IMPACTS OF SHIPBREAKING INDUSTRY IN BANGLADESH: SEARCH FOR A SUSTAINABLE SOLUTION

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ABSTRACT

The impacts of shipbreaking industry in Bangladesh and effectiveness of legal instruments relating to it have been identified through the analysis of peer reviewed journal articles, reports and related online materials. This has revealed that, although Bangladesh is one of the top shipbreaking nations in the world, the industry is poorly regulated with little consideration for workers' occupational health & safety matters or the impact on the coastal environment. Heavy metals, polychlorinated biphenyl (PCBs), asbestos and hazardous wastes are potentially damaging to both the natural environment and to worker's health. Despite this, the industry is important as a contributor to the national economy providing significant employment and supplying steel as a raw material underpinning the vibrant development sector. The plethora of international regulations including the Basel Convention, Hong Kong Convention, ILO guidelines, and the Shipbreaking Rules, 2011 in Bangladesh, have not changed this situation and this research investigates the legal tools and how these are implemented by the industry in Bangladesh. Resource scarcity, lack of expertise, coordination, and monitoring are identified as the main challenges although there have been some recent improvements with the government as well as businessmen committed to greening the shipbreaking industry in Bangladesh. The sustainability of the industry depends on effective management and implementation of the legal instruments by government institutions, businessmen and stakeholders. An Environmental Impact Assessment (EIA) evaluation matrix, with mitigation measures for improving the industry, is recommended.

Key words: Shipbreaking, occupational health & safety (OH&S), heavy metals, sustainability, stakeholder.

INTRODUCTION

The normal lifespan of sea going commercial vessels is 30-40 years after which overhaul is no longer cost effective (Sarraf et al., 2010), with some broken earlier for the scrap metal value due to the global financial recession (Shameem, 2012). 28,968 ships were scrapped in 2016 worldwide (UNCTAD, 2017). These ships, at the end of their service, are sold to shipbreaking countries so that components, comprising about 95% steel, can be extracted and recycled; the residual 5% consists of hazardous substances. Non steel components, such as equipment, tools, machinery, wooden parts and sanitary items are refurbished for secondhand use creating recycling industries (Greenpeace-FIDH, 2005; Fery, 2014).

The ship owners want to sell their ships for scrap to the breaking yards in South Asian countries because they get a better price-sometimes as much as ten times more than in developed countries (Werth, 2013). Heidegger, Jenssen, Mulinaris, & Carlsson (2017) reported that this

is due to yards circumventing occupational health and safety (OH&S) and pollution control rules that would increase processing costs and labour is cheap (Iqbal and Heidegger, 2014). The ILO has declared shipbreaking the most dangerous job in the world; where there is high unemployment (as in Bangladesh), the poor may have no choice but to take risky and perilous jobs. Workers may suffer long-term health effects because of the exposure to hazardous substances, toxic fumes, heavy metals such mercury (Hg), cadmium (Cd) & lead (Pb) and asbestos. In addition, explosions or falling materials can seriously injure, maim, or kill workers (Heidegger et al., 2017).

Historically, shipbreaking has been considered a mobile industry. The geographical shift over time is a direct reflection of low labour cost combined with local demand for the recycled products (Kagkarakis, Merikas & Merika, 2016). Many breaking yards were established in the UK after World Wars I and II to process redundant naval vessels (Bowen, 2000). Before the 1960s, the breaking of end of life (EOL) vessels was a recognized mechanical process in the developed and industrialized countries including the USA, UK, Germany and Italy. Subsequently, there was a shift firstly to semi-industrialized nations such as Turkey, Spain and Taiwan and secondly to India, Pakistan and Bangladesh reflecting lower operational expenses (Boran and Demirel, 2016; Kagkarakis et al., 2016).

This in-depth study has been undertaken to investigate the shipbreaking sector in Bangladesh and specifically to:

- identify the impacts of the shipbreaking industry in Chittagong
- review the regulatory context
- evaluate the effectiveness of the regulatory frameworks in practice
- recommend improvement in Environmental Impact Assessment (EIA) for this industry

The overarching objective is to inform the development of a strategy to reduce the environmental impact of shipbreaking activities in Bangladesh and to improve health and safety procedures and so the condition of workers in the industry.

METHODS

This review has been carried out on the basis of secondary data and many spatial and non-spatial sources have been used. It is focused on the shipbreaking industry in Bangladesh and brings together published and un-published material including library resources (books, journal articles and periodicals), published online journal articles, organizational reports as well as data from national and international level, conference and seminar reports, newspaper articles, MSc and PhD dissertations, videos, and images.

The data has been analyzed through organization, segregation, reducing and coding (Church, 2001; Johnston, 2014) and interpreted by graphical presentation, tables and figures. This will form the basis for addressing the research questions and formulate recommendations for future economic, social and environmental sustainability of the shipbreaking industry in Bangladesh.

LITERATURE REVIEW

Shipbreaking activities in Bangladesh have both positive and negative consequences from a socio-economic perspective. A baseline study was conducted by Young Power in Social Action [YPSA], 2005 on shipbreaking worker's overall working environment, health, hygiene, safety issues and financial conditions. This study found that there was no safety equipment like

helmets, goggles, gloves, protective boots, or medical facilities and moreover, that there was no financial security for the shipbreaking workers in Chittagong. Similar research was conducted by Hossain and Islam (2006), Hossain, Chowdhury, Jabbar, Shafiullah, & Rahman (2008), Zakaria, Ali & Hossain (2012), Hossain (2015), Hossain, Fakhruddin, Chowdhury, & Gan (2016), Rabbi and Rahman (2016), Rahman (2017); the findings were the same.

The lack of appropriate safety measures and protection exposes workers to heavy metals, asbestos, Tributyltin (TBT), Polychlorinated Biphenyl (PCBs), other hazardous substances and explosions resulting in serious effects on worker health (Hossain et al., 2008; International Law and Policy Institute [ILPI], 2016). Research by Jobaid, Khan, Haque, & Shawon (2014) revealed more than 400 workers were killed, and 6000 seriously injured in the previous 20 years and children between 7 and 18 of age comprised 10.94% of the labour force in Chittagong. The ILPI report (2016) found the life expectancy of male shipbreaking worker in Bangladesh was 20 years lower than national average.

The study of Zakaria et al., (2012), Hossain (2015), Hossain et al., (2016), Rabbi and Rahman (2016), Rahman (2017) and Choi, Kelly, Murphy, & Thangamani (2017) all investigated not only the negative impacts of shipbreaking but also positive aspects including employment generation, supply of steel and raw materials as well as contribution to the economy of Bangladesh. Hossain (2015) identified that shipbreaking contributes around US$ 2 billion annually to the national economy and creates two million jobs. This study compared death statistics across different sectors including the garment industry, manufacturing, day labouring, transport and shipbreaking between 2005 and 2009; the highest numbers occurred in the transport sector with shipbreaking having the lowest figure among the sectors above. Sujauddin et al., (2016) found that of the 29,30,000 tons domestic steel consumption in Bangladesh in 2010, shipbreaking contributed around 51% of the demand of raw materials and 37% of finished steel production. Choi et al., (2017) highlighted that economic viability depends on many factors including the purchasing price of the ship, labour cost, value of scraped goods, overhead fees, safety costs and the shipbreaking method used.

Hossain and Islam (2006) identified discharge of pollutants such as PCBs, heavy metals (Hg, Cd and Pb), asbestos, oils and assessed impacts of these on coastal biodiversity, sea water, sediments, local inhabitants and fishermen in the Chittagong shipbreaking area. Sarraf et al., (2010) found environmental protection was limited in most yards and appropriate management of asbestos, PCBs, ozone-depleting substances (ODS), and a range of heavy metals was virtually nonexistent. Jobaid et al., (2014) and a European Commission [EC], report (2016) also identified environmental impacts associated with the Chittagong shipbreaking industry with persistent organic pollutants (POP's), asbestos, heavy metals, and oil pollution found in the coastal area. Similar results were found by Hossain (2015), and Hoque and Emran (2016) who examined environmental impacts of bilge and ballast waters and found asbestos, PCBs, oils, and fuel residues. Hossain et al., (2016), Rabbi and Rahman (2016) and Rahman (2017) all conducted the similar studies with the latter providing explanation of the effects of heavy metals on the environment. This study recommended that all scrapped ship should have three essential certificates: ISO 9001:2008 (quality assurance), ISO 14001:2004 EMS (environmental management) and ISO 18001:2007 OHSAS (occupation health safety assessment).

Zakaria et al., (2012) and Muhibbullah, Molla, Ali, Sarwar, & Hossain (2014) investigated environmental impact assessment (EIA) of the shipbreaking industry using primary and secondary data. Muhibbullah et al., (2014) found positive impacts (30.14%) including social

factors (12.92%), and economic (17.22%) factors identified negative impacts (69.46%) comprising biotic (21.05%), abiotic (19.14%), social (14.35%) and economic (15.31%).

Legal aspects of shipbreaking especially those on international laws and conventions, for example Basel Convention of 1989, the International Labour Organisation (ILO), and the London Convention were reviewed by Hossian and Islam (2006). A presentation by Mikelis (2009) described the role of International Maritime Organisation (IMO), its conventions, treaties and interagency cooperation with the ILO. This explained that the Basel Convention, and the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (commonly known as the Hong Kong Convention) were adopted for the disposal of hazardous wastes and promotion of safe and sound ship recycling activities. In addition, Sarraf et al., (2010) suggested installing Marine Pollution (MARPOL) facilities, compliance with the Hong Kong Convention (HKC) and other international conventions for the reduction of hazardous substances should be a pre-requisite for shipbreaking in Bangladesh.

Zakaria et al., (2012) and Hossain (2017) reported that, according to directives of the Supreme Court of Bangladesh, the shipbreaking was declared as an industry by Government. This led to the formulation of the Ship Breaking and Ship Recycling Rules 2011 and, the Hazardous Wastes and Ship Breaking Wastes Management Rules 2011, for the safe disposal of the hazardous wastes. The Ship Building and Ship Recycling Board (SBSRB) was constituted to providing one-stop services to enable compliance. Shameem (2012) investigated how the Bangladesh government monitors the issue and analyses the newly enacted shipbreaking rules, and the implication for appropriate practical training and education of shipbreaking workers.

Alam and Faruque (2014) compared the legislation in Bangladeshi with the requirements of the international laws and conventions relevant to the shipbreaking industry. This revealed that, although most aspects were included, they suggested that amendments or new laws were required to comply with the Basel Convention. In contrast, the ILPI (2016) reported that, although a range of health and safety, security and environmental protection guidelines had been adopted by different international organizations since 2000, but most basic had not been followed in Bangladesh. However, this report does not describe the initiatives of the Bangladesh government in preparation of the Hazardous Wastes and Ship Breaking Wastes Management Rules 2011 or the Ship Breaking and Recycling Rules 2011 or evaluate the effectiveness of these steps.

While the preceding sections have revealed a significant body of research into the shipbreaking industry in general, and the social, economic, legislative and environmental perspectives, there is little evidence that the effectiveness of the regulatory framework enacted by the Government of Bangladesh has been evaluated. A mixed picture has been revealed in this review of an industry that is highly economically important, at both national and local scale, but that is causing significant damage to both the environment and to workers' health.

RESULTS

Livelihood and Employment

95% of the workers are migrants coming from underprivileged parts of Bangladesh, especially the north where employment is scarce, and lack of education and economic under-development prevail (Sarraf et al., 2010; Kutub, Falgunee, Nawfee, & Rabby 2017). The shipbreaking sector directly or indirectly provides employment for around 2.8 million people, a significant figure reducing the unemployment problem in Bangladesh. The workers do not have formal training, and there is no workers' welfare union (Hoque and Emran, 2016; Rahman, 2017). Almost 50%

labours are illiterate and two-fifth have just primary education (see figure 1), compelling them to do low paid risky jobs (Kutub et al., 2017).

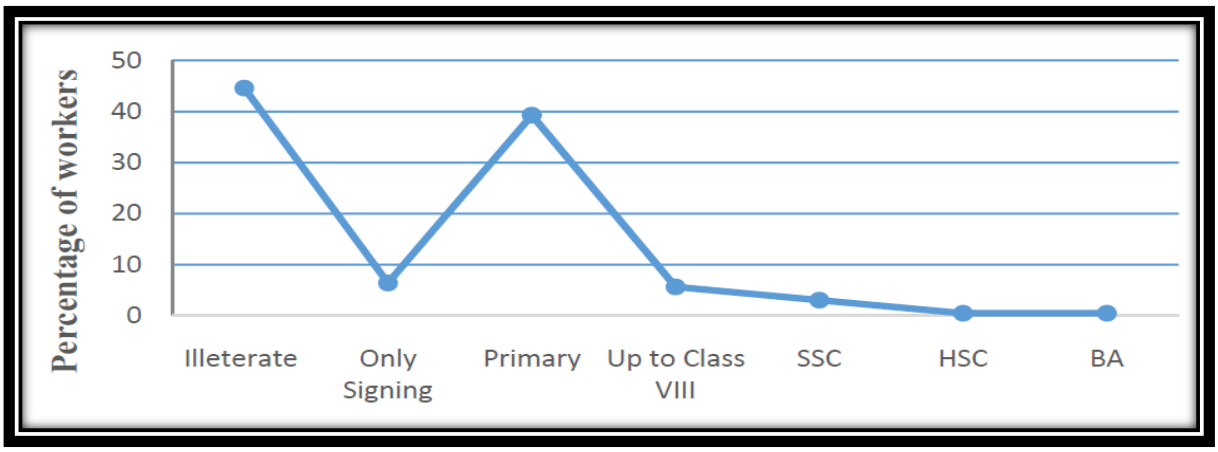

Figure 1: Educational qualification of breaking workers in Chittagong (Source: Kutub et al., 2017).

More than 40% of workers were between 19-22 years old, with 11% were children or minors, i.e. less than 18 years old (see figure 2). Despite this 'no child labour in this yard' type notices are frequently seen displayed in yards. The issue is ignored by officials from the Department of Inspection (Kutub et al., 2017).

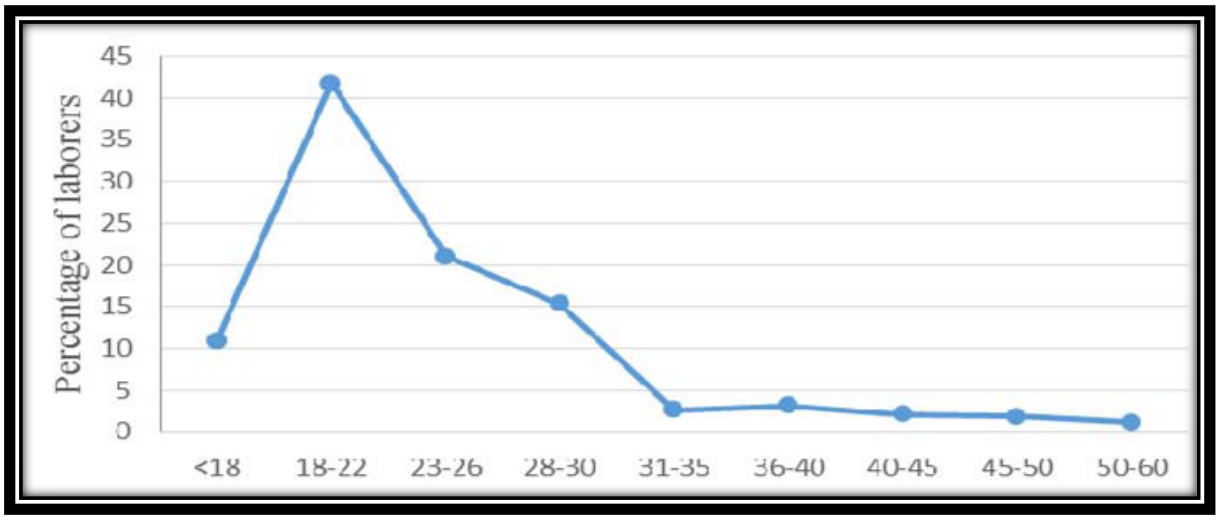

Figure 2: Workers' age limit in Chittagong shipbreaking area (Source: Kutub et al., 2017).

Economic Aspects

In Chittagong, breaking of EOL ships has created an impressive recycling economy with reuse and re-processing including iron and steel production (in re-rolling mills), re-conditioned machinery production (engineering products) and refurbished wooden furniture. The Global Destruction Network (GDN) connects the communities of ship dismantling nations and facilitates distribution of recycled metals into a Global Production Network (GPN), so they can be reused with minor modification (Gregson, Crang, Ahmed, Akter, & Ferdous 2010; Gregson et al., 2012; Herod, Pickren, Rainnie, & Champ 2013). The material flows and recycling of products from the industry are shown in Figure 3.

There are no iron ore mines in Bangladesh, so this industry reduces imports (Sujauddin et al., 2016) providing substantial amounts of raw materials for industries such as inland shipbuilding, construction, re-rolling steel mills, oxygen plants, cables, ceramics, and furniture factories (Hossain 2015; see Table 1). The raw scrap steel feeds around 350 re-rolling mills that provide 60% of the annual steel consumption in Bangladesh (Zakaria et al., 2012; Hossain, 2015).

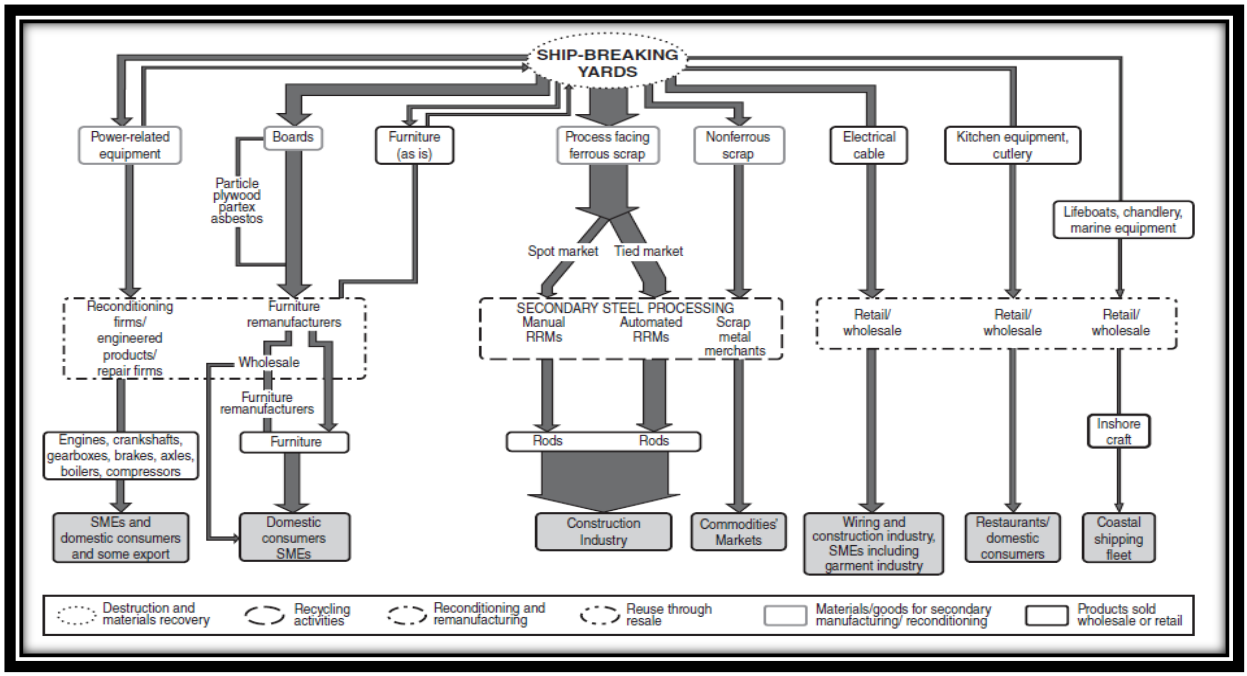

Figure 3. Material flows and other recycled products from EOL ships in Chittagong (Gregson et al., 2012).

Table 1: Materials and machinery produced from shipbreaking

Materials/machinery	Use/Reuse
Steel	• re-rolling mills raw material • steel plate, frame, and girder for construction of inland vessels
Compass, anchor, navigation light, block, life boat and buoy, wear, battery, hatch, firefighting equipment, chain, pulley, rope, deck eye, various fittings & fixture	• inland shipbuilding and other industry
Marine engine	• re-exported • inland shipbuilding industry
Generator, electric cable, motor, switch, switchboard, pump, crane, compressors, light, fans, furniture, bedding materials, refrigerator, utensils, washing machine, bathroom fittings	• some are exported • inland shipbuilding industry • household use
Fuel and lube oil	• transport and inland vessel industry
Burnt oil and oil sludge	• fuel for brick fields
Coolants	• refrigerant industry
Dye	• dying industry
Heavy metals (Cu, Zn, Hg)	• metal industries • other industry and sometimes export

Source: Hossain (2015)

The net economic gain from dismantling ships can be calculated by cost–benefit analysis. The expenditure includes the purchasing of EOL ships, transport to the breaking yard, labour costs

for cleaning and dismantling, government taxes, compliance costs for safety and environmental regulations. The income includes the sale of scrap steel, non-ferrous metals, recovered furniture, equipment and machinery. The net economic benefit (E_B) for the ship breaker, total income less expenses, is represented by the following equation.

$$E_B = \sum_i^n (\mathrm{LDTi} \times \mathrm{Pi}) - (\mathrm{S} + \mathrm{T} + \mathrm{L} + \mathrm{Gt} + \mathrm{W} + \mathrm{E} + \mathrm{O})$$

(Choi et al., 2016).

Where;
LDTi = Light Displacement of Tonnage (LDT) of material i, Pi = market price per ton of material i, S = ship purchase price, T = transportation cost, L = labor cost, Gt = government taxes, W = cost to comply with worker safety regulations, E = cost of complying with environmental regulations, and O = overhead costs.

The right side of the equation calculates the income from recycled and recovered materials based on local market price. The ship purchase price (S) and transportation cost (T) are influenced by recycling location. Government taxes (Gt) differ time. Labour cost (L), worker safety regulations (W) and environmental regulations (E) are location specific and, in the case of Bangladesh, these are minimum (Iqbal and Heidegger, 2014).

Though ups and downs prevail in the global shipping and shipbreaking industry, Bangladesh has achieved average annual growth of around 14% in this sector since 1980. Output was worth, on average US$770 million in the five years from 2010 to 2015 (Ahammad and Sujauddin, 2017). This accounts for the industry being a major tax payer in Chittagong Division, second only to the Chittagong Port which generates more than US$150 million from import duty, yard tax, land tax, sales tax, municipality tax and other fees (Hoque and Emran, 2016).

Occupational Health and Safety (OH&S)

In 2005, 2006 and 2008, three separate studies found no personal protective equipment (PPE) such as hoods, protective footwears, eye protectors, gloves, or medical services for the workers in Chittagong (YPSA, 2005; Hossain and Islam, 2006; Hossain et al., 2008). After 2011, when legal instruments came into force in Bangladesh, similar studies found that the situation remained unchanged (Hossain, 2015; Hossain et al., 2016; Rabbi and Rahman, 2017; Rahman, 2017). There is potential for workers' health to be seriously affected by asbestos, heavy metals, PCBs, TBT and other hazardous and explosions as they continue to work without appropriate safety measures or protection (Hossain et al., 2008; ILPI, 2016). Common OH&S hazards associated with the industry and subsequent mitigation measures are illustrated in Table 2. Legally, employers should provide PPEs and workers should use these PPEs during operation.

Table 2: Major OH&S hazards associated with the industry vis-à-vis mitigation measures

Major hazards	Mitigation measures
Exposure to Hazardous materials • asbestos • heavy metals • batteries, fire-fighting liquids • PCBs, PVCs, PHA	• use personal protective equipment (PPE) like gloves, goggles, apron, mask and helmet, safety belts • training on safe handling of equipment • environmentally sound storage and management of hazardous substances • health monitoring.
Frequent accidents • heavy materials falling from height • accidents related to confined space • cuts and injury • fire and explosion	• ship recycling plan (SRP) and daily work plan • use of PPEs • use of crane for dropping objects • remove flammable materials before cutting • maintain toxic gas free safe working area • training

Physical hazardous • noise, extreme temperature, vibration • radiation (ultra violates, radioactive materials)	• use PPEs • remove radioactive materials safely before dismantling
Mechanical hazardous • lack of PPEs • poor maintenance of equipment	• supply necessary PPEs • proper training
Biological hazardous • risk of transmittable diseases including TB, malaria, dengue, respiratory infections	• use standard control mechanism against communicable and infectious diseases
Psychological hazardous • poverty, low wages and under age work • long time and stressed work • temporary job, uncertainty	• maintain a basic income • follow ILO guidelines and Labour Law
General problems • lack of OH&S training • insufficient medical and first-aid provision	• provide OH&S related training • ensure sufficient medical facilities

Sources: ILO (2004); Samiotis et al., (2013); Hossain (2015); Hossain et al., (2016)

Environmental Impacts

A mixture of wastes and materials are generated from the shipbreaking activities including ferrous and non-ferrous scrap, flammable substances (oils, chemicals, gas) and hazardous wastes (e.g. asbestos, PCBs) (United Nations Environmental Programme [UNEP], 2003). Almost all these items are found in the breaking yards in Chittagong with the oils, chemicals, gas and toxic hazardous substances the main environmental concerns and requiring safe disposal. The materials, victims, standard and usual local disposal procedures in Bangladesh are shown in Table 3.

Table 3: List of hazardous materials, victims and standard disposal practice compared with 'usual' practice

Hazardous materials	Who/what is affected?	Standard disposal practice	Usual practice in Bangladesh
Asbestos	• breaking workers • adjacent inhabitants	• wet before removal • storage separate chamber • cover with lick proof material • landfill, solidification	• reprocess for insulation in cold storage and central air conditioning system • unrestrained landfill
Antifouling materials/paint coating	• breaking workers	• solidification, landfill	• no standard practice followed
Polychlorinated biphenyls (PCBs)	• workers • soil, water and crops	• high temperature incineration • chemical dichlorination	• reprocess for some PCB containing equipment and materials • no standard format followed
Ozone depleting substances (ODS)	• adjacent inhabitants • environment	• high temperature incineration	• release in the atmosphere
Heavy metals (cadmium, chromium, lead, mercury)	• workers • fishery resources and others biota • soil and sediments	• physico-chemical treatment • secured landfill	• batteries, light fittings • no standard practice
Radioactive substances	• workers	• recovery, secure landfill	• no standard practice
Bilge water, waste oils	• fishery resources • soil and sediments	• physico-chemical treatment • recovery	• release to sea
Sludges	• soil and sediments	• incineration	• re-use in brick field

Sources: Zakaria et al., (2012); Watkinson (2012); Hossain (2015); Rahman (2017)

DISCUSSION

This review has revealed that, although there are significant differences in the way shipbreaking is carried out in different countries across the world the situation in South east Asia – and in Bangladesh in particular – is that the industry has both positive and negative aspects. It is vitally important for both the local and the national economy providing jobs and providing materials for processing but working conditions are sub-standard and the environment is not being adequately protected.

Sarraf et al., (2010) stated that non-compliance with legal instruments had been considered large scale development of SBRI in South-Asian countries like India, Bangladesh and Pakistan. The environment and OH&S regulations are not so strict in Pakistan (Ahmed and Siddiqui, 2013) whereas India is going to implement the HKC immediately (Linnenkoper, 2017). The national, international and EU regulatory frameworks in connection with the political determination to positive changes in the shipbreaking sector emphasis on workers OH&S issues and environment (Samiotis, Charalampous & Tselentis, 2013). Alam and Faruque (2014) focused on the discrepancies between international laws and conventions and the legislations in Bangladesh and suggested that in accordance with the Basel Convention existing laws should be modified or prepared new laws. Besides, the ILPI report (2016) indicated that, although several guidelines have been provided by universal organizations since 2000 for OH&S and environmental protection, the most elementary guidelines are still not implemented in Bangladesh. Hoque and Emran (2016) suggested that Bangladesh could demand a 'Fund for Green Shipbreaking' for sustainable change of the sector according to the Basel Convention.

In 2006, the Bangladesh Labour Act (BLA) is enacted for maintaining workers OH&S, wages and work-related injury compensation. Chapter IV (Workers Safety) and Chapter VII (Management of OH&S) of the Ship Breaking and Ship Recycling Rules (SBSRR), 2011 specifically deal with OH&S. The main problem is to implement these legal instruments effectively. The shipbreaking workers in Pakistan do not use PPEs for their OH&S and nobody bothers about the issue (Shah, Hussain, & Hussain 2017). In Turkey, gas free certificates are mandatory for ships intended for breaking and an asbestos disposal center and standard working conditions (Neşer, Ünsalan, Tekoğul, & Stuer-Lauridsen, 2008). The standardization of conditions in breaking yards is possible only through improved investment in workers' training, welfare, equipment and infrastructure (Schøyen, Burki, & Kurian, 2017).

Effectiveness of Regulatory Frameworks

The way in which both workers' conditions and environmental impacts are controlled by legislation. However, even when robust and appropriate laws and policies are in place these need to be implemented effectively and this requires inspection, monitoring and for infringement or non-compliance to be penalized. The effectiveness of legal instruments in the ship breaking & recycling industry (SBRI) particularly in Bangladesh depends on the capacity of the government agencies to carry out monitoring and enforcement. Scarcity of resources, infrastructure, and equipment are common in Bangladesh (Alam and Faruque, 2014). A comparative study of regulatory frameworks in the major shipbreaking nations is shown in Table 4.

Table 4: Comparison between major shipbreaking nations in the world

Country	Social and livelihood	OH&S issues	Economic gains	Environmental impacts	Effectiveness of legislations
Bangladesh	• employment creation	• neglected	• excellent for government revenue, yard owners, other recycling industries	• immense impacts	• poorly implemented; recently improved one yard (PHP SBRI)
India	• employment creation	• neglected; recently improved some yards (Leela, Sarvag yards) but need more attention	• same as Bangladesh	• immense impacts	• poorly Implemented; recently improved some yards
Pakistan	• employment creation	• neglected	• same as Bangladesh	• massive impacts	• poorly implemented
China	• standard methods require less people	• follow regulations	• good	• minimum	• effectively implemented
Turkey	• require less people	• follow regulations	• good	• minimum	• effectively implemented

Sources: Ahmed and Siddiqui (2013); Hiremath et al., (2015); Menon and Zarar (2016); UNCTAD (2017), Jian and Pruyn (2017).

This clearly demonstrates that the overall condition of Bangladesh is not promising, although strong legal tools exist. So, it can be said that, in general, the national and international regulatory instruments are not implemented effectively in Bangladesh. There is however, one exception. In one yard, PHP SBRI (a private shipbreaking yard), both compliance and workers safety issues have been improved recently through a two-phase project funded by the Norwegian Aid Agency (Norad) with the IMO and the European Union. The yard followed the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships in terms of the handling of hazardous materials, workers training and using PPEs. Some yards, though a small number started to invest more to infrastructure development and in-house training facilities to improve the situation (Corbett, 2017; Das and Wallis, 2017). This shows that it is possible to dismantle EOL ships environment friendly manner in compliance with national and international legal requirements.

EIA Matrix for Shipbreaking Industry in Bangladesh

One of the ways in which the negative impacts could be addressed is to implement a robust Environmental and Socio-Economic Impact Assessment for existing and new enterprises. The Bangladesh Environmental Conservation Rules 1997 (Schedule I) places the shipbreaking industry is the category ‘Orange-B’. This category requires an environmental approval from the DoE and requires all proposals to undergo Initial Environmental Examination (IEE) prior to commencement of any activities. An evaluation matrix formulated on the basis of the findings in this review for Environmental Impact Assessments (EIA) of this industry is shown in Table 5.

Table 5: EIA evaluation matrix for the industry in Bangladesh

Agenda	Positive impacts				Negative impacts				Mitigation measures
	High	Moderate	Low	Nil	High	Moderate	Low	Nil	
Social and livelihood									
Employment creation	√								-
Engagement of child labour		√							Implement BLA 2006
Migrant workers		√							-
Labour education			√						-
Housing facilities			√						Proper housing should be provided
Recreation				√					Implement BLA 2006
Job and workers welfare									
Job satisfaction			√						Salary and other facilities should be increased
Job security				√					BLA 2006
Central bargain unit (CBA)/workers welfare union				√					Govt. and recyclers should come forward
Grieve redress system (GRS)				√					Establish GRS unit in every yard
Occupational Safety & Health (OS&H)									
Scarcity of personal protective equipment						√			ILO-OH&S Guidelines 2001
Inadequate cranes and other modern gears						√			SBSRR 2011
Exposure to hazardous and toxic materials (asbestos, heavy metals)					√				ILO Guidelines 2004, SBSRR 2011
Physical hazardous (Noise, extreme temperature, vibration, radiation)					√				ILO Guidelines 2004, SBSRR 2011
Frequent accidents					√				SBSRR 2011
Biological hazardous							√		ILO Guidelines 2004, SBSRR 2011
Training facilities					√				ILO Guidelines 2004
First aid and medical facilities						√			ILO Guidelines 2004
Emergency preparedness							√		ILO Guidelines 2004, SBSRR 2011
Sanitation							√		SBSRR 2011
Economic issues									
Source of steel and raw iron	√								-
Demand for recycled products	√								-
Demand for secondary wooden furniture	√								-
Government revenue earning	√								-
Contribution to GDP	√								-
Recyclers profit	√								
Environmental impacts									
Coastal biodiversity, water and soil					√				Follow the Basel, HKC Conventions, EU SB Regulation 2013, SBSRR 2011
Hazardous materials (asbestos, PCV)					√				
Heavy metals (Hg, Pb, Cr, Cu)					√				
Impacts of oil, and fuel residues						√			

Air pollution							√		
Noise pollution						√			
Deforestation for expansion of yards					√				Establish integrated shipbreaking zone

Author's own creation (colour variation denotes the intensity of positive and negative impacts)

From Table 5, it can be seen that the industry is seriously suffering from two major negative issues, OH&S and environmental impact and these should be addressed urgently and this could be achieved if the existing regulatory framework was implemented effectively. However, this depends on factors such as institutional capacity in the government regulatory bodies, regular inspection and monitoring, yard owners' attitude, initial investment and overall political will. Many yards are now moving toward compliance with the legal guidelines (Sujauddin et al. 2016) and one yard, namely the PHP SBRI has recently attained international standards (Corbett, 2017; Das and Wallis, 2017).

CONCLUSION

This review was conducted in order to:

- identify the impacts of the shipbreaking industry in Chittagong
- review the regulatory context
- evaluate the effectiveness of the regulatory frameworks in practice
- recommend improvements in Environmental Impact Assessment (EIA) for this industry

Due to advantageous conditions including a long and perfect sloping of the beach with soft and muddy ground, a large tidal range, local demand for recovered materials and low labour costs Bangladesh has become a paradise for shipbreaking (Hossain, 2015). There are many positive aspects to the industry but, as this review has revealed, the industry requires modernization; negligence in respect of workers' Occupational Health and Safety and environmental impacts is no longer acceptable. If this is not, then neighboring competitors such as China, India, and Pakistan will take this opportunity. 'Green Shipbreaking' is now demanded, and there is emerging evidence that the yard owners and businessmen will respond developing an environment friendly industry.

Further research is required regarding the effective implementation of legal instruments in Bangladesh. From the ethical point of view, the industry should not flourish at the cost of poor, ill-paid labours, and damage to the environment.

A list of recommendations that could ensure the development of a sustainable, safe and environment friendly shipbreaking industry in Bangladesh is given below.

- ❖ an integrated shipbreaking zone should be developed with modern facilities
- ❖ it should be mandatory for breakers to follow the international and national legal requirements
- ❖ the 'polluter pays' principle should be included in the national legislation
- ❖ coordination, monitoring and accountability among government organisations should be strengthened
- ❖ yard owners and businessmen should be required to invest part of their profit in corporate social responsibility (CSR) projects
- ❖ the initiatives of the PHP shipbreaking yard in Chittagong should be used as an example of good practice to encourage others to adopted better practices

If this was done then this would increase the competitiveness of the Bangladesh shipbreaking industry, improve workers conditions, reduce damage to the environment and contribute to several of the Sustainable Development Goals for example, SDG 1 (No Poverty), 2 (Zero Hunger), 3 (Good Health and Well-being), 8 (Decent Work and Economic Growth) and 11 (Sustainable Cities and Communities).

ACKNOWLEDGEMENTS

This research was conducted as part of the requirements for an MSc in Environmental Conservation at the University of Greenwich, UK. I would like to acknowledge the Government of Bangladesh for funding me to complete this programme and to the University staff for supporting and encouraging me to complete this project successfully. The support of my wife and daughter was also invaluable.

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