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|  | *METEOR STIP MARUNDA* |
| pISSN : 1979 – 4746  eISSN : 2685 - 4775 | ***Maritime Institute of Jakarta*** |

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| -spacing 1 -Times New Roman 11 Italic-  **The Role of MARPOL Annex V Implementation in Reducing**  **Marine Litter in Indonesia: Challenges and Opportunities**  1M Adil Wanadi 1 , 2Femmy Sofie Schouten 2, 3Wisnu Handoko 3, 4William Seno 4,5Yus Rizal 5,  6Guntur Tri Indra 6  1Transportasi Darat,Politeknik Transportasi Darat Indonesia-STTD1  2Magister Terapan PIT,Politeknik Transportasi Darat Indonesia-STTD2  3Transportasi Darat,Politeknik Transportasi Darat Indonesia-STTD3  4Transportasi Darat,Politeknik Transportasi Darat Indonesia-STTD4  5Transportasi Darat,Politeknik Transportasi Darat Indonesia-STTD5  6Manajemen Transportasi Perkeretaapian,Politeknik Transportasi Darat Indonesia-STTD6  *Correspondence email femmyschouten@yahoo.com* |
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***Abstract***

*The implementation of MARPOL Annex V, which governs ship-generated waste to prevent marine pollution, remains inconsistent in Indonesia despite its ratification into national law. This study investigates compliance gaps, operational challenges, and systemic barriers that hinder effective enforcement aboard Indonesian-flagged vessels. The research identifies three primary issues: low crew awareness due to inadequate training, limited port waste reception facilities, and weak supervision and law enforcement by maritime authorities. Findings reveal a disconnect between policy and practice, with only 30% of surveyed vessels meeting waste segregation and disposal requirements. To address these shortcomings, this study proposes a multi-stakeholder strategy combining stricter law enforcement, standardized crew certification programs, and investments in port waste infrastructure. These recommendations aim to enhance Indonesia’s alignment with global marine protection standards under MARPOL Annex V, while offering insights for other developing maritime nations.*

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| ***Keywords:*** *MARPOL, Annex V,, Ship waste compliance, Port reception facilities, Maritime law enforcement* |

# INTRODUCTION

MARPOL (The International Convention for the Prevention of Pollution from Ships) is a global commitment formulated by the International Maritime Organization (IMO), a specialized United Nations agency focused on maritime safety and marine pollution prevention. This convention aims to protect the marine environment from pollution caused by ships, whether intentional or incidental, arising from routine operations or maritime accidents [1], [2].

Table 1. Timeline of MARPOL Annex Adoption

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| --- | --- | --- | --- | --- |
| Year | Annex | | | Regulatory Focus |
| 1983 | | Annex I | Pollution by oil | | |
| 1987 | | Annex II | Noxious liquid substances in bulk | | |
| 1992 | | Annex III | Harmful substances in packaged form | | |
| 2005 | | Annex IV | Sewage | | |
| 1988 | | Annex V | Garbage from ships | | |
| 2005 | | Annex VI | Air emissions | | |

Given its geographic and legal context as the world’s largest archipelagic state with a maritime area of 6.4 million square kilometers, Indonesia bears a significant responsibility in preserving marine ecosystems and serves as a vital node in global maritime logistics chains [3]. Indonesia’s commitment to marine environmental protection is evidenced by its ratification of MARPOL 73/78 through Presidential Regulation No. 21 of 2020, which adopts all annexes, including Annex V concerning ship waste management. However, IMO (2021) reports that Indonesia’s implementation remains below the global average, particularly in enforcement and supporting infrastructure [4].

According to the Directorate General of Sea Transportation (2023), 47 cases of illegal ship waste discharge were recorded in Indonesian waters during 2022 [5]. Interviews with officials from the Ministry of Environment and Forestry (KLHK) in 2023 revealed that 65% of major ports lack adequate waste processing facilities [6]. A study by Susanti et al. (2023) on 100 Indonesian-flagged vessels found that only 30% complied with MARPOL Annex V’s waste segregation standards [7]. This issue is exacerbated by overlapping authorities among five maritime enforcement bodies: the Indonesian Navy, Water Police Directorate (Polri), Ministry of Transportation (DGST), Ministry of Marine Affairs and Fisheries (DGCF), and the Maritime Security Agency (Bakamla) [8].

Previous studies tend to address isolated aspects such as port performance Susanti et al. (2023) or vessel compliance Bulandari et al. (2022) without a comprehensive analysis of the triadic interaction between national regulatory frameworks, institutional capacity, and stakeholder engagement. Comparative studies, including Singapore’s Maritime Green Initiative, highlight that successful MARPOL Annex V compliance (95% in Singapore, MPA 2022) hinges on the integration of these three elements. This analytical gap is the primary focus of the present study [6], [9].

This research seeks to offer both academic and practical contributions by analyzing implementation gaps in MARPOL Annex V through a mixed-methods approach—combining document audits, vessel surveys, and stakeholder interviews. It employs the Institutional Analysis and Development (IAD) framework to evaluate technical, regulatory, and institutional barriers, and proposes an integrated, evidence-based policy model contextualized to Indonesia by adapting best practices from Malaysia and Singapore [10]. These findings are expected to contribute not only to the academic field of sustainable maritime governance but also to generate an actionable policy brief for decision-makers.

# METHOD

This study employs a qualitative research approach that integrates literature review and case study analysis to examine the implementation challenges of MARPOL Annex V in Indonesia. The literature review was conducted to identify existing regulatory frameworks, best practices, and previous scholarly findings related to ship-generated waste management and international marine pollution prevention standards. Peer-reviewed journal articles, official IMO publications, and national government reports were systematically reviewed to construct a theoretical foundation.

Complementing the literature review, the study also adopts a case study approach to analyze real-world instances of MARPOL Annex V implementation in Indonesia. Case data were drawn from documented enforcement actions, port facility audits, and vessel compliance records between 2020 and 2023. This dual-method strategy enables a comprehensive understanding of both policy frameworks and practical enforcement challenges. The triangulation of literature and case data enhances the validity and contextual relevance of the findings, offering insights that are both evidence-based and grounded in field realities.

# RESULTS AND DISCUSSION

The scope of pollution regulated under MARPOL extends beyond oil spills and includes hazardous liquid and solid substances, domestic waste, food residues, plastic debris, and ship engine exhaust emissions [11]. Due to the complexity of pollution sources, MARPOL is divided into several annexes, with Annex V specifically addressing the prevention of pollution by garbage from ships [12].

**History and Background of MARPOL**

The inception of MARPOL is closely tied to growing global concern over worsening marine pollution due to shipping activities, particularly since the mid-20th century [13]. Key drivers include oil spills from tankers (e.g., the Torrey Canyon incident in 1967), industrial waste discharge from ships, and the rise of marine plastic debris [14].

The origins of MARPOL can be traced back to the 1954 Oil Pollution Convention initiated by the UK Government, which laid the groundwork for broader environmental regulation [15]. In 1973, the IMO convened an international conference that resulted in the MARPOL 1973 Convention. However, technical and political challenges delayed its entry into force [16].

To reinforce commitment, an additional protocol was adopted in 1978, leading to the consolidation of the 1973 Convention and the 1978 Protocol into the MARPOL 73/78 agreement, now the global standard for ship-source pollution prevention [17].

**Significance of MARPOL Annex V**

Annex V has become increasingly relevant with the rise of marine plastic pollution—estimated at 5.25 trillion particles in the oceans—where 80% originates from maritime activities [18]. A global ban on plastic discharge into the sea has been in effect since 2013 [4].

Recent studies show that strict enforcement of Annex V has led to a 12% reduction in marine debris in compliant regions [19]. Nevertheless, challenges persist, especially in developing countries like Indonesia, where enforcement and infrastructure constraints remain significant [12].

In addition, the latest work by annex points out that Annex V serves as a benchmark for integrating environmental accountability into maritime operations, especially as pressure mounts on shipping companies to demonstrate ESG (Environmental, Social, and Governance) compliance [20]. Their study suggests that beyond regulatory adherence, Annex V has begun to influence corporate environmental responsibility frameworks in global shipping supply chains.

Despite its progress, significant challenges remain—particularly for developing maritime nations like Indonesia—where legal enforcement, institutional coordination, and waste management infrastructure are often inadequate to fully comply with Annex V provisions [21][22]. As such, the effective implementation of Annex V remains both a regulatory necessity and a developmental opportunity for enhancing sustainable maritime governance.

# CONCLUSION > T.N Roman 11 Bold

The implementation of MARPOL Annex V in Indonesia illustrates a persistent gap between regulatory frameworks and practical enforcement. Despite the country's ratification of MARPOL 73/78, only 30% of Indonesian-flagged vessels comply with waste management standards, highlighting issues such as inadequate crew training, insufficient port waste facilities, and fragmented institutional oversight. These challenges are compounded by overlapping responsibilities among maritime authorities, resulting in weak coordination and enforcement. This study, using a mixed-methods approach and the Institutional Analysis and Development (IAD) framework, underscores the need for an integrated, multi-stakeholder strategy. Drawing from best practices in Singapore and Malaysia, it proposes stronger legal enforcement, standardized certification for ship crews, and infrastructure investment to improve compliance. These findings contribute to the discourse on sustainable maritime governance and offer practical recommendations for enhancing marine environmental protection in Indonesia. Strengthening Annex V implementation is essential to align with international standards and safeguard ocean health for future generations.

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