

Shipbreaking industry in bangladesh: Legal, health, safety, & technical issues

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Abstract

Shipbreaking is one of the indigenous industries in the world. A ship is dismantled in a yard after her lifespan. Dismantling ship generates huge revenue, support backward industry and creates employment opportunities for a country. Many developed countries were pioneers in this industry. However, this industry moved to Asian countries due to cheap labor and substandard regulations. Being a maritime nation, Bangladesh holds an elevated position in the shipbreaking industry consistently. Though having potentiality, Bangladesh reflects a shady image due to disregarded environmental pollution, health and safety issues. Therefore, this study effort to examine the issue concerning shipbreaking, identify challenges, and put forward strategies for their mitigation to get the optimum output in the shipbreaking industry. The study depended on data compiled from secondary sources. Secondary data were sourced from published books, documents, reports, scholarly articles, and the internet. This study exhibited the existing shipbreaking practices relying on the conventional beaching method resulting in environmental pollution, occupational health, and safety hazards. Moreover, the underlying causes are deficiency in legal compliance, less concern in human resources, insufficient technical facilities. Therefore, this study recommends obligatory legal compliance, human resource development, and technical standardization requiring the utmost priority for sustainable development and keeping up the continuous growth of this industry.

Keywords: Shipbreaking, Health Hazard, Environment Pollution, Bangladesh.

1. Introduction

Shipbreaking is one of the primitive industries in the world. Ships are being used for transporting goods through the ocean over the centuries. The nature of shipbuilding

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changes from the “Wooden Ship” to “Tudor Ships” and finally to the “Metal Ships” (Dunkley, M., 2016). The lifespan of a ship is about 25 – 30 years (Dinu and Ilie, 2015). The ship will become non-profitable to operate after its lifespan. In ancient times, broken ships were burned down or the timbers were used to build a new one. At present, different parts of ships have the potential for metal forming as a raw material in different industries. The eras of ship operating and shipbreaking have existed concurrently and have developed through time. In this modern era, almost every ship is metal-built. Hence, Shipbreaking illustrates the process where an obsolete ship's structure is being dismantled for demolition or scrapping or disposal involving extraction of raw materials, carried out at a pier or in a dry dock. (Ibeanu, 2009) However, Shipbreaking fulfills metal demand, it also pollutes the environment.

Shipbreaking operation was considered highly mechanized operation in industrialized countries until the 1960s. The United States of America, the United Kingdom, Germany, and Italy were considered pioneers in shipbreaking operations. Previously, the UK held 50% of the industry and Scotland was the leading country in shipbreaking operations globally. (Dunkley, M., 2016) Afterward, shipbreaking operations motivated the semi-industrialized countries like Spain, Turkey, & Taiwan between 1960 to 1970s due to their cheap labor cost. Shipbreaking moved to Asian countries like India, China, Pakistan, and Bangladesh while health and safety standards were minimum and workers were desperate to work. (Hossain and Islam, 2006)

Bangladesh is an emerging country in the ship scrapping business in the international market. Bangladesh topped in Shipbreaking with 47.2% of the Global tonnage in 2018. (UNCTAD, 2019) Low labor costs, flat uniform intertidal zone, moderate enforcement of laws, steel, and iron demand in the local market offered advantages to the shipbreaking industry (SBI) in Bangladesh. In Bangladesh, ships are scrapped on open beaches. Harmful substances like Persistent Organic Pollutants, Asbestos are a threat to the marine environment. Consequently, the government of Bangladesh (GOB) has introduced a new national policy and legislation in 2011 named “The Shipbreaking and Recycling Rules-2011”. (Neşer et al. 2008) These regulations were introduced to develop the environmental, health, and safety issues in the shipbreaking yards. In parallel, the “Labor Law Act 2006” consolidates and amends the laws relating to the employment of labor.

However, rules and regulations are seldom enforced or followed in Bangladesh. (Barua et al., 2018), As a result, a shady image is reflected in the shipbreaking industry in Bangladesh. The purpose of this study is to examine the current shipbreaking sector in Bangladesh, identify challenges, and provide recommendations for development.

2. Objective

The objective of this study is to investigate the impediments of the SBI in Bangladesh considering overall environmental issues and to suggest recommendations to overcome those impediments. The expected outcome of this study would be an in-depth analysis of the impediments under the existing shipbreaking practice. It is expected that the outcome would include strategies to mitigate identified impediments to get the optimum output in the ship scrapping market of Bangladesh.

3. Scope of The Study

This research will span the years 1960–2020. The time selected corresponded to Bangladesh's historical entry into the ship-breaking industry. Additionally, this period is deemed appropriate for conducting an impartial review of shipbreaking techniques to assist Bangladesh in developing its capabilities.

This study examines solely shipbreaking-related concerns in Bangladesh, including environmental, health, and technical information relevant to significant shipbreaking trends. The context for this study subject was established within Bangladesh's shipbreaking legal policy, health and safety issues, and technological theme.

4. Methodology

Bangladesh has grasped the potentials of Shipbreaking and boosted its economic growth. Shipbreaking is a challenging operation due to the complexity in ships' structure and hence, the effect on the environment (i.e. Labor safety, metal waste, etc.). However, shipbreaking activities contaminate the coastal soil and environment. The leftover scrapped vessels often get mixed with seawater, soil, and pollute the environment physically, chemically, and biologically. It also affects human health and nearby marine inhabitants. (Barua, P. et al., 2017) European countries eagerly focused on the environmental effects due to the shipbreaking while, Bangladeshi companies are searching for quick economic benefit avoiding those major environmental threats. Therefore, this study pursues to find solutions to the aforesaid research problems.

While conducting research, the study adopted applied research employing a qualitative approach to enable established new factual information. However, the nature of data collected for this study was an integration of qualitative and quantitative data for analysis. This paper is accomplished based on secondary data and many published and unpublished material have been used. It involves the gathering of official documents

and policy guidelines from different ministries. Bangladesh Ship Breakers Association (BSBA) and publications include various books, journals, scholarly articles, other maritime university research papers, dissertations, Internet, newspapers, magazines, shipping statistics, markets review, relevant published and unpublished materials. Analyzed data were presented in a descriptive form. In some cases, the collected data has been converted into pie charts, tables, flow charts, bar diagrams, and line chart bar diagrams for clarity. The analyses were used to draw conclusions and make recommendations to get the optimum output in the global ship scrapping market.

5. Limitations of The Study

In Bangladesh, data paucity and a lack of record-keeping were challenges for this research. Access to confidential materials posed considerable difficulties, particularly in light of the weak and imprecise record-keeping practices prevalent among linked organizations in Bangladesh. However, via conversations and consultations, all of these efforts have been made to overcome these constraints. Additionally, this research is being undertaken during the COVID-19 period. It was fairly difficult to gain access to any office for data collection and interview responses. The researchers, however, overcame these obstacles through the use of email and general online support.

6. Overview of The Shipbreaking Industry in Bangladesh

A violent cyclone in 1960 drove a Greek ship named "M D Alpine" ashore. Due to her damage, the ship could not be refloated and was restricted to Faujdarhat. Chittagong Steel House bought the ship and scrapped it in 1964, introducing Bangladesh to shipbreaking. During Bangladesh's liberation war in 1971, Pakistan's Al-Abbas was bombed (Das and Shahin, 2019). The wrecked ship was rescued from Chittagong by a Soviet rescue team. They towed the ship to Faujdarhat. In 1974, Karnaphuly Metal Works bought the ship as scrap, marking Bangladesh's first entry into shipbreaking (Hossain and Islam, 2006). Shipbreaking occupied a 3 km coastal zone of Sitakunda in 1985, which gradually extended to 19 km in 2012. (NGO Shipbreaking Platform, 2020)

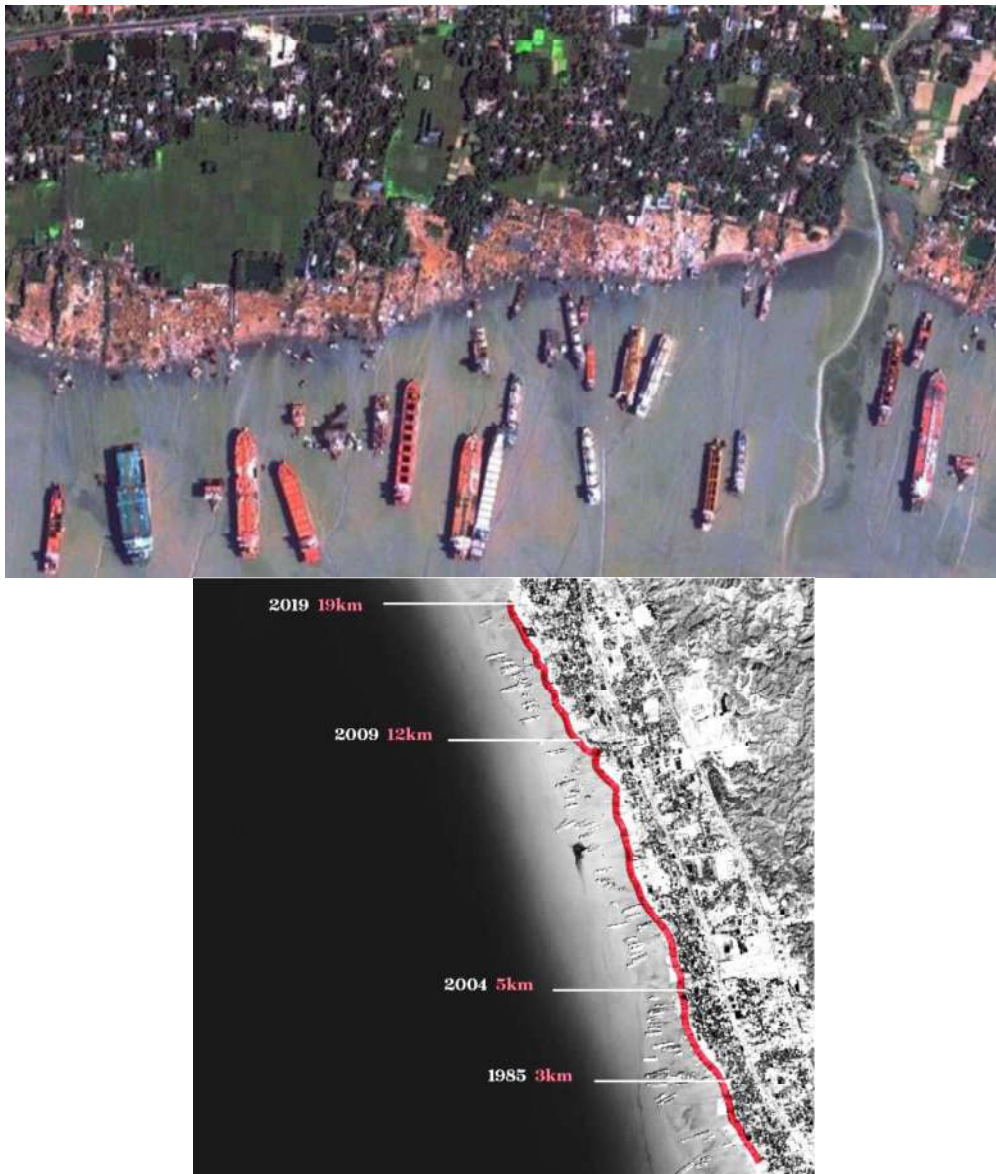


Figure 1: Satellite View of Shipbreaking Yards (Shitakundu, Chittagong)
 (Source: Satellite view (Google Map) and NGO Shipbreaking Platform, collected by the researchers)

According to the NGO platform 2020 report, 630 ships were dismantled globally. Out of these, Bangladesh dismantled 144 ships of approximately about 6.69 million GT made the country the preferred scrapping destination worldwide in terms of tonnage.

Despite the leading position in the ship dismantling industry, the safeguard of workers' health and safety, the protection of the environment is still poor in condition. (NGO Shipbreaking Platform Impact Report, 2018-19) This study looks at the progress of dismantling ships in South Asia. Ship dismantling in Pakistan is unstable in the last couple of years while India and Bangladesh are in the race for the top position. *Figure 1* shows a satellite view of shipbreaking yards (Shitakundu, Chittagong).

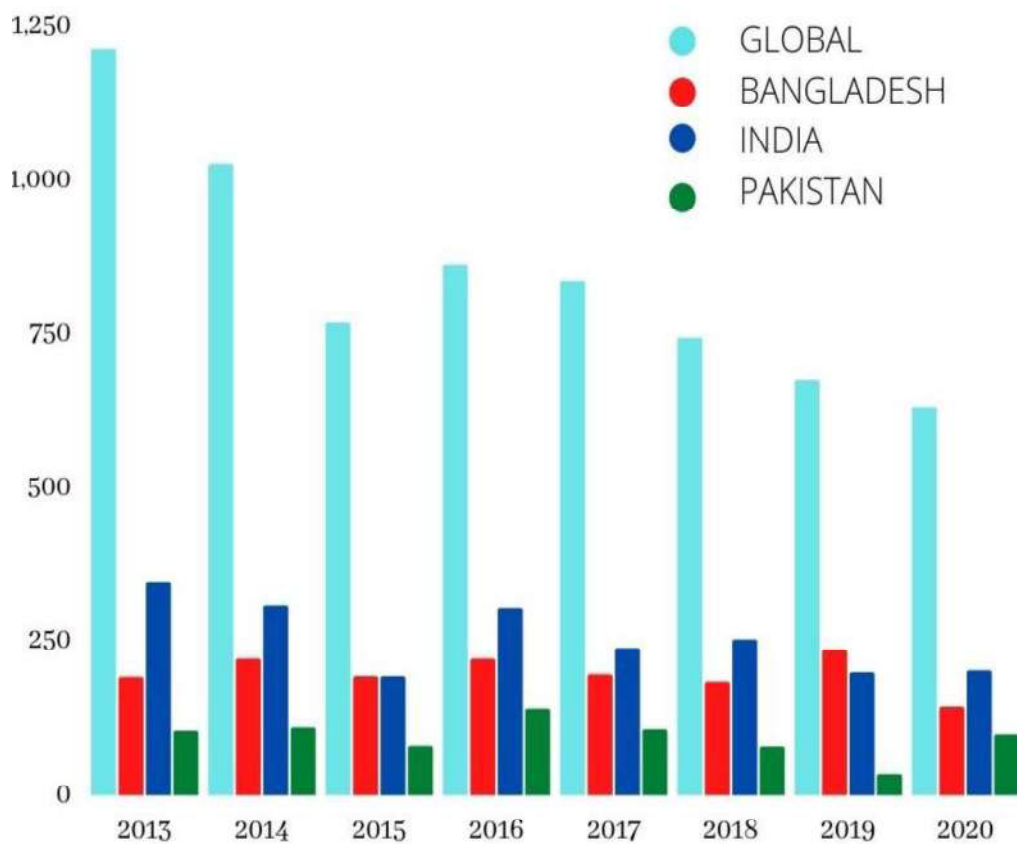


Figure 2: Number of Ships Dismantled Worldwide (2014-2020)
(Source: Compiled by the researcher based on data from NGO Platform)

Bangladesh has dismantled more than one-third of the global tonnage in the year 2020. In Figures 2 & 3, the study shows the real competition in global dismantling. Bangladesh ranks topped in dismantling ships in terms of Global Tonnage in the years of 2019 and 2020 even while the number of ships was less than India in 2018 and 2020.

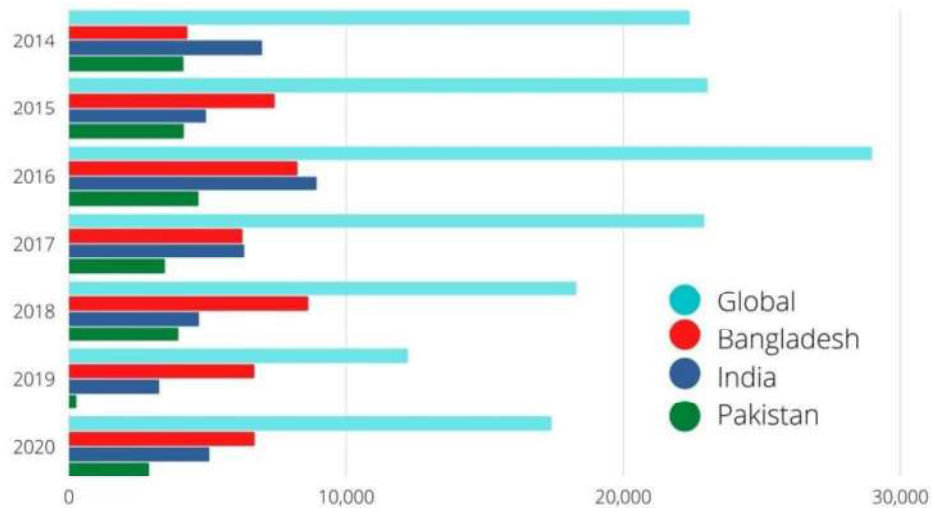


Figure 3: Ship Demolition (Thousands of Gross Tonnage) Worldwide (2014-2020)
(Source: Compiled by the researcher based on data from “UNCTAD report”)

When the lifespan of a ship ends, it will go under demolition or recycling process. Figure 4 shows the shipbreaking sequences in Bangladesh. These ships are offered for bidding on the scrapping market. A ship breaker or ship recycling owner purchases a ship through a middleman or cash buyer. (Karlis, T. et al., 2016) The liaison between the local buyers and international sellers. Before arriving at the territorial waters of Bangladesh, vessels are anchored in international water to be inspected. Inspection is done by the administrative body for no objection certificate (NOC) about any radioactive heavy metal hazardous to the environment. After getting signal green from this administrative body, the Chittagong Port Authority permits the ship to enter the territorial waters of Bangladesh. (Rahman, S. 2017) The process of breaking in Chittagong involves intertidal beaching. (Andersen, A. B. 2001) The vessel beached to the specific yard during maximum high tide. (Pasha, M. et al., 2012) The vessel is lightened by removing stores, machinery, and all other removable items with the help of mechanized winches. Thereafter, the vessel requires gas freeing and removal of residual oil to prevent environmental hazards. Initially, during the intertidal zone, primary cutting is done at the beaching yard with large chunks of section. These heavy metals are pulled onto the shore yard for additional cutting known as secondary cutting area. (Shameem, K. A. B. M., 2012) In the secondary cutting area resizing, sorting, segregating, loading, delivery take place. Scraps are then stocked and sold to the national and international markets. Finally, scrapes are transported to re-rolling industries for recycling and also used as a raw material for shipbuilding and other industries.

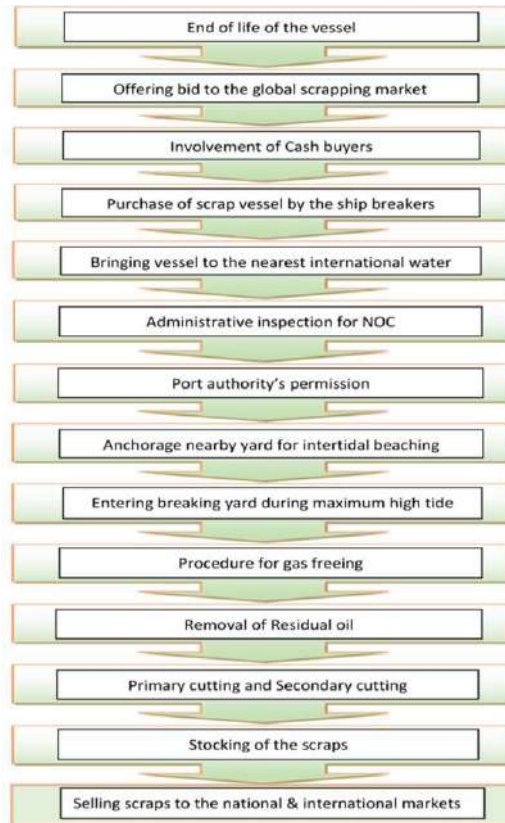


Figure 4: Flow-Chart of Shipbreaking Sequences in Bangladesh.

(Source: Compiled by the researcher based on information from Pasha, M. et al. (2012) and Karlis, T. et al. (2016))

A ship, when it finishes operational life and is ready to be scrapped is known as the end of life (EOL) for a ship. The ship becomes too expensive to operate after its lifespan and affects human safety. *Figure 5* shows the time cycle of shipbreaking practices in Bangladesh. Typically, EOL ship decommissioning choices were made quickly, before the broker allocated it for sale, which may take up to a month. Eligible buyers can be found within two weeks by bidding on the best prices. Thereafter, relevant documents are prepared for their selling purpose, goals, and attributed responsibility. Designated surveyor's inspection of the buyers and memorandum of understanding (MOU) agreement signing takes place in approximately five days. EOL ship's ownership transfers to a buyer within a couple of days for preparing required documents according to the recycling country's terms and conditions. Furthermore, the ship reaches the recycling yard from 3 to 30 days by towing or using its engine power. Finally, ships are placed according to their size and type depending on the tide.

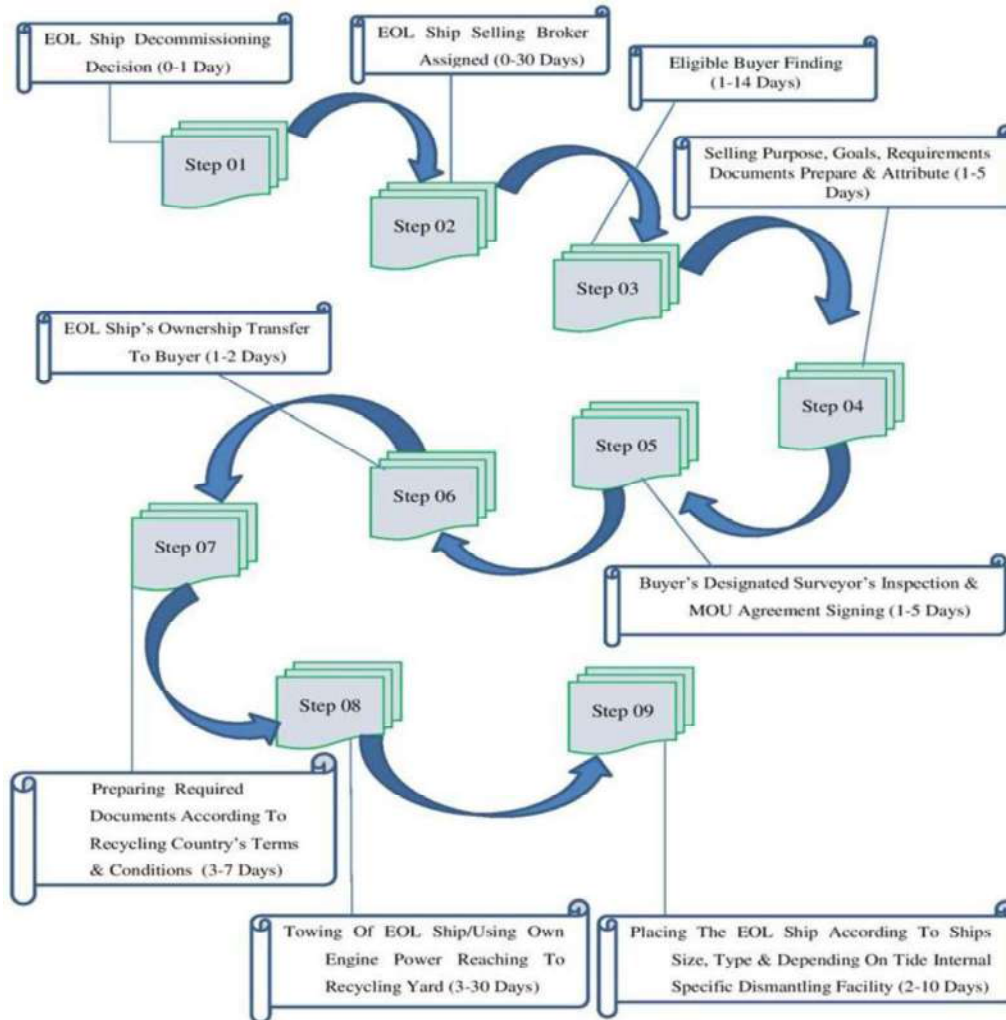


Figure 5: Time Cycle of Shipbreaking Practices in Bangladesh.

(Source: Compiled by the researcher based on the information from Hossain, K. A. on October 2019, “Bondor Barta” (A monthly magazine published by the CPA))

In Bangladesh, ships are demolished on open beaches with minimum consideration emphasized on safe and environmentally friendly waste management practices. As a result, harmful substances like Asbestos, Polychlorinated Biphenyl (PCB), heavy metals, poisonous paint, flammable substances (oils, chemicals, gas) have easy access to the environment. (Hasan, R. R. & Rahman, A. 2017)

However, inept management of hazardous substances during the scrapping of ships may cause soil contamination in beaching sites of Bangladesh. Shipbreaking activities pose a

threat to the terrestrial and marine environment. Moreover, shipbreaking is time-consuming and prone to labor health hazards due to its complex procedure. In Bangladesh, the enhancement of the legislative framework with technical adjustments is needed to overcome those difficulties.

7. Issues Involved in Shipbreaking of Bangladesh

The major issues involved in the shipbreaking of Bangladesh are the international legislative framework, domestic laws for shipbreaking in Bangladesh, occupational health & safety issues, and technical themes. these are subsequently discussed below:

7.1 International Legislative Framework

The shipbreaking practices experience international legislation to safeguard the health and safety of workers as well as the marine environment. The ultimate responsibility lies upon the yard management and national authorities where the shipbreaking industries are situated. There are some international regulations regarding shipbreaking practices to maintain global standards and to control environmental pollution. Followed by, there is also some domestic legislation that has been implemented from the national perspective of Bangladesh. Relevant international and domestic legislations are mentioned here.

- **Basel Convention (BaC), 1989:**

Basel Convention is the first convention that can be applied to ship recycling practices named “Control of Trans Boundary Movements of Hazardous Wastes and their Disposal (1989)”. The Basel Convention targets to ensure human health and the environment mitigating the hostile effects resulting from the production, transboundary movements of hazardous waste. It also controlled the disposal of hazardous wastes in a secured environmental manner. (Werven, B. V., 2019) The Basel Convention has three objectives, they are: Promoting local management of wastes, Minimizing the number of hazardous wastes, and promoting environmentally sound management and disposal of wastes.

The parties to the Basel Convention developed some rules for the sound environmental management for dismantling of ships to give more specific guidelines for ship recycling. End-of-life ships can be recognized as waste when the owner has the intention to dispose of the ship and thus fall under the regulation of the Basel Convention. (Matz-Lück, N.,2010)

- **Hong Kong Convention (HKC), 2009:**

The Hong Kong International Convention (HKC) for the Safe and Environmentally Sound Recycling of Ships was adopted in 2009. The purpose of the convention is to ensure that ships recycled will not occur any unwanted risks to human health and safety of current shipbreaking practices. It also includes the design, operation, construction, equipment, and maintenance of ships, and preparation to facilitate safe and environmentally sound recycling. It must be specific to each ship for demolition if the ships are sent to the countries that are fully complied with the HKC for demolition. (Nikitakos, N. & Papachristos, D., 2014)

The HKC was set up by the IMO in cooperation with the International Labor Organization, (ILO) and the conference of parties to the Basel Convention. The complementary goals are:

- Designing the ship's life cycle to facilitate safe and sustainable recycling.
- Operating ship-recycling facilities in a safe and sound environment.
- Ensuring compliance with these goals by setting up ways of enforcement.

To fulfill these objectives, some concrete responsibilities are in place. Ship-owners are required to provide an Inventory of Hazardous Materials (IHM) throughout the life of the ships and are restricted for the use of certain materials within the construction and during repairs. (Rossi, V., 2011) Ship recycling facilities must provide a ship recycling plan for each ship they dismantle, organize training and arrange protective equipment for the employees. The main jurisdiction lies on flag states for enforcement of the ships and recycling states for enforcement of the facilities. Ship-owners must inform the flag state before dismantling takes place to get a 'Ready to Recycle' certificate for the ship. (Otsubo, S. 2014)

Of late, the agreement between IMO and the Government of Norway was signed to support Phase III of the project on Safe and Environmentally Sound Ship Recycling in Bangladesh. (SENSREC). It is assumed that this project will pave the way for Bangladesh to move forward on its path towards becoming a party to the IMO Hong Kong Convention, the treaty that will set global standards for safe and environmentally sound ship recycling. (IMO, 2020)

- **Marpol (Marine Pollution) Convention 1973/78**

International Convention for the Prevention of Pollution from Ships (MARPOL) deals with appropriate waste-reception facilities. Amendments are made intermittently by the Marine Environment Protection Committee (MEPC) of IMO. The requirements of MARPOL are included in six Annexes.

Annexes I, II, IV, and V to the MARPOL Convention need the founding of appropriate waste-reception facilities for the reception of waste from ships during shipbreaking. (Alam, S. and Abdullah, F., 2014)

- **Domestic Laws for Shipbreaking in Bangladesh**

The government of Bangladesh has introduced laws for monitoring the shipbreaking industries to make it a potential sector of Bangladesh. Many accidents and deaths happened in the shipbreaking industry but few of them have been reported. The legal battle between the environmentalist group and the shipbreaking association even brought a short-term stoppage of all shipbreaking practices in the year 2010. (Zakaria, N. M. G. et al., 2012) Some of the domestic laws for shipbreaking in Bangladesh are:

- The Fatal Accidents Act, 1855 (Act No. XII of 1855)
- The Bangladesh Environment Conservation Act, 1995 (Act No. I of 1995)
- The Environment Conservation Rules, 1997
- The Environment Court Act, 2010 (Act No. LVI of 2010)
- The Shipbreaking and Recycling Rules (SBSR), 2011
- The Hazardous Wastes & Shipbreaking Waste Management Rules, 2011
- The Bangladesh Ship Recycling Act, 2018 (Act No. 08 of 2018)

The Bangladesh Environment Conservation Act 1995 prevails the most significant environmental legislation that intentions to improve environmental standards and to control environmental pollution in Bangladesh. Besides, Bangladesh's High Court issued an order on May 17, 2009, prohibiting shipbreaking yards from importing ships without first obtaining an “Environmental Clearance Certificate” (ECC) from the Department of Environment. Conferring to an affidavit, given by the ministry in the court, 36 yards are operating their business without clearance. (Jobaid, M. I. et al. 2014) In January 2011, the Ministry of Environment and Forests issued a Shipbreaking Guideline to achieve Environmentally Sound Management. On February 13, 2011, the Bangladesh government recognized shipbreaking as a formal industry. The Ministry of Industries issued 'The Shipbreaking and Recycling Rules, 2011'.

In May, the Ministry of Environment and Forestry issued the "Hazardous Waste and Management of Hazardous Waste in Ship Breaking-2011" regulation. In July 2011, However, the import of a ship will require the yard owner to get a “No Objection Certificate” (NOC) by submitting the yard’s environment clearance certificate and an inventory of hazardous materials on board before the import of the ship at the outer anchorage. (The Shipbreaking and Recycling Rules, BD- 2011) Moreover, the rules specify that the yard owner has to present a Ship Recycling Plan (SRP) and a Ship Recycling Facility's Plan. Until 2017, close to 100 shipbreaking yards were awarded Environmental Clearance Certificates (ECCs). PHP Shipbreaking and Recycling Industries, one of the Bangladeshi shipbreaking yards have purchased its first vessel to be recycled under the Hong Kong Convention. In October 2017, PHP became the first

Bangladeshi recycling facility to get a statement of compliance with the convention (Maritime executive, 2017)

7.2 Occupational Health & Safety Issues

Shipbreaking generates many occupational and environmental health hazards. It may cause high levels of fatalities, injuries, and work-related diseases. By any means, the demolition of ships is dirty and dangerous work and carries danger to life. The old beaching method is being used for shipbreaking and ship recycling with little environmental protection. (Alam, S. and Abdullah, F., 2014) Workers working in shipbreaking yards are mostly uneducated and they don't have any knowledge about their work. The majority of workers wear no protective gear. The workers involved in SBI are exposed to a wide range of hazardous materials inevitably causing occupational illness and diseases. Many of them work barefooted. Hence, more accidents happened that were liable to serious injuries and deaths to the workers. *Table 1* shows the dismantling activity and related worker's exposure. These include asbestos, paint, lead, and polychlorinated biphenyls (PCBs), etc.

Table 1: Dismantling Activity and Related Worker's Exposure

DISMANTLING ACTIVITY	WORKER'S EXPOSURE
Asbestos removal and disposal	Exposure to asbestos fibers, through inhalation, causes asbestosis or cancer.
PCB removal and disposal	Exposure through inhalation, ingestion, or absorption through the skin may cause adverse health effects.
Bilge and ballast water removal	Toxic organics, cause serious health effects. Discharge of toxic organics may cause the release of poisonous gases.
Paint removal and disposal	Chemicals used in stripping evolve VOCs and hazardous air pollutants. Abrasive blasting and mechanical removal generate particulates. These emissions are toxic and may cause cancer through inhalation.
Metal cutting and metal disposal	Torch cutting generates fumes, smoke, and particulates that may have toxic effects.
Removal and disposal of various ship machinery	Workers handling ship machinery components may be exposed to contaminants, like asbestos, PCBs, oil, and fuels.

Source: Adapted from "Worker safety in the ship-breaking industries" by Andersen A. B., 2001

Dangerous work situations can be created due to inadequate safety controls and poor monitoring. Moreover, ships contain many hazards which must be handled and disposed of safely. Otherwise, these can have significant detrimental effects on human health. (Sarraf, M. et al. 2010)

Before 2011, there were no recognized education and training schemes for workers other than a few workshops organized by the Bangladesh Institute for Labor Studies, so they were unaware of work-related hazards. There is no system of employment contract letters between contractors and the workers. (Greenpeace-Fidh Report, YSPA, 2005) However, the first formal training institute introduced on 21st April of 2011 named “BSBA Training Center” without a particular superstructure was under the supervision of the Director of Environment under the MOEF. Then in the year 2015, a training center was established on top of the under-construction BSBA hospital. (Shameem, K. A. B. M., 2012) It was found that the training was not fully adapted to the sector. There were prevailed some deficiencies like self-developed by local trainers and delivered according to personal ability. The delivered schedule was implemented by the trainers, yet was deficient in formalizing the adequate training. (FIDH. , 2002)

8. Technical Themes

Shipbreaking practices are highly prone to environmental pollution for any nation. In Bangladesh, when a ship is at her EOL, breaking authority needs to take the NOC from assigned government officials. This NOC is to be issued after the de-ballasting without any cargo on board ship for inexpensive "Beaching Method" (*Figure.6*) of shipbreaking. (Sujauddin, M. et al., 2013) Technically, the port city Chittagong has the geographical advantages of a gradual continental shelf with suitable width and depth of water. Moreover, it is also located in the middle hub of the mainstream of east to westbound. Therein, with the advantage of natural coastline, this allows the world’s largest tanker vessels to accommodate the inshore of Chittagong for beaching method ship recycling. (Shameem, K. A. B. M. 2012)

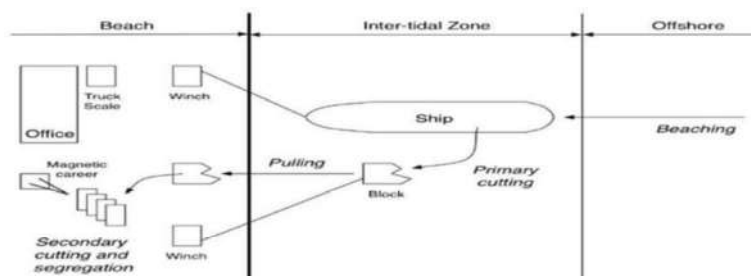


Figure 6: Beaching Method Used in Bangladesh.

(Source: Adapted from “Characterization of Shipbreaking Industry in Bangladesh”- Sujauddin, M. et al. (2013)

At the EOL of a ship, every single machinery detail has to dismantle. Thus, Technical support and technical tools come into play for the shipbreaking yard. Depending on the ship's capacity, yards are selected for shifting the ship to the nearby beaching place. In the beginning, machinery spaces like pumps, valves, filters, and different plants are dismantled and removed. Usually, this is done by the normal tools like a spanner, pulleys, grinders, or else some different plants' specific tools which already exist onboard. Consequently, all the furniture (i.e. Sofa, Bed, Table, Chair, Galley Accessories) and reusable things (i.e. Fridges, Television, lamps, Switches, Bulbs, Switchboards, Bathroom Accessories) are removed from the Ship. Later on, those are sold to different recyclers through auctions and most of those are reusable for household or business places. (Hossain, K. A., 2015)

Moreover, all the waste oil and sludge are taken away to the shore through a ship-shore connection. Practically in Bangladesh, gas cutting is commonly used for cutting down metal plates and different structures. This process is done in two steps: initial cutting and secondary cutting. In the initial cutting, around chunks of sections 20-50 MT each is cut by the gas cutter. (Shameem, K. A. B. M., 2012) *Figure 7* shows different equipment and cutting tools used in SBYs of Bangladesh. Thereafter, it is dragged towards the land with the winch. Secondary cutting starts with an auto-cutter or gas cutter. Consequently, metals are cut and removed towards stacking areas through trucks or workers while winch and ropes are used to transport those metal plates, heavy machinery, and different materials from the intertidal zone to the storing places. Metals are pulled inwards to land with the help of a winch while metal ropes are tied around. Furthermore, the wagon is used to remove small accumulated metal parts (i.e. boxed shape metal), which makes it easier for removing more metals more efficiently by the winch.

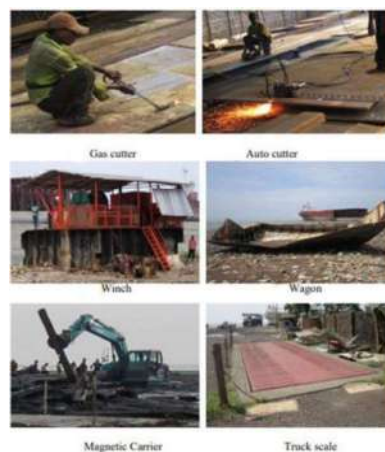


Figure 7: Equipment and Cutting Tools Used in Shipbreaking Yards of Bangladesh
(Source: Adapted from “Contributions of Ship Recycling in Bangladesh: An Economic Assessment” Ahammad, H. & Sujauddin, M. (2017)

Moreover, “Magnetic Handling Carrier” is used to transfer the iron and steel items is by the magnet lifting. Electrical cables and cable sheathing, navigational instruments such as Navigation Light, Lifeboat, Life-buoy, Life-raft, Fog-horns, Batteries are also carried with cranes and sometimes it is done by the labor’s help considering its size. In secondary cutting, Marine Engine, Generator, Anchor, Chain Block, Air compressors, Auxiliary Boiler, Hatch, Hatch coaming are separated and moved with cranes. Thereafter, these are sold by the auction to the inland shipbuilding industry, industrial factories, and relevant training purposes. (Ahammad, H. and Sujauddin, M., 2017) Generally, the whole process of cutting and dismantling takes typically 5-6 months. (Hossain, S. M. et al., 2011)

The beaching method helps in the removal of huge chunks of sections to land for further secondary cutting and preparing for transportation in different areas according to availability. Hence, technical segregation of shipbreaking is the most important part of technical support; usage of modern tools can make shipbreaking practices easier, safer, and efficient.

9.Impact of Prevailing Shipbreaking Practices in Bangladesh Seaside Bio-Diversity

The SBI causes severe disruption to the natural coastal environment. The dearth of environmental laws and regulations, besides occupational health security guidelines, has worsened the situation of SBIs in Bangladesh. The toxic concentration of ammonia, marine organisms is traced around the area having an increase in PH level. Lower “Dissolved Oxygen” (DO) and higher “Biochemical Oxygen Demand” (BOD) are obtained with huge floatable materials. A variety of non-reusable materials are discharged in shipbreaking areas of Sitakunda which are emitted from scrapped ships and intensely get mixed with the sand. The scraps from vessels are stacked haphazardly on the seashore. (Jobaid, M. I. et al. 2014) Toxic materials impaired primary productivity by killing off the “Phytoplanktons” and “Zooplanktons” in the intertidal zones. As a result, the fish resources degraded due to the scarcity of food. Therefore, deforestation due to shipbreaking extension, polluted water, and toxic soil destroyed and degraded the seaside habitat, and biodiversity. *Table 2* shows the physicochemical properties of seawater and beach soil within and outside shipbreaking areas.

Table 2: Physiochemical Properties of Seawater and Beach Soil within and Outside Shipbreaking Areas.

Physiochemical Properties of the Seawater	Sampling Stations		
	Fauzdarhat	Kumira	Baroaoliar Mazar
Turbidity (JTU)	720	723	470
Toxic Shock Syndrome (mgl-1)	4194	4038	2284
Total Dissolved Solid (mgl-1)	1990	1982	1288
PH	7.8	7.7	7.2
Electrical Conductivity ($\mu\text{s cm}^{-1}$)	1600	1710	3036
Chloride (mgl-1)	470	502	789
Iron (mgl-1)	36.02	37.62	2.26
Ammonia (mgl-1)	2.67	2.92	0.26
DO (mgl-1)	4.10	3.90	6.36
BOD (mgl-1)	7.63	6.98	4.08
Oil (mgl-1)	10,600	9,200	--

Source: Data were taken from “Shipbreaking Activities and its Impact on the Coastal Zone of Chittagong, Bangladesh: Towards Sustainable Management” Hossain, M. M. & Islam, M. M., (2006)

10. Fatalities and Human Rights

The demolition of ships is a dirty and dangerous occupation. Shipbreaking bears a very real risk to life. Accidents kill or maim numerous workers each year. In 2017, NGO Platform recorded at least 15 workers were killed and about 22 were suffered from severe injuries, in the year 2018 and 2019, documented the stories of 44 workers who were killed and 46 were severely injured.⁷⁶ Due to insufficient transparency in the SBI, the actual number of workers that have been killed or maimed is much higher. They are also not covered by any health or worker’s insurance or compensation system. Accidents, injuries, or deaths originate due to:

- Falling from a high height
- Torch cutting without protection (eye injuries)
- Noise (hearing defects)
- Improper gas freeing and gas monitoring procedures cause serious fire hazards
- Carrying heavy metals physically. (back injuries)
- Enclosed spaces on the ships are not properly cleaned before beaching and may contain harmful chemicals or fumes which are a major cause of the explosion.

- If enclosed space is not properly cleaned, workers enter in confined space may suffer from suffocation, injuries to the lungs, etc.
- Hatches contain explosive gases, and as the gas cutters drill holes to release the gases will cause severe explosions and fires. (Andersen, A. B., 2001)

The workers are poor and they could not find other alternative jobs for supporting themselves and their families so they had to work in the shipbreaking yards. Violations of human rights involved in the SBY are:

- When injured the workers don't get proper treatment.
- No overtime is given to the workers.
- Necessary equipment, gears are not provided by the shipbreaking yards.
- Workers don't receive their wages timely.
- No specific rule is provided about their jobs. (Hassan, R. R. & Rahman, A., 2017)

11. Prolonged Process

In the beaching method, secondary and tertiary cutting is done on the land and indoor facilities. (Jain, K. P., 2018) Transportation of chunk parts is done by the workers, which is time-consuming and affects workers' health. However, falling objects from high and less awareness within workers about safety matters have created huge inconvenience in the workplace. Using of proper tools and training for use of cutting tools are not present within maximum workers. (Andersen, A. B., 2001) Moreover, organized yard places and signboards for particular places, access permissions for particular areas such as safe for entry, hot works only, heavy machinery zone is not present also. Segregation of the process step by step is not posted or signed through the yard but in some inside the facility is found. Hence, it increases the possible ship recycling in SBI of Bangladesh, while it offers to cut in a chunk part of the ship and drag through tidal water flow. However, it takes time for the whole process of Shipbreaking limiting 5-6 months on average. (Hossain, M. M. and Islam, M. M., 2006)

12. Economic Returns

Shipbreaking operation holds potential as it creates economic openings for thousands of workers and contributes to the economic growth of the regions. Practically 100% of the ship is recycled. In this perception, shipbreaking can be demanded to be a sustainable industrial activity. According to the OECD (2001) report on ship scrapping, ship dismantling removes huge volumes of obsolete tonnage from fleets, recycles many of the materials used in a ship's construction, and is a key employer in the main shipbreaking areas. Besides, the ship recycling sector contributes significantly to Bangladesh's economy. In 2009, Maria Sarraf's team predicted in their report "Shipbreaking and Recycling Industry in Bangladesh and Pakistan" that the average

revenue from a Panamax oil tanker with 80,000 DWT is approximately USD 920,000. The government earns annual revenue of about BDT 700 crore from shipbreaking. Of which, the percentage of import duties is 7.5, and yards tax is 2.5. (Hossain, M. M., and Islam, M. M., 2006) In the years 2010-2015, the industry produced around Taka 53.3 billion (US\$700 million) worth of output every year on average. Besides, customs duties, income taxes, and value-added taxes totaled over Taka 5 billion (about US \$68 million) per year. Additionally, the industry pays significant fees and charges as mandated by the regulatory and compliance frameworks. Notably, the industry employs a large number of trained and semi-skilled individuals from all parts of the nation. The industry is estimated to have provided between 25,000 and 40,000 full-time equivalent jobs, spanning from administrative positions to technical and support positions (Ahammad, H. and Sujauddin, M., 2017).

However, Senior officials from Bangladesh Ship Breakers and Recyclers Association (BSBRA) stated that SBI of Bangladesh provides 60-70% raw materials to the re-rolling mills, and the vessels plying on the inland routes, and the lighter vessels are constructed from steel dismantled from scrapped vessels. Moreover, shipbreaking practices play a vital role in the national economy. Furthermore, the SBI of Bangladesh is the 2nd largest industry in Chittagong after the commercial activity in the port. Shipbreaking activities are of great importance in the national economy as it saves a lot of foreign exchange by decreasing the import of steel materials.

13. Summary of The Research Findings

Shipbreaking in Bangladesh has started back in 1960 in an unanticipated way while a Greek ship was struck by a cyclone and was beached near the seashore of Faujdarhat. Later due to the demand and supply paradox of world shipbreaking, industries shifted to Bangladesh from Europe. This study discusses prevailing shipbreaking practices in Bangladesh affecting the environment and human health. Shipbreaking is an environmental hazard in nature and an accident-prone job. International policies and laws were established for preventing and minimizing environmental pollution, occupational health, and labor safety. Besides, Bangladesh adopted several legislative regulations on shipbreaking by ratifying international conventions. Meanwhile, some of the international regulations are yet to be ratified in Bangladesh. Even so, today's world focuses on the environment where the SBI of Bangladesh is still in a shaded image. The shipbreaking industrialists in Bangladesh are not aware of workers' health hazards. Labors are not providing proper industrial training and sufficient safety items to enter into SBYs. As a consequence, workers are working with minimal instruments with barefoot and bare hands. Several accidents (i.e., falling from height with no safety

harness, crushed falling steel beams and heavy plates, as well as explosions and electrical shocks, etc.) lead to injuries and even to deaths. Simultaneously, Bangladesh uses the traditional beaching method requires where it 5 to 6 months for breaking a ship. Though Bangladesh is tops in ship demolition, long-term sustainability is still uncertain. Present shipbreaking practices in Bangladesh have a huge negative impact on the environment. Toxic hazardous materials mix with nearby seawater due to the inadequate waste management plan, which causes an increase in PH value and degrades the sea biodiversity, micro-organism, and fishery.

14. Policy Implication

Obligatory Legal Compliance

National rules regarding the shipbreaking practices of Bangladesh aren't well complied with in most cases. Besides, there is no other alternative way other than compliance with HKC as soon as possible. A timed implementation strategy is presented (Table 3) for the advancement of HKC compliance within 10 years. To comply with the HKC, steps are needed concerning the modifications of shipbreaking procedures, performance, equipment, and infrastructure in the SBI of Bangladesh. The strategy should target for achieving through interventions based on the subsequent objectives:

- Reduction of risk towards workers and the environment from dangerous dismantling practices in the SBYs.
- Safeguard storage, transportation, and disposal facilities for hazardous materials derived from the recycling process to reduce the supply of risky materials.
- Possibilities for financial investments and organizing them providing through public-private partnerships.

Table 3: Outline Strategic Plan to Comply with the Hong Kong Convention

Time	HKC Article	Institutional Actions Based on HKC	HKC Article	Institutional Actions Based on HKC
Short-term (1-2) Years	R 15	Draft guidelines for facility operation, local standards from IMO.	R 22	Worker safety–training and PPE.
	A 9	Develop facility inspection regime. (Existing legislation)	R 21	Prepare plans and Emergency preparedness.
		Establish health and training centers that also include training for inspectors.	R 19	Prevent adverse effects on human health. (Gas free entry, Spill prevention)

Mid-term (3-5) Years	R 15	Establish internal standards.	R 18	Prepare plans and Ship recycling facility.
	R 16	Authorize facilities—a simplified version	R 23	Incident reporting. Etc.
	R 20	Inspect facilities like existing legislation.	R 17	Establishment of managing systems to protect laborers and the environment.
	PR	Establish hazardous waste management facility Establish laboratory	R 20	Establishing safe and sound environmental management of hazardous materials.
Long-term (6–10) Years	A16	Ratify Convention	R 24	Updating facility to HKC guideline.
	A4, R16	Full authorization of facilities	R 25	Reporting—notify the start of recycling.
	R 15	Designate competent authority		Completion
	A9, A10	Control violations		
	R 16	Notify IMO		

Source: Adopted from Shipbreaking and Recycling Industry in Bangladesh and Pakistan by Sharraf, M. et al. (2010)

15. Human Resource Development

Training has a multidimensional progressive impact in any organization. Training creates a unique opportunity to expand the knowledge for an individual and the whole industry. Reduction of fatalities, loss of assets, legal accountability, sickness, workers' compensation rights is possible when an individual goes through a pragmatic and effective training program. (Shameem, K. A. B. M., 2012) It is expected that after receiving training workers will be able to raise their situational awareness in hazardous environments.

Moreover, the overall productivity of the yard and working conditions will be enhanced by the higher-skilled workers. So, this requires establishing training institutes for workers in SBI. A training curriculum was formulated by Safe and environmentally sound ship recycling (SENSREC) that comprises eight modules. Modules were adapted to introduce three levels of trainees in the SBY: level 1- for all workers, level 2- for additional training for skilled and specialized workers; and level 3- for awareness needed for managers. (Gunbeyaz, S. A. et al., 2019)

Table 4: Proposed Training Modules Based on SENSREC Project.

Module No	Title	Contents
1	Ship-recycling administration & regulative framework	Discuss international and local ship recycling practices and regulatory framework, provide knowledge about employers' responsibilities, the importance of occupational health safety management & incidents, accidents and diseases, and reporting.
2	Job hazard awareness, hazard, and risks	Discussion of the concept of hazard, hazard identification, risk, and risk assessment, ship recycling-related hazards and risks, and how to mitigate these hazards.
3	Environmental Awareness	Details of the environmental awareness in the ship recycling yards, waste management, pollution impact, prevention, and response.
4	Inventory of hazardous materials (IHM) designed for skilled laborers.	Details of the IHM principles as per the HKC, the use of IHM for proper understanding of IHM, and related consideration for planning the ship recycling activities.
5	Personal protective & safety equipment	Describe PPE and its legal requirements. List various types of PPE and their purpose, the importance of using proper PPE for the type of task evaluating the condition of PPE, and maintenance.
6	Worker wellbeing and health	Discussion of the worker's health and well-being in the Bangladesh ship recycling industry through OHS practices.
7	Awareness & conducting of hazardous Materials	Discussion of awareness and handling of various hazardous materials found on board.
8	Vocational education and training	Explaining the use and maintenance of the equipment and machinery used in the ship-recycling yards, activities work with heavy machinery and tools, hot-work, and its safety precautions.

Source: Compiled from Gunbeyaz, S. A. et al. (2019) "A study on evaluating the status of current occupational training in the ship recycling industry in Bangladesh"

Funding and long-term training will be required to be established to make sure the sustainability of relevant training. To improve safety standards for the Shipbreaking industry, relevant training existing in the maritime training field may be perceived.

16. Technical Standardization

Green ship recycling yards and standard technical framework could provide the most efficient and effective solution for any SBI to meet the best of their potential growth. In modern days technology has overtaken all the fields with its huge range of facilitation. However, it includes the finance overview, internalities, externalities, cost control, operation management, repair maintenance, docking system, and the technological process of recycling, such as: cutting technology, decoating technology, material handling technology of the tech and tools to be used for ship dismantling to keep up with innovation in maritime technology and ships construction (Pandya, A. A. et. al., 2011). Proper use of technological tools urges skilled workers' safety and health care. (Legaspi, R. D., 2000)

Contrarily, the open beaching method is cost-saving but it possesses environmental impact handling of hazardous materials during shipbreaking. The dry-dock technique requires bringing the E-O-L ship into a solid infrastructure with secondary containment. In this method pollutants from the ship will not direct contact with water. Hazardous materials are thereby contained within the sealed area during the shipbreaking process. Moreover, the Improved Beaching method for the demolition of the ship can be made by constructing a special bed (*Figure 8*) rather than a mudflat. The bed would be of four layers- likely top layer, upper-middle layer, lower-middle layer, and base layer. The layers would be made of concrete materials, sand, and pebbles. It will restrict the concentration of hazardous materials. Accordingly, hazardous materials will not be able to flow into the sea.

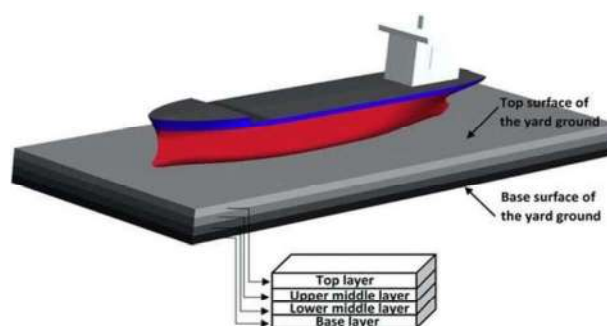


Figure 8: Beaching on Specially Constructed Bed

(Source: Adopted from Olalekan Adekola, Md Jahir Rizvi “How to recycle a huge ship – safely and sustainably”. The Conversation (Australia). Published on 24 August 2020)

The widespread use of beaching techniques can be upgraded by incorporating a few pieces of technological equipment (Jain, K. P., 2018). A solution could be impervious flooring with suitable facilities, such as the installation of heavy-duty part-moving cranes or superstructures within the beaching region. The marking of specified places and the installation of signboards for access points can help increase worker awareness. The aforesaid measures can result in inefficient work and mitigate workers' prolonged total time consumed and accidents happening due to improperly planned recycling facilities.

17. Recommendations

Based on the findings and literature review, we would like to recommend some important points that will increase economic growth and work safety in the SBI of Bangladesh. It is recommended that:

- The Hong Kong International Convention (HKC) should be ratified as soon as possible for environmentally sound and safe shipbreaking practices.
- Existing national legislation should be strictly complied with by the government regulatory authorities.
- A "Containment Beaching Method" for shipbreaking should be set up to mitigate environmental pollution.
- Creating awareness among industrialists and laborers relating to well-designed working conditions, workers' safety, and environmental issues should be of high concern in shipbreaking practices.
- Human resource development by establishing industrial and institutional training in the SBI of Bangladesh.
- Financial support is to be provided by government agencies and vessel owners to motivate shipbreakers to go green.
- Adopt modern technologies in ship cutting and dismantling processes.

18. Conclusions

The shipbreaking industry is considered the graveyard of the vessel. Today's Ship demolition market focuses not only on its key job of economic returns but also emphasizes from an environmental point of view. Keeping this in mind, major Shipbreaking nation nowadays focuses on environment-friendly and accident-free industry practices. On the other hand, as a leading Shipbreaking country, Bangladesh still depended on its conventional demolition practices. Ignoring sustainable practices

creates a shady image in this particular industry. The study revealed that prevailing shipbreaking practices of Bangladesh impacted seaside biodiversity, fatalities and human rights, prolonged process, and economic returns. The study also identified that the dearth of legal compliance, lack of skilled human resources, and insufficient technical facilities are the key challenges of the shipbreaking industry in Bangladesh. Therefore, compliance with Hong Kong International Convention, Human resource development, and technical standardization can lead towards linear growth with a green and sustainable shipbreaking industry.

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