waste management, and advance the circular economy.

CONCLUSION

This research concludes that the Indonesian ship recycling industry still faces a significant gap between regulations and field practices. Ratification efforts and the establishment of domestic frameworks have not fully aligned with global conventions, resulting in environmental risks, weak worker protection, and low institutional enforcement effectiveness. Comparisons with practices in Bangladesh and India demonstrate the importance of policy coordination and institutional capacity building to achieve a sustainable and safe ship recycling system.

Modernising the ship recycling industry requires ratification of the Hong Kong Convention, integrated regulatory reforms, and increased shipyard capacity aligned with the *Astagatra* framework to strengthen maritime security, sustainable resource utilisation, community welfare, and governance, as well as economic and defence resilience. These efforts emphasise the strategic role of ship recycling for Indonesia's National Resilience. This research is limited to analysing regulations and practices without examining microeconomic aspects and technological efficiency. Therefore, further research is needed to formulate policy evaluation models, assess maritime economic impacts, and strengthen institutional capacity based on national resilience indicators.

REFERENCE

Abdullah, A., Awal, Z. I., Alamgir, M. Z., Mia, M. J., & Mim, F. (2023). A review on ship recycling industry in Bangladesh from global perspective. *Journal of Ocean and Coastal Economics, 10*(1). https://doi.org/10.15351/2373-8456.1165

Agung, B. J., & Afriansyah, A. (2021). The urgency of green ship recycling methods and its regulations in Indonesia from the international law perspective. *UNRAM Law Review, 6*(2), 136-149. https://doi.org/10.29303/ulrev.v6i2.236

Akriananta, W., & Suastika, K. (2017). Pengembangan galangan daur-ulang kapal ramah lingkungan di Indonesia menggunakan metode ANP: Studi kasus galangan daur-ulang kapal di Kamal, Madura. *Jurnal Kelautan Nasional, 12*(1), 33. https://doi.org/10.15578/jkn.v12i1.6196

Alcaide, J. I., Rodríguez-Díaz, E., & Piniella, F. (2017). European policies on ship recycling: A stakeholder survey. *Marine Policy, 81*(December 2016), 262-272. https://doi.org/10.1016/j.marpol.2017.03.037

Buchary, E., Pitcher, T. J., & Pramod, G. (2006). An estimation of compliance of the fisheries of Italy with Article 7 (Fisheries Management) of the UN Code of Conduct for Responsible Fishing. In *Evaluations of Compliance with the UN Code of Conduct for Responsible Fisheries* (pp. 1–38).

Celik, M. S., Akyar, D. A., & Ceylan, B. O. (2024). Navigating environmental sustainability in the ship recycling industry: Integrated SWOT-TOWS-ANP approach. *Ocean Engineering, 295*(January), 116906. https://doi.org/10.1016/j.oceaneng.2024.116906

Chang, Y. C., Wang, N., & Durak, O. S. (2010). Ship recycling and marine pollution. *Marine Pollution Bulletin, 60*(9), 1390–1396. https://doi.org/10.1016/j.marpolbul.2010.05.021

Choi, J.K., Kelley, D., Murphy, S., & Thangamani, D. (2016) 'Economic and environmental perspectives of end-of-life ship management', *Resources, Conservation and Recycling*, 107, 82–91. https://doi.org/10.1016/j.resconrec.2015.12.007

Elizabeth, A., Cecilya, S., & Sunaryo, S. (2024). Waste and hazardous material handling at green ship recycling facilities. *Maritime Technology and Research, 6*(3). https://doi.org/10.33175/mtr.2024.268423

ElMenshawy, O. M., Ülkü, M. A., & Hsuan, J. (2024). Navigating green ship recycling: A systematic review and implications for circularity and sustainable development. *Sustainability, 16*(17), 7407. https://doi.org/10.3390/su16177407

Fariya, S., Anil Gunbeyaz, S., Emek Kurt, R., Turan, O., Giagloglou, E., Ates, A., Budi Djatmiko, E., & Nugroho, S. (2021). An online risk assessment tool to improve the standards of ship recycling operations. In *Proceedings of the 1st International Conference on the Stability and Safety of Ships and Ocean Vehicles* (pp. 7–11).

Fariya, S., Gunbeyaz, S. A., Kurt, R. E., Sunaryo, S., & Djatmiko, E. B. (2020). Developing sustainable green ship recycling facilities in Indonesia: Investigation of current situation. *Sustainable Development and Innovations in Marine Technologies - Proceedings of the 18th International Congress of the International Maritime Association of the Mediterranean, IMAM 2019*, 439-445. https://doi.org/10.1201/9780367810085-58

Fariya, S., Manfaat, D., & Suastika, K. (2016). Technical analysis of the development of ship recycling yard in Indonesia. *The 2nd International Seminar on Science and Technology* (February), 1–10.

Golbabaei, F., Bunker, J., Yigitcanlar, T., Baker, D., Mirhashemi, A., & Paz, A. (2024) 'Sustainable end-of-life management of abandoned and derelict vessels through the lens of circular economy', *Journal of Cleaner Production*, 474(October 2023), 143559. https://doi.org/10.1016/j.jclepro.2024.143559

Günes, E., Flaz, E., & Arslan, O. (2024). Comparing the ship recycling process for different countries: A comparative study of Türkiye, Bangladesh, and India. In Global Maritime Congress (GMC'24) (pp. 265–267).

Hadjiyianni, I., & Pouikli, K. (2024a). End-of-life ships "from cradle to grave" under the Hong Kong Convention and the EU Ship Recycling Regulation. In *The Regulatory Landscape of Ship Recycling* (pp. 165–213). https://doi.org/10.4337/9781035314683.00013

Hadjiyianni, I., & Pouikli, K. (2024b). *The Regulatory Landscape of Ship Recycling*. https://doi.org/10.4337/9781035314683.

Hariyanto, Gutami, N. I., Qonita, Z., Shabrina, N., Wibowo, D. A., & Muhtadi, A. (2023). The development of ship recycling facility cluster in Indonesia. *IOP Conference Series: Earth and Environmental Science, 1166*(1). https://doi.org/10.1088/1755-1315/1166/1/012007

Hartanto, D.R. (2024) 'National Policy on Particularly Sensitive Sea Ares: Step Towards Indonesian Marine Protection and Sustainable Shipping', *Jurnal Lemhannas RI*, 12(3), 309–332. https://doi.org/10.55960/jlri.v12i3.980

Hiremath, A. M., Pandey, S. K., & Asolekar, S. R. (2016). Development of ship-specific recycling plan to improve health safety and environment in ship recycling yards. *Journal of Cleaner Production, 116*, 279–298. https://doi.org/10.1016/j.jclepro.2016.01.006

IMO (2011) *ANNEX 2 Resolution MEPC.196(62): 2011 Guidelines for the Development of the Ship Recycling Plan*, *Hong Kong Convention*.

IMO (2012a) *ANNEX 4 Resolution MEPC.210(63): 2012 Guidelines for Safe and Environentally Sound Ship Recycling*, *Hong Kong Convention*.

IMO (2012b) 'ANNEX 5 Resolution MEPC.211(63): 2012 Guidelines for the Authorization of Ship Recycling Facilities', *Hong Kong Convention*, 211(March), pp. 1–12.

IMO (2012c) *Resolution MEPC.222(64): 2012 Guidelines for the survey and certification*

of ships under the Hong Kong Convention, *Hong Kong Convention*.

IMO (2012d) *Resolution MEPC.223(64): 2012 Guidelines for the inspection of ships under the Hong Kong Convention*, *Hong Kong Convention*.

IMO (2023) *ANNEX 18 Resolution MEPC.379(80) IHM: 2023 Guidelines for the development of the Inventory of the Hazardous Materials*.

Jain, K. P., Pruyn, J. F. J., & Hopman, J. J. (2014). Design foJadi manar recycling: A route to green ship recycling. *Maritime Technology and Engineering*, 269-276. https://doi.org/10.13140/2.1.1517.3127

Jamaluddin, Zaman, M.B., Pitana, T., Prastowo, H., Priyanta, D., Siswantoro, N., Hasanuddin, Purnomo, A., Sunaryo, & Hariyanto, S. (2022). Safety analysis and ship recycling yard evaluation of Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships. *IOP Conference Series: Earth and Environmental Science, 972*(1). https://doi.org/10.1088/1755-1315/972/1/012052

Mannan, B., Rizvi, M. J., & Dai, Y. M. (2023). Does end-of-life ships research trends change in last three decades? A review for the future roadmap. *Journal of International Maritime Safety, Environmental Affairs, and Shipping, 7*(1). https://doi.org/10.1080/25725084.2023.2187603

Mannan, B., Rizvi, M. J., & Dai, Y. M. (2024). Ship recycling in developing economies of South Asia: Changing liability to a commodity. *Green Technologies and Sustainability, 2*(2), 100064. https://doi.org/10.1016/j.grets.2023.100064

Mathew, E. (2021) 'Ship recycling, market imperfections and the relevance of a consortium of ship recycling nations in the Indian subcontinent', *Journal of International Maritime Safety, Environmental Affairs, and Shipping*, 5(2), 23–31. https://doi.org/10.1080/25725084.2021.1921994

Menteri Perhubungan RI (2014) *Peraturan Menteri Perhubungan Republik Indonesia Nomor: PM 29 Tahun 2014 Tentang Pencegahan Pencemaran Lingkungan Maritim*.

Menteri Perhubungan RI (2019) *Surat Edaran Nomor: 19/PK/BK/2019 tentang Penutuhan Kapal Berbendera Indonesia*.

Menteri Perhubungan RI (2022) *Peraturan Menteri Perhubungan Republik Indonesia Nomor PM 24 Tahun 2022 tentang Perubahan Atas Peraturan Menteri Perhubungan Nomor PM Tahun 2014 tentang Pencegahan Pencemaran Lingkungan Maritim*.

Mikelis, N. (2019). *Ship recycling, Sustainable Shipping: A Cross-Disciplinary View*. https://doi.org/10.1007/978-3-030-04330-8_6

Mikelis, N. E. (2008). A statistical overview of ship recycling. *WMU Journal of Maritime Affairs, 7*(1), 227–239. https://doi.org/10.1007/BF03195133

Munabari, F., & Sellita (2025) 'The Reorientation of Indonesia's Maritime Fulcrum in Addressing Shifting Priorities and Strategic Challenges', *Jurnal Lemhannas RI*, 12(4), 551–566. https://doi.org/10.55960/jlri.v12i4.967

Mutmainnah, W., Fauzi, F., Mauliani, D. R., Kurniawan, M. A., Hendratna, K. K., & Sunaryo, S. (2024). Steel scrap prediction from Indonesian ship recycling: Ship type point of view. *IOP Conference Series: Earth and Environmental Science, 1423*(1). https://doi.org/10.1088/1755-1315/1423/1/012042

Oktaviany, M.A. (2019) *Challenges for the ratification of the Hong Kong Convention for Challenges for the ratification of the Hong Kong Convention for in Indonesia Indonesia*. World Maritime University.

Prabowo, H. (2019). The methodologist for regulation a new policy of ship recycling in Indonesia based on HKC 2009. *World Maritime University*.

Pulungan, E. D. (2024). From Archipelago to Maritime Hub: Indonesia's Quest to Become the World's New Maritime Axis. *Jurnal Ilmiah Ilmu Sosial, 10*(2), 106–117. https://doi.org/10.23887/jiis.v10i2.78631

Ramli, I. M., & Michelle, C. K. (2023). Integrative Report on Implementation of the Circular Economy in ASEAN.

Republik Indonesia (2005) *Intruksi Presiden Republik Indonesia Nomor 5 Tahun 2005 Tentang Pemberdayaan Industri Pelayaran Nasional*.

Republik Indonesia (2008) *Undang-Undang Republik Indonesia Nomor 17 Tahun 2008 Tentang Pelayaran*.

Republik Indonesia (2009) *Undang-Undang Republik Indonesia Nomor 32 Tahun 2009 tentang Perlindungan dan Pengelolaan Lingkungan Hidup*.

Republik Indonesia (2010) *Peraturan Pemerintah Republik Indonesia No.21 Tahun 2010 Tentang Perlindungan Lingkungan Maritim*.

Republik Indonesia (2014) *Peraturan Pemerintah Republik Indonesia Nomor 101 Tahun 2014 tentang Pengelolaan Limbah Bahan Berbahaya dan Beracun*.

Republik Indonesia (2015) *Peraturan Pemerintah Republik Indonesia Nomor 142 Tahun 2015 tentang Kawasan Industri*.

Republik Indonesia (2016) *Peraturan Pemerintah Republik Indonesia Nomor 40 Tahun 2016 tentang Pajak Penghasilan atas Penghasilan dari Pengalihan Real Estat dalam Skema Kontrak Investasi Kolektif Tertentu*.

Republik Indonesia (2020) *Peraturan Pemerintah Republik Indonesia Nomor 31 Tahun 2020 tentang Penambahan Penyertaan Modal Negara Republik Indonesia ke dalam Modal Saham Perusahaan Perseroan (Persero) PT Permodalan Nasional Madani*.

Republik Indonesia (2021) *Peraturan Pemerintah Republik Indonesia No.31 Tahun 2021 Tentang Penyelenggaraan Bidang Pelayaran*.

Sari, W. R., Gunawan, G., Surjosatyo, A., & Muzhoffar, D. A. F. (2024). Systematic analysis of potential marine renewable energy for coastal ecological balance on Bawean Island: A review. *International Journal of Marine Engineering Innovation and Research, 9*(2), 349–362. https://doi.org/10.12962/j25481479.v9i2.20298

Sari, W. R., Gunawan, G., Waskito, K. T., & Muzhoffar, D. A. F. (2025). Integrating marine renewable energy with green hydrogen production from seawater: Feasibility and future prospects for sustainable energy development in Indonesia. *Journal of Marine Science and Application*, (January). https://doi.org/10.1007/s11804-025-00631-6

Sarjito, A. (2023) 'Peran Teknologi Dalam Pembangunan Kemaritiman Indonesia', *Jurnal Lemhannas RI*, 11(4), 219–236. https://doi.org/10.55960/jlri.v11i4.483

Sarjito, A. (2023) 'Peran Teknologi Dalam Pembangunan Kemaritiman Indonesia',

Jurnal Lemhannas RI, 11(4), pp. 219–236. Available at: https://doi.org/10.55960/jlri.v11i4.483.

Sarraf, M., Stuer-Lauridsen, F., Dyoulgerov, M., Bloch, R., Wingfield, S., & Watkinson, R. (2010) 'The Ship Breaking and Recycling Industry in Bangladesh and Pakistan', *The Ship Breaking and Recycling Industry in Bangladesh and Pakistan*, (December), 1–92. https://doi.org/10.1596/2968

Solakivi, T., Kiiski, T., Kuusinen, T., & Ojala, L. (2021). The European Ship Recycling Regulation and its market implications: Ship-recycling capacity and market potential. *Journal of Cleaner Production, 294*, 126235. https://doi.org/10.1016/j.jclepro.2021.126235

Sornn-Friese, H., Roth, E., Sofev, P., Kaiser, B., Sinding, K., Vagsheyg, H., Eikås, A., Høivik, H., Langhorst, K., Larsen, F.T., Olsen, T. Dyrhol Paulsen, M., Lange, B., & Stuer-Lauridsen, F. (2021). Creating circular economy clusters for sustainable ship recycling.

Sunaryo, Hanura, A. R., & Hussein, F. (2020). Feasibility study on the financial aspect of green ship recycling yard business model. *AIP Conference Proceedings, 2227*(May 2020). https://doi.org/10.1063/5.0001072

Sunaryo, S., & Indianto, A. F. (2024). Environmentally friendly ship recycling yard design for general cargo ship up to 30,000 DWT and ship-sets: Tug and barge. In *Recent Progress on: Mechanical, Infrastructure and Industrial Engineering* (pp. 1–6). https://doi.org/10.1063/5.0001028

Sunaryo, S., & Aidane, M. A. (2022). Development strategy of eco ship recycling industrial park. *Evergreen, 9*(2), 524–530. https://doi.org/10.5109/4794183

Sunaryo, S., Djatmiko, E., Fariya, S., Kurt, R., & Gunbeyaz, S. (2021). A gap analysis of ship-recycling practices in Indonesia. *Recycling, 6*(3). https://doi.org/10.3390/recycling6030048

Sunaryo, S., & Tjitrosoemarto, B. A. (2022). Integrated ship recycling industrial estate design concept for Indonesia. *IOP Conference Series: Earth and Environmental Science, 972*(1). https://doi.org/10.1088/1755-1315/972/1/012042

Supriyanto, R. A. (2015). Beyond the Archipelagic Outlook: The Law of the Sea, Maritime Security and the Great Powers, Indonesia's Ascent. https://doi.org/10.1057/9781137397416

Turk Loydu (2014) *Survey and Certification Rules for Ships under the Hong Kong Convention (According to MEPC 222(64))*.