INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 09 Issue 06 June 2026

DOI: 10.47191/ijmra/v9-i6-05, Impact Factor: 8.685

Page No. 3267-3282

Current Challenges of Bangladesh Ship Recycling and Sustainable Solution of Local Industry

Dr. Hossain K A

Vice Chancellor, Bangladesh Maritime University, Dhaka, Bangladesh

ORCID ID:0009000708926069

ABSTRACT: Ship recycling, a reverse engineering process, involves the deconstruction of End of Life (EOL) vessels for recovering valuable materials through safe, reasonable and eco-friendly procedures. Over the last three decades, ship recycling has mostly been centered around a few South Asian countries—mainly Bangladesh, India, China, and Pakistan; where vessels are usually beached and dismantled through labor-intensive methods which have moderate safety measures at best. Roughly 90% of the global scrap tonnage is recycled in South Asian nations, e.g. Bangladesh's local recycling yards currently account for almost 40% of the world's ship recycling tonnage, ranking alongside India and Pakistan as the world's top ship recycling nations. Local yards supply the necessary raw materials and employ large numbers of workers in economically vulnerable coastal areas. However, the industry faces unique challenges in managing coastal zones, addressing environmental deterioration, enforcing laws, and ensuring occupational health and safety (OHS). This study will evaluate the potential, prospect and challenges of the Bangladesh ship recycling industry utilizing a mixed-methods approach, combining secondary and primary data analyses, available literature including a material flow analysis (MFA) of 26 recycled ships over a period of seven years, along with primary stakeholder interviews. This study will also point out the solutions to these challenges, ultimately aiming for sustainable industrial growth.

KEYWORDS: EOL ship, reverse engineering, MFA, reusable material, asbestos, distribution channel

1. INTRODUCTION

The dismantling and recycling of End-of-Life (EOL) vessels is known as the ship recycling industry which is a pivotal component of the global circular economy, facilitating the recovery of steel, machinery and non-ferrous metals. Ship recycling is an important and profitable industry, as thousands of outdated ships are recycled annually (Hossain, 2015a, b). The beaching technique is widely used in South and Southeast Asia owing to geographic locations and tidal conditions. The dry-dock system, on the other hand, is mostly used in wealthy nations like the USA and the EU and is seen as the safest and most environmentally sound, regardless of the expenses that come with it. Some countries, such as Turkey and China, have adopted a middle-ground approach using the "alongside" or "pier breaking" method rather than the conventional ones (Hossain, 2023a, b, c). Among these, Aliaga in Turkey and certain locations within the European Union are leading advocates for high-standard, environmentally friendly ship recycling practices, openly opposing the traditional beaching or slipway techniques. End-of-life (EOL) ships are usually beached for recycling and deconstruction in South Asian nations including Bangladesh, India, and Pakistan, taking advantage of the region's intertidal mudflats. These countries have played a significant role in environmental preservation by efficiently recycling decommissioned vessels—many of which, as history suggests, were once discarded in deep seas. Looking ahead, it is estimated that nearly 20,000 ships worldwide aged between 25 to 30 years which are approaching the end of their service life will soon require recycling (Hossain, 2023f, g).

At the Hong Kong Conference (HKC) in 2009, the International Maritime Organization (IMO) introduced the International Convention for the Safe and Sustainable Recycling of Ships to encourage ecologically conscious practices. Stricter requirements imposed in 2017 under the European Union Ship Recycling Regulation (EU SRR) are expected to have a major impact on global ship recycling, even though important maritime nations and South Asian ship recycling yards currently follow HKC standards and hold "Green Certifications"(Mambra, 2017). Major investments could occur from the EU's official recognition of the HKC-2009 compliance, particularly in the upgrade of ship recycling facilities in Alang, India; Chattogram, Bangladesh; and Gadani, Pakistan, thus ensuring the long-term sustainability of the beaching model (Hossain, 2023d, e). To improve business processes, maintain

worker safety, environmental standards and preserve the financial benefits of ship recycling in the area, a concerted effort is required (Khandakar, 2025). Ship recycling emphasizes on resource recovery and environmental sustainability by dismantling EOL vessels for recovering valuable raw materials like steel, machinery and equipment. In this sector, Bangladesh has become a major stakeholder and industry leader.

The coastline of Chattogram, particularly the Faujdarhat area, serves as the nation's primary hub for ship recycling operations, contributing to it becoming a billion-dollar business in Bangladesh(Hossain, 2021, 2024).Initiating in 1965, it currently provides over half of the nation's raw resources for domestic shipbuilding and steel production. The industry provides employment at a mass scale (around 200,000) and supports the livelihoods of around a million people, thus creating a vital source of income in economically vulnerable regions. Now, around 40% of the global EOL gross tonnage (GT) is recycled annually on the beaches of Bangladesh alone. However, the reliance on beaching continues to raise environmental concerns (Khandakar, 2025). This study will analyze the quantity and types of reusable and waste materials generated by the ship recycling process in Bangladesh, based on field-level data collected by author. It will further assess the efficiency of the domestic distribution channels (Hossain, 2025c).

Although fully green ship recycling, which complies with strict European regulations, is still costly, improving the beaching techniques currently employed in South Asian recycling yards can result in a more practical and ecologically friendly model. This study examines the industry's historical development, current regulatory challenges, performance from a global standpoint, and its socio-economic contributions. As an analytical and research-based investigation, the study offers critical insights into the current state of Bangladesh's ship recycling sector, forecasts its future trajectory, challenges, and outlines actionable pathways for sustainable and competitive growth in the global market (Hossain, 2025c). This research study seeks to address the following queries-

What is the current operational capacity and economic potential of Bangladeshi recycling sector?

a. What are the quantified outputs of useable and hazardous materials from local recycling yards?
b. What is the distribution channel of recycling materials?
c. What are the looming challenges currently plaguing the recycling industry of Bangladesh?
d. How can Bangladesh minimize health and environmental risks by optimizing economic benefits?
e. How can local recycling yards mitigate the present challenges of the industry?

2. DATA COLLECTION AND METHODOLOGY

Primary Data Collection and Assessment of Local Recycling Yards' Material Output.

To evaluate and depict the picture of Bangladesh ship recycling, data were collected in a span of seven years (2011–2017) from multiple ship recycling yards in Chattogram, covering 26 EOL ships of different sizes and types—including five bulk carriers, five tankers, six container ships, five cargo vessels, and five other miscellaneous types like passenger ships and offshore vessels (shown in figure 1). To provide a representative and logical sample, the ships were deliberately chosen based on differences in ship design, lifetime (15–25 years), diversified area (e.g., Asia, Europe, America), LDT range (8,000–60,000 MT), operational history, and adherence to dismantle regulations. Data collection has been directly aided by the Bangladesh Ship Breakers Association (BSBA), yard operators, and regulatory/law enforcement agencies like the Ministry of Industry (MOI), Ministry of Shipping (MOS), Department of Environment (DoE), Department of Labor (DoL), Ship Building and Ship Recycling Board (SBSRB), Chittagong Port Authority (CPA), DG Shipping, Bangladesh Navy, and Coast Guard. This strategy of involving multiple stakeholders guaranteed thorough and accurate data gathering that reflected operational refinements and real-world practices (Hossain, 2015a; Hossain & Zakaria, 2018; Mikelis, 2013, Hossain, 2019b, Hossain, 2024). This chapter will exhibit the current state and challenges of Bangladesh's local ship recycling sector and also focus on appropriate recycling procedures and distribution channel along with recommendations for sustainability going forward (Khandakar, 2025). The author has illustrated the actual distribution channels of reusable and waste materials generated by local industries in Bangladesh which has been achieved through on-ground analysis (Bois, 2009; Eolog, 2025) although it excludes nuclear waste or other releases, such as atmospheric emissions and diffuse water pollution (Eolog, 2025; Hoque & Emran, 2016). The average annual production of recyclable materials has been estimated from a sample of 26 different types of ships . Each ship's inventory took between six to eleven months for completion, involving sustained collaboration with the industry. Figure 1 below presents data and figures for these 26 EOL ships (Hossain, 2025c).

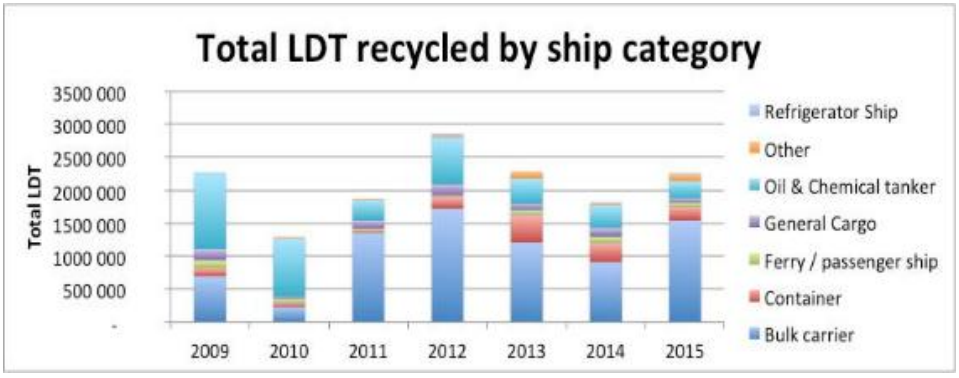

Figure 1. Data collection history including different type/category of ships with LDT

Secondary Data Collection, FGDs and Procedure.

Secondary data were gathered from various sources to provide the study's foundational context. These included academic journals, books, policy briefs, industry and yard records, government and institutional reports (e.g., MOI, BSRB, DoE, CPA), international organizations (IMO, UNCTAD, NGO Ship-breaking Platform), media reports, grey literature, and actual fieldwork carried out over the previous 20 years. Data on ship-breaking volumes, employment, scrap steel output, accidents, and environmental breaches were gathered to evaluate industry trends and compliance issues over the past two decades. Focus groups, quantitative forecasting, benchmarking, expert validation, historical and regulatory analysis, and secondary data collection are all included into the technique. This all-encompassing strategy aims to provide a comprehensive understanding of the industry's social, economic, environmental, and regulatory aspects. The data, analysis, and conclusions outline a complex yet crucial path as Bangladesh's ship recycling sector navigates the post-Hong Kong Convention (HKC) enforcement phase. Based on primary data from more than 500 stakeholders, field observations, the researcher's significant 20-year industry experience, and secondary data from global shipbreaking records (2014–2025), the report offers insights into industry readiness, competitiveness, and future prospects. To incorporate all ship recycling related **perspectives**, a series of Focus Group Discussions (FGDs) have been done with Shipyard workers (both skilled and unskilled), Yard owners and managers, Government officials (like Department of Environment, BSRB), NGO representatives (e.g., YPSA, Shipbreaking Platform), Local and international expertise, Yard Owners and executives, and Environmental and labor rights activists. Each FGD involved 6–10 participants, guided by a semi-structured questionnaire. Perceptions of workplace safety, obstacles to compliance, the consequences for social livelihoods, and opinions on the need of modernization are among the themes. FGDs have aimed to capture community-level insights that were often underrepresented in macro-level policy analysis. To examine Bangladesh's ship recycling industry, this research study will employ a mixed-methods research strategy that combines qualitative, quantitative, and policy analysis methods.

3. ANALYSIS OF OUTPUT OF LOCAL RECYCLING INDUSTRY OF BANGLADESH

Assumption and Analysis Procedures.

All reusable and trash elements of different sizes and types from 26 EOL ships that were disassembled and recycled in Bangladesh make up the essential data for this study, as figure 1 above illustrates. Data input, analysis, compilation, computing, and the calculation of numerical values (such as the industry's annual reusable and waste materials) have all been done using Microsoft Excel and the material flow analysis (MFA) application STAN. This study project does not cover nuclear waste or other outflows, such as air pollutants and diffuse pollutants into water. The non-economic value stream (NEVS) and the economic value stream (EVS) are the two primary material streams for each process. The recycling yard can profit from the products in the EVS stream that can be recycled or sold in the market for other uses. The recycling yard must pay for the materials in the NEVS stream that need to be disposed of at landfills or waste treatment plants (Chowdhury, 2019; Hoque et al., 2010; Hiremath et al., 2015). So, EVS stream products result in cash inflow for the recycling yard. And NEVS stream products cause cash outflow for the recycling yard. The distribution of material streams into the EVS and NEVS for yards might change depending on a variety of factors, such as location, recycling practices, demand in the used market, the presence of forward and backward linking companies, laws, and time (Hossain, 2018b, c and 2023a).

Calculation and Analysis of Reusable Material Output.

Ship recycling yields an extensive range of reusable materials, often comprising hundreds to thousands of distinct items per vessel. In this study, the author took the task of preparing a comprehensive inventory of materials and components from 26 EOL ships. Given the industry's restrictive nature and the sheer scale of the data, the process required sustained effort for over 7 years. To

facilitate this data-intensive project, the researcher assembled a dedicated team consisting of six data entry personnel and two supervisory managers (Hiremath et al, 2015; Hoque et al, 2010, and Chowdhury, 2019). The reusable materials extracted from the selected sample of ships were categorized into four chief groups in accordance with the guidelines set forth in the Hong Kong International Convention for the safe and environmentally sound recycling of ships (HKC, 2009; Gramman et al., 2007; Gregson et al., 2012) and has been shown in figure 2 below. This classification was further reinvigorated using principles of ship design and construction, drawing on the researcher's professional expertise as a naval architect. The classification scheme was also updated by existing academic and technical literature (Andersen, 2001; Arab News, 2024; Abdullah et al., 2010; EC Regulation, 2006; Eolog, 2025; Hossain & Zakaria, 2010a). The Material Flow Analysis (MFA) has been used as a tool to visualize, compile, estimate, plan, and analyze different scenarios that can arise as a result of breaking and recycling of EOL ships. The output of reusable materials and their amount from EOL ships have shown in Figure 3.

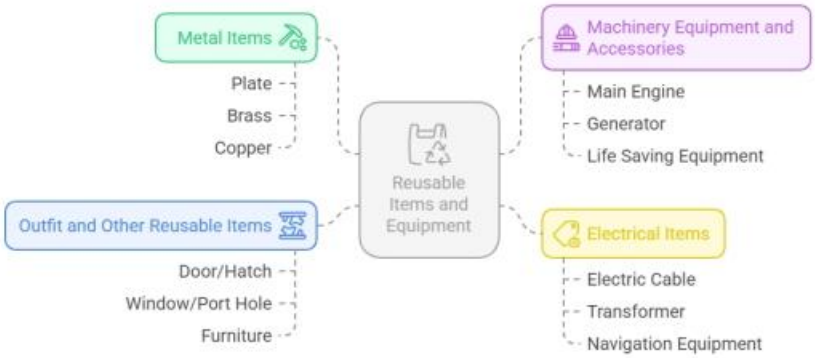

Figure 2. Illustration of reusable items and equipment extracted from EOL ships

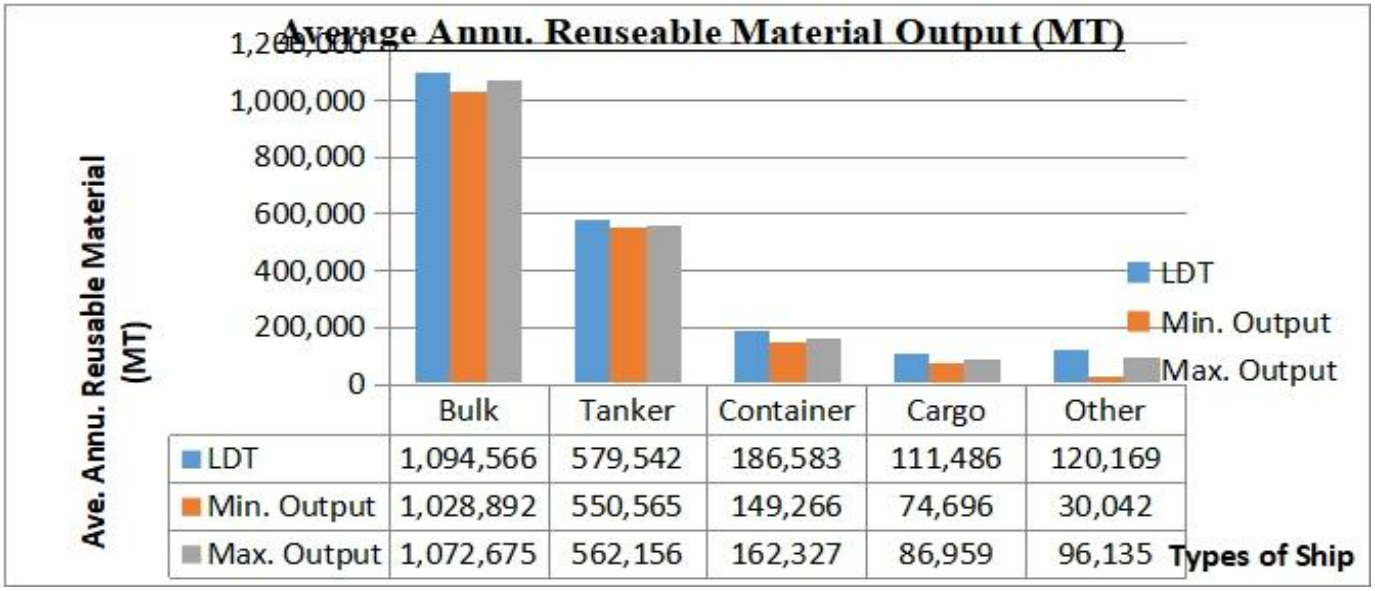

Figure 3. Average annual LDT against reusable material output in MT (Hossain, 2018b, c)

Calculation and Analysis of Waste Material Output.

To quantify waste material output and determine the amount and other factors, a combination of manual calculations and digital tools have been employed. It was observed that results from manual computation only differed by 0.4% compared to those generated by STAN, while outputs from Microsoft Excel were consistent with manual estimates (Eolog, 2025; Galley, 2014; Hossain et al., 2010a). The average yearly amount of hazardous material (in metric tons) produced from the sampled EOL ships have been shown in Figure 4. However, figure 5 below illustrates the relation among average reusable, waste and asbestos factor with LDT of EOL ships in Bangladeshi recycling yards (Hossain, 2018b, c, and Hossain, 2019b, c).

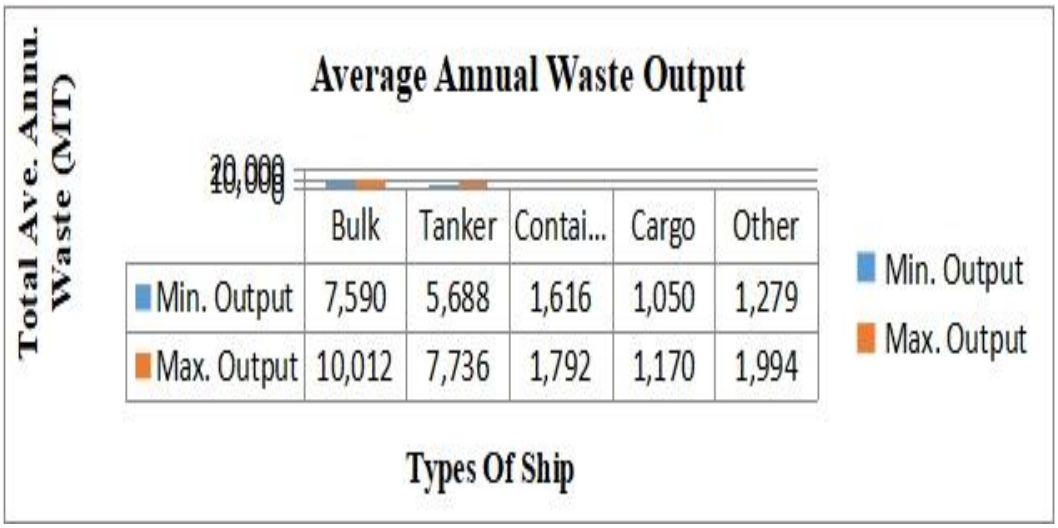

Figure 4. Total average annual HazMat or Waste output in MT from different types and sizes of EOL ships

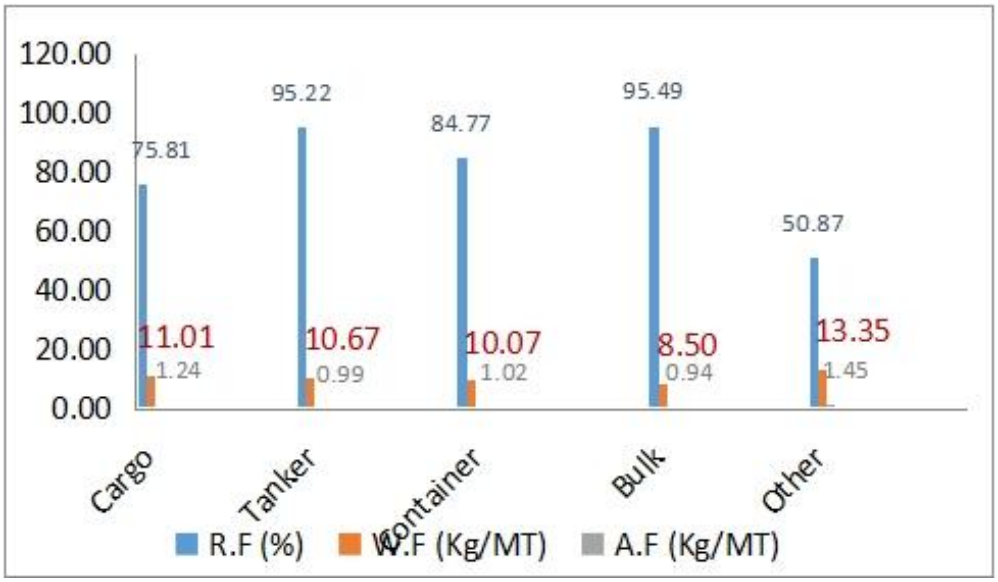

Figure 5. Relation among average reusable, waste and asbestos factor with LDT of EOL ships

Analysis of Result of Reusable Materials Factor and Annual Output (EVS).

Reusable materials, constituting ~73–95% of LDT (1,833,461–1,989,252 MT annually), are categorized in line with HKC (2009) guidelines into four groups to ease compilation and market distribution as discussed above. These materials are integral to local industries, re-rolling mill, supporting shipbuilding, construction, and small-scale enterprises (Hossain, 2015a; Sujauddin et al., 2017). Approximately 97% of materials including metal and even glass wool insulation (valued at USD 110/ton in Bangladesh vs. USD 100/ton in India), are recycled locally, due to strong demands in secondary markets (Hossain and Zakaria, 2018; Sarraf et al., 2010).Nonetheless, the renewable material factors and annual output of local recycling yards have been shown in table 1 below (Hossain, 2019b, c and Khandakar, 2025).

Table 1. Reusable material factors and annual output (2009–2016)

Ship Type	Reusable Factor (% LDT)	Annual Output (MT, Min–Max)
Bulk Carrier	75–92	450,000–550,000
Tanker	73–90	500,000–600,000
Container Carrier	78–95	400,000–480,000
Cargo Ship	76–93	350,000–420,000
Other Types	74–91	133,461–139,252
Total	73–95	1,833,461–1,989,252

Current Challenges of Bangladesh Ship Recycling and Sustainable Solution of Local Industry

Analysis of Hazardous Material or Waste Factor and Annual Output (NEVS).

Hazardous waste, comprising ~1+ % of LDT (17,215–22,702 MT annually), is categorized into six groups per HKC (2009) and Bangladesh Environment Conservation Act (1995) to ensure systematic management and disposal as discussed above. Efficient maintenance of these substances is integral to solving environmental and health risks (HKC, 2009; Demaria, 2010). About 97% of glass wool is recycled locally, with below 2% sent to TSDF. Bilge water, waste oil (USD 10–16/barrel), and solvents are sold to local industries (like brick furnaces). Incineration is technically viable but costly, while landfilling, though economical, poses long-term environmental risks (Hossain & Zakaria, 2018; Reddy et al., 2004). Hazardous material or waste factors and annual output of local recycling yards have been shown in table 2 below (Cencic et al, 2008; Devault et al, 2017 Demaria, 1010; Hiremath et al, 2015; Hoque et al, 2010, and Chowdhury, 2019 and Khandakar, 2025).

Table 2. Hazardous Material or Waste Factors and Annual Output (2009–2016)

Waste Category	Waste Factor (kg/LDT)	Annual Output (MT, Min–Max)
Asbestos (Group A)	0.5–2.0	1,000–4,000
Landfillable (B)	0.3–1.5	600–3,000
Incinerable (C)	0.2–1.2	400–2,400
Bilge/Liquids (D)	0.3–1.8	600–3,600
Heavy Metals (E)	0.1–0.5	200–1,000
Ozone-Depleting (F)	0.05–0.3	100–600
Total	1.45–7.3	17,215–22,702

Comparative Analysis with Other Countries.

A comparative assessment with Alang in India, informed by a longitudinal survey of 241 ships dismantled between 2011 and 2013, puts both similarities and clear differences to the fore in ship recycling practices. Bangladesh shows a higher average recovery of reusable materials per Light Displacement Ton (LDT), largely due to strong local market demand and minimal resale limitations. In Table 3, Bangladesh achieves greater material recovery compared to India across most categories. Reusable outputs range from 750 to 920 metric tons per 1,000 tons of LDT, compared to 600 to 725 metric tons in Alang. On the other hand, hazardous waste outputs, including asbestos, incinerables and bilge liquids, show relatively similar levels between the two referred locations, which highlights shared challenges in waste handling. However, table 3 has given a comparative analysis between Bangladesh and India of reusable and waste material output in kg per ton of LDT of EOL ships (Jain et al, 2013, 2017 and ILPI, 2016). The data indicates that Bangladesh records efficiency in resource extraction. However, waste generation remains consistent across ship types, but the process of disposal, such as landfilling and incineration, vary with local management capability (Hossain, 2019b, c and Khandakar, 2025). A closer comparison reveals that Alang maintains a more structured regulatory framework, primarily administered by the Gujarat Maritime Board and related agencies. On the other hand, Bangladesh relies on the Ship Breaking and Ship Recycling Board (SBSRB) and the Department of Environment (DoE), signifying that institutional strengthening and monitoring capacity are a prerequisite. While Bangladesh achieves efficient material recovery due to a robust domestic market and an active informal resale network, this informality complicates supply chain transparency and the traceability of recovered materials. Moreover, there is a discernible shift in documentation trends in Bangladesh, shifting from informal estimates to more structured inventory records, although notable gaps in data accuracy and consistency persist, which greatly hamper the potential to reach international benchmarks (Hossain, 2025c).

Table 3. Comparison of reusable and waste material factors (Bhatiary, Bangladesh vs. Alang, India)

Material Type	Bangladesh (kg/LDT)	Alang, India (kg/LDT)
Reusable (EVS)	730–950	700–900
Asbestos	0.5–2.0	0.6–2.2
Landfillable	0.3–1.5	0.4–1.8
Incinerable	0.2–1.2	0.3–1.5
Bilge/Liquids	0.3–1.8	0.3–2.0

4. DISTRIBUTION CHANNEL OF REUSABLE AND WASTE MATERIAL WITHIN THE COUNTRY

The author has illustrated the actual distribution channels of renewable and hazardous materials generated by the local recycling industry in Bangladesh, based on active field efforts and detailed analysis through direct involvement and a distribution channel model has been illustrated and that has shown in figure-6 below. The material distribution channel shown flows from recycling yards to end markets with disposal facilities, and then optimized through MFA to maximize resource efficiency and limit adverse environmental effects (Cencic et al, 2008; Devault et al, 2017 Demaria, 1010, Hiremath et al, Hossain 2019a, b). However, during the last decade, several notable accomplishments of ship recycling industry have come to the forefront, such as in handling hazardous waste, safety during confined space recovery, and at heights, fire, PPE, controlled cutting/paint removal, facilities for workers (rest, recreation, showering, medical, and accommodation), emergency planning, confined space entry procedures, asbestos management, hazardous waste inventory/storage, environmental awareness; worker health/welfare planning, employment of naval architects/technical staff, and training of workers on new technology and regulations (on a regular basis over a period). Now 26 yards from Bangladesh are HKC certified, while another dozen are likely to get the recognition soon. Despite around 40 yards expected to be "ready" within the next year, Bangladesh needs more than the said amount to be active HKC-certified facilities, requiring immediate assistance from both the government and yard owners to sustain the cooperation and maintaining global dominance (Hossain, 2019a, b, c and Hossain, 2025c).

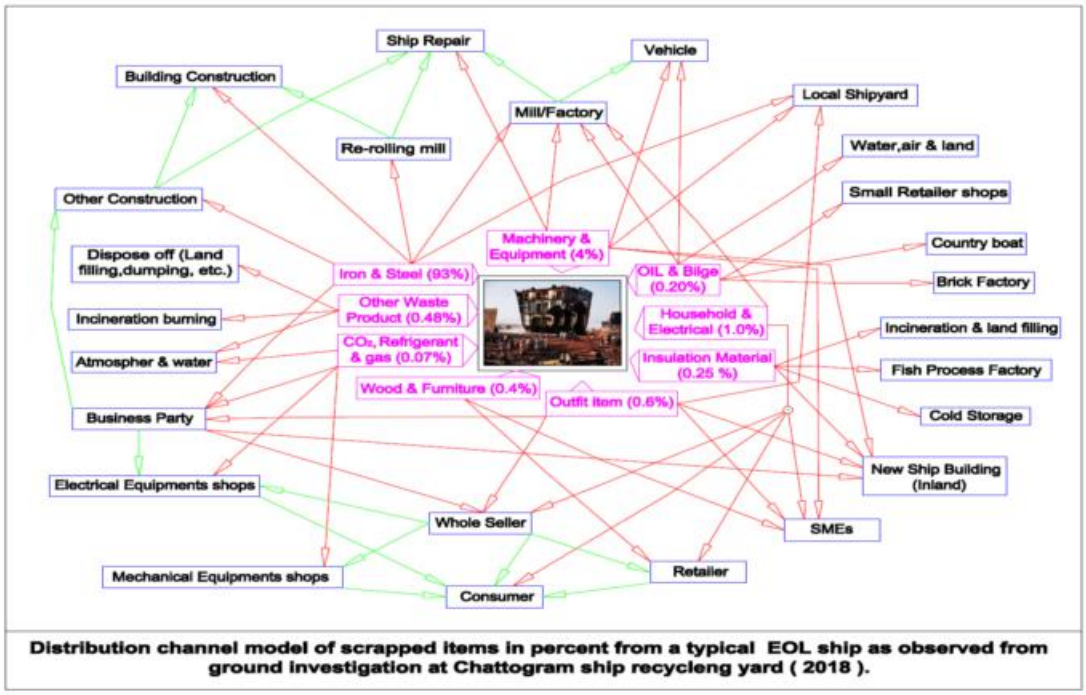

Figure 6. Distribution channel model of scrapped items of EOL ships in Bangladeshi yards.

5. PRESENT STATUS AND FUTURE DOMINANCE OF GLOBAL SHIP RECYCLING INDUSTRY

Present Status of Local Yards.

Recycling yards in Bangladesh have received relatively less national and international investment for upgrading than their regional competitors. To date, the most significant international engagement has come through IMO's SENSREC initiative, a long-running technical-assistance program funded by Norway. SENSREC has emphasized mostly on legislative reforms like enacting national legislation, training programs, and strengthening regulatory frameworks. In late 2023, Norway allocated about $1.36 million to fund upgrades to green yards and waste-treatment infrastructure. This project was undertaken to reduce the environmental impacts of shipbreaking in Bangladesh. By promoting sustainable practices and green technologies, the initiative seeks to protect local ecosystems and support broader global efforts to mitigate climate change by limiting the ecological footprint of intertidal dismantling. Currently, the Bangladeshi ship recycling industry generates an annual revenue of Tk 12,750 crore and provides employment to around 200,000 people, especially in poverty-stricken areas. It significantly upgrades peoples' standard of living and involves over a million individuals throughout the arena. Each year, this industry brings in approximately US$130 million (Mohiuddin et al., 2023).Additionally, n the fiscal year 2015-16, Bangladesh customs reported the import of 250 scrap ships, bringing in about Tk 8.22 billion in revenue. The following year, 188 ships were imported, earning Tk 6.32 billion. Furthermore, the number of imported ships increased to 202 in the subsequent year, contributing a total revenue of Tk 5.96 billion or Tk 596 crore

(Hossain, 2025c). Figure 7 illustrates an estimation of earnings from the ship recycling industry in Bangladesh. It has found that although recycling industry earnings notice a positive slope over time, without the required HKC-certified recycling yards, Bangladesh may find it hard to stay afloat in the global market; as a result, there will soon be a crisis in the steel and other relevant industries. So, this issue cannot be sidelined and must be dealt with immediately (Hossain, 2025c).

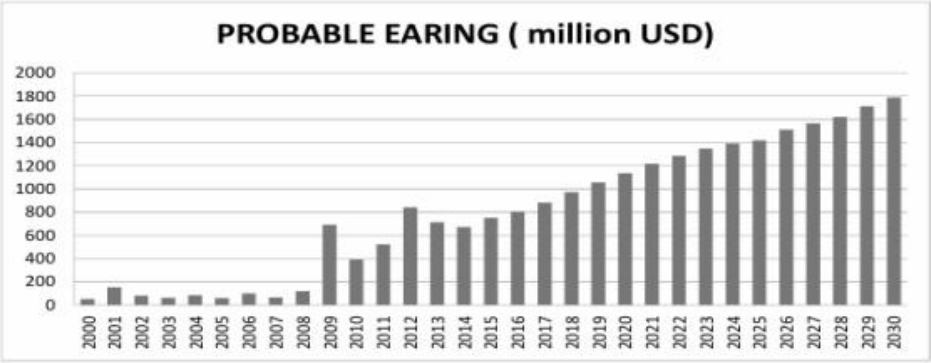

Figure 7. Estimated earnings from the ship recycling industry of Bangladesh

Estimation of Future Position.

Bangladesh's ship recycling industry is expected to go through an economic boom owing to its huge and reasonably priced labor pool, which gives it an upper hand in operational effectiveness. Steel and other metals obtained from ship recycling demand high prices in the local market, supporting the sectors like re-rolling, shipbuilding, house-building, manufacturing and construction (Hossain, 2018c and d). Bangladesh's rapidly expanding infrastructure demands significant iron resources as it gets closer to acquiring the title of a developing country. A lack of native iron ore forces Bangladesh to be heavily dependent on imports , but the ship recycling sector supplies over 60% of the country's steel needs and is indispensable to both national development and sustaining the foreign reserve. Bangladesh's reuse techniques diminish the need for new manufacturing, thereby fostering environmental sustainability, in contrast to developed nations, where EOL ship parts are often left unutilized (Sivaprasad, 2010; Nikos, 2017). Furthermore, the inland shipbuilding sector is totally reliant on materials from recycling yards, underscoring its vital role in advancing both environmental and economic goals (Hossain, 2015; 2023a, d, and f).

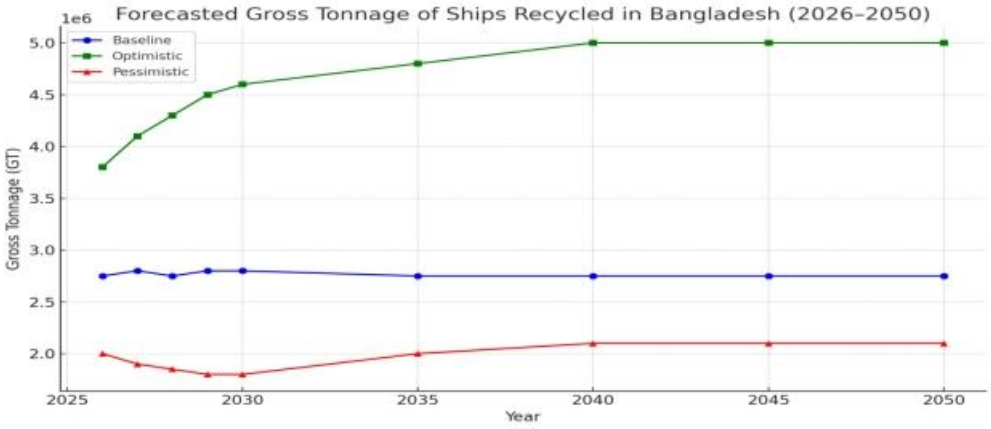

Figure 8. Future projected Gross Tonnage (GT) of Ships Recycled in Bangladesh (2026–2050)

Here, the author has employed "ARIMA-style time series forecasting" to anticipate future scrap levels using gross tonnage (GT) data from IHS and UNCTAD records from 2014 to 2024, aiming to provide a realistic forecast. The projection assumes that past trends are excellent markers of future developments unless heavily affected by changes. Figure 8 shows the expected Gross Tonnage (GT) of Ships Recycled in Bangladesh (2026–2050) based on this forecasting method and uses three categories (Baseline, Optimistic and Pessimistic) to analyze and predict the GT of recycled ships (IMO, 2024, 2025, and Khandakar, 2025). According to ARIMA estimates, a "business-as-usual" baseline of about 2.7 million GT per year is expected until 2050. The graph portrays a hypothetical optimistic scenario where green yards grow their capacity to around 5 million GT and just below that, a pessimistic scenario where reforms fail, reducing GT below 2 million. Focusing on these perceptions, five strategic policy pillars are proposed: (1) enact and enforce HKC-aligned legislation through a unified regulatory authority; (2) fund sustainable development projects while embedding rigorous safety protocols into the workforce culture; (3) establish blended financing mechanisms and

performance incentives to modernize the local yards in line with India; (4) institutionalize a national recycling information system and fund targeted R&D; and (5) engage regionally and internationally to hoist Bangladesh as a suitable “green” haven under ESG mandates (Hossain, 2025c).

6. ANALYSIS OF FUTURE CHALLENGES OF LOCAL RECYCLING INDUSTRY

Bangladesh currently operates in a high-stakes regional environment. As global sanctions tighten their grip on trade, Bangladesh's ship recycling industry, which supplies around 60% of the country's steel needs and completely supports inland shipbuilding, faces steady but hostile competition from neighboring modernizing yards (Maritime Executive, 2025, BIMCO, 2025. This industry's vital role in sustaining foreign reserves is accentuated by Bangladesh's exit from the Least Developed Country (LDC) category and its ever-rising infrastructure demands, which largely depend on imported iron as aforementioned (Maritime Executive, 2025a; Eolog, 2025).The amount of EOL ships being recycled in India, Bangladesh, Pakistan, and China have been shown in figure 9 below (NGO Ship-breaking Platform, 2024). Though, judging by volume or total LDT, Bangladesh is still spearheading the global market. Nevertheless, recent developments indicate that India is going to take over soon in this regard.

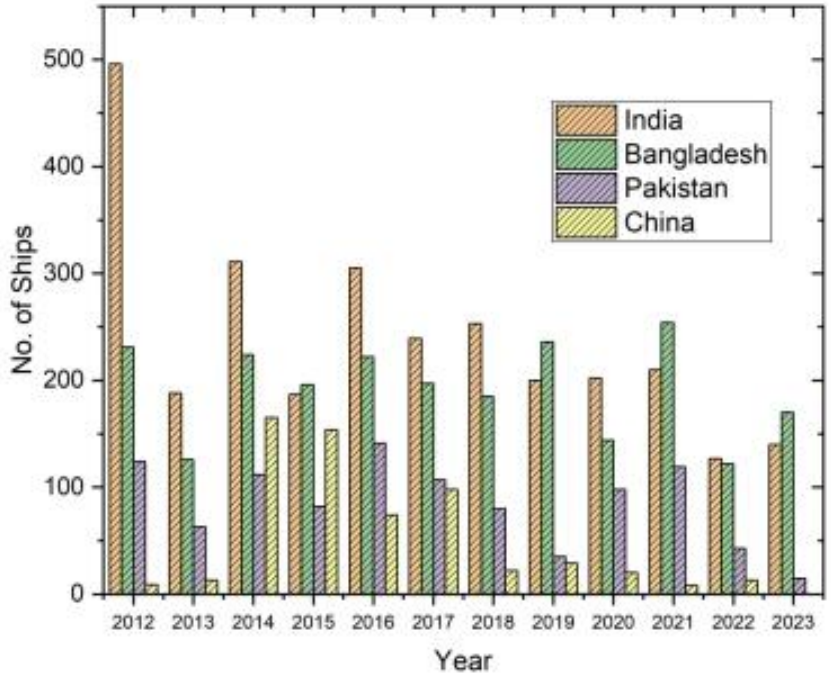

Figure 9: Number of EOL ships recycle in India, Bangladesh, Pakistan, and China.

A significant compliance disparity has emerged between the major South Asian hubs. Despite these advantages, Bangladesh ratified the Hong Kong Convention (HKC) in June 2023, but as of mid-2025, merely 26 local yards are HKC-compliant. In stark contrast, India has successfully upgraded 120 yards, achieving a 95% compliance rate while Pakistani government funding is specifically earmarked to transform their ports into green facilities. (Maritime, 2025; BIMCO, 2025; Maritime Executive, 2025). Bangladesh handled around 46% of the world's recycling tonnage in 2023, compared to 16.6% and 33% for Pakistan and India respectively in 2022 (Dawn, 2023; Eolog, 2025). However, professionals warn that if Pakistan's Gadani yards start modernizing and India's donor-backed "green yards" attract more investments, Bangladesh may suffer in the long run (Eolog, 2025; Olgn News, 2025). India has a competitive advantage as it focuses on strong waste management under the Recycling of Ships Act, 2019 and Ready-for-Recycling certificates (IndustriALL, 2025a, b; Hossain, 2025c). The Pakistani surge is accelerated by government funding, integrating modern pollution control and worker welfare infrastructure. (Arab News, 2024; BIMCO, 2025; Dawn, 2025).So, if Bangladesh does not go the extra mile and align its yards with HKC rules in order to stay in business, the risk of losing EOL vessels to its competitors neighbors looms over.

Regulatory Enforcement and Policy Frameworks.

As Bangladesh's regulatory system, governed by the Ship Breaking and Recycling Rules, 2011, does not fully correspond with HKC standards, new ship recycling imports have been briefly adjourned (Maritime, 2025, TBSNews, 2025). At the onset of 2025, potential modifications developed under the IMO's Norway-funded SENSREC project were presented in order to comply with the HKC, Basel, Rotterdam, and Stockholm conventions (IMO, 2024 and 2025). The existing Ship Recycling Act (2018) must be fully aligned with these conventions. NGOs and other parallel parties voice their support for stricter supervision and penalties to

implement environmental and safety rules (IMO, 2024). Even though new laws are expected in 2025, the current makeshift framework and inadequate enforcement remain shortcomings as compared to regional rivals. For example, The Recycling of Ships Act, 2019, which mandates authorized facilities, ship-specific recycling programs, and strict waste management with forfeitures for breaches, bolsters India's market leadership (PIB, 2019). Similarly, after ratifying the HKC in December 2023, Pakistan is developing a Federal Ship Recycling Act and provincial acts in Balochistan, but much like Bangladesh, its Gadani yards consistently operate under obsolete regulations with limited oversight, which bring about conversations regarding ecological and safety issues (Dawn, 2023). Nevertheless, Pakistan is getting help from the ILO and IMO to address legal shortcomings, including shipyard authorization and hazardous waste management regulations, in order to meet its obligations under the HKC. (Dawn, 2023). Bangladesh's revamping efforts signal incumbent obstacles, while Pakistan's regulatory problems confine its competitiveness until these steps are enacted (Hossain, 2025c).

Financial Investment and International Support.

Bangladesh's ship recycling industry, despite its economic importance, has failed to notify foreign investors with respect to its rivals in the vicinity. The IMO's SENSREC initiative, supported by Norway, offers technical support, including a USD 1.36 million grant in late 2023 aimed at upgrading green yards and waste management facilities (IMO, 2024). However, fulfilling HKC standards requires much more capital (around 100 million USD) which is tough to acquire due to limited credit access (Maritime, 2025). Conversely, India has invested over USD100 million utilizing donor and public funds to improve 120 "green" yards in Alang and other locations with cranes, concrete hard stands, and waste treatment units, facilitating prompt recognition of 120 HKC-compliant yards (Eolog, 2025; Olgn News, 2025). Likewise, Pakistan allocated Rs12 billion (~USD 42 million) in June 2025 to transform Gadani into an upcoming green facility, with state of the art infrastructure, roads, hospitals, and waste treatment plants (Arab News, 2024; Dawn, 2025). These incentives portray Bangladesh's reliance on limited international aid, while its two South Asian rivals employ significant funding to broaden their ship recycling sectors efficiently (Eolog, 2025; Arab News, 2024; Dawn, 2025).

Technological Modernization and Yard Infrastructure.

Only 65% of Bangladesh's yards are HKC certified and they depend on lone private initiatives rather than holistic effort. As a result, Bangladesh's ship recycling yards, which are coast-focused, lag behind when it comes to technology (IndustriALL, 2025a, b; Islam, 2025; Eolog, 2025). Efficiency and compliance are hampered by limited mechanization, such as slipways or modular cranes. India's situation is quite the opposite, with cutting edge facilities like shore cranes, forklifts, piped water systems, and hazardous waste containment being just a few of many which are found at India's more than 120 green yards in Alang(Eolog, 2025). With the Rs.12 billion investment paving the way, Pakistan's conventionally less mechanized Gadani yards will undergo major renovations with an emphasis on innovative machinery and waste management to meet eco-friendly shipping objectives (Arab News, 2024; Dawn, 2025). The Gadani yards must modernize or go back to square one, according to Pakistan's marine minister (Arab News, 2024). So, Bangladesh's ship-recycling stronghold is at risk if modernization doesn't expedite through programs like SENSREC, as it mostly relies on small mechanized beach plots in contrast with Pakistan's planned enhancements and India's sophisticated technology led by local support and government funding (Arab News, 2024; Eolog, 2025; Maritime, 2025; BIMCO, 2025).As EU and global ship-owners face stricter ESG reporting mandates, they will gradually ignore non-compliant yards for certified and technologically superior facilities.

7. SUITABLE AND SUSTAINABLE SOLUTION

To bridge the gap between economic growth and environmental responsibilities, Bangladesh must swiftly change its dependence on geographical advantage to more versatile strategies. Anam Chowdhury, President of the Bangladesh Marine Officers Association (BMOA), pointed out the noticeable contrast between Faujdarhat tidal shores and India's developed Alang yards in an interview with Business Standard, saying: "India has built 120 green yards on the Gujarati coast of Alang to recycle ships in accordance with the HKC thanks to more than $100 million in funding from foreign donors (UNCTAD, 2025)." This substantial foreign venture has accelerated India's certification process, enabling the development of 120 yards compliant with the Hong Kong Convention (HKC), and lessening dependence on foreign subsidies for basic yard upgrades. Indian yards use semi-automated processes using shore-based cranes and mechanical lifting while Bangladesh hasn't transitioned from manual dismantling yet.

Bangladesh is competing for constrained foreign aid and credit, unlike India and Pakistan, which have mobilized greater financial resources to support their ship-breaking industries. This disparity poses challenges for Bangladesh to remain competitive in regional and global ship recycling markets. A dozen more Bangladeshi yards need HKC-certification to tread water; otherwise, failure looms large. High expenditures ward off many local recycling owners, as modernizing a single ship recycling yard sets them back at least Taka 200-300 million (around $2.5 million USD), and upgrading the entire sector to meet HKC standards, as discussed above, could cost approximately Taka 12 billion (about $100 million USD in total. (Hossain, 2025a, c).

Current Challenges of Bangladesh Ship Recycling and Sustainable Solution of Local Industry

Bangladesh faces an existential threat due to the initiatives taken by rival governments. Experts warn that India is expected to attract more business in the near future, potentially overtaking Bangladesh as Indian yards upgrade and expand, supported by large donor-funded 'green yard' projects (Eolog, 2025; Olgn News, 2025; Hossain, 2025c).With the absence of a blended financial structure, the expense of streamlining a port may never be met. Consequently, environmental compliance remains a key challenge for Bangladesh. Ultimately, Bangladesh's recycling yards and the sector as a whole must undertake capital investments, modernization, and upgrades. To strengthen this industry, Bangladesh should focus on the following strategies:

- Invest in modern infrastructure, modern cutting and dismantling system, including concrete flooring and mechanical lifting equipment (Hossain, 2025a, b).
- Establish additional Treatment, Storage, and Disposal Facilities (TSDF) to manage hazardous waste effectively (Hossain, 2021).
- Enhance worker training and enforce mandatory PPE usage (Hossain, 2024, 2025b, c).
- Create a dedicated monitoring and controlling body similar to India's Gujarat Maritime Board (Hossain, 2023a).
- Foster stakeholders' collaboration to secure financing and technical support (Hossain, 2023e, f, g).
- There is a severe need for government financial and technical support (Hossain, 2023b, c).
- Arrange foreign and local support/investment (Hossain, 2023b, d).
- Implement and ensure sustainable recycling process/system (YPSA, 2024).
- Local recycling yards must have a Ship Recycling Facilities Plan in order to comply with HKC (like SRFP).
- Local yards must get ready to ratify HKC and an EU RRC as soon as possible; otherwise, it will be more difficult and complicated to carry on with local recycling operations in the future (Mohiuddin & Hossain, 2023a).
- The government might provide financial incentives like tax refunds, accelerated depreciation, and import duty waivers for investments in green yard infrastructure, including impermeable floors, drainage systems, shore-based cranes, and waste treatment units (Hossain, 23a, b, c; Mohiuddin and Hossain, 2023a, b).
- **Every significant yard cluster must have on-site clinics/hospital, safety response units, and qualified emergency workers in order for Bangladesh to create on-site medical and safety facilities (HRW, 2023a, b).**
- A country may establish a blended finance structure to promote local recycling yard upgrades, especially for small and medium-sized recyclers, using both national budget allocations and international funds like IMO, World Bank, ADB, JICA, etc. (Hossain, 2025c).
- Government needs to insert a suitable budget to meet the global competitor to modernize the local ship recycling sector for its sustainable development as a whole

8. CONCLUSION

The key takeaway from this research study is that the Bangladeshi ship-recycling industry is at a critical inflection point. There is a significant crevice between Bangladesh and its key regional competitors when it comes to modernization and monetary assistance. While Bangladesh has made significant headway, the progress is still uneven. Ratifying the HKC, initiating Ship Recycling Facility Plans (SRFPs), and participating in international donor-supported programs are all constructive achievements but this breakthrough still remains feeble and heavily dependent on external technical assistance. A majority of its yards remain non-compliant or only partially aligned with HKC norms, and institutional enforcement remains weak due to regulatory ambiguity and limited inter-ministerial coordination. Caution must be taken so that this development doesn't turn into a double-edged sword. Bangladesh's ship recycling industry, the global leader, processes ~2,000,000 LDT annually, steadying the economic wheel through steel supply and employment opportunities. However, impediments like outdated manual dismantling, environmental pollution, and inadequate SHE standards persist. Ship recycling is a major ecological effort in the path of the "Green Revolution" to maintain environmental balance, and this responsibility is being shouldered by Bangladesh, Pakistan and India. These three populous and developing countries consumed and reused almost 98% of the material output from the recycling process.

Frameworks like the European Union Ship Recycling Regulation (EU SRR) and the Hong Kong International Convention (HKC 2009) for the Safe and Environmentally Sound Recycling of Ships are driving major changes in the global regulatory landscape for ship recycling by imposing stricter laws and mandates. As these regulations advocate for safer work environments and sustainable practices, additional pressure is being applied on the South Asian ports. Bangladesh has lingered in the grey area in this regard because of local yard owners' attitudes and a lack of government funding, whereas nations like Turkey and India have successfully updated a significant number of yards to fulfill HKC and EU compliance requirements. However, Bangladesh established a national goal to bring all operative yards into line with HKC standards by 2025 and passed the Ship Recycling Act in 2018. Even though the goal hasn't been fully realized yet, significant progress has been made in infrastructure development, regulatory compliance, and institutional control, especially through the Shipbuilding and Ship Recycling Board (SBSRB) within the

MOI. Bangladesh's historic fortress in ship-building is volume which is being tackled by India's technological improvement with 120 HKC certified yards, modernization investments combined with legal certainty, and significant modernization inflows (~USD 100 million). Pakistan's Rs. 12 billion (~USD 42 million) renovation plan for Gadani, even though it is at its initial stages, represents a geopolitical shift that, if not accompanied by countermeasures, might put Bangladesh's regional dominance into a disadvantageous position. However, in Bangladesh, 65% of local ship recycling facilities that are currently in operation are HKC approved (where 26 yards are HKC certified and another dozen yards are waiting). Besides, the path forward lies in a collaborative ecosystem involving the government, academia and private stakeholders.

The environmentally sustainable and practical ship recycling process, supported by an efficient material distribution network, establishes a foundation for sustainable operations by utilizing Bangladesh's low-cost labor and strong market demand. By overcoming safety, environmental, and regulatory deficiencies through infrastructure modernization, skilled workforce development, and adherence to HKC and EU standards, Bangladesh can preserve its global leadership while advancing long-term sustainability. For this industry to remain relevant in the near future, continuous monitoring, balanced leadership, financial ventures, along with government and stakeholder support are imperative. **We might make commercial credit more accessible in order to collaborate with public and private institutions and create low-interest green loans with technical evaluation help for revamping recycling infrastructure. The helpful "Ship Recycling Act," which fully incorporates HKC rules and complies with Basel, Rotterdam, and Stockholm agreements, can be finalized and enforced. This regulation must impose facility permission, waste disposal compliance, hazardous material inventory management, and environmental impact audits as a precondition. In order to coordinate oversight, inspections, and certifications, we may introduce a special Ship Recycling Regulatory Authority (SRRA) comprising of delegates from the MOI, MOE, MOS, DoE, DoL, BSBA, and SBSRB as industry collaborators in addition to BUET and Bangladesh Maritime University (BMU) as academic consultants.**

Setting a preordained transition period, we can mandate that all yards submit approved SRFPs and receive HKC certification (within a year). Penalties for non-compliance should be incorporated into routine third-party audits. The following actions are advised to guarantee sustainable practices in Bangladesh and other Asian ship recycling facilities. To ensure safe and ecologically sustainable in the ship recycling process, strong rules and international standards must first be put into place and enforced. By developing laboratory facilities and strengthening the capacities of pertinent departments, efforts should be made to improve environmental monitoring and control. The labor and environmental dimensions present perhaps the most urgent challenges. Although some yards have embraced reforms and other yards need also follow the others. All ship recycling yards should immediately adopt HKC 2009 and be prepared to comply EU SSR for the safe and environmentally sound recycling of ships, which provides a comprehensive framework for ship recycling operations. Steps should be taken to raise the safety standards and working conditions for the employees in local yards. It has to be made sure that personal protective gear and equipment are accessible and utilized. Every hazardous substance must be labeled and extra caution must be used before starting the beaching operation. Governments and relevant stakeholders should place a high priority on promoting research and development in environmentally friendly ship recycling technology. Government needs to insert a suitable budget to meet the global competitor to modernize the local ship recycling sector for its sustainability. There should be industry and academia collaboration to solve the upcoming problems and sustainable strategy and policy formulation and national development.

REFERENCES

1) Andersen, A. B. (2001). Worker safety in the ship-breaking industries (Sectoral Activities Programme Working Paper WP.167). International Labour Organization, available at: https://www.ilo.org/public/english/dialogue/sector/papers/shipbreak/wp167.pdf, accessed on 11 Aug 2025
2) Arab News, (2024), International Maritime Organization launches major ship recycling project in Pakistan, 1 October 2024, available at: https://www.arabnews.pk/node/2605790/pakistan, accessed on 11 Aug 2025
3) Abdullah, H.M., Mahboob, M. G. and Biruni, A.A. (2010), Drastic expansion of ship breaking yard in Bangladesh: a cancerous tumor to the coastal environment, In Proceedings of the International Conference on Environmental Aspects of Bangladesh (ICEAB), Japan, Sep 2010, accessed on 11 Aug 2025
4) Ahamed, S. U., (2011), Legislation, regulations and court orders for ship breaking and recycling industry in Bangladesh, Seminar on ship recycling: Bangladesh perspective, Jul 2011, accessed on 11 Aug 2025
5) Abdullah, A., Awal, Z., Alamgir, Z., Mia, M., Mim, F. and Dhar, U. K., (2023) "A Review on Ship Recycling Industry in Bangladesh from Global Perspective," Journal of Ocean and Coastal Economics: Vol. 10: Iss. 1, Article 4. DOI: https://doi.org/10.15351/2373-8456.1165, accessed on 07 Aug 2025
6) Basel Convention. (1989). Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. United Nations Environment Programme, available at:

http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx, accessed on 11 Aug 2025

7) BIMCO, (2025), Ship recycling is about to change, available at: 25 June 2025, available at: https://www.bimco.org/news-insights/bimco-news/2025/06/25-hkc/, accessed on 11 Oct 2025
8) Bois, R. D., (2009), "Information and analysis bulletin on ship demolition", Ship-breaking.com; July, 2009, accessed on 11 Aug 2025
9) Chowdhury, M. S., (2019), Study report on child labour in the shipbreaking sector in Bangladesh, University of Chittagong, accessed on 15 Sep 2025
10) Cencic, O., and Rechberger, H., (2008), "Material Flow Analysis with Software STAN," Journal Environment Engineering Management, Vol 18, Oct 2008, accessed on 15 Sep 2025
11) Choi, J. K., Kelley, D., and Murphy, S. (2016). Environmental and economic assessment of ship recycling strategies. Journal of Cleaner Production, 114, 287–296, available from: https://doi.org/10.1016/j.jclepro.2015.10.019, accessed on 11 Aug 2025
12) Demaria, F. (2010). Shipbreaking at Alang-Sosiya (India): An ecological distribution conflict. Ecological Economics, 70(2), 250–260. https://doi.org/10.1016/j.ecolecon.2010.09.006, accessed on 11 Aug 2025
13) Devault, D. A., Beilvert, B., and Winterton, P. (2017). Ship breaking or recycling? A review of environmental, economic, and health perspectives. Environmental Science and Pollution Research, 24(33), 25752–25764. https://doi.org/10.1007/s11356-017-0138-2, accessed on 11 Aug 2025
14) Dawn, (2023), Pakistan ratifies Hong Kong Convention for ship recycling, December, 2023 available at: https://www.dawn.com, accessed on 11 Aug 2025
15) Dawn, (2025), ILO launches study to reform ship recycling sector, DAWN e-paper, June 29, 2025; available at: https://www.dawn.com/news/1920881/ilo-launches-study-to-reform-ship-recycling-sector#:~:text=, accessed on 11 Aug 2025
16) EC Regulation, (2006), Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste, 2006, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006R1013, accessed on 11 Aug 2025
17) Eolog, (2025), Ship recycling market analysis: Bangladesh, India, and Pakistan, available at: https://eolog.com/en/bangladesh-could-lose-top-position-in-the-global-shipbreaking-market/#, 12 Jan 2025, accessed on 09 Oct 2025
18) Gramman, H., Mutlu, F., and Rogge, J., (2007), Ship-Building Development and Research Strategies for Useful Fulfillment of Ship-Dismantling Processes, Joint Project of Turkish Undersecretariat for Maritime Affairs and Germanischer Lloyd for the period 2006/2007, accessed on 09 Oct 2025
19) Gregson N, Crang M, Ahamed FU, Akhter N. and Ferdous, R., (2010), Following things of rubbish value: end-of-life ships, 'chockchocky' furniture and the Bangladeshi middle-class consumer, Geoforum, 41(6):846–854, 2010, accessed on 09 Oct 2025
20) Gregson, N., Crang, M., Ahamed, F.U., Akter, N., Ferdous, R., Foisal, S. and Hudson, R., (2012), Territorial agglomeration and industrial symbiosis: Sitakunda–Bhatiary, Bangladesh, as a secondary processing complex, Economic Geography 88(1):37–58; Dec, 2012, accessed on 09 Oct 2025
21) Hoque, M., and Emran, M. M. (2016), Role of ship-breaking industries in Bangladesh and ILO guidelines: a critical discussion. Global Journal of E-Economics, 16(3), 9, accessed on 09 Aug 2025
22) Hossain, K. A., and Zakaria N. M. G., (2009), "Service provides and supporting industries of shipbuilding sector on Bangladesh and its impact on overall development of shipbuilding", Proceedings of the 6th International Conference & 13th Annual Paper Meet, Dhaka, Mechanical Engineering Division; The Institute of Engineers, Bangladesh (IEB), 30-31 Dec 2009, accessed on 11 Aug 2025
23) Hossain, K. A., and Zakaria N. M. G., (2010a), "Ship Recycling Prospects in Bangladesh," Proceeding of MARTEC 2010; 8th International Conference of Marine Technology, BUET, Dhaka, Aug 2010, accessed on 11 Sep 2025
24) Hossain K. A., Iqbal K. S. and Zakaria N. M. G., (2010b), A Study of Socio-Economic and Ecological Impact of Ship Recycling in Bangladesh, The Journal of NOAMI, Vol.27, No.1, page 35-47, Jun. 2010, accessed on 29 Sep 2025
25) Hossain, K. A., (2015a), "Overview of Ship Recycling Industry of Bangladesh," Journal of Environmental and Analytical Toxicology, Vol 5, Issue 5, July 2015, accessed on 23 Sep 2025
26) Hossain, K. A. (2015b), Leadership Qualities for 21st century Leaders, Journal of Management, Social Science and Humanistic, Volume 1, Issue 2, May 2015, accessed on 23 Sep 2025

27) Hossain, K. A., (2015c), Essential Tips and Tactics of motivation, Journal of Management, Social Science and Humanistic, Volume 1, Issue 1, April 2015, accessed on 23 Sep 2025
28) Hossain, K. A., (2017a), "Ship recycling status of Bangladesh and annual reusable material output," Journal of Toxicology, Vol 2, Issue 2, Oct 2017, accessed on 11 Aug 2025
29) Hossain, K. A., (2017b), "Ship recycling practice and annual reusable material output from Bangladesh ship recycling industry," Journal of fundamentals of renewable energy and application, Vol 7, Issue 5, Sep 2017, accessed on 11 Aug 2025
30) Hossain, K. A., and Zakaria N. M. G., (2012), "Underlying Problems of ship-recycling industry in Bangladesh and way forward", 6th International Mechanical Engineering Conference & 14th Annual Paper Meet 2012; 28-29, Sep 2012, accessed on 11 Aug 2025
31) Hossain, K. A., (2018a), "SWOT Analysis of China Shipbuilding Industry in the Third Eyes", Journal of recent advancement of petrochemical science, Volume 4, Issue 2, Jan 2018, accessed on 11 Aug 2025
32) Hossain, K. A., (2018b), "Analysis of important steering factors which give Success to Global Shipbuilding Leaders", Journal of recent advancement of petrochemical science, Volume 4, Issue 5, Jan 2018, accessed on 11 Aug 2025
33) Hossain, K. A., (2018c), "Calculation of Yearly output of reusable material of Ship Recycling Industry of Bangladesh," Journal of Recent Advancement of Petrochemical Science, Vol 5, Issue 3, Jun 2018, accessed on 11 Aug 2025
34) Hossain, K. A., (2018d), "Material Flow Analysis (MFA) is A Better Tool to Calculating Reusable Material for Ship Recycling" 11th International Conference of Marine Technology, UTM, Malaysia, Aug 13-14, 2018, accessed on 11 Aug 2025
35) Hossain, K. A., and Zakaria N. M. G., (2018e), "Proposed Sustainable Ship Recycling Process for South East Asian Recycling Yards" 11th International Conference of Marine Technology, UTM, Malaysia, Aug 13-14, 2018, accessed on 11 Aug 2025
36) HKC, (2009). Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, International Maritime Organization, available at: http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/The-Hong-Kong-International-Convention-for-the-Safe-and-Environmentally-Sound-Recycling-of-Ships.aspx, accessed on 11 Aug 2025
37) Hiremath, A.M., Tilwankar, A.K. and Asolekar, S.R., (2015), Significant steps in ship recycling vis-a-vis wastes generated in a cluster of yards in Alang: a case study, Journal of Cleaner Production 87, pp: 520-532; Jun 2015, accessed on 11 Aug 2025
38) Hossain, M. M. and Islam M. M., (2006), Ship Breaking- Towards Sustainable Management" Published by YASA, Chittagong, ISBN: 984-32-3448-0, Jul 2006, accessed on 29 Sep 2025
39) Hossain, K. A., (2019a), *'Material Flow Analysis Technique for Material Assessment of Ship Recycling Industry" Bangladesh Maritime Journal, BSMRMU, Vol 3, Issue 1, Jan 2019,* accessed on 11 Aug 2025
40) Hossain, K. A., (2019b), *"Development of an Assessment Model for Ship Recycling Industry in Bangladesh" Proceedings of the 2nd International Conference on Industrial and Mechanical Engineering and Operations Management (IMEOM), Dhaka, Bangladesh, December 12-13, 2019,* accessed on 11 Aug 2025
41) *Hossain, K. A.,* (2021), Sustainable Ship Recycling Regulation and Process in Contest of Bangladesh, Navy Journal 7 (1), 1-23, Dec 2021, accessed on 11 Aug 2025
42) HRW, (2023a), Human Rights Watch Report, available at: https://www.hrw.org/news/2023/09/27/bangladesh-shipping-firms-profit-labor-abuse, 27 Sep 2023, accessed on 01 Aug 2025
43) HRW, (2023b), Human Rights Watch Report, available at: https://www.hrw.org/the-week-in-rights/2023/10/06, 06 Oct 2023, accessed on 01 Aug 2025
44) Hellenic, (2025), Weekly ship recycling report
available at: https://www.hellenicshippingnews.com/wp-content/uploads/2025/05/Weekly-Ship-Recycling-Report-03-May-09-May-2025_compressed.pdf, accessed on 11 Aug 2025
45) *Hossain, K. A., et al, (2023a), Evaluation of present ship recycling scenario and opportunity for Bangladesh, Journal of Environment and Analytical Toxicology (JEAT), Vol 13, Issue 4, April 2023, ISSN 2161-0525, accessed on 11 Aug 2025*
46) *Hossain, K. A.,* et al., *(2023b), Global Major Ship Recycling Players and Their Fate in Future, International Journal of Novel Research & Development (IJNRD) 8 (5), Jun 2023, accessed on 18 Aug 2025*
47) *Hossain, K. A., (2023c), Analysis of present global ship recycling status and challenges for Bangladesh, Global Scientific Journals (GSJ), Vol 11, Issue 4, April 2023, ISSN 2320-9186, accessed on 11 Aug 2025*
48) *Hossain, K. A., (2023d), An overview of merchant ships, International Journal of Research and Development (IJNRD), Vol 8, Issue 6, June 2023, ISSN 2456-4184, accessed on 11 Aug 2025*

49) *Hossain, K. A., (2023e),* An Overview of Naval Ships, Scientific Research Journal (SCIRJ) 11 (6), ISSN: 2201-2796, June 2023, accessed on 11 Aug 2025
50) *Hossain, K. A., (2023f),* Evaluation of prospects and challenges of local ship recycling industry in context of global, In Proceedings of the 6th Industrial Engineering and Operations Management Bangladesh Conference, IEOM Society International, available at: https://ieomsociety.org/proceedings/2023dhaka/19.pdf, accessed on 11 Aug 2025
51) *Hossain, K. A., (2023g), Analysis of present global ship recycling status and challenges for Bangladesh, Global Scientific Journals (GSJ), Vol 11, Issue 4, April 2023, ISSN 2320-9186,* accessed on 11 Aug 2025
52) Hossain, K. A., (2024), Analysis of ship recycling, ISBN-13, 979-8343259971, Oct 2024, Amazon, US.
53) Hossain, K. A., (2025a), Evaluation of Internet of Things (IoT), ISBN-13, 979-8306216980, Jan 2025, Amazon, US
54) Hossain, K. A., (2025b), Artificial Intelligence (AI), ISBN-13, 979-8328010290, 2025, Amazon, US
55) Hossain, K. A., (2025c), Bangladesh's Ship Recycling Industry in the Global South: Readiness, Regional Competition, and Reform Imperatives, Sustainability 2025, 17, 10998, Dec 17, 2025; Available from: https://doi.org/10.3390/su172410998
56) Islam, S. M. M. U., (2025), Upcoming challenges of the ship recycling industry in Bangladesh, The Daily Star, 4 April 2025, available at: https://www.thedailystar.net/law-our-rights/news/upcoming-challenges-the-ship-recycling-industry-bangladesh-3863051, accessed on 11 Aug 2025
57) Industriall, (2025a), Global union report on ship recycling in Bangladesh, available at: https://www.industriall-union.org, accessed on 11 Oct 2025
58) Industriall, (2025b), Progress and challenges in Bangladesh's shipbreaking sector, https://www.industriall-union.org/progress-and-challenges-in-bangladeshs-shipbreaking-sector, accessed on 11 Oct 2025
59) IMO, (2024), International Maritime Organization, SENSREC project updates for Bangladesh, available at: https://www.imo.org, accessed on 11 Oct 2025
60) IMO, (2025), *available at:* https://www.imo.org/en/mediacentre/pages/whatsnew-2229.aspx#, 26 Feb 2025, accessed on 11 Aug 2025
61) ILPI Paper, (2016), Ship-breaking Practices in Bangladesh, India and Pakistan; Published by International Law and Policy Institute (ILPI) on May 18, 2016, accessed on 11 Aug 2025
62) Jain, K. P., Pruyn J. F. J., and Hopman J. J., (2013), Critical Analysis of the Hong Kong International Convention on Ship Recycling", International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering; Vol:7, No:10, 2013, accessed on 23 Sep 2025
63) Jain, K. P., Pruyn J. F. J. and Hopman J. J., (2017), Material flow analysis as a Tool to improve ship recycling, Journal of Ocean Engineering, pp. 674-683, Vol 13, Aug 2017, accessed on 23 Sep 2025
64) Mambra, S., (2017), What is Green Ship Recycling, Green Shipping Marine Environment, Marine Insight, Oct 04, 2017, available at: https://www.marineinsight.com/environment/what-is-green-ship-recycling, accessed on 28 Jul 2025
65) Mohiuddin, G., and *Hossain, K. A., (2023a),* Strategic Plan to Ratify HKC 2009 by Bangladesh: Challenges & Approach toward implement SRFP in local yards toward Green Ship Recycling, International Journal of Novel Research & Development (IJNRD) 8 (5), May 2023, accessed on 11 Aug 2025
66) Mohiuddin, G., and *Hossain, K. A., (2023b),* Analysis of Present Global Ship Recycling Status and Challenges for Bangladesh, Global Scientific Journal 11 (4), May 2023, accessed on 11 Aug 2025
67) Mohiuddin, G., Kh, Hossain, okar A., & Ali, M. T., (2023), Evaluation of present ship recycling scenario and Oppurtunity for Bangladesh, Environmental & Analytical Toxicology, accessed on 11 Aug 2025
68) Mandaviya, M. (2019), Ship recycling bill will boost Indian economy. The Statesman. https://www.thestatesman.com/opinion/ship-recycling-bill-will-boost-indian-economy-1502834117.html, accessed on 11 Aug 2025
69) Maritime Executive, (2024), NGO highlights continuing problems in ship recycling in 2023, February 2024, available at: https://maritime-executive.com/article/ngo-highlights-continuing-problems-in-ship-recycling-in-2023, accessed on 11 Aug 2025
70) Maritime Executive, (2025), To save Bangladesh's ship recycling industry, phase in the HKC, available at: https://maritime-executive.com/editorials/op-ed-to-save-bangladesh-s-recycling-industry-phase-in-the-hkc#, accessed on 11 Oct 2025
71) Muhibbullah, M., Molla, M. H., Ali, K. M. B., Sarwar, M. I. and Hossain, N., (2014), Health Hazards and Risks of Ship Breaking Activities in Bangladesh: An Environmental Impact Assessment Approach, European Journal of Advanced Research in Biological and Life Sciences 2(1): 1-15 pp. Jun 2014, accessed on 11 Oct 2025

72) Nikos Mikelis, (2017), What Will 2017 Bring to the Ship Recycling Industry? Available at: http://www.maritime-executive.com/editorials/what-will-2017-bring-to-the-ship-recycling-industry, accessed on 28 Jul 2025
73) NGO Shipbreaking Platform (2024). Annual Lists of Scrapped Ships (2012-2021). Accessed June 23, 2023. https://shipbreakingplatform.org/annual-lists/, accessed on 11 Aug 2025
74) Olgn News, (2025), Comparative analysis of ship recycling yards in South Asia, available at: https://www.olgn.news, accessed on 11 Aug 2025
75) Sivaprasad, K., (2010), "Development of best practices for ship recycling processes," Thesis Submitted to the Department of Ship Technology, Cochin University of Science and Technology, India, Dec 2010, accessed on 13 Aug 2025
76) SENSREC, (2025), *available at:* https://www.imo.org/en/mediacentre/pages/whatsnew-2229.aspx#, accessed on 11 Aug 2025
77) Sujauddin, M., Koide, R., Komatsu, T., Hossain, M. M., Tokoro, C. and Murakami, S., (2016), Ship Breaking and Steel Industry in Bangladesh: The Material Flow Perspective, Journal of Industrial Ecology, Vol 10, Mar 2016, accessed on 29 Sep 2025
78) TBSNews, (2021), Bangladesh remains on top in ship breaking, October 22, 2021, *available at:*
79) https://www.tbsnews.net/dropped/industry/bangladesh-remains-top-shipbreaking-319333, accessed on 07 Aug 2023
80) TBSNews, (2025), Bangladesh top global ship recycling again*, available at:* https://www.tbsnews.net/economy/industry/bangladesh-top-global-ship-recycling-again-541874, 24 Jul 2025, accessed on 11 Aug 2025
81) UNEP, (2012), Basel Convention - Technical guidelines on the environmentally sound co-processing of hazardous wastes in cement kilns, accessed on 11 Aug 2025
82) *UNCTAD, (2025),* Ship recycling, by country, annual (analytical)*, on 10 Jun 2025, available at:* https://unctadstat.unctad.org/datacentre/dataviewer/US.ShipScrapping*,* accessed on 31 Jul 2025
83) YPSA, (2024), The Challenges to be Green Ship Recycling Yard in Bangladesh: YPSA Round Table Meeting, available at: https://ypsa.org/2024/02/the-challenges-to-be-green-ship-recycling-yard-in-bangladesh-ypsa-bsbrs-round-table-meeting/#, 16 Feb 2024, accessed on 31 Jul 2025

There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (https://creativecommons.org/licenses/by-nc/4.0/), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.