Impact of Shipbreaking on Worker's Health and Water Quality: A Case Study of Shipbreaking Yard, Gaddani, Pakistan

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CERTIFICATE

This is to certify that this thesis entitled: **"Impact of Shipbreaking on Worker's Health and Water Quality: A Case Study of Shipbreaking Yard, Gaddani, Pakistan"** submitted by **Mr. Danish** accepted in its present form by the School of Public Policy, Pakistan Institute of Development Economics (PIDE), Islamabad as satisfying the requirements for partial fulfillment of the degree in Master of Philosophy in Environmental Economics.

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Dedication

I dedicate my thesis work to my honorable and ever-loving, My Parents, I also dedicate this thesis work to honorable mentor Dr. Nazia, Mr. Manzoor Shigri (Safety Officer at Shipbreaking Yard Gaddani), Mr. Usama Khan Jadoon (State Bank of Pakistan) and Mr. M. Mansoor Isani (Research Assistant), my best friends and the source of encouragement at every step of my life. If the support of all above would not be there, I would have not been able to complete my thesis. All credit of my success goes to them.

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Abstract

Shipbreaking is the process of breaking ships into parts and get them reusable and recyclable. it plays a major role in the economy of Pakistan but on the cost of environmental and human health. So, this study is based on finding environmental pollution and health cost faced by workers of shipbreaking industry, Gaddani. For testing water quality, the samples were collected from the study area from inside and outside of the shipbreaking yard. Seawater and well water were collected and analyzed through the laboratory. The physiochemical parameters were tested such as pH level, Biochemical Oxygen Demand, Total Dissolved Solid, Turbidity, Dissolved Oxygen, and Electrical Conductivity. The values of parameters such as Electric Conductivity, Turbidity, Dissolved Oxygen, and Total Dissolved Solid were found high compared to that of standard values in seawater and well water. Shipbreaking directly affects the environment by contamination through the beaching method. and it also impacts the workers' health. The primary data was collected from shipbreaking workers through a questionnaire and the sample size was (n= 235). The impact on the health cost of the worker was measured through the Ordinary Least Square method on Stata software. There are socio-demographic variables that are also directly related to health cost such as age, education, marital status, and income. Where education has a negative relationship with health cost, marital status also has a significant positive relationship with health cost. Industry-related variables where the nature of employment has a negative relationship with a health cost, diseases have a positive relationship with a health cost. Similarly, experience also has positive relation, working hours, safety equipment has a negative relationship with a health cost and drug use. Among many policy interventions, the best policy is to issue a green passport to the ships before they come to shore for recycling. The standard-breaking methods should also be followed as suggested by International Labor Organization and other standards defined. Lastly, the use of personal protective measures and the working environment can be considered as a critical policy recommendation.

Chapter # 1

1.1 Introduction

Shipbreaking is the process of splitting ships to get them reusable and recyclable. Around the globe, one thousand ships per year go for recycling. Ships contain all types such as passengers' ships, bulkers, oil tankers, etc. (Shah, Hadi , & Mujahid, 2017). Ships have an average life of 30 to 40 years and after their expiry, they are brought to the shipbreaking yard to be used as scrap.,. and Its repair or renovation is uneconomical (Khan, et al., 2018).

Most of the products found from ship breaking are reusable, resalable, and recyclable such as scrapped iron that can be used to reduce the destruction of the earth by mining activities. Likewise, it also fulfills the demand for steel because it is an important alternative source of iron ore. In 2015, the demand of steel was 7.1 million ton (Kusumaningdyah, Agustina, & Rahmi, 2013; Karlis, Dionysios, & Anastasios, 2016; Sabir, 2019).

After having a deep look at the history of the shipbreaking industry since the 1970s, it is provided that the industry moved from North America and Europe to East Asia, and then in the 1980s, it found its way towards South Asia due to low wage rate, less care of the environment and worker's health, and non-enforcement of labor rights (Kusumaningdyah, Agustina, & Rahmi, 2013; Hossain & Mohammad, 2006). 70% ship breaking is carried out in South Asia, includes mainly India, Pakistan, and Bangladesh whereas China and Turkey are adding remaining 20% with 10% of the overall world in ship breaking industry (Ahmed, D.R, Siddiqui, & D, 2013).

According to NGO, Shipbreaking Platform, 630 ocean-going commercial vessels were sold in the world for scrap from which 446 large ships were broken by India, Bangladesh, and Pakistan making it almost 90% of gross tonnage (GT) dismantled globally in these countries. In 2020, Bangladesh had broken 144 ships generating scrap by 6,946,774 GT, India had dismantled 203 ships with a scrap of 4,515,973 GT and Pakistan had dismantled 99 ships generating scrap by 2,256,705 GT (Jenssen, 2020; Platform, 2021). According to NGO, Shipbreaking Platform, since 2009 there were 6876 ships beached in developing nations. Resulting in 407 deaths and 293 were injured due to usage of inappropriate methods of shipbreaking.

The industry has shown many contributions to economic growth as it pays 5 billion of tax from which 30% goes to Provincial Government of Baluchistan but at the cost of environmental and

human wellbeing because when ships come to shore, they contain with themselves paint from small to large vessels that include 10 to 100 tons which is a mixture of lead, mercury, zinc, arsenic, chromium, etc. Polychlorinated biphenyl compound (PCB's), the large amount of oil and other substances and combined emission of gas and improper disposal of waste material that affects the local communities with ecology damage, wherefrom these toxic substances that create problems for workers health risk. Furthermore, PCBs are categorized as a human carcinogen which means workers are directly involved causing cancer (Heidegger, et al., 2018).

Mostly, the method used for dismantling ships in developed countries which is safer and environmental friendly is the dry-dock approach, in which ships are brought at dock and broken afterwards. Furthermore, Pier approach is another sustainable method of shipbreaking, which is also known as alongside or top-down method Whereas a Slipway or landing which means the breaking of the ship is off the shore and are considered as less harmful methods., The most vulnerable method is the beaching method. In this method, the breaking of ships is done directly on the beach without taking care of any effects of breaking on human health and environment. (Rahman S. , 2017). Most of the ships end their life at Chittagong beach, Bangladesh, Alang beach, India, and Gaddani beach, Pakistan. Mostly, 95% of the method here in these countries adopt for ship breaking is called beaching method which is the cheapest method that creates the problem for health and safety of human and for the environment (Hossain, et al., 2008).

According to International Labor Organization (ILO), the most dangerous job in the world is ship breaking. Millions of tonnages of hazardous waste is exported by world's ship owners to South Asia by selling their ships per year. Bangladesh and Pakistan are suffering from hazardous waste treatment Besides, in India the asbestos material is legal to re-sell which is detrimental to human and environmental health (AB, 2001). Ships contain hazardous substance such as asbestos, oil sled, paints containing lead, and several types of heavy metals such as cadmium, arsenic, poisonous biocides as well as polychlorinated biphenyls (PCBs). it contains even more dangerous radioactive substances that create problems for the environment by the spill of hazardous materials into the sea that pollutes soil, water, and whole coastal environment (Hameed, 2019). The study was done in Ontario proves that the exposure of lead toxicity in the shipbreaking industry increases the blood-lead and other diseases such as respiratory and (Nosal & Wilhelm, August, 1990).

On the beaches of the South Asia, the ship decommissioning has turned sandy beaches into gooey and black. Whereas the water of the Arabian Sea has been covered with floating oil globules. The environment in these regions and marine biodiversity has been ruined due to the dropping of metal pieces, asbestos sheets, glass bites, equipment from the ship, oil and other substances strewn all over that the sea. These toxic materials have serious effects on coastal soil and seawater environment through high turbidity which increases BOD and decreases DO (Puthucherril, 2010). There is a high need of research to be carried out on the environment, economic, and social aspect to overcome the problem of breaking ships towards sustainable shipbreaking.

Shipbreaking has negative effects which can be categorized in three dimensions such as environmental, social, and economic dimension. Shipbreaking workers suffer from all types of cancer such as esophagus cancer, trachea bronchus, Lung Cancer, etc., skin diseases, weakness, and chest pain that are mainly caused by toxic gas explosions, missing of safety equipment, more heat, sparks, and fires, stressful work, smog, dust, and others (Rahman S. , 2017).

The shipbreaking industry creates environmental pollution from its toxic material and explosion, endangering health as well as polluting seawater through polychlorinated biphenyl compound, waste oil, TBT, and others that highly affects the labor life and marine life. (Kutub, Nishat, Shahreen, & Yasin, 2017). Unsafe drinking water causes many problems at shipbreaking yards such as abdominal problems (Hossain, et al., 2008).

Seawater pollution caused by shipbreaking increases its turbidity, salinity, and acidity. Most studies found all kinds of heavy metals contamination of sediments in the seawater at Alang, India. As another study found tributyltin by 19.4 mg/kg in seawater and if the seawater is polluted it results in surface water pollution (Kumar, 2018). Shipbreaking activity contaminates the seawater environment of coastal areas of Chittagong, Bangladesh because of a high toxic concentration of ammonia, marines' organisms in seawater by increasing high Potential Hydrogen level (pH) of coastal areas of Chittagong, Bangladesh (Talukder, A., & Mohammad, 2015).

Several research papers have been published and practical research has been carried out in the region on the Shipbreaking sector, however, lack of research has been evident particularly in this sector of Pakistan, which demands thoroughly research paving way for its sustainability. In Ship breaking industry, Gaddani, the research on environmental and health aspect has been ignored by the researchers. So, this research will fulfill the gap of environmental and health aspects by

investigating the impact of shipbreaking on the health cost of workers at the shipbreaking yard and water quality testing the samples around the shipbreaking yard, Gaddani.

1.2 Problem Statement:

Shipbreaking has gained much economic development in the world but with the growth in the industry it becomes vulnerable to the environment and human life. The shipbreaking industry moved from the hands of developed countries to developing countries due to its low-profit margin in developed countries adherence to safety rules and regulations about the environment and worker's health. In developing countries, there are low wage rates, weak regulation of environmental laws, increasing demand for steel, and the absence of health and safety measures. Currently, Pakistan accounts for a 15% share in shipbreaking but in the 1980s Pakistan was on top in South Asian countries with much more contribution. Gaddani ship-breaking industry has gained much economic development in Pakistan but due to environmental and safety measures violation, this industry has witnessed decline in its productivity. In Bangladesh (Hossain, et al., 2008; Showva & Adib, 2019) there has been much concentration on the ship-breaking industry in terms of research from different aspects to make it sustainable.

There are negative effects of shipbreaking on the beach as the method employed, beaching approach, on Gaddani beach threatens directly to both environment and human health. The marine biodiversity has also been directly threatened by ship breaking on the beach in Pakistan. Although, research has been conducted on different aspects of this industry such as, on skill gap and asbestos hazardous materials effects at shipbreaking industry (Shah, Hadi , & Mujahid, 2017; Shaista, Ali, & Nergis, 2015) , Gaddani. However, this research is based on environmental and health impacts in general and fulfill the gap of environmental and worker’s health in the shipbreaking industry, Gaddani by investigating water quality and its indirect impacts on workers and measuring the impact of shipbreaking on the health cost of workers.

1.3 Research Question

1. Does the ship-breaking industry affect the workers’ health through the water quality of the study area?
2. How much health cost do the workers bear due to ship breaking and what impacts on their health cost due to shipbreaking?

1.4 The Objective of the Study

1. To investigate the effect of Shipbreaking on Water quality and its adverse effects on workers, working on the shipbreaking yard.
2. To measure the health cost of workers due to working in the shipbreaking industry and the impact of shipbreaking on Health cost.

1.5 Significance of the Study:

Shipbreaking is one of the important industries in Pakistan that generates employment and contributes significantly to its economy. Pakistan is the country which was at the top in the world in this industry in the 1980s however, due to an increase in taxes, import duties and negligence of the authorities this industry witnesses decrease in its efficiency and thus declining. In 1990s, a 45% customs duty was imposed on ships imported for dismantling. After 2001 the government reduce the import duty from 10% to 15%. The data from NGO, Shipbreaking Platform, reveals that Pakistan has dismantled 141 ships in 2016 as the highest in the last ten years. In this period, the yard has many demolition ships, but the explosion occurred due to aces fire in an oil tanker that burned some 19 peoples. (Desk, 2016). Furthermore, due to violation of safety and health standards the health of labor is also a prominent issue in the industry. This study will contribute in terms of testing the quality of water of the study area which is contaminated affecting the workers and will measure the health cost of labor working in the shipbreaking industry, Gaddani. In the end, this thesis will investigate the impact of shipbreaking on worker's health costs. By achieving these objectives, this research will help government, owners of the industry, NGOs, and other stakeholders to make the policy about the safety of workers and the environment.

1.6 Organization of the Study:

This thesis is comprised of a total six chapters from which chapter 1 is introduction on Shipbreaking and its effects on the environment and human health. Whereas Chapter 2 describes in detail the literature review on worker's health problems and water quality analysis. Chapter 3 describes the theoretical framework in the thesis. Chapter 4 Briefly describes the methodology of the study which includes a study area, data collection, and sampling methods, empirical work that has been done and Chapter 5 describes the descriptive statistics on the current situation at the shipbreaking yard and describe the results of the study Finally, chapter 6 presents conclusion with a policy prescription simultaneously.

Chapter # 2

Literature Review

Shipbreaking is an economically good activity, but the cost of the environment and human health affects not much better for wellbeing. Ship dismantling is the way to use the material that cannot be disposable as reusable and recyclable also resalable in different markets such as steel industries, wood market, and others also. The process of dismantling ships has negatively affected the environment by making pollution such as water quality, soil quality, and air quality. It also affects a human's health. The literature review is divided into four parts first one part is about the surface water quality analysis, where 2nd describes literature on the occurrence of diseases and health issues in workers, 3rd part is literature on bearing of health cost by workers of shipbreaking industry.

2.1 Impact of Shipbreaking on Water Quality Analysis and Impacts on Health of Workers:

Shipbreaking is a vital and economically viable industry when economic activity has been done properly but when that does not manage by stakeholders that contaminate the environment and affect human life directly or indirectly. The environmental problems generated by shipbreaking such as air pollution, water pollution, and land pollution that affect directly and indirectly human life (Hameed, 2019). South Asian countries have taken over the industry before the 1980s the ships end their life in developed countries but after the increasing costs of demolishing ships, the industry moved from the developed countries towards developing countries. Developing countries are at the vanguard of shipbreaking. This industry is more profitable due to various factors such as meager wage laws, the ever-increasing demand for steel, weak regulation of environmental laws absence of health and safety measures. There are several effects of shipbreaking on humans and environments both are in danger due to low-quality adaptation of the method to dismantle the ships.

In Pakistan Water Pollution is a major problem. Industrial wastewater is the basic source of water pollution and a common threat to marines and human life. The study (Siddique, 2019) on the industrial area of Faisalabad has been done by taking water samples and tested through a laboratory in Faisalabad. The results revealed that the contaminated water used by people suffering from different diseases such as skin diseases, diarrhea, and typhoid fever, etc., and the use of

groundwater increases it also increases the chance of occurrence of disease and alternatively it will increase the health cost.

In a study, the author examines the effect of urban and industrial effluent on the quality of water at the Hindan River of Ghaziabad, India (Suthar, Sharma, Chabukdhara, & Nema, 2010). The author collected the six water samples from the river from different sites and all the samples were from along the Hindan River. The samples were analyzed at the laboratory for Physio-chemical parameters like pH, TDS, EC, TA, total hardness, calcium, BOD, DO, and turbidity. The results show that the parameter was higher than the standard limits set by National Pollution Control (NCP). The overall quality of water at the Hindan River was very poor to use for domestic peoples.

(Khan M. M., 2020) The author estimated the health effects and health costs faced by the peoples living in Tehsil Bhalwal district Sargodha, Pakistan due to the consumption of contaminated groundwater. To check the quality of groundwater and water supply lines. The water samples were chosen from four different areas of tehsil Bhalwal which were near to waste low from the sugar industry. Total seven parameters were analyzed through the laboratory. From which four were Physio-chemical parameters and 3 were bacteriological, calcium, and magnesium were chosen. The logit model was used by the author for analyzing the health effects of water and the Ordinary Least Square method was used for health cost analysis. To check the impact of water quality on health the primary data were collected from the households through a questionnaire. The sample Sze was 200. The results show that the households were using 2% only uses groundwater for cooking and drinking. The tap waters were 52% and 60.5% used for drinking and cooking purposes by the households. Whereas 40% of households were using bottled water for drinking and 30% for cocking purposes. The results overall show that the households were suffering who were using groundwater and tap water and their health cost increase with an increase in a visit to the doctor as compared to households who were using bottled water.

(Khan, et al., 2013) **e**xamined the health risk related to heavy metals in the drinking water around Swat, the Northern area of Pakistan. Author analysis the heavy metal which comes from the effluent of industries in the drinking water. The water sample from both ground and surface water were collected from the areas of Swat and a questionnaire was generated to examine the impact of heavy metal in drinking water on humans. The primary data were collected from areas of Swat such as Madyan, Fatehpur, Khwazakhela, and Mingora. The ANOVA technique was used to

analyze the health impacts. The results show that heavy metals were found in the drinking water such as Mn, Ni, Zn, Cd, Cu, and Pb that are directly affecting the peoples of Swat.

(Hasan, Shahriar, & Jim, 2019) There are many major problems faced by humanity are related to water quality issues. In the future, these problems are going to be worse than now. Water is the basic need of humans which needs to be cleaned to consume. In Bangladesh, the water around the country was contaminated by many industries' effluent released. The pollution makes water quality inconsumable at both surface water and groundwater. Anthropogenic activities turn water quality as bad as they continue the activities which alternatively effects to human by generating waterborne diseases that can be the cause of death to humans by consuming contaminated water. In the article, the author reviewed the different documents, articles, conference proceedings, and many other materials and concluded that the water of Bangladesh is contaminated everywhere around the country. Water contains metals, high level of iron, chromium, nickel, and lead was concluded at surface level and groundwater.

In the study of (Islam, M., M., & S., Physicochemical Assessment of Water pollutants Due to Ship Breaking Activities and Its Impact on the Coastal Environment Of Chittagong, Bangladesh, 2013) the physicochemical assessment has been done of water pollutants due to shipbreaking activities and their impact on the coastal zone of Chittagong regions. The sample data of water were collected from 30 different shipyards of the Chittagong region in airtight bottles in different time durations from 2011 to 2012. Samples were collected with Safe precautions and analyzed in the laboratory and parameters were compared with BSTI and WHO standards limits like ph., DO, BOD, Turbidity, etc. The results show that ph. level range from 8.22 to 6.79, EC were varying from 32500µS cm-1 to 25150 µS cm-1, TDS range from 17740 mg L-1 to 9370 mg L-1. The water quality is affected due to shipbreaking, and it affects Rivers in the Chittagong region and may affect biodiversity.

Environmentally negative impacts imposed by the shipbreaking industry through different types of pollution air pollution, water pollution, and degrading soil. In the study (Talukder, A., & Mohammad, 2015) author focuses on environmental impacts due to ship dismantling; this was done by measuring the magnitude of environmental impacts and analyzing water quality by collecting the samples from inside and outside of the shipbreaking industry Sitakunda Upazila in Chittagong, Bangladesh. The results show that Turbidity varies from 7.71 to119 FTU inside and

4.07 to 41.74 FTU outside of shipbreaking yard, salinity varies from 0.95 to 14.28 ppt in inside and 0.06 to 0.79 ppt outside the ship breaking yard, Dissolved Oxygen vary from 3.77 to 7.94 mg/l in inside and 1.95 to 5.34 mg/l outside the yard, and the environmental impact assessment value of the area was found as -93 whereas ecological parameters value was found by -72, physic-chemical parameters value by -70 and human interest was found by +49.

According to (Showva & Adib, 2019) evaluate the range of pollution in water bodies with its effects on biodiversity due to ship breaking industry, the physicochemical parameters were observed by testing of water analysis that was collected from offshore and from the shore, the results shows that the turbidity was lying as above the standard value by 2624 NTU where standard value is 5 NTU, BOD also above the standard value by 11.30 mg/l, Pb was found by 0.07018 mg/l in seawater which above the standard limits. The evaluated parameters have a serious threat not only to biodiversity but it also threatening to environment and human.

(Neser, Unsalan, Tekogul, & Stuer-Lauridsen, 2008)The research was also done in turkey to make shipbreaking safe and sound by following the rules and regulations that are issued by an organization such as IMO, ILO, BIMCO, etc. Shipbreaking is also helping to avoid mining of iron from ore and fulfill the demand of the economy. Mostly the government has taken regulations and measures to overcome the effects of the shipbreaking industry in Turkey. Still in Turkey, the rules and regulations are followed by the owners of the shipbreaking industry.

Environmental pollution was observed in the research paper of (Titah, Pratikno, & Moesriati, 2019) due to ship dismantling as it releases heavy metals by using bioaugmentation technology. The author's aim was to determine the removal of iron by using Vibrio Alginolyticus and it is a bacteria removal from seawater at the study area. The collected sample was tested by the laboratory using size Erlenmeyer of 250 ml. whereas 5% of Vibrio was added in the reactor and nutrients were added with the ratio of C: N: P (100: 10:1) in each reactor and the process was gone for 2 weeks. The concentration of iron was analyzed by Atomic Absorption Spectrophotometers. The results describe that the removal of iron was observed in two different locations and compared with each other, so the first locations were only 94.9 ±3.6% and controlled by 50.4±1.8% and at 2^{nd} location was 53.7± 13.1% and controlled by 16.7±13.1%. That shows the removal of iron in the seawater can be treated with Vibrio Alginolyticus and nutrients addition.

South Asian countries concentrate on higher economic development rather than environmental sustainability because that they import ships that are full of toxic waste. These toxic waste imports due to earning economic profit rather than to mitigate the health and environmental impacts of shipbreaking with the beaching method. In this study author try to get the answers from 50 respondent about negative impacts on the environment and on worker's health and the results from dismantling of ships, 22.31% of respondents lost their body organs, 13.83% suffered from skin diseases, 16.97% are witnessed on the spot death, 3.26% are affected by cancer and 11.74% are suffered from weakness and chest pain. Also, there are many negative impacts on the environment such as soil, water, and air pollution by the ship breaking in Sitakunda, Bangladesh (Kutub, Nishat, Shahreen, & Yasin, 2017).

There is much literature available on shipbreaking and there have been done critical reviews by the researchers as (Rahman S. M., 2020) has done with it and made future directions to research on shipbreaking from every corner of it. In this paper author briefly analysis 110 research papers and describes the effects of shipbreaking from three sides one was environmental effects, economic exploitation, and social effects that maximize the profit in South Asian countries here rules do not much follow, and because of that industry moved from developed countries to developing. The life cycle sustainability assessment was introduced to capture the gaps of the tradeoff between three main factors of an economy in the industry and found that there is no research paper where there should be research on the tradeoff between environmental, economic, and social factors that can be better to inform the policy formulation for improvement of labor safety and environmental pollution.

(Hossain, Sharifuzzaman , & Chowdhury, December 2016) There were many projects injected by many organizations in Bangladesh to compete with India in the ship breaking industry by dismantling ships environment friendly and following the rules and regulations for workers to move towards breaking of the ship. The Safe and Environmentally Sound Ship Recycling (SENREC) project was designed in Bangladesh to increase the growth of safe and environmentally sound shipbreaking in Chittagong. This project was led by the government of Bangladesh and the technical support was done by International Maritime Organization. The main objective was to make the industry sustainable for the future through doing help to improve the environment and safety and health of the workers.

Another study revealed that there are negative impacts of occupational health hazards and diseases occur in workers due to shipbreaking in Bangladesh through collecting of primary data of 500 workers and the study's results described that 20.17% use boots, 50% cutting of muscles, 25% fractures, fainting/ unconsciousness 3%, loss of limbs 4% and at least one skin disease is common in 47.8% of workers from which 19.4% dermatitis, scabies 15.8%, lichen simplex Chronic us 3.4%, urticarial 2.4%, psoriasis by 1.2% (MS, Bhuiyan , Ghosh, & Rabin, 2017).

In the study of (Toufique, 2012) there were found from the sample that there is 88% accidental injury occurs, 72% of the problem of breathing was recorded in the Bangladesh shipbreaking industry. And the study also mentioned that there should be a policy to make the ship-breaking industry a sustainable sector rather than stop its economic contribution.

In ship breaking the environmental issues occurs due to the dismantling of ships and directly release in the environment these hazardous materials polychlorinated biphenyls (PCBs), lead, oil, mercury, antifreeze, solvents, Tributyltin (TBT), etc. There was Systematic dynamic model has been used by the author to show the tradeoff between three dimensions environmental impacts, economic impacts and other is social impacts of the shipbreaking industry (Kusumaningdyah, Agustina, & Rahmi, 2013).

The workers who join the ship-breaking industry are mostly illiterate and cheap in terms of wages and they do not have any skills that how to keep protect to self from hazardous work. As in the study of (Shah, Hadi , & Mujahid, 2017) the author has figured out the incidents and deficiency inefficiency in ship breaking industry Gaddani as a comparison to other industries and the results revealed that there more lacks in workers of shipbreaking industry as compared to other industries such as mining, manufacturing, services, etc.

(Halder & Islam, 2015) The study analysis the pollution in the Turag River and the effects on the health of residents of the surroundings of the river in Dhaka the capital of Bangladesh. The water samples were collected from the study and tested by the laboratory where the parameters were chosen such as DO, TDS, Cl, CO_2, BOD, chemical oxygen demand (COD), and others. The results were showing aquatic lives cannot stay in the river due to low DO levels. The level of higher concentration of parameters like turbidity, TDS, BOD, hardness, and COD was found in the Turag River. The health effects were found in the local communities living surrounding the river. Their respiratory problems occurred in the households.

In Pakistan, there is less concentration on this industry as in (Memon & Muhammad, 2016) study the comprehensive analysis has done to expose the current situation and to check the impacts on workers and local community living thereby collecting data of 450 respondent through focus group discussion, questionnaire and expert opinion all these data were analyzed on SPSS and then results from shows through tables, charts, diagrams, graphs and figures the results show that health hazards were affecting to community and workers by 23.19% is the organ of bodily injury and permanent loss, 7.54% on-site death, 8.84 eyesight and headache, 17.39% breathing problems, skin diseases by 15.94%, Diarrhea and dehydration 4.78%.

In Pakistan, there was a lot of literature was available on water quality analysis with its impacts on the communities and biodiversity. But there was no water quality literature was found particularly from the shipbreaking industry in Gaddani, Pakistan. So, this study fulfills the gap of the literature by analyzing the water quality due to the shipbreaking process in the study area.

2.2 Occupational Health Cost:

The literature on the impact of shipbreaking on the occupational health cost of the worker was not available in Pakistan and even in South Asian Yards. There is a lot of research has been done by researchers in Pakistan in different industries' worker's health cost analysis. Here the other industries worker's health costs affected by a different source of pollution were described internationally and nationally.

According to WHO, in 2017 the estimated global health care spending was the US $7.8 trillion or 10% of global GDP, from which governments provide an average of 51% of a country's health spending and more than 35% comes from out-of-pockets (Jasarevic, 2019). In Pakistan spending on health was 2.899% of GDP that is $45 in 2017 (database, 2019).

In the study of (Leigh, et al., 1997) the direct and indirect costs were estimated for occupational injuries and illness in the USA. The secondary data were collected from the Bureau of Labor Statistics and the method was applied as a Proportion method. The result of direct cost in monetary form was $65 billion and indirect was some 106 billion dollars, this study does not include intangible cost because it cannot measure in monetary form.

The research in shipbreaking has been done by the researchers from three common sides of the economy one is environmental side effects, economic profit, and social effects but (Gunbeyaz,

Kurt, & Baumler, 2019) in this paper author introduced the tanning facility for the workers to make their work safe and hazardous free. Because due to their work there is evidence of fatalities and accidents in a shipbreaking yard in the world. The author also compares the training requirements with international rules and regulations which were introduced by IMO's Hong Kong Convention and International Labor Organization (ILO). In these regulations, there is an available detailed recommendation for the breaking of ships in the yards to increase occupational health and safety training in the yards.

A study conducted by (Ullah, Malik, & Hassan, 2019) aimed at finding the repercussions of health status on the level of worker's productivity. To find quantification between health status and workers' productivity, the Auto Regressive Distributed Lag (ARDL) using data for Pakistan from 1980 to2010. The results reflect that there is a positive correlation between health status and productivity of workers. The study found that the productivity of workers increases by 13.39% in response to a 1% improvement in the health status of workers. Moreover, the coefficients of education and experience have also shown a positive correlation with worker's productivity in the case of Pakistan. Likewise, FDI (which is taken as a proxy for technology transfer) also depicts a positive but statistically insignificant correlation with the productivity of workers. However, inflation has negative impacts on the level of worker's productivity.

This study was carried out in the United State of America (Davis, Collins, Doty, Ho, & Holmgren, 2005). In this paper, the economic impact of health problems on the productivity of workers was estimated. There were 18 million adults from the age of 19 to 64 who were unemployed due to their disability or due to health issues they were not contributing to the economy. The working days lost by seventy-two percent due to health issues or that of their family members. Fifty-five percent have reported the loss of productivity due to not concentrated by the workers due to their own illness or family member's illness. The total labor productivity is lost in monetary form by $260 billion each year.

In the study of (Gupta, 2008) the author estimated the affected children's health cost due to air pollution. Low pollution helps individuals by decrease the cost of health. There is the various source that makes environment degraded such as industrial carbon emission, transport pollution, and many other sources. Decreasing air pollution can be a benefit to the individual in the form of monetary terms by less spending on health from the urban industrial area of Kanpur, India. When

the air pollution reduces to the level of safe air will lead to a decrease in the health cost of children by Rs165 and total annual benefits to the whole population can benefit by Rs213 million.

Shipbreaking affects the air pollution by doing the dismantling activities as it is dangerous for peoples to breathe at the shipbreaking yard. (Adil, 2017) Has estimated the direct and indirect cost of the physical health and cognitive abilities of children due to the air pollution from the brick kiln that makes them vulnerable. The air pollution was identified through a quality checking device that shows there were 247 $\mu g/m_3$ at the area of brick kiln within a 3km radius at Peshawar. The Raven-test scores model was used by the author to estimate the cognitive ability of children between the age of 5-12 years. The results show that children who are living in the affected area have a lower cognitive ability by 0.93 SD as compared to unaffected area's children. And also, the children can lose their wage in the future by 20% because of the brick kiln on their cognitive ability.

The author (Mitra, et al., 2020) estimated the energy-based CO_2 emission, and its effects on health were estimated. The CO_2 emission was estimated from three different energy uses such as fuel consumption, electricity consumption, and metal gas consumption. To estimate the CO_2 the guidelines by Intergovernmental Panel and Climate Change, Environmental Protection Agency's Emission and generation Resources Integrated Database emission factors were used. The geographically weighted regression model was used to estimate carbon emission was applied to capture the influencing factors. To assess the worker's health effects and environmental degradation perception, a semi-structured questionnaire was made by the author, and collected survey from 118 workers was collected. The author concluded as carbon emissions from gas consumption were 43.39 mega tones, fuel consumption was 17.91 megatons yearly were emitted by the industry. The results of the survey which were collected revealed that the susceptibility to accidental hazards specifically death was 91% and pollution 79% were observed, there should be attention on this shipbreaking industry by national and international level.

Although shipbreaking causes environmental pollution by this activity. In the article of (Yan, Wu, & Yu, 2018) some hazardous materials were introduced in shipbreaking. The breaking method of ships at the yard was introduced at China and international levels by changing the method of cutting through the new technology which is termed as the Abrasive water jet cutting method. This method is less damageable to the environment and health consequences because it is using water pressure for cutting. The feasibility of this technology in shipbreaking is environmentally sound,

economically, efficiency and safety were observed. The author concluded that the abrasive water jet technology is economically good, environment-friendly, safety and efficient in the breaking of ships at the yard.

In the USA, (Leigh J. P., 2000) a study was conducted to measure the cost of occupational accidents, injuries, and illness. Two types of cost were estimated one is direct cost was estimated by taking medical center cost that includes doctor fee, nurse fee, diagnostic test cost medicine cost, etc. and 2nd is an indirect cost that covers loss workdays, loss of wages, etc.

In Spain, a study was conducted to estimate the health and safety cost of workers by (Pellicer, Carvajal, Rubio, & Catalá, 2014) in a construction project. There was a total of four costs are estimated by the author one was insurance cost, 2nd was avoidance cost, 3rd was accidental cost and last was recovery cost. The data of labor accidents were taken from 1990 to 2007 for the whole construction industry of Spain. The data were analyzed through a mathematical method and enable to managers and employers or cost that bear because of occupational health and safety during the project of construction in Spain. The results show that the total cost of occupational health and safety was overall 5 percent of the total budget of the construction project in Spain.

The author in this paper estimated the economic cost of occupational injuries which is low in developing countries of the world which prevents the economic consequence and social consequences. In this paper, the author estimated the direct health care cost of accidents during work in the Mexican Institute of Social Security which employed 12,735,856 workers. The author estimated the cost of treatment of injuries of 295,594 workers which were officially reported nationwide. The results showed that 2.9 on every 100 workers was an occupational injury. The average cost of one occupational injury was $2,059. The total cost of recognized injuries was $753,216,460 and concluded the health care cost of the accident was like death compensation and disability in the social security system in Mexico (MScE, et al., 2008).

(Morse, Dillon, Warren, Levenstein , & Warren, 1998) There are different economic consequences of occupational health problems to workers and families. One of the reasons is absence duration from the work may affect their income loss. The reason for missing the working days is the basic measurement of economic cost bear by workers. The developed countries make sure their workers' health status and insurance for workers in case of any injury or fatal. But in the developing countries, there is the opposite of it happened. The economic profit gets importance on the health

of workers in the developing countries. In developing countries, the cost of health beard by workers not by industries or by any governmental schemes. The author reported that workers who have suffered from musculoskeletal disorder 2.5 times and 3.5 times more lost their cars and homes.

(Fatusi & Erhabor, 1996) In this article, the author examines the impact of sawdust exposure on worker's health from 59 sawmills in Nigeria. The workers were chosen as a two-stage random sampling method from fifteen sawmills that were privately owned. The questionnaire was fulfilled by the worker of occupational-related symptoms. The results show that there is a high occurrence of respiratory symptoms in sawmill workers. 94.9% of workers were aware of hazardous work in the sawmill industry's workers. There is a need of controlling dust in particularly in developing countries.

In the study of (Chowdhury & Imran, 2010) author determine the morbidity cost to decrease air pollution by using the cost of illness approach in Dhaka, the capital of Bangladesh. Whereas the cost of illness is the total sum of the loss of working days and the expenditure on mitigating the pollution from the air. The primary data were collected seasonally from the households through a questionnaire base survey from Dhaka. To analysis, the data for measuring the loss of income due to loss of working days by using random-effects Zero Inflated Poisson regression model and for determining the mitigation cost the Tobit regression was used. The results show for the loss of earning was Taka 131.37 or $1.88 annually and the expenditure on medical treatment was decreased by Taka 150.49 ($2.15) on each individual. The total annual saving to the economy of Bangladesh was Taka 239 million ($34.09 million) estimated.

(Bogahawatte & Herath, 2008) The report was prepared on air pollution such as dust, suspended particulate matter, fume, and gases from the cement production industries. This air pollution affects the households who are living around the cement industry. The health cost was estimated due to air pollution bearing by households in the cement factories area o district Puttalam, Sri Lanka. The primary data were collected from 500 households within the area of 3 km around the cement factory and author to estimate mitigation cost and the dose-response function for different types of respiratory diseases by measuring seasonal air quality. The results show that 14% of the individual has the respiratory illness and author estimated the expected annually welfare increase by reducing 50% level of SPM was $7 per individuals living around the cement industry in Sri Lanka. Moreover, the author also estimated the expected overall welfare gain to the whole households living around the cement factory by $29,600.

(Madheswaran, 2004) The author has estimated the value of life and limb in the metropolitan areas of both cities Chennai and Mumbai of India. The Hedonic wage differential approach was used that implies the risk related to the job was dependent on job evaluation. The high-risk job gets back a high wage. The study area was chosen due to high registered industries. The male workers were chosen from the manufacturing sector and three main risks were chosen to analysis such as fatal, non-fatal, and environmental degradation. The results show that the workers were ready to trade-off fatal job risk in both cities Chennai and Mumbai at an economic price of 14.3 million and 15.4 million Indian rupees, respectively. The statistical value of injury (VSI) was estimated for Chennai by INR 6470 and Mumbai by INR 9000. The environmental effects on worker's health but did not account separately and there were not any estimation of environmental pollution and its impact on workers death.

The study of (Mehwish & Dr., 2016) estimating the impact on worker's health and the cost of illness due to dust pollution in the textile industry of Faisalabad through cross-sectional data. In this research 200 workers were selected randomly, and the model used to analyze the data was Structural Equation Model (SME). The results show that 62% of workers were suffering from the cost of illness, 69% of workers have a low performance during work due to illness, 43% of workers lost their working day from the last two weeks. The study also estimated the cost of illness such as 30% workers bearing the cost from 1 to 1500 rupees, 15% workers range from 600 to 1000, 15% workers bearing cost from 1100 to 2000, and 2.5% were lying in the range of 2100 to 2500 from last two weeks.

(A.M.Makin & Winder, 2008) According to the author, a conceptual framework was developed for occupational health and safety management system has been introduced to get together the merits of hazard's three-stage like a safe place, safe person, and safe system. The occupational health and safety hazards were determined in the organization and have been addressed appropriately. The types of business operations have been identified and the hazards were also in occupational health and safety hazards and the factors which were affecting the occupation health and safety management system.

(Rehman, 2015) The author in his MPhil dissertation tried to capture the effect of the marble industry on the health of workers and their loss of working days. The primary data were collected from the workers of the industry with two sampling methods one was probabilistic and non-

probabilistic, and the sample size was 346 respondents. The data were collected from two groups one was marble industry's workers which were 173 respondents, and another was from non-marble industry workers which were also 173 respondents from the residential areas of near marble industry in FATA, Pakistan. A multiple linear regression model was used to examine the number of workday losses due to the diseases that occur due to air pollution in the marble industry area. The results of the study were that there is a high correlation between higher working hours in the industry will increase the exposure of dust in and around the marble area. Whereas the workers of the marble industry are suffering more than no-marble industry workers. The dissertation was concluded that the workers were unaware of exposure to dust-related diseases.

The study was conducted in district Buner of KPK, Pakistan to determine the impurity weight by the industrial effluent and specifically marble industry's effluent in groundwater. To analyze the pollution weight in groundwater the eight samples were collected from different eight units of industrial areas. The samples were brought to the laboratory for testing of the physical and chemical parameters. The physical and chemical parameters were Temperature, pH level, EC, TDS, TSS and BOD were analyzed. The results show that effluent release by industrial units have a serious effect on surface water and groundwater and even somehow on human being also but the seriousness of owners of the industry are costing the negative externalities due to the industrial activities (Khan, Haq, & Saeed, 2012).

In a study, the author examines the impact of biomass fuel on the health of the people and the willingness to pay for improved cocking stoves by the peoples in the rural areas of district Khairpur, Sindh. The primary data were collected from the households of rural areas in which the snowball sampling was chosen and the sample size was 72 households were interview. The Logistic model was used to identify the willingness to pay for improving the cocking stove and the Ordinary Least Square method was used to analyze the health cost of households. The results show that there is a direct relationship between using biomass fuel and health costs. The people of Khairpur are willing to pay for improved cocking stoves. The policy recommendation was given by others to the government that there should be a construct of gas pipeline to the rural areas where it can increase the productivity of rural area's people (Muhammad, 2020).

(Ayaz & Dr., 2018) This study examining environmental pollution and estimating the cost of illness of coal mining workers in Baluchistan. The primary data were collected through the questionnaire with 300 sample sizes and the model which was used in this study to analyze the

data is the Double-hurdle model technique by Stata software. The results reveal that socio-economic and demographic variables have a significant impact on the cost of illness and there is a positive impact of environmental variables like poisonous gases on the direct cost of coal mining workers. The coal mine workers suffered from high illness costs as compared to non-coal workers.

(Yasmeen, 2002) The author has found the negative effects of carbon emission by factories and pollutes on the air quality that affects the health of humans in the area of Gujranwala, Pakistan. The author conducts the survey to identify the causes of air pollution from the respondents like does it affect humans and how it can be controlled. The sample of 100 people from 3 areas of the city Gujranwala that are patients of respiratory diseases. The respondents were mostly from the factories' workers with low income.

(AHMED, 2013) The author was evaluating the status of registered cases of respiratory and cardiovascular patients and was compared the value of statistical life of the patients who were affected due to air pollution in the selected area off Gujranwala. The contingent valuation method was used to measure the willingness to pay for a reduction in air pollution of Gujranwala city's mortality. The 175 totals respondents were interview through a proper questionnaire. The results show that the statistical valuation of life for three risk reductions was Rs4.647 million, Rs1.592 million, and Rs1.117 million.

(Bangash, 2012) The quality of life of labor and economy determines by health stats. In this study author analysis, the health protection program, and the effects of cement factory on environment and health of workers. The author tried to analyze occupational illnesses such as pulmonary, eyes, and cardiac. Also, risk related to health cost of worker at the factory. This study was conducted at the cement plant of Khyber Piketon Khwa (KPK), Pakistan. The primary data were collected from the workers and other locals. The sample size s 260 were interviewed from workers and peoples living around the cement plant in KPK. The results show that there is significant relation of cement plants to diseases and health costs.

The previous literature mostly was done in neighboring countries like Bangladesh, India, and China, etc. in Pakistan mostly the work has been done in the shipbreaking industry as qualitative work. This study has done quantitative work as a collection of primary data on health status and costs from workers and water samples were collected from the site directly and analyzed in the laboratory which has no one found in previous literature from the study area. This study includes

the estimation of the health cost of workers due to the ship-breaking industry. The gap of literature was no one working on this industry as estimating health cost and impact of socio-demographic variables and industry-related variables on health cost and for analyzing the impact of shipbreaking on water quality in Shipbreaking industry Gaddani.

Chapter # 3

Theoretical Framework

As shipbreaking is dangerous work in the world for both environmentally and human's health. It can be done as sustainable in the region by apply sustainable methods of breaking. In South Asia, there has been doing this work with cheap methods which increases their cost but now the world is going towards sustainability. As European Union has issued safe and strict methods for breaking ships to get safe both environment and human's health (AB, 2001; Yujuico, 2014).

The Honk Kong Convention for Safe and Environmentally Sound Recycling of Ships, adopted in May 2009, provides for regulations to ensure that ship recycling does not affect human health or environment. Pakistan still has not ratified it which indicate negligence towards human life and coastal environment (Hameed, 2019).

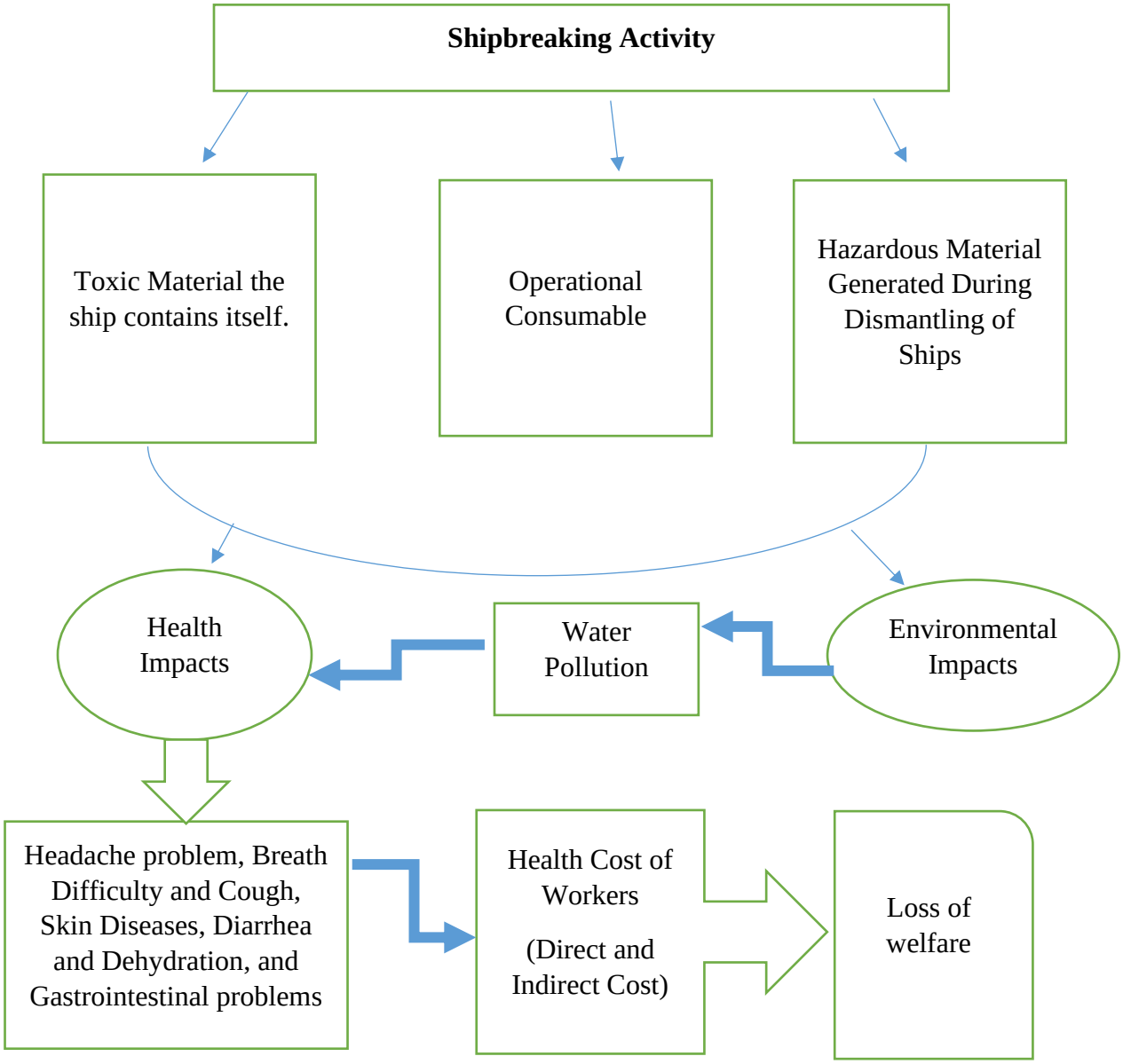
The research has been done in the world in different aspects to make the industry sustainable. In Pakistan, there has been also researching has been done on different aspects (Shah, Hadi , & Mujahid, 2017; Sarraf, et al., 2010; Shah, Hadi , & Mujahid, 2017) but the environmental aspect particularly water pollution has remained and also the industries direct and indirect effect on human's health and their health cost was remains. So this research will fulfill the gap by testing of water quality of the study area and collecting primary data through question directly from the workers.

Environmental effects generated by ship breaking industry such as water pollution which is affected in two different parameters one physical parameter and chemical parameter. Here in this thesis, there were chosen both parameters which termed as physicochemical parameters that include Ph level, Turbidity, Electrical Conductivity, Biological Oxygen Demand, and Dissolved Oxygen which are polluted by anthropogenic activities and causes waterborne diseases like acne, demerits, and other skin diseases also (Hasan, Shahriar, & Jim, 2019).

Human health is affected both directly by ship breaking and indirectly through environmental degradation. Mostly the health problems occurred in workers of the industry such as respiratory problems, eye problems, abdominal problems, skin problems, muscle problems, etc. and the causes of these problems are poor quality of water, inadequate sanitation, toxic metals, TBT, PCB, asbestos, fires, etc. These material ships contain when it comes to the shore of south Asia to

dismantle that has serious effects (Khabirul, Imtiaz, & Hawlader, 2018; Sangeeta, Sonak, & Giriyan, 2008).

The below diagram described better for ship breaking in the yard with the effects generated by breaking of ships on the beach which is called beaching method that affects both environment and worker also to local. Mostly some migrant workers came to make themselves vulnerable without knowing the dangerous materials that release from the ships.



Flow Chart: Impact of Shipbreaking on Environment and on Health of Workers

The flow chart shows that the human activity affects which is done by the breaking of ships on the shore affects to environment and workers' health. When Ships comes towards shipbreaking yard it contains toxic materials such as asbestos, lead, paint, tin-based fouling, glass wool, and others, ships release material when operational work starts to consume the ship's material such as ballast water, sewage, garbage, oily rags, batteries nickel, equipment, refrigerants, halon, and many others. When the cutting process starts it releases hazardous material during the cutting process such as heavy metals, particulate matter, oil-contaminated sand generated when washing oil tanks with sand, and oily bottom parts of ships (Vivek, Singh, & Asolekar, 2019). The beaching method followed by developing countries due to low rules and regulations followed by owners creates many problems from different aspects. Firstly, when the ship breaking begins it releases many hazardous substance-like PCBs, oil slagging, asbestos, etc. The shipbreaking directly affects worker's health, but it also generates pollution in water that ultimately affects the health of workers through diseases such as headache, breath and cough problem, skin diseases, loss of body organs, diarrhea and dehydration problem, the gastro-intestinal problem that affects the health cost of workers which is the direct loss of welfare of the economy (Karlis, Dionysios, & Anastasios, 2016; Khan, et al., 2018; Yan, Wu, & Yu, 2018).

Chapter # 4

Methodology and Data Collection Techniques

This section will cover the Data Collection procedure, Sampling Technique, and Empirical framework of models.

4.1 Study Area:

Informal Shipbreaking started in Pakistan in 1947 at Gaddani beach. Gaddani is the coastal village of Hub tehsil of district Lasbella, Baluchistan, along the Arabian Sea, 50 km away from Karachi, Pakistan. The yard consists of 132 plots and the annual capacity of ship breaking is 125 that come under private ownership and Baluchistan Development Authority (BDA). The climate of Gaddani is moderate and moist more than other areas of district Lasbella. The average annual temperature of the Lasbella district is about 26.3°C. The average rainfall in Gaddani is 169 mm. Gaddani ship-breaking yard is on 3rd largest in the world in capacity and it is on 4th in scrapping in the world. The industry was at its peak in the 1980s in the world due to imposing taxes on this industry in 1999 that increased the number of competitors. This industry provides employment more than 20,000 skilled and unskilled workers. The ship breaking Gaddani indirectly provides livelihood to more than 200,000 individuals which includes contractors, transporters, petty traders and cottage industry etc. Currently, this ratio comes down to 5000 workers (Shah, Hadi , & Mujahid, 2017; Humayun & Zafar, 2014; Hameed, 2019).

4.2 Data Collection Procedure and Sampling Technique:

4.2.1 To identify the Impact of Shipbreaking on Water quality:

For water testing, water samples were collected from inside the ship-breaking yard from different sources like well and Seawater in the summertime of August 2020. Seawater was collected from two different yard's seashore during low tide. Well water sample was collected from two different locations which were away about 0.5km and 1km from seashore. The study area of water collection lies between longitude 66.7000 and latitude 25.0667. The map of the location is presented in figure 4.1. These water samples were collected in summer. The samples were bought after collected samples to the laboratory as early as possible for avoiding further contamination. The samples were carried in airtight sample bottles to PERAC Research and Development Foundation Laboratory, Government of Pakistan, Ministry of Energy, Petroleum Division.

The parameters were measured such as Turbidity, Electric Conductivity, Dissolved Oxygen, Total Dissolved Solids, Biological Oxygen Demand, and pH, tested through Water Testing Laboratory (Talukder, A., & Mohammad, 2015). The pH @ 25 ºC was measured using (D-1293), BOD was measured with unit mg/L using (APHA-507), turbidity was determined in NTU unit by using (HACH-8237), EC was measured with unit µs/cm by using (D-1125), TDS was determined as unit mg/L by using (APHA-209B) and DO was measured in the unit of mg/L by using (D-888).

Figure 4.1 (a): Location of Water Samples Collection

The source of figure 4.1 (a) was Google Map.

Figure 4.1 (b): Location of Study Area

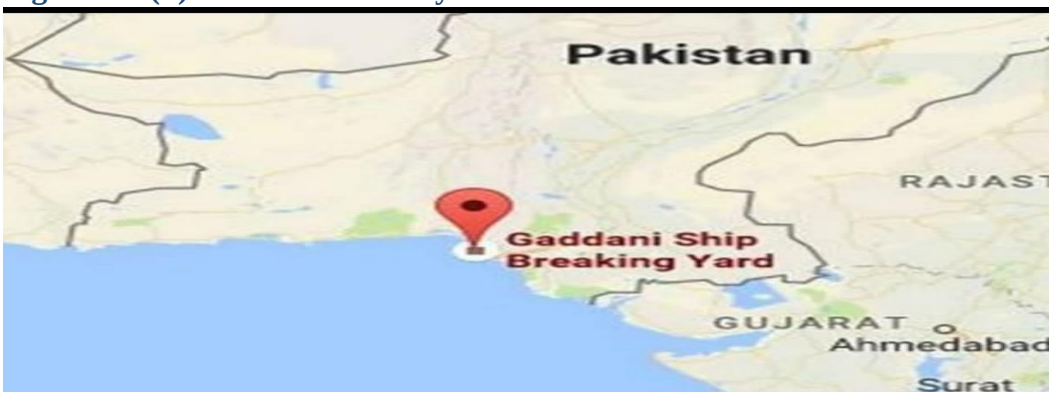


Figure 4.1 (b) was taken from Google Map.

4.2.2 To Calculate Health Cost and Estimate the Impact on Health Cost by Shipbreaking:

The primary data was collected through open and closed-ended questionnaires directly from those workers who were currently working in the ship-breaking industry. A convenience sampling technique was used to capture the impact of shipbreaking on worker's health because there were obstacles came in the process of collecting data due to restriction of COVID-19 (Cochran, 1977;

J.Freund, Wilson, & Mohr, 2010). The sample size was 235 at a confidence interval of 95%, with Margin level of 6.14% and the total population was 3000. The data were randomly collected from the workers' shipbreaking yard, Gaddani.

4.3 Empirical Framework:

The questionnaire is divided into 3 sections where 1 section is for the personal information of workers such as their age, name, type worker, income, etc. and 2 section covers health issues due to shipbreaking such as usage of water quality, usage of water in food cooking, the occurrence of different diseases such as loss of body parts, eyesight and headache problem, skin diseases, breath and cough problem, diarrhea, gastrointestinal problem, etc. And the last 3rd section is about the cost spend on health by workers due to working in the shipbreaking industry directly and indirectly such as medical cost non-medical cost, cost of working days off due to illness, etc.

4.3.1 Econometric Model:

In the shipbreaking industry, the health cost has not been estimated of workers but in this research, it has been estimated to fulfill the gap. Many factors are affecting health costs in different ways. Many aspects affect the healthcare system some are poverty, poor administration, commissions, inexperienced doctors and nursing staff, lack of medical equipment, lack of personal protective equipment, etc. In Pakistan, the mean spending on healthcare is about 34% by the economy and most spending is privately (Khan M. M., 2020). Most factors that are related to life are somehow related to health and when health cost increases then it alternatively leads to poverty.

So, here in this study it cannot measure all aspects that affect health cost but some major factors that are affecting workers due to shipbreaking can be expected to have an impact on their health cost. As the health cost is a dependent variable here in the model in this thesis and it is non-binary form, or we can say it is in rupees form. So, to capture the impact of independent variables on the dependent variable we are using the Ordinary Least Square method. Whereas this method was used (Isani, 2019; Siddique, 2019; Muhammad, 2020) There have been other measures of the impact on health cost Ordinary Least Square method has been adopted because of the non-binary form of dependent variable which is health cost (HC).

4.3.2 Specification of Model:

$$HC = \beta_0 + \beta_1 Age_i + \beta_2 I_i + \beta_3 NOE_i + \beta_4 MS_i + \beta_5 EDW_i + \beta_6 WE_i + \beta_7 Ds_i + \beta_8 WH_i + \beta_9 Se_i + \beta_{10} DU_i + \varepsilon$$

Table 4.1 Variables Description

Dependent Variable	**Variable Explanation**	**Unit of Variable**	**Expected Sign**
HC	Health cost (In rupees)—Health cost includes medicinal and treatment cost as well as travel cost, opportunity cost, and time cost, etc.	Continuous	
Independent Variables	**Variable Explanation**	**Unit of Variable**	**Expected Sign**
Age	Age of respondent (in Years)	Continuous	Positive (+)
I	Income (Total income in rupees)	Continuous	Negative (-)
NOE:	Nature of Employment (Daily wages=0 Permanent=1)	Dummy	Pos/Neg (+/-)
MS	Marital Status (Married = 1 Unmarried = 0)	Dummy	Pos/Neg (+/-)
WH	Specifically working in the shipbreaking industry	Continuous	Positive (+)

WE	Working Experience in years specifically in Shipbreaking Industry.	Continuous	Positive (+)
EDW	Education of Worker (in Years)	Continuous	Negative (-)
Ds	Diseases due to shipbreaking (Occurrence of diseases = 1, Non-Occurrence of diseases = 0)	Continuous	Positive (+)
Se	Safety Equipment's (Using of PPE = 1, Non-Using of PPE =0)	Continuous	Negative
DU	Drug Use by Workers (Drug use =1 No Drug Use =0)	Dummy	Positive (+)

4.3.3 Theoretical Justification:

To estimate the impact on health cost the variables were chosen from the literature as they can affect the health cost of workers in the shipbreaking industry. These variables included socio-demographic variables and related to work in the shipbreaking industry and also health-related variables (Isani, 2019; Siddique, 2019).

Health Cost:

Health cost is consisting of direct cost on health which includes diagnosing test cost, doctor fee, cost of hospitalization and accommodation, lab test cost, and medicine cost. While on the other side indirect costs consist of travel costs, food costs, and the cost of working days off by the workers of the shipbreaking industry.

Age

The expected sign of age was taken as positive because with increasing age the respondent can be affected more due to the bad environment at the working location. So, aged workers may suffer more from diseases and facing high health costs.

Marital Status

The workers of shipbreaking were asked that either they are married or not because if a worker is married then the marriage factor may increase his health cost.

Income of Workers

This refers to the two months' income of workers in PKR. This income of those workers who were working t shipbreaking yard Gaddani at the time of collecting data.

Nature of employment

This term refers to the nature of workers either the worker is on a daily wage or permanent wage. The workers who were working at the shipbreaking yard mostly of them were on daily basis and the other was permanent which of them busy with the office job at the yard and others who were working out of the office, but they were on the permanent bases.

Diseases

This refers to either worker who suffered in the last 8 weeks from diseases directly or indirectly due to shipbreaking or the worker who did not suffer from diseases.

Working Hours

Working hours means that how much hour's worker engaged in working in the industry per day. Here the extra working hours are not asked from workers because workers do not engage themself with extra hours daily occasionally, they do.

Working Experience

The workers who have experience in shipbreaking were asked directly to the workers and confirmed from the offices of yards. Working experience refers to how many years a worker is engaged particularly with the shipbreaking industry.

Education

Education of workers was asked because the higher the education of workers may impact the low cost of health due to taking precautions properly. It was asked from the working in fulfilling time of questionnaire from the workers directly at yards. The education was collected in the years of education.

Safety Equipment

This refers to either workers using personal protective equipment, or they do not because if workers are using maybe, they face low health costs.

Drug Use

Drug use may affect the health cost directly and can increase the health cost. If a worker is engaged with a drug his health cost may increase and it decreases the productivity of workers at the yard.

Chapter # 5

Descriptive Statistics and Results

Introduction:

Descriptive statistic explains the features of a specific data set by describing short summaries about sample and measure of data. Descriptive statistics of Socio-demographic variables have been discussed that were collected through questionnaires from the workers of the industry. Socio-demographic variables discussed including age, gender, education, nature of work, and health status. The data on the socio-economic variables of the respondent are presented in graphs.

Figure 5.1 Age of respondents:

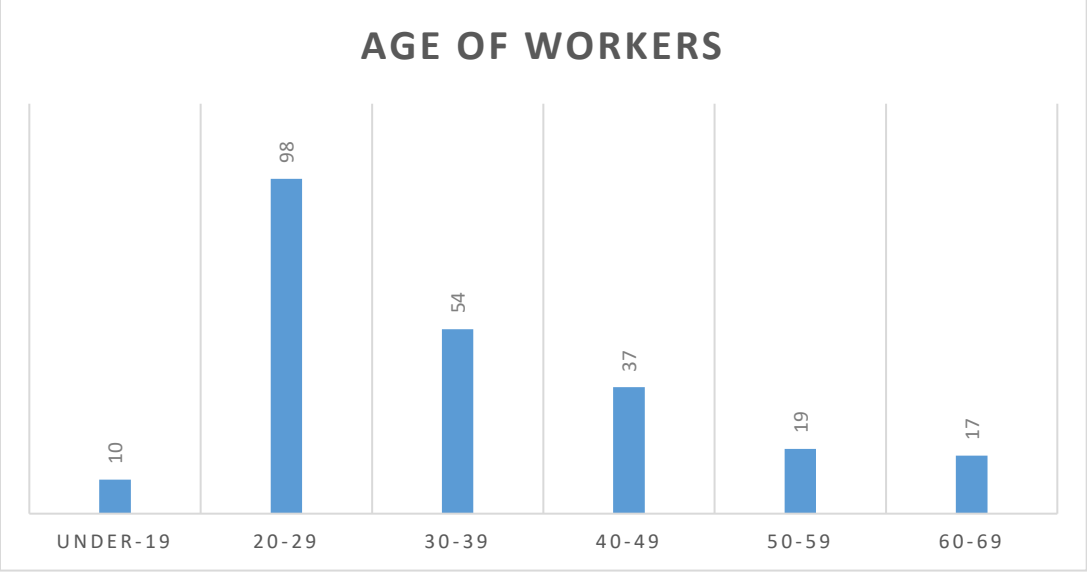


Figure 5.1 shows the age of workers that were interviewed. There were mostly workers who were in their young age, and they have no other option available there for earning for their families. The range was set from 0 to 69 years. The age was divided into 6 groups and the range of every group is 10 except under 19. The total sample size was 235. The first group contains 10 workers who are under 19. 98 workers are lying in the second group that has the 20-29 range. While the 3rd group which has 30-39 range contained 53 workers. The 4th age group has 37 workers that have a range of 40-49. There are19 workers who are lying in the 5th age group that has 50-59 range. And the last age group has range 60-69 which contained 17 workers.

Figure 5.2 Education of Respondents:

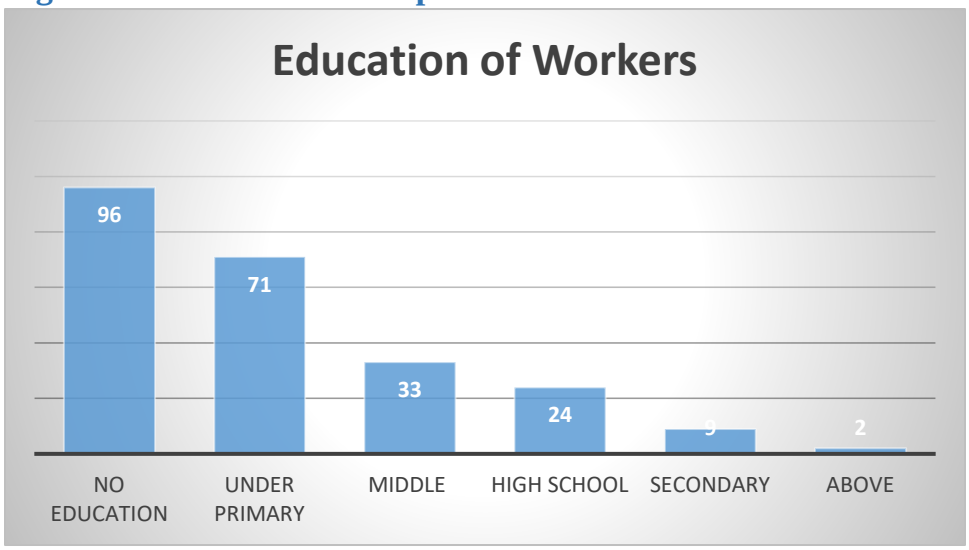


Figure 5.2 Describe the education of workers in the industry. The education was distributed in different groups such as no education show 0 years education, under primary shows 1 to 5 years of education, middle show 6 to 8 years of education, High School shows 9 and 10 years of education, secondary means 11 and 12 years of education of workers, and above means 14 years of education. There are 96 out of 235 workers which have no education. 71 and 33 workers have primary and middle education. 24 out of 235 have high schooling education. While 9 out of 235 have secondary education and only 2 have 14 years of education.

Figure 5.3 Working Experience of Workers in Shipbreaking

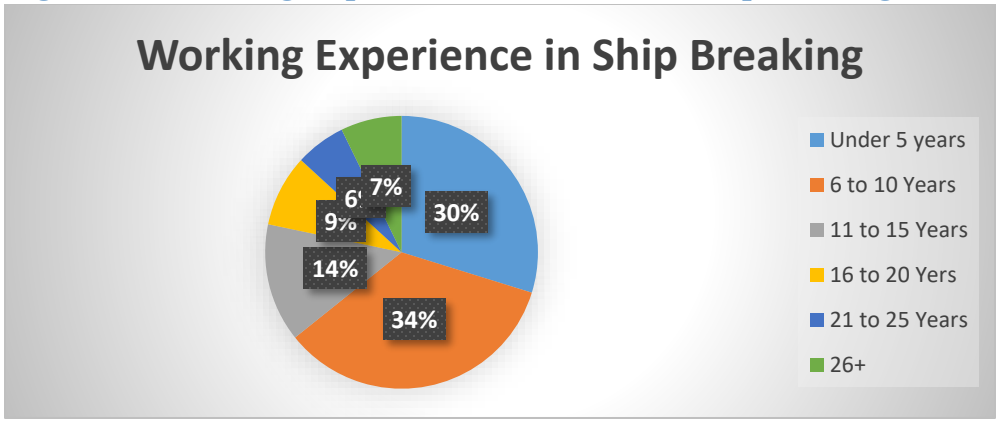


Figure 5.3 describes the working experience in shipbreaking particularly. When we look at the experience graph that is divided into 6 groups such as under 5 years of experience, 6 to 10 years of experience, 11 to 15 years of experience, 16 to 20 years of experience, 21 to 25 years of experience, and the last one is above 26 years of education. So there are 70 out of 235 workers

have under 5 years of experience in this industry, 81 out of 235 workers has 6 to 10 years of experience, 33 out of 235 have 11 to 15 years of experience, 20 out of 235 have 16 to 20 years of experience, 14 out of 235 workers have 21 to 25 years of experience and only 17 out of 235 workers have above 26 years of experience.

Figure 5.4 Nature of Employment of Workers:

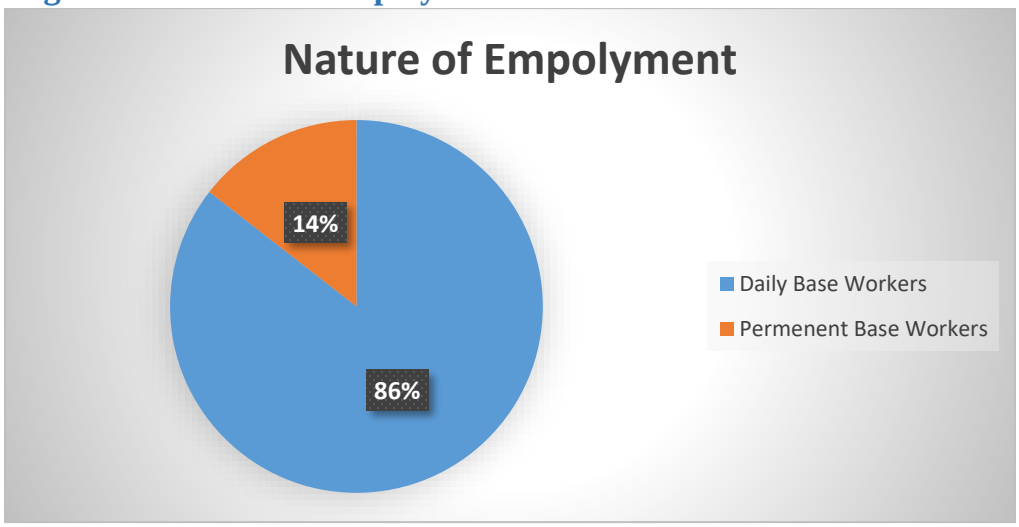


Figure 5.4 showing the employment nature of workers it shows that the worker is either on a daily wage base or permanent base in the ship breaking yard Gaddani. In the shipbreaking industry mostly there was daily wage labor was working. There are 201 workers which is equal to 86% of the sample that employed on daily basis. The remaining 14% were employed permanently because there less work of permanent there except office jobs and guards.

Figure 5.5 Work Types of Respondent:

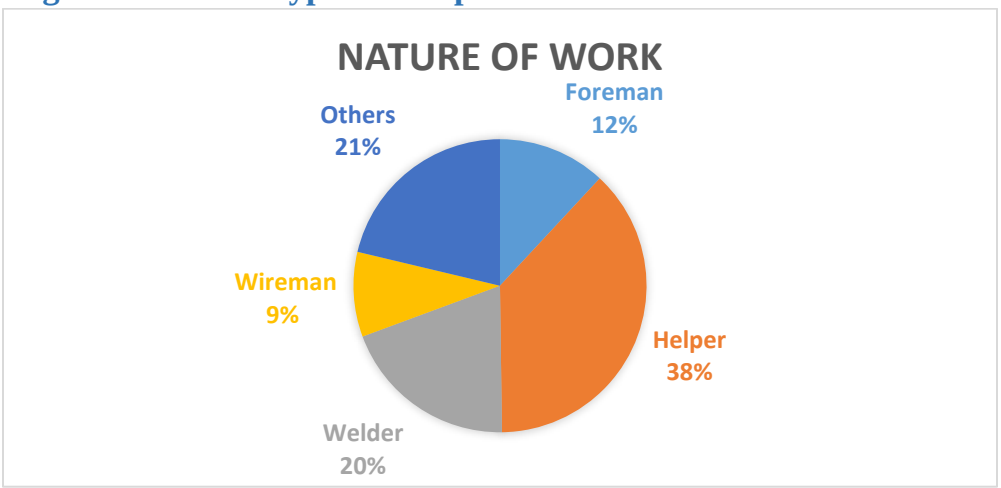


Figure 5.5 defines the nature of the work of the respondent. The data were collected from different yards randomly where workers were working. There are different types of occupational workers were working. There are four major types of workers were doing their job such as foreman, helper, welder, wireman. The types others include different types such as accountant, safety in charge, guard, crane operator, mechanic, etc. There were 28 out of 235 workers which is equal to 12% foreman working on different yards. Whereas 89 out of 235 which is equal to 38% were helpers on different yards was working. Where 20% or 46 out of 235 were welders were working on different yards. Only 9% or 22 out of 235 were wireman workers engage in their work. And 21% or 50 out of 235 workers were engaged in other works such as accountant, safety in charge, guard, crane operator, mechanic, etc.

Figure 5.6 Health Status Of Respondent:

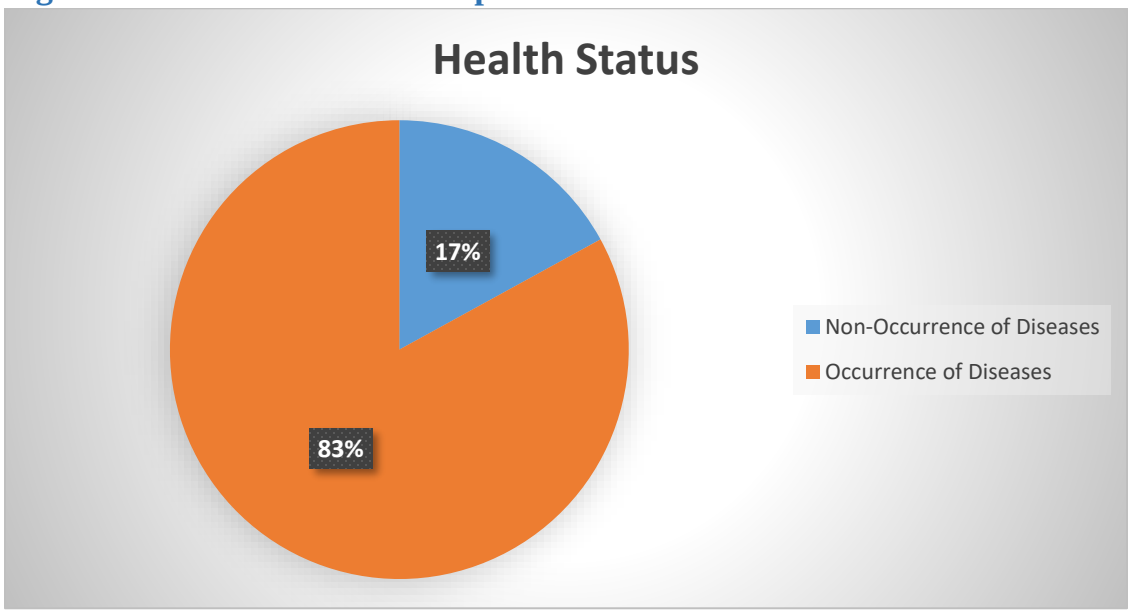


Figure 5.6 shows the health status of workers who suffer in the last 8 weeks in the shipbreaking industry. There were 17% (40 out of 235) workers who have no occurrence of any disease. 195 out of 235 (83%) workers have occurred disease because of environmental pollution, not the use of safety equipment. Shipbreaking creates many problems through breaking ships with the beaching method. The working environment and the impact of hazardous materials from the ships affect the workers' health and also environmental degradation. There is much substance that causes workers to suffer from the diseases that are described below.

Figure 5.7 Diseases in Workers:

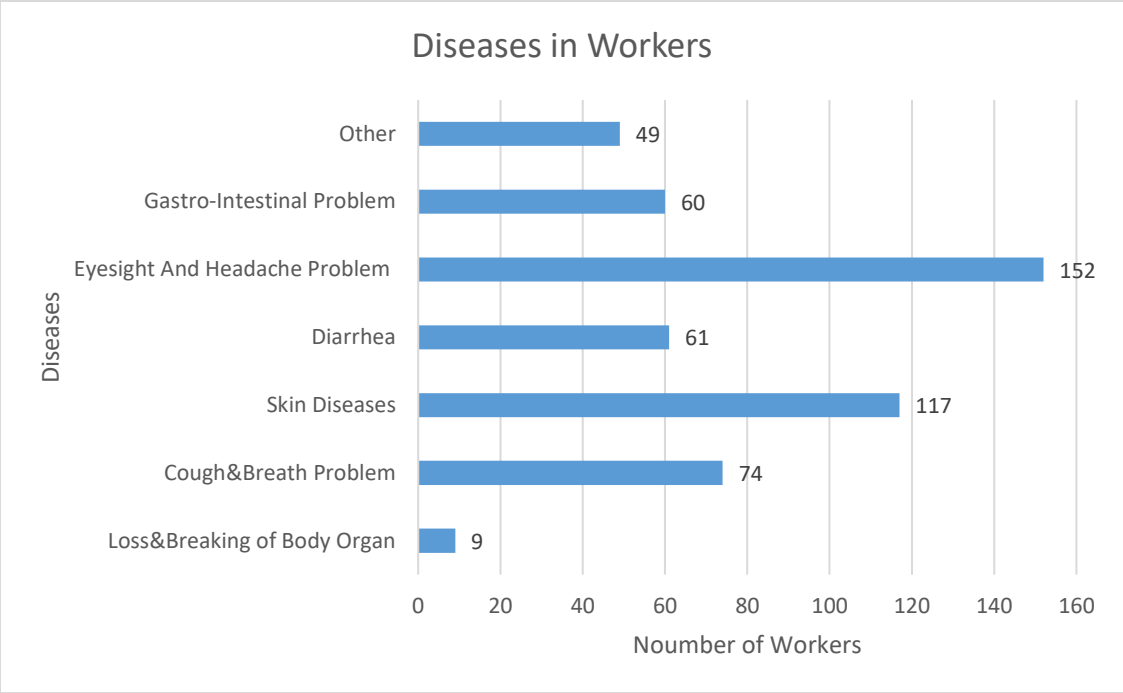


Figure 4.7 shows the data of different diseases in respondents that suffer in the last 8 weeks in the shipbreaking industry. 9 respondents out of 235 have suffered from loss and breaking of body organs due to heavy workload such as loading plates on truck, slipping of wires, slipping of plates, etc. 74 respondents out of 235 was suffered from cough and breathing problem due to continuous working in dusty environment and somehow lack of personal protective equipment. 117 out of 235 have faced different skin diseases like scabies, acne, dermatitis, etc. 61 out of 235 workers have suffered from diarrhea problems because of water pollution. 152 out of 235 labor has faced eyesight and headache problem. Whereas 60 workers out of 235 have faced gastro-intestinal problem. And 49 out 235 has suffered from other types of diseases such as kidney problem, sugar, blood pressure problem, heart problem, body pain, etc. There are many reasons behind these diseases such as a toxic gas explosion, toxic oil, warm condition, polluted environment, emit of spark, fire band, heavy work, work pressure, smoke, dust, sand, noise pollution, air pollution, water pollution, lack of PPE, etc.

Estimation Results and Analysis

This chapter is divided into two sections. Section one discusses the results of water testing from the PERAC Research and Development Foundation laboratory. The second section discusses the results of the impact on health costs.

5.8 Water Quality:

Ship dismantling is a way to fulfill the demand of steel industries, generating employment, earning profit. Shipbreaking is better for the economy but not based on affecting the health of both humans and the environment. There are many safe methods to the dismantling of ships but to get higher profit the owners of ship breaking yard does not follow the regulations and safe methods. In the 1980s Pakistan's shipbreaking industry was leading in the world but due to taxation and many other reasons were overcome by south Asian fellows like India China and Bangladesh. India and Bangladesh are now leading the world in the ship recycling industry. The south Asian countries are on top in the shipbreaking industry on the cost of degrading environment and threat to humans also.

In figure 4.1 (A) showing the red dotted points which are showing the collection of water samples from the study area. The water quality parameters were analyzed by collecting water samples from different sampling locations like seashore in a high tide and second through well water that was away from the beach by 1 and ½ km. Total four samples were collected from which two were from seashore from two different yards and two samples were collected from well water that was ½ km and 1 km away from the seashore.

Table 5.1 is the standard limit values of parameters by Pakistan and WHO. The second table 6.2 shows the results of collected samples from shipbreaking yard Gaddani.

Table 5.1: limits of Parameters and Results of Water Quality

Parameters	**Standards**	**Sea Water (Sample-1)**	**Sea Water (Sample-2)**	**Well Water (Sample-1, After 0.5 km away from Beach)**	**Well Water (Sample-2, After 1 km away from Beach)**
pH Level	6-9	8.11	8.23	7.52	7.41
Biochemical Oxygen Demand (BOD) mg/L	80**	26	18	15	50

Total Dissolved Solids (TDS) mg/l	3500	54400	55000	15200	5900
Turbidity (NTU)	<5 NTU	400	500	2	4
Electrical Conductivity (EC) µs/cm	1500	82000	83300	23200	9300
Dissolved Oxygen (DO) mg/l	5	1.4	2.1	4.0	9.0

The standards values were taken from the Environmental Protection Agency of the Sindh Government (Gagette, 2016)

The above table is showing the standard limits for water quality and results of water quality that were tested in the laboratory. The standard limit of pH level is established by Pakistan is 6.5-8.5, and by WHO its standard limit is the same as Pakistan 6.5-8.5. The standard limits of Biochemical Oxygen Demand (BOD) are 80 mg/l by both Pakistan and WHO standard limit values. The standard limits of total dissolved solids (TDS) are 3500 mg/L is described by both Pakistan and WHO. The standard value of turbidity was set by WHO as less than 5 NTU and it is also still pending to set by Pakistan. The standard limit value of electric conductivity set by WHO is 1500 µs/cm, but Pakistan still did not specify the standard limit of Electric conductivity (EC). The value of the standard limit of dissolved oxygen set by WHO is 5 mg/L but still in Pakistan it will be set.

The water quality around the country is contaminated by many sources such as industrial effluent, agricultural waste, urban areas waste, and others. The pH level is almost similar in different sampling areas and the pH level is under standard limits**.** The value of pH was 8.11 at seawater sample 1 and sample 2 of seawater is 8.23 observed. Well water sample 1 found the pH level at 25 ºC was 7.52 and at sample 2 of well water the ph level was found by 7.41. the biological oxygen demand was found from the samples which were collected from the study area were lying under the standard limits. The BOD is varying from place to place but it is under limits defined by Pakistan and WHO in all samples collected from the seashore and well water. The well water which was away from the seashore by 0.5 km and 1 km, the level of BOD in well water sample 1 was 17 mg/l from the 0.5 km away from the beach but at the distance of 1 km, the BOD was found high from other samples as 50 mg/l. The BOD was found at seawater sample 1 was 26 mg/l, seawater sample 2 by 18 mg/l.

When we look at the results of tested samples of water the TDS is above its standard limits that are set by the Environmental Protection Agency of Pakistan and the World Health Organization. The TDS in seawater sample 1 was 54400 mg/l, seawater sample 2 by 55000 mg/l but in both samples of well water which was away from the beach by 0.5 km and 1 km and the results by laboratory tested and the results show 15200 mg/l at 0.5 km and 5900 mg/l at 1 km, respectively. High TDS can cause stiffness of joints, kidney stones, gallstones, and blockage of arteries, etc.

When we concentrate on turbidity has a range of allowable water quality is <5 NTU by both EPA Pakistan and WHO. Whereas the turbidity of seawater is high than well water. The turbidity was found 400 and 500 in seawater sample 1 and seawater sample 2, respectively. But the turbidity was found low in well water samples by 2 NTU and 4 NTU in well water sample 1 and well water sample 2, respectively. As high turbidity can cause heavy metals in the water supply, it can be harmful for aquatic life by reducing food supply degrading spawning beds, etc. The high turbidity leads to waterborne disease which cause significantly intestinal sickness.

The Electric Conductivity of the collected sample is much higher than who standard value. The EC was lying between seawater samples 1 and 2 by 82000 µs/cm and 83300 µs/cm. the EC in both samples 1 and 2 of well water was found as 23200 µs/cm and 9300 µs/cm, respectively. The overall EC value was high in samples.

The dissolved oxygen is measured from collected water samples from the seashore and away from the beach from the well by ½ and 1 km distance. The DO values were found as 1.4 mg/l and 2.1 mg/l in both samples 1 and 2 of seawater, respectively. The value of DO was found as 4.0 mg/l and 9.0 mg/l in well water samples 1 and 2, respectively. The aquatic life disturb due to low or higher value of DO.

5.9 Health Cost:

Total ten variables are regressed to estimate health cost from which there are some variables from sociodemographic has impact on health cost and others are from health status due to their work in the shipbreaking industry. All the variables are discussed in detail below.

Table 5.2 Results of Health Cost

Variable Type	Variable	Coefficient	t-value	p-value

SOCIO-DEMOGRAPHIC VARIABLES	AGE	-16.94744	-0.78	0.437
	INCOME	.0176917	1.26	0.209
	MARITAL STATUS	1422.602	3.36*	0.001
	EDUCATION	-91.10587	-2.22**	0.027
HEALTH AND INDUSTRY-RELATED VARIABLES	NATURE OF EMPLOYMENT	-4904.504	-2.06**	0.041
	DISEASES	1012.839	2.22*	0.027
	EXPERIENCE	32.43756	1.14	0.256
	WORKINGHOURS	941.4077	1.59	0.113
	SAFETYEQUIPMENT	-735.5085	-1.92	0.057
	DRUGUSE	1856.961	5.77*	0.000

If we look at table 5.9, from socio-demographic variables there are only two significant variables; education and marital status that lie between socio-demographic variables and health cost. Total socio-demographic variables are four of which two are significant. When workers are married then their health cost increase by 1422 PKR because maybe married workers can take good care of diseases with better treatment increases health cost but when the worker is unmarried his health cost decline by 1422 PKR, respectively. Mostly, unmarried do not care of himself as compared to married. As one year of increase in education of worker will decline the health cost y 91 PKR and if the one-year decline in education shows the decline the health cost by 91 PKR.

The remaining two variables have also an effect on health cost like age has a negative relation with a health cost, but it is insignificant it means that the relationship between age and health cost is insignificant. According to The Employment of Children Act 1991 there should not be any under 19 labors in the industry but there were 10 workers were under 19 as it is restricted by the labor law in Pakistan. Another is income which has a direct relation to health cost, but it is insignificant, again there is an insignificant relationship between income and health cost.

In table 6.2, Whereas in health status and industry work-related variables such as Nature of Employment, Diseases, Experience, Working Hours, Safety equipment, Drug Use. Total six variables from health and work in industry-related were regressed, from which only three variables are significant and the remaining three are insignificant. Nature of employment, diseases, and drug use are significant variables. When the working is on permanent based in the industry its health cost will decrease by 4904 PKR, and when the worker is working daily in the industry the cost will increase by 4904 PKR. Because in the shipbreaking industry only permanent workers get insurance from the industry.

Diseases have a positive relationship with health costs, and it is significant. When the worker goes through diseases his health cost also increases by 1012 PKR and vice versa. The third variable is drug use that is highly significant and has a positive relationship with the health cost of workers in the shipbreaking industry. When the worker is using drugs his health cost increases by 1856 PKR in the shipbreaking industry and vice versa. When we discuss experience, it has a positive relationship with a health cost, but the experience is insignificant. And working hours have a positive relationship with health costs but it is also insignificant. The last one is safety equipment has a negative relationship with health costs, but safety equipment is an insignificant variable.

5.10 Summary:

The study contains two aspects one is a water test, and another is a regression model to estimate health cost.

Shipbreaking has negative effects on both environments such as water pollution which affects alternatively to biodiversity, soil pollution which affects mangroves ad humans alternatively and air pollution which affects humans. Shipbreaking also directly affects peoples that are involved in the breaking process through hazardous material that a ship contains with itself when it comes towards the seashore for dismantling. To capture the effect of shipbreaking on the environment and health of workers there were two mains objectives were chosen to fill the gap of research one was to identify the effect on worker's health costs and effects on water quality around the study area.

The effect of shipbreaking on worker's health through making water pollution and directly working in the ship breaking industry affects the worker's health and their health cost. The above

results of water samples and health cost which was collected through questionnaire is summaries below.

The results of collected water samples from two different sources of seawater and well water. Total four locations were chosen from which two samples were collected from different two seashores and two from well water one was 1 km away from the beach and the other was ½ km away respectively. The pH was high in seawater at 8.23 and was low in well water by 7.41 which was 1 km away from the beach. The level of BOD was high at well water by 50 mg/L and seawater has 26 mg/L of BOD level.

TDS was also high in seawater with 55000 mg/L which much higher than the WHO standard. Turbidity was also high in seawater by 500 NTU. Low in well water by 2 NTU which in limits. EC is also high in seawater by 83300 µs/cm. DO was high in well water by 9 mg/L and low in seawater by 1.4 mg/L. the overall concentration of pollution in water was found with high range because of shipbreaking at the Gaddani shipbreaking yard.

The impact of shipbreaking on worker's health costs was estimated of collected the questionnaires through the Ordinary least square method. The results of a health cost analysis of the workers of a selected sample of the shipbreaking industry in table 6.2. The variables are divided into two categories. One is socio-demographic variables, and the other is the health and industry-related variables were included of the ship breaking industry's workers.

Whereas socio-demographic variables are age, income, marital status, and education. On the other side, health and industry-related variables that were experience in the industry, nature of employment either the worker is the daily or permanent base, diseases, safety equipment, and drug use. The different types of diseases were suffered by workers such as loss of body organs, skin diseases (aches, scabies, and dermatitis), eyesight and headache problem, breath and cough problem, diarrhea, gastro-intestinal problem, kidney problem, etc.

In socio-demographic variables, there are only two variables that are significant marital status and education. Whereas marital status has a positive relationship with health cost because the married can take good care of himself as compared to single so the married worker has higher health cost. When we look at education it has a negative relationship with health costs hen 1-year increase in education will decrease the health cost. The remaining two variables age and income are

insignificant. In health and industry-related variables, there are only three variables that are significant nature of employment, diseases, and drug use.

In this study diseases and health, costs are correlated significantly, and also, they have a positive relationship. Nature of employment has a negative relationship with a health cost, where diseases and drug use have a positive relationship with health cost. The remaining three variables are insignificant experience, safety equipment, and working hours. Safety equipment has a negative relationship with health cost it means if the worker uses safety equipment, then his health cost will decrease by 735 PKR, but it is insignificant.

The conclusion of the analysis shows that the workers in the ship-breaking yard are affected from both sides directly through working in the industry and indirectly by water pollution which is polluted by the industry. It can be concluded that the water is polluted by the shipbreaking industry, and it also contributes to the increase of health cost due to both by using polluted water which creates disease to workers and by the shipbreaking which directly create the chance of occurrence of diseases in the workers.

Chapter # 6

Conclusion and Policy Recommendation

6.1 Conclusion:

The study conducted on the environmental side because there was research has been done before, but the environmental aspect was remains specifically water pollution, so it is fulfilled by this study. And the health cost of the workers was not calculated and estimated in this study that is done by in study. The water samples were collected from different yards and two different sources such as well water and seawater and about health-related the questionnaires were collected directly from workers who were currently working at the yards. The sample size was calculated through simple random sampling of Cohen's with a total population of 5000 with 95% confidence interval and the sample came up of 235 for collecting primary data through questionnaire.

In this study, it is revealed that shipbreaking has a direct relationship with water quality that alternatively affect worker's health by the occurrence of different diseases which contribute to increasing of health cost. Because except pH and BOD all other physicochemical parameters such as DO, turbidity, EC have high value also TDS is high in seawater and well water. Turbidity was also high and above the standard limits in seawater samples but was low and within the standard limits in well water samples that were collected from 1 and ½ km away from the beach/seashore. EC was also high and DO was high in one sample of well water which was collected from 1 km away from the beach. Due to shipbreaking in Gaddani through beaching method that pollutes water quality in the area that alternatively affect biodiversity.

Due to ship breaking the workers suffered from different diseases due to their work in the industry. The diseases that prevail in workers are loss and breaking of body organs, cough and breathe problem, skin diseases (Scabies, Dermatitis, and Acne), diarrhea, eyesight, and headache problem, gastrointestinal problem, and other types such as kidney, BP/cholesterol, and Diabetes. This study result revealed that there is negative relation of some variables from the econometric model on the health cost of the workers in the shipbreaking industry Gaddani. Most of the workers are unaware of the exposure to hazardous material by shipbreaking at the study area. There are some variables from socio-demographic which has significance result with a health cost, and some are variables from industry-related variables has significance relation with a health cost.

The worker's health is affected directly by shipbreaking also indirectly through environmental degradation. The shipbreaking industry can be better without affecting the environment and human health by adapting new methods of dismantling which can even be faster for worker's productivity level y doing work in a better environment. Currently, workers were doing work on the beach without any shade or any proper facilitation. The government should focus on this recycling industry that helps in producing steel. This industry also has a role in employment.

6.2 Policy Recommendations:

Environmental Protection Agency, Baluchistan Development Authority, and other Federal and Provincial authorities should take strict steps to make the industry green and sustainable by adapting modern and sustainable as followed in neighboring and developed countries. Following policy recommendations are suggested in order to improve health of workers in shipbreaking yard and minimize their health cost along with improving the quality of water for sustainability of this industry and economy:

- Water quality can be improved by adapting to modern mechanics such as proper treatment of water through treatment plants, induction of filtration plants for drinking water and avoiding spillage of oil and toxic material into sea.
- The polluter pay principal must be applied to generate sense of responsibility. There is a need to formulate new rules and regulations.
- There should be strict restriction on using of drugs for the workers around the yard.
- The yard's owners should provide health insurance to all workers equally to make their health cost low.
- All asbestos containing material should be banned and legislation should be introduced for this purpose which must witness strict implementation.
- The government must adopt environment friendly and technological methods for shipbreaking which enhance the quality of health and environment.
- Government and other stakeholders can place a proper medical center for workers to decrease their health cost.
- Government and Non-governmental organizations can go to shipbreaking yards for spreading awareness among workers and provide proper training for safely breaking of ships and reopen training center for workers.

- Government and stakeholders should use separate area for the shipbreaking activities, such as Dockyard, to mitigate damage to the coastal areas.

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APPENDIX: 1

Results of Water Quality

PRD

PERAC RESEARCH & DEVELOPMENT FOUNDATION

Government of Pakistan, Ministry of Energy, Petroleum Division

TEST REPORT | Page 1 of 4

Customer 's Name	M/s. Danish Bhutto	**Test Report No**	2021000109-001
Customer's Ref	Telephone -	**Reporting Date**	04-08-2020
Date	27-07-2020	**Sample Code**	20000091-01
Sample Description	Sample # 1, (Sea Water)	**Receiving Date**	27-07-2020

TEST METHOD	PARAMETERS	TEST RESULTS
D-1293	pH @ 25 °C	8.11
APHA-507	Biochemical Oxygen Demand (BOD5), mg/L	26
APHA-209B	Total Dissolved Solids (TDS), mg/L	54400
HACH-8237	Turbidity,NTU	400
D-1125	Electrical Cunductivity, µs/cm	82000
D-888	Dissolved Oxygen, mg/L	1.4

Prepared By | **Section Incharge (E)/(HC)/(ST)** | **Head R&ASD**

The analysis based on Sample (s) provided to us by the Client. The interpretation or options expressed represent the best judgment (E. & O.E.). We have no responsibility and warranty or representation in connection with which such report is used.

Rev. No.0 | Dated: 21-01-2000 | F-10-05

7-B, Korangi Industrial Area, Adjacent NRL, Karachi - 74900
Ph: +(92-21) 35121857, 35121805, 35054669-72, Fax: +(92-21) 35054745
Website: www.prdlab.com, Email: info@prdlab.com, prd@cyber.net.pk

PERAC RESEARCH & DEVELOPMENT FOUNDATION

Government of Pakistan, Ministry of Energy, Petroleum Division

TEST REPORT

Customer 's Name	M/s. Danish Bhutto	**Test Report No**	2021000109-002
Customer's Ref	Telephone -	**Reporting Date**	04-08-2020
Date	27-07-2020	**Sample Code**	20000091-02
Sample Description	Sample # 1, (Tube Well Water)	**Receiving Date**	27-07-2020

TEST METHOD	PARAMETERS	TEST RESULTS
D-1293	pH @ 25 °C	7.52
APHA-507	Biochemical Oxygen Demand (BOD5), mg/L	15
APHA-209B	Total Dissolved Solids (TDS), mg/L	15200
HACH-8237	Turbidity,NTU	2
D-1125	Electrical Cunductivity, µs/cm	23200
D-888	Dissolved Oxygen, mg/L	4.0

Prepared By | **Section Incharge (E)/(HC)/(ST)** | **Head R&ASD**

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PRD

PERAC RESEARCH & DEVELOPMENT FOUNDATION

Government of Pakistan, Ministry of Energy, Petroleum Division

TEST REPORT

Customer 's Name	M/s. Danish Bhutto	**Test Report No**	2021000109-003
Customer's Ref	Telephone -	**Reporting Date**	04-08-2020
Date	27-07-2020	**Sample Code**	20000091-03
Sample Description	Sample # 2, (Sea Water)	**Receiving Date**	27-07-2020

TEST METHOD	PARAMETERS	TEST RESULTS
D-1293	pH @ 25 °C	8.23
APHA-507	Biochemical Oxygen Demand (BOD5), mg/L	18
APHA-209B	Total Dissolved Solids (TDS), mg/L	55000
HACH-8237	Turbidity,NTU	500
D-1125	Electrical Cunductivity, µs/cm	83300
D-888	Dissolved Oxygen, mg/L	2.1

Prepared By	Section Incharge (E)/(HC)/(ST)	Head R&ASD

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Government of Pakistan, Ministry of Energy, Petroleum Division

TEST REPORT

Customer 's Name	M/s. Danish Bhutto	**Test Report No**	2021000109-004
Customer's Ref	Telephone -	**Reporting Date**	04-08-2020
Date	27-07-2020	**Sample Code**	20000091-04
Sample Description	Sample # 2, (Tube Well Water)	**Receiving Date**	27-07-2020

TEST METHOD	PARAMETERS	TEST RESULTS
D-1293	pH @ 25 °C	7.41
APHA-507	Biochemical Oxygen Demand (BOD5), mg/L	50
APHA-209B	Total Dissolved Solids (TDS), mg/L	5900
HACH-8237	Turbidity,NTU	4
D-1125	Electrical Cunductivity, µs/cm	9300
D-888	Dissolved Oxygen, mg/L	9.0

Prepared By | **Section Incharge (E)/(HC)/(ST)** | **Head R&ASD**

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APPENDIX: 2

Survey Questionnaire

Impact of Ship Breaking on Worker's Health and Water Quality: A Case Study of Ship Breaking Yard, Gaddani, Pakistan

Dear Respondent,

This survey is conducting as part of M.Phil. Degree at Department of Environmental Economics at PIDE, Islamabad. The following questions are thus purely for academic purposes and mainly concerned with **Impact of Ship Breaking on Worker's Health and Water Quality: A Case Study of Ship Breaking Yard, Gaddani, Pakistan.** This information and the identity of the respondent will be kept confidential. Your cooperation is highly appreciated.

Investigator: Danish (Danishbhutto_18@pide.edu.pk) (03345216005)

Research Supervisor: Dr. Nazia Bibi (Nazia@pide.org.pk) (051-9248038)

Section: 1

Personal Information

Name: _____ Age: _____ Gender: _____

Marital Status: _____ (0 for No, 1 for Yes) Household Size: _____

Family Income: _____ Nature of Employment: A) Daily Basis (0) B) Permanent (1)

Nature of Work: A) Foreman (0) B) Helper (1) C) Welder(2) D) Wireman(3) E) Other _____(4)

Income per day or per month: _____ Daily Working Hours: _____

Education (in Years): _____ Previous Nature of Employment: _____

Work Experience in Ship Breaking (in Years): _____

Section: 2

Impacts on Health.

1) On which yard you are working in Shipbreaking industry Gadani?

Working hours per day_____ Working days per week_____

Wage per 2 weeks (Rs) _____ Income from Other Sources_____

2) Do you use drugs? (0 for No, 1 for Yes) **(If Yes then)**

A) Which type of drug you use_____

B) How much you spent on it per day _____

3) Do you use any **Personal Protective Equipment** during work in Shipbreaking?

A) Boots 1 for Yes / 0 for No
B) Helmet 1 for Yes / 0 for No
C) Goggles 1 for Yes / 0 for No
D) Gloves 1 for Yes / 0 for No
E) Jacket 1 for Yes / 0 for No

4) Any accident occurred within the last 8 weeks in breaking yard? 1 for Yes / 0 for No

(If yes then which type)

A) Gases Explosion B) Snapping Cables / Ropes / Chain / Slings C) Drop of Plates

B) Due to an accident, any injury/death occurred? 1 for Yes / 0 for No (**If Yes then)**

1. How many injured/deaths? _____
2. Any insurance given by company/ Government? _____
3. Which hospital they depart for treatment? _____

5) In last **8 weeks** did you faced any of the following health problems?			Frequency (No: of Times)
	Yes	No	
A) Loss and Breaking of Body Organ (Due to work) B) Cough and Breathe Difficulty Problem (Asthma) C) Skin Disease (Scabies, Dermatitis, fungal, Acne) D) Diarrhea (motions) E) Eyesight and Headache F) Gastrointestinal Problem (Stomach problem) G) Other			

6) Do you have currently any illness from above? 1 for Yes / 0 for No (If Yes Then)

A) Do you go to doctor for checkup?

7) Do you have any family history for any disease mentioned above? _____

8) Mostly where you go for checkup?
A) Private Health Center (0) B) Governmental Health Center (1) C) Other (2)

9) Who supply food while working in the yard?
A) Household (0) B) Locally Purchased (1) C) Canteen of Yard (2)

10) Which source of water used for cooking?
A) Filter water (0) B) Pond water (1) C) Tube well (2) D) Other (3)

11) What are the sources of drinking water?
A) Filter water (0) B) Pond water (1) C) Tube well (2) D) Other (3)

12) What is the quality of water?
A) Good (0) B) Bad (1) C) Other (2)

Section: 3

Health Cost

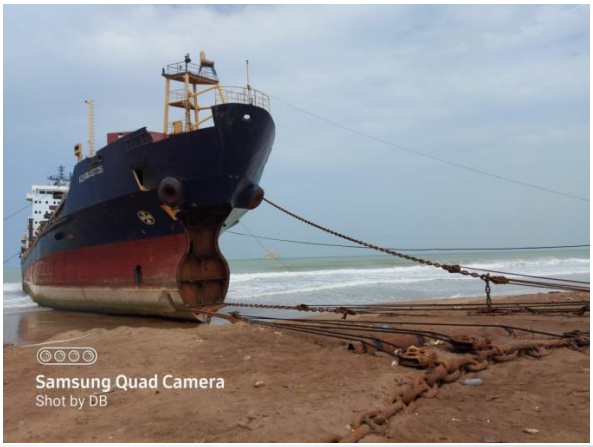
13) Direct and indirect costs on each disease within last **8 weeks**?

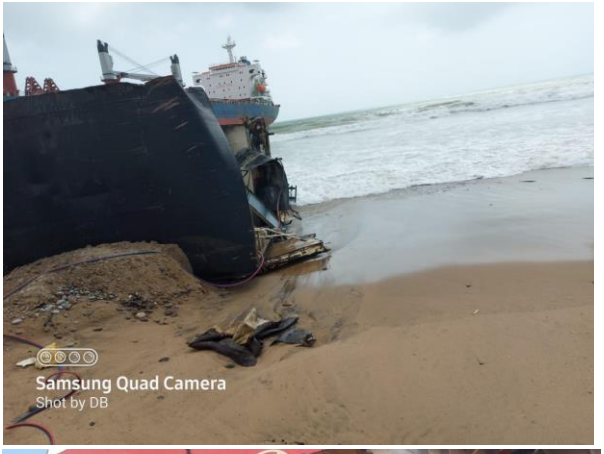
Disease and its Cost	Loss and Breaking of Body Organ	Eyesight and Breathe Difficulty Problem	Skin Disease	Diarrhea	Cough and Headache	Gastrointestinal Problem	Others
Frequency of Illness (No of Times)							
Diagnostic Test Cost in							
Its Frequency							
Doctor Fee							

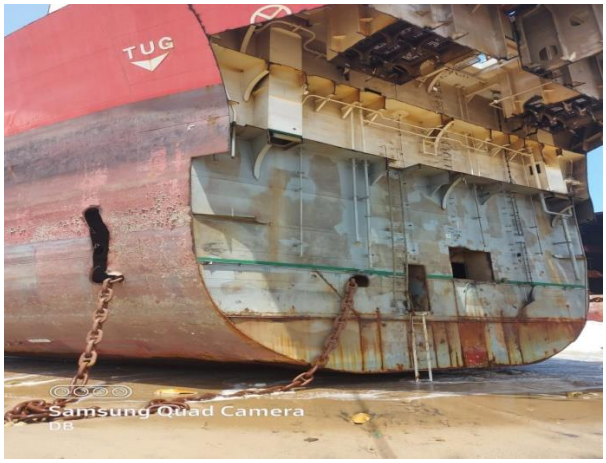
No: of Visit							
Cost of Hospitalization, **Accommodation**							
Its Frequency							
Cost of Medicine							
Food Cost							
Travel Cost							
Other Cost Like **Protective Measure.**							
Total Cost							
No of Workdays Off.							

APPENDIX: 3

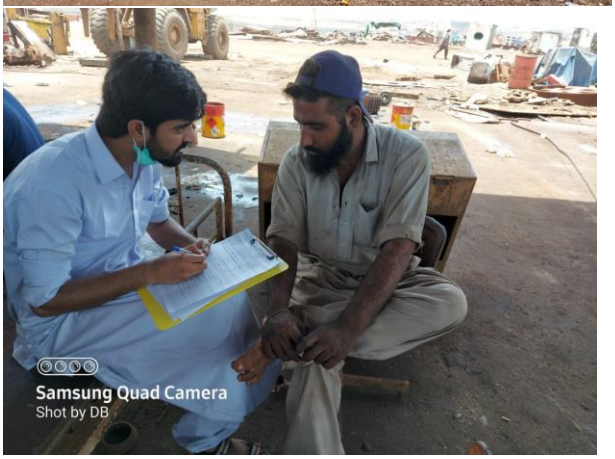
Picture of Survey








Samsung Quad Camera
DB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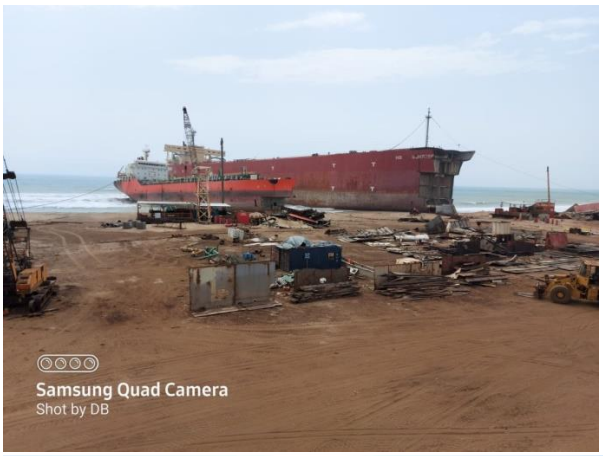
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