Environmental Degradation and its Impact on Fish Handler's Health: A Case Study of Karachi Fish Harbour

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CERTIFICATE

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Abbreviations

EU	European Union
US	United States
GDP	Gross Domestic Production
MGD	Million Gallons Daily
STP/TP	Sewerage Treatment Plant/Treatment Plant
LMICs	Low and Medium Income Countries
SIDS	Small Island Developing States
FAO	Food and Agriculture Organization
FAOUN	Food and Agriculture Organization for United Nation
EEZ	Exclusive Economic Zone
WWF	World Wildlife Fund
TDAP	Trade Development Authority Pakistan
SEPA	Sindh Environmental Protection Agency
KW&SB	Karachi Water & Sewerage Board
KPT	Karachi Port Trust
ISO	International Standards Organization
CBFM	Community Base Fisheries Management
OECD	Organization for Economic Co-operation and Development
SITE	Sindh Industrial Trading Estates
UC	Union Council
CETP	Combined Effluent Treatment Plant
KMC	Karachi Metropolitan Corporation
DMCs	District Municipal Corporations
SSWMA	Sindh Solid Waste Management Authority
SSWMB	Sindh Solid Waste Management Board
KDA	Karachi Development Authority
SBCA	Sindh Building Control Authority
CDGK	City District Government Karachi
GTS	Garbage Transfer Station
MPCD	Marine Pollution Control Department
NEQS	National Environmental Quality Standards
KATI	Korangi Association of Trade and Industry

NM	Nautical Miles
IDCS	Indus Delta Creek System
PQ	Port Qasim
KANUPP	Karachi Nuclear Power Plant
KFHA	Karachi Fisheries Harbor Authority
MFD	Marine Fisheries Department
FCS	Fishermen Cooperative Society
OLS	Ordinary Least Square
CVD	Cardiovascular Disease
Cu	Copper
Ni	Nickel
Fe	Iron
Zn	Zinc
Mn	Manganese
BDL	Below Detection Limit

Parameters

Ppm	Parts per million
BOD	Biochemical Oxygen Demand
pH	Potential of Hydrogen
TS	Total Suspension
TSS	Total Suspended Solid
TDS	Total Dissolved Solid
COD	Chemical Oxygen Demand

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Abstract

The fishing industry is one of the consistently growing sectors in Pakistan's economy. In 2018 it was grown 16.32 per cent and contributed 1.97 per cent in Pakistan's GDP. But its growth is related to an increase in domestic demand, not because of exports. European Union had denied importing Pakistani seafood because of the declining marine environment which is not meeting their environmental quality standards. Multiple public sector departments are assigned to maintain the environmental quality standards in which Sindh Environmental Protection Agency, Karachi water and sewerage board, Karachi municipal corporation and Sindh solid waste management board are prominent but all of them are failed to perform their job. After the study, it is concluded that due to political appointments, lack of interest in a job, public sector lazy culture and unclear legislative authority made the issue more complicated and all of them playing a blame game. Wastewater quality analysis data was added in the study and most of the parameters are above national environmental quality standards but below threshold levels, because none of the sewerage water treatment plants is working. Health cost of the fish handlers are measured with the comparison of hand cart loaders of Karachi wholesale market and OLS regression model is used to estimate the results and found that health of fish handlers is higher than comparison group due to lack of education, low wages and wet working conditions. No government support or any health care facility is available for the fishing community and failure from the environment protection departments their health and life are not meeting the standards.

Keywords: Environmental Degradation, Waste Water, Health Cost, Fishery

Jel Classification: I10,Q5,Q53,Q22

CHAPTER I

INTRODUCTION

This chapter highlights the contribution and importance of fish and fish products in human life by defining the historical background and current global situation and the domestic importance of fishing sector also discussed. It is not just introducing the fish as a food but also a financial contribution to the world economy as well as domestic.

1.1 Historical Background

Fishing is a prehistoric practise dating back at least 40,000 years (documented) but in actual fishing is in practice is old as humans exist. We can find its traces in Egyptian civilization as well as in Mesopotamian civilization dating back 3500BC, which is oldest among all (Adhikari, 2014). From the beginning of the 16th century, fishing practices increased across the oceans, due to advancement in vessel making and catching gears. From the beginning of the 19th century, it is been possible to use large vessels which can process the fish on board and it was a time when fishing became an industry (Wikipedia, 2019)

Fish contributes a major part as world food consumption and play a vital role in nutrients intake because it is most nutrient-dense animal-source food among all meat). Quantity of fish produced was twice that of poultry and thrice that of cattle (Christophe, et al., 2016).

1.2 Current Global Situation

Fish and fish products provide primary nutrition for more than one billion people and their increasing impressively (World Bank, 2011). annual approximate increase in universal fish production and consumption between 1961 and 2016 increased by 3.2 per cent, double than population growth which is 1.6 per cent and 2.8 per cent more than of meat from all consumable animals combined (FAOUN, 2018) If we talk about individual annual consumption of fish and fish products, then it grew from 9.0 kg in 1961 to 20.2 kg in 2015, which is an average increase

of 1.5 percent annual and estimated that in 2016 and 2017 it would grow more to 20.3 and 20.5 kg per capita/year respectively (Garibaldi & Simon, 2018).

World total capture fisheries production was 90.9 million tonnes in 2016 from which marine catch was 79.3 million which is slightly less than 2015 which is 81.2 million and 11.6 million tonnes were inland captured. Total aquaculture (Inland and Marine) in 2016 was 80 million tonnes and made World fisheries and aquaculture production maximized to 171 million tons in 2016. Overall human consumption of fish is 151.2 million tonnes and it is increasing consecutively ever year so the per capita consumption was increased from 20.2 kg to 20.3 kg but the secondary uses of fish were declined as compared to 2015 from 20.3 million tonnes to 19.7 million tonnes(Table 1.1) *(*FAOUN, *2018).*

Table 1.1: World fisheries and aquaculture production and utilization (million tonnes).

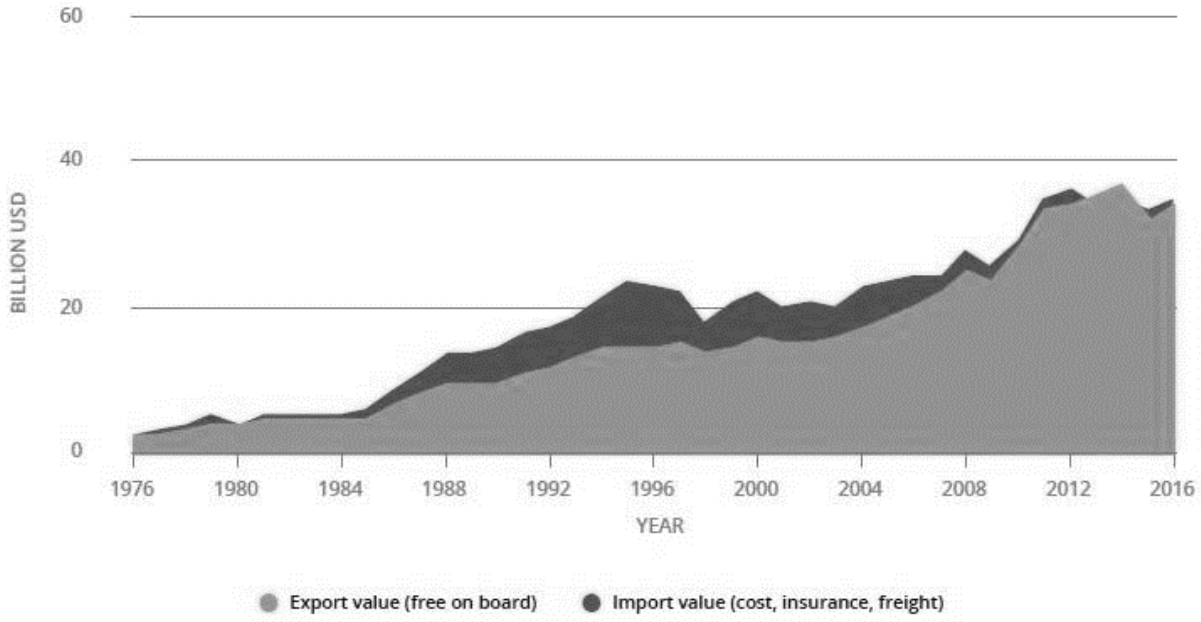
Category	2011	2012	2013	2014	2015	2016
Production						
Capture						
Inland	10.7	11.2	11.2	11.3	11.4	11.6
Marine	81.5	78.4	79.4	79.9	81.2	79.3
Total Capture	**92.2**	**89.5**	**90.6**	**91.2**	**92.7**	**90.9**
Aquaculture						
Inland	38.6	42.0	44.8	46.9	48.6	51.4
Marine	23.2	24.4	25.4	26.8	27.5	28.7
Total aquaculture	61.8	66.4	70.2	73.7	76.1	80.0
Total world fisheries and aquaculture	154.0	156.0	160.7	164.9	168.7	170.9
Utilization [b]						
Human Consumption	130.0	136.4	140.1	144.8	148.4	151.2
Non-food uses	24.0	19.6	20.6	20.0	20.3	19.7
Population *(billions)*[c]	7.0	7.1	7.2	7.3	7.3	7.4
Per capita apparent consumption (kg)	18.5	19.2	19.5	19.9	20.2	20.3

[a] Excludes aquatic mammals, crocodiles, alligators and caimans, seaweeds and other aquatic plants.
[b] Utilization data for 2014—2016 are provisional estimates.
[c] Source of population figures: UN, 2015e.

Fish and fish products are one of the most trending food items in the world. In 2016 35 per cent of the total fish production contribute in the world trade. Around 59 million tonnes of total fish and fish products were exported which costs approximately US$ 143 billion with the annual growth rate of 4 per cent in real terms. Developing countries contribute a majority share in fish and fish product's trade and approximately 54 per cent of total trade had been done from developing countries in terms of value and 5 per cent in term of quantity. China is the largest

producer as well as exporter of the fish and fish products since 2002, although fisheries sector represents only one per cent of its total export market (Figure 1.1) (FAOUN, 2018)

Figure 1.1: Net trade deficit or surplus (Asia excluding China)



Since 1980s aquaculture production is growing impressively and somehow meeting the fish demand and its increasing demand makes it most widely traded food in the world; nearly 40 per cent (by volume) of world fish production is traded internationally and it also exceeds among all type of meats in consumption as well as trade (Garibaldi & Simon, 2018). Low and medium-income countries (LMICs) (mostly Asian countries) play a major role as they supply 50% of all fish exports by value and more than 60% by quantity (World Bank, 2011). In general, fish production contributes 0.5-2.5% of global GDP, but in countries like Mauritania and Vietnam, the contribution is 10% or more (Allison, 2011), and in some Pacific Island states share to GDP ratio goes up to 25% (Robert & Chris, 2002). Approximately 2 billion people in third world countries rely on fisheries for living. Besides, fish accounted for 20 per cent per capita protein intake for 3.2 billion people. People in developing countries have a higher share of fish Protein

in their food than those in developed countries. Maximum individual fish consumption is more than 50 kg annually is found In several small islands developing states (SIDS), while the lowest level is about 2 kg, are in Central Asian landlocked countries (Garibaldi & Simon, 2018).

As per 2016 statistics 59.6 million people were employed in the primary fishing sector, from which 19.3 million people were related to aquaculture and remaining were in fisheries. The proportion of employment in those sectors were decreased from 83 percent in 1990 to 68% in 2016, while increase in employment in aquaculture is from 17 to 32 percent. From the total population engaged in with fisheries sector 85 percent was from Asia and remaining is from rest of the world (Table 1.2) (FAOUN, 2018)

Table 1.2: World Employment for Fishers by Region (Thousands)

Region	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Fisheries and aquaculture										
Africa	2392	4175	4430	5027	5250	5885	6009	5674	5992	5671
Asia	31296	39646	43926	49345	48926	49040	47662	47730	50606	50468
Europe	530	779	705	662	656	647	240	394	455	445
Latin America and the Caribbean	1503	1774	1907	2185	2231	2251	2433	2444	2482	2466
North America	382	346	329	324	324	323	325	325	220	218
Oceania	121	126	122	124	128	127	47	46	343	342
Total	**36223**	**46845**	**51418**	**57667**	**57514**	**58272**	**56716**	**56612**	**60098**	**59609**
Fisheries										
Africa	2327	4084	4290	4796	4993	5587	5742	5413	5687	5367
Asia	23534	27435	29296	31430	29923	30865	29574	30190	32078	31990
Europe	474	676	614	560	553	544	163	328	367	354
Latin America and the Caribbean	1348	1560	1668	1937	1966	1982	2085	2092	2104	2085
North America	376	340	319	315	315	314	316	316	211	209
Oceania	117	121	117	119	122	121	42	40	334	334
Total Fishers	**28176**	**34216**	**36304**	**39157**	**37872**	**39411**	**37922**	**38379**	**40781**	**40339**
Aquaculture										
Africa	65	91	140	231	257	298	267	261	305	304
Asia	7762	12211	14630	17915	18373	18175	18088	17540	18528	18478
Europe	56	103	91	102	103	103	77	66	88	91
Latin America and the Caribbean	155	214	239	248	265	269	348	352	378	381
North America	6	6	10	9	9	9	9	9	9	9
Oceania	4	5	5	5	6	6	5	6	9	8
Total fish farmers	**8049**	**12632**	**15115**	**18512**	**19015**	**18861**	**18794**	**18235**	**19316**	**19271**

Asia was the highest consumer of fish with 106 million tonnes at 24.0 kg per capita (two-third of total fish consumed in the world). Oceania is the lowest in fish consumption. Variation in the structural changes in the fish consumption is because of the growing market (Production and Consumption) in the Asian countries with high capture and production cost of consumption got low, but it is not an only reason behind it, in Europe and America trend is changed and per capita purchasing power is increased in last decade so they got more choices. Japan consumption is also getting the change they are also shifting towards other meat products. In developed countries share of fish consumption in 1961 is 12.1 per cent which peaked to 13.9 per cent in 1989, but decreased to 11.4 per cent in 2015, in the same time consumption of other meat protein had been increased (Table 1.3) *(FAOUN, 2018)***.**

Table 1.3: **Total and Per Capita Apparent Fish Consumption by Region and Economic Grouping, 2015**

Region/economic grouping	**Total food fish consumption** (million tonnes live weight equivalent)	**Per capita food fish consumption** (kg/year)
World	148.8	20.2
World (excluding China)	92.9	15.5
Africa	11.7	9.9
North America	7.7	21.6
Latin America and the Caribbean	6.2	9.8
Asia	105.6	24.0
Europe	16.6	22.5
Oceania	1.0	25.0
Developed countries	31.4	24.9
Least-developed countries	12.0	12.6
Other developing countries	105.4	20.5
Low-income food-deficit countries	20.8	7.7

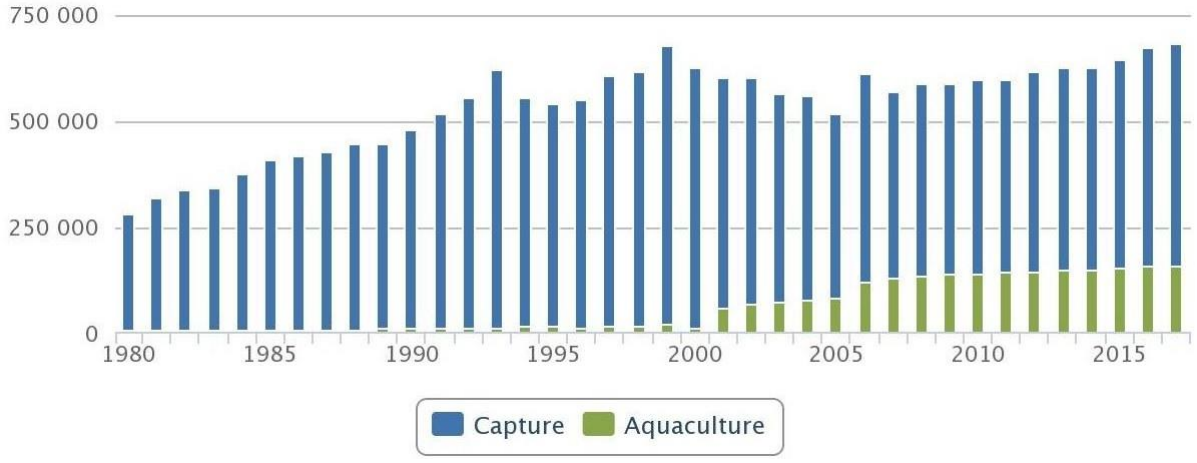
1.3 Fisheries in Pakistan.

The coastline of Pakistan is extending from Iran to India which is 1050 Km with an EEZ and 50,270 Km^2 continental shelves. 30 per cent of the maritime zone of Pakistan is a land area which is very rich with mineral resources, fish and fish products (WWF Pakistan, 2004). In Pakistan, marine fisheries are being executed in two different areas i.e. coastline of Gwadar, Makran (Balochistan) and Karachi coast (Sindh). Karachi and Makran are the most important fishing ports ever being developed by the Government of Pakistan for the fishing purpose. Fisheries play

a crucial role in the national economy. Marine fisheries share about 359,534 tons in 2015 which is approx. 56 per cent of total fish production. Fish and fish products were valued at US$ 266 million in 2010 which was around 1.2 per cent of total exports of Pakistan. In 2011 fish exports were at the highest level with the growth rate of 16 per cent in terms of value and 6 per cent in quantity as compared to the same period in 2010 (FAO, 2017).

The fishing industry in Pakistan is based on the primary capture since the beginning and one of the growing sectors consistently, it is not because of the development and technological improvement but it is because of increasing domestic demand with the increasing population. Fish is also less expensive and considered as much fresh among other meat intakes in Pakistan. Aquaculture started contribution since 1990 but it was boosted after 2001 and since then it shares more than previous. Pakistan's fish production peaked in 2017 which is 67.94 thousand tonnes from which 52.19 thousand tonnes are captured and 15.74 thousand tonnes came from aquaculture before that it was peaked in 1999 which is 67.76 thousand tonnes from which 65.45 are captured fish and remaining 23.0 thousand tonnes are produced from aquaculture (Figure 1.2) (FAO, 2018)

Figure 1. 2: Total capture and aquaculture production for the Islamic Republic of Pakistan (tons)



Fish and fish products are one of the major exports of Pakistan. It is one of the few sectors of Pakistan with the growth rate and it has grown 16.32% in 2018 and contributes 1.97% in Pakistan's total exports in 2018which valued US$ 423,977 million (TDAP, 2018). The WWF official said tuna, kingfish, and billfish are transported to Iran through Gwadar and as such these exports are not reflected in Pakistani export figures. If the trade of tuna and other species which is sent to Iran is done through the legal export channel, Pakistan's seafood exports would have crossed $500m The US also ban imports of shrimp from Pakistan in 2016-17 which affects its exports. If these issues can be resolved, then our exports can be much higher (Khan A. S., 2017).

1.4 Marine Pollution at Karachi Coastline.

Marine pollution is defined as discharge of substances to the marine environment resulting in adverse effects such as hazards of human health, obstruction in marine activities, marine water and coastal land zones (Wilhelmsson & Eriksson-Hägg, 2018). Unfortunately; the only disposing source to Karachi is sea, and every gallon of wastewater either it is municipal waste or industrial waste will end in open sea which is gifted to Pakistan from nature. The 30 km of Karachi coastal water receives a heavy pollution load of both domestic and industrial origin. The industrial and municipal sewer discharge around 500 MGDs. About 25% sewer discharge generated by municipal sewer and remaining generated from industries. About 26.5% effluent reaches the coastal waters through Gizri-Korangi creeks via Malir River and about 73.5% reaches through Karachi harbour via Lyari River (SEPA, 2017).

With around 22 million people, Karachi produces up to 12000 tons of solid waste every day, almost all of it ends up in the sea. Dumping of garbage and pouring sewerage water into the sea has badly affect fish count nearby harbour. There are six industrial zones in Karachi with around 10,000 industrial units that manufacture everything from textiles to chemicals and paints. The authorities admit that solid waste and toxic industrial effluents are dumped into the sea untreated.

Authorities estimate that Karachi produces around 500 million gallons per day (MGD) of wastewater. Around one-fifth of water comes from industries while the rest is the domestic or municipal sewerage and entire sewerage and industrial water goes into the sea without treatment which may lead to a natural disaster. According to data collected by the Sindh Environmental Protection Agency (SEPA), there is also the waste from, the local cattle colony, which houses around a million animals & waste produced by them is also dumped in the sea (Guriro, 2016).

Sindh Environment Protection Agency (SEPA) and Karachi Water & Sewerage Board (KW&SB) are the key authorities &responsible for the release of untreated effluent into the marine water. Additionally, Karachi Port Trust (KPT) is also responsible for marine pollution because most of the operations and activities along the coastal line are operated by KPT.

Oil spill from the ship in the vicinity are common, and the Tasman spirit oil in 2003 was one of the world's worst, it was carrying 67500 tons of crude oil broke near the Karachi port killing thousands of fish and birds in the area. The impact of the spill remains. Ecologists and Environmentalists are worried about the increasing marine pollution. Along the Karachi coast, locals sometimes find corpses of endangered green turtle which died due to throwing plastic waste into the sea (Guriro, 2016).

Aqua ecological pollution nearby the coast and jetty is not just affecting the aquatic species but also affect the health of the people which lives nearby and deal with the fishes at harbour every day, because dumped waste and toxin water are dangerous for health. This study mainly focuses on the health of those people who work (labour) on the Karachi fish harbour and deal with it daily and how much they bear to fight with the health issues. If these issues of health cross the limit, then it might possible that they will not promote their profession and expertise to the next generation and it costs a lot to a nation in terms of trade.

1.5 Significance of The Study

A study focuses on multiple dimensions, to understand the waste management of Karachi and highlight the reasons which are hurdle to deal with it, further relative health cost is measured for fishing community specifically fish handlers because they are most effected from the city's solid and water waste. This study can be beneficial for those authorities which are engaged with waste management in Karachi and also helpful in policy making related to health in fishing community of Karachi.it will also contribute in literature for future studies.

1.6 Objectives

The overall objective of the study is to estimate the health of fish handler due to ecological indignity at Karachi Fish Harbor. Specific objectives of the research are as follow:

a) To know the status of the fishing industry in Pakistan.

b) To analyze the environmental condition of Karachi fish harbour.

c) To analyze the health status of the fish handler at Karachi fish harbour and to estimate their health cost.

1.7 Research Questions

Following are the research questions of the study:

a) Does ecological indignity at harbour affect the fish catch nearby Karachi fish harbour?

b) Does environmental degradation affect the health of fish handler at Karachi fish harbour?

c) Does fish handler's health cost is higher than the comparison group?

1.8 Organization of the Thesis

In the beginning chapter historical background, global and domestic statistics and environmental status at Karachi coastal lines are described, a further objective of the study and research questions are mentioned. In Chapter II literature review has been done which is related to environmental condition, health issues and at the health cost estimation techniques has been

reviewed. Qualitative analysis on marine pollution at Karachi fish Harbor and authorities responsible for it and their duties are detailed discussed in Chapter III. Chapter IV covers the data collection technique for methods to achieve one of the objectives of the study which is the health cost of fish handlers. Descriptive and estimation results are mentioned in Chapter V and the last Chapter summary of the study, conclusion and policy recommendations has been made.

CHAPTER II

Literature Review

This chapter is divided into three sections which cover thematic literature review on the previous work done on 1) Environmental condition of Karachi fish harbour 2) Health issues and diseases in fishing communities 3) Health Cost Estimation Techniques and issues respectively.

2.1 Environmental Condition of Karachi Fish Harbour

Pakistan had a marine area of 240,000 km (sq.) which was extended in 2015 and Pakistan become the first country in North Indian Ocean whose extension of continental shelf has been approved by UN, and Pakistan has an additional 50,000 km (sq.) seabed territory (Sajjad, 2015). Pakistan is not only become a more resource-rich country, but its responsibilities are also increased regarding sustainable marine ecology and environmental issues related to pollution. Study reveals that pollution of the most populated city of Pakistan generates approximately 295 MGD of household sewerage and 111MGD of hazardous industrial wastewater which is direct reaches to coastal water without any treatment or partial treatment enters through Karachi Harbor via Lyari River. Another issue was discussed in the same study which is neglected before this, and that is heavy maritime shipping traffic, due to shipping traffic many boats and ships bilge cleanings at harbour and adjacent areas, from bilge, trawlers, industrial waste and other source estimated 15 to 20 thousand tons of oil was released per year into Karachi harbour and adjacent waters due to which total anoxic situation with no oxygen value was found at Lyari river mouth. Water samples were collected from different points of Karachi Fish harbor and adjoining areas to analyze the prints of oil and grease in water and found that the highest level of oil and grease at Manora channel adjacent to Karachi Fish Harbor which is 49.9 mg/l, which indicates that Karachi Fish Harbor s highly polluted with respect to oil pollution (Adel, et al., 2009).

Another study conducted by World Wide Fund (WWF) to investigate the heavy metal pollution at five major coastal sites of Pakistan, in which Gwadar, Karachi harbour, Buleji, and two creeks of Karachi was compared, study was investigated about the five hazardous metals (Zinc, Copper, Cadmium, Chromium, and nickel) which are dangerous for marine ecology and also for humans by consuming fish products. Study deeply examines and further concluded that Karachi Harbor is most polluted area among all sites, the concentration level of Nickel, Zinc, Copper, cadmium and Chromium are 46 ppm, 192.7 ppm, 89 ppm, 1.12 ppm and 94.25 respectively. The study also examines the fishes and mussels to get the effects to metals on aquatic life and samples was collected from Gwadar, Karachi Harbor and Korangi creek's results revealed that the highest concentration of zinc was at Karachi Harbor, the highest level of zinc was also found in sediments of Karachi Harbor. Cadmium is the most poisonous element after mercury for Aquatic life as well as for humans; this poison is also led at Karachi harbour and was found 0.6 ppm in a fresh fish of Karachi Harbor, in the same manner, all other metals are at the highest level at Karachi Harbor (Saleem, 2002).

Study on Turkey's Green port project indicates that Green Port/Eco port has extraordinary benefits for marine ecology as well as for nation's economy because many EU countries restricted there trade with those countries which are following the ISO standards and international environmental standards (Akgul, 2017). Study on biomarkers of fish health in ports was carried out at two Australian ports nearby and comparison was made with the remote area to check the Immune characteristics between the fish at port premises and distance area. By examining the samples study for 8 kind of metals and 15 organophosphate compounds and 19 organochlorine compounds and found that both types of compounds and metals were found in all kind of species but under a standard limits, study also said that results are slightly higher in port areas as compare to remote area, author(s) itself made an argument regarding study that a sample size is very

minimum and it is also not sure that fish is existed at remote area or recently travelled between port and remote area (Gagnon & Rawson, 2016).

Many studies were conducted on the environmental condition of port and harbour and almost all studies prove that harbour which is adjoined with ports are much ecologically disturbed and polluted by externalities like oil, grease, industrial as well as sewerage waste, many recommendation and suggestion were discussed like regular check and balance of heavy metals at Karachi harbour, national environmental quality standards for water should be implemented, upgrade the sewage treatment capacity at coastal areas to deal with sewage as well as industrial waste (Saleem, 2002). Other recommendations were also made regarding management side to make strategies to protect and restore environment: introduce community-based fisheries management (CBFM) also emphasize on the fishing rights, Another strategy was introduced by OECD is "Polluter Pays" which was adopted by European Commission in 1987 and promoted in Rio Declaration in 1992, by this way those fishermen who are using old machinery or prohibited nets will pay fines so they will be forced to upgrade their equipment and avoid banned nets. Many other strategies and recommendations are proposed in the reviewed studies like to adopt fisheries-related environmental issues based on participatory decision-making, enforcement and further review and revision of existing laws etc. However, competency, political will and law enforcement are fundamental requirements for the improvement in aquatic environmental issues.

2.2 Health Issues and Diseases in Fishing Communities

Research and development into different health concerns in fishing communities have recently become an area of focus in developed countries and still neglected in 3rd world countries. Fishery policies have always struggled to incorporated social objectives, such as health. Most studies focused on fishers themselves, as opposed to other subgroups within fishing communities (Woodhead, et al., 2018). Fish grown in fertilized or wastewater may be contaminated with pathogens. Transgenic fish is hazardous because of their potential allergenicity and toxicity.

Awareness of the health hazards involved in the handling of industrial fish is important. In the United States fish-related illness are mostly associated with mild gastroenteritis or localized skin infections, but sometimes more serious resulting in amputations or death. The high risk in aquaculture, however, comes from closed-loop, indoor, canal base drinking water supply system. During past 15 years, the number of dinoflagellates blooms (toxic to fish) has increased, perhaps due to trends in warming water and stillness of coastal waters as well as an increased influence from the growing numbers of people now living in the coastal areas. There is a different kind of blooms but Pfiesteria piscicida is associated with human exposure. the impact of this dinoflagellates bloom has gained attention when symptoms of eye irritation, respiratory problems, weakness, joint pain, nausea, abdominal pain, skin lesions, paresthesia, headache, myalgia, vomiting, asymmetrical excessive perspiration, decrease of speech fluency with hesitation in word choice, emotional changes and memory loss has been found in the living societies at Atlantic coast (Durborow, 1999). Some of the studies also have been done on the health issues related specifically to fish handlers; fish handler's disease is a disease or syndrome of humans that may occur after handling fish or activities that can create cuts and scrapes in the skin, where bacteria may enter. It occurs when cuts or scrapes in the skin become infected with the bacteria *"Erysipelothrix rhusiopathiae and Mycobacterium marinum. E. rhusiopathiae"* most commonly causes erysipeloid localized cellulite usually found on the fingers or hands of a patient, fever and arthralgia are also some outcomes in fish handling. Most of the fish handler's disease is cured by medical treatments like antibiotics and penicillin shots in case of severe infections removal of infected tissues through surgery can also be done, average time of the treatment in these kinds of disease may vary from two to 18 months (Adityanti dan, et al., 2010). Transfer of bacterial infection or bloom from any animal or aquatic species to human is known as zoonosis effect and there are many bacterial infections which are dangerous for humans, zoonotic infections which can damage humans are Vibrio vulnficus, Edwardsiella tarda, Streptococcus

iniae and Mycobacterium. these infections are not hazardous for humans only but they can also become a reason for economic loss for many countries, because these infections can damage so critical not only physically but also psychologically and best way to prevent from these infections are to use protective equipment when human has to come in contact with fish or any other aquatic species (Haenen, Evans, & Berthe, 2013).

Major issue with the health in fishing communities is that their health activities and not properly recorded even under-reported so that is why most of the policies were made on the basis of partially available data which is not affected most of the time, another issue, especially in the developing countries, is education in the fishing communities, due to low education they will not understand the long term consequences of these health hazards.

2.3 Health Cost Estimation Techniques and Issues

Medical care cost accounts for nearly 18% of Gross Domestic Product (GDP) and 20% of government spending globally. Health accounting is not easy, statistical Agencies have struggled with it for decades. Specifically, two types of issues that arise, which are, difficulties in valuing non-market activity and second issue deal with how to decompose the growth in that value into price and volume measures (Aizcorbe, et al., 2018). There is no universal, standardized, and valid instrument to use in all economic evaluations in mental healthcare and health settings. Health systems and instruments for identifying economic data are heterogeneous, hindering the comparability of costs among services. Questionnaires for measuring health services use and costs rely on patient self-report, allowing several biases and methodological challenges to their validity. Cognitive impairment, memory recall bias, mode of interviewing, type of psychiatric diagnosis, and social desirability are common biases affecting cost estimates. Despite limitations, people with mental disorders can answer self-report questionnaires on mental health services use in specific circumstances. Multiple sources of information are recommended (Sousa, et al., 2017). A questionnaire-based cross-sectional study was conducted in Ghana in which data were obtained

from 116 persons working in the fish value chain in Accra region and the aim was to check the bacteria zoonosis among them and descriptive statistics were enough to show the picture of the whole situation (Doe, et al., 2017). Another study like above mentioned was conducted at Alexandria City, Egypt; the sample was collected from 124 fishermen and the control group. Author(s) put special concentration on data collection process and follow the standards of Questionnaire makings, like; sampling techniques, exclusion criteria, sample selection criteria, Data collection method includes personal and socio-demographic data – occupational history – past and family history – Nordic Musculoskeletal Questionnaire – questions about stress proposed by British Stress Management Association – questions about different types of accidents – inquiry about auditory complaints by using audiometric questionnaire proposed by Oregon State University Environmental Health and Safety Department and complains from sunburn and its degree was included in questionnaire (El-Saadawy, et al., 2014).

Research work on fishermen has been done extensively as they were considered as a doorkeeper on oceans, but the fish handlers are highly neglected and there are many issues related to health which are mostly found in handling of fish not in catching of it and by the time these bacterial diseases grow among them and in some parts of the world they become a part of their immune system. Industrialization and modernization also play its role to pollute oceans especially harbours, increasing consumption of water increases the pollution in sea waters and effecting Aqua species and further humans by bacteria zoonosis, these bacterial infections cost them in terms of monetary, disability and also death in some cases, some studies also have shown that how these infectious fish products become a source in decline in economy. There are many issues to measure a health cost because in almost all welfare countries it is pure public good but increasing health issues also increase a cost and it is reflected in the economic balance sheet. My aim is to find the health cost of Fish handlers which are working on the Karachi fish harbour and adjacent fish market because no study was found on the fish handler's health in case of Pakistan,

Increasing efficiency of fish handlers may increase the production process and effects on domestic production as well as help in increase in exports.

CHAPTER III

Marine Pollution &Environmental Status of Karachi Coastline & Fish Harbor

In chapter III; Qualitative analysis has been made about the environmental status of Karachi and authorities responsible to maintain the environment of the city. An analysis is based on the information given by key informants during interviews and also from available reports, publications and news articles.

3.1 AN OVERVIEW

Information arranged by Dr Monawar Saleem, National Institute of Oceanography on the existing state of Sea waters of Karachi, which uncovers the reality of six (06) manufacturing zones involving six thousand manufacturing units are in Karachi. These are Sindh Industrial Trading Estate (SITE), Landhi Industrial Estate, Bin Qasim, Korangi Industrial Estate, North Karachi Industrial Estates and Gharo. Together six thousand manufacturers are pouring or throwing their waste for the most part untreated, legitimately or in a roundabout way in the different creek zones of Karachi and Gharo. Roughly five hundred million gallons of Industrial and local scrap water is being created and released via two waterways (Malir and Lyari river) into western and southeastern beachside (Gharo, Gizri and Korangi Creek) of the metropolitan city. Of the whole gushing, less than a quarter is being dealt with. The most exceedingly awful hit bits of Karachi coast are Harbor and Korangi/Phitti creeks where the gushing from all the industrial zones of Karachi and nation's biggest mechanical Unit-Pakistan Steel Mill is being released into the ocean. Port Qasim and Korangi fish Harbor have occupied with transportation and angling pontoons in the Phitti, Korangi and Gharo streams create oil release (a gauge some 5,00-10,000 tons), which is bringing about incredible harm to the widely varied vegetation of Pakistan's largest city waterfront zone. Mangrove and biological systems of Karachi springs are confronting ceaseless

weights of residential and modern contamination and resultant corruption of water quality, natural surroundings misfortune, limited eutrophication, metal amassing in shrimp and fish. There are three noteworthy kinds of contamination in the seaside territories which incorporate profluent from businesses, local wastewater and sludge. The Indus River Delta gets contaminations from up-nation utilization of pesticides, composts and businesses. Gadani Coast gets poisons from the Shipbreaking Industry and Hub Industrial Trading Estate. A portion of the intensely dirtied territories by oil incorporate Korangi Creek, Gizri Creek, Clifton Beech, China Creek, Boat Basin and the primary harbour. Oil spills in seaside zones and tar balls on the shorelines have been accounted for. The significant effect of contamination has been seen around the release purposes of seaside enterprises (Kalhoro, 2018).

3.2 AUTHORITIES RESPONSIBLE FOR MARINE POLLUTION AND ENVIRONMENTAL CONDITION AT KARACHI COASTLINE AND FISH HARBOR

There are some departments/authorities which are one way or other contributions in the marine pollution because of their ill management, inexperienced staff, non-serious attitude, zero or minor communication between them, unawareness about the issue and above all corruption make the things more severe.

3 .2.1 Karachi Water and Sewerage Board (KW&SB)

The formation of Karachi Water and Sewerage Board (KW&SB) includes thirteen thousand representatives and yearly consumption of Rs.4, 825 million. Yearly possibility use is Rs.462 million and operation and maintenance consumption is Rs.1, 433 million for each year. The use of buildout works completed by KW&SB from its very own source is Rs.57 million for every year. The wellspring of freshwater is Hub Dam and Indus River at 100 MGD and 550 MGD separately. Putting the water supply part on the side, if we look into the sewerage handling of the KWSB.

Karachi is creating more than 450MGD to 550 MGD sewage, which incorporates city, hospitals and industrial fluid waste. The whole sewage, which is for the most part untreated, in the wake of adhering to various waste procedures sink in six channels/streams viz. Malir, Nehr Khayyam, Kalri, Railway, Frere and Lyari (for the most part infringed upon with the intrigue of the important offices and experts) at last end up in the ocean.

There is no legitimate arrangement of expelling solid waste, which is for the most part thrown in various nallas of seepage framework, which causes a flood of drains, yet adds incredibly to sanitation issues and builds working and support expenses of the Nallas (Munawar, 2017)

3.2.1.1 Sewage water treatment plants

Three processing plants for treating such sewerage effluent. Sewerage treatment plant – I (STP-I) is based on activation sludge process in which aerobic process has been done in the presence of oxygen to clean the filters and there is no disinfecting agent (chemicals) used in the process. STP-II is conventional treatment plant in which boulders filter the water from spread sewerage, in this process momentum of the boulder and spread of sewerage should match, but now STP-II has encroached. STP-III is based on ponds, this type of sewerage processing requires access to land, in this process water stores in ponds for a specific time (base on the intake level of B.O.D), after some time sediments and impurities settle down and after testing, water is released to open sea. Yet they are for the most part lying non-functional**(Appendix A)** (Nadeem, 2019).

- **STP-I Treatment Plant Shershah Site, Haroonabad** was built in 1964 with a limit of 20 MGD which was later upgraded to 51 MGD and planned existence of its common infrastructure was 7 decades, and 15 years for the mechanical and electrical structure including channelling foundation. What's more, this processing Plant is lying non-useful since 2013, because of further additional up-gradation of 49 MGD, yet on this non-useful processing Plant (STP-I) the staff of ninety individuals is appointed against the capacity of 55 individuals and Rs.2.75 million are

spent on the compensations of the staff. Consistently a measure of Rs.4.7 million is used to make this plan operational **(Appendix A1)** (Kalhoro, 2018).

- **STP-II Treatment Plant, Mehmoodabad** was built in 1964 with treating limit of 20 MGD; 50-00 sections of land of which were rented out by the KW&SB to the City Government in the year 2009 and 40-00 sections of land of its property has been infringed upon by numerous individuals. KW&SB official stated that the land was allotted to Lyari express way's effected by the former mayor Mustafa Kamal. The former mayor pointed that the land of the treatment plant is too much for processing and he allotted 40 acres to the people but in actual all the land of the treatment plant has encroached because land mafia's political connections were so strong at that time so no one had done anything. Now that land was fully captured and a complete society was built. It is non-useful since 2009 and has an allocated team of 72 individuals against the capacity of 55 individuals. The aggregate sum spent on the salaries is Rs.1.975 million and 6.2 million spent to run sewerage processing plant **(Appendix A2)** (Kalhoro, 2018).
- **STP-III Maripur Treatment Plant, New Truck Stand,** was worked in the year 1998 with a limit of 54 MGD and planned existence of its common structure is 60/65 years. Officials stated about this treatment plant is that lying nonfunctional due to improvement and after that this plant has a capability to treat 180 MGD water daily, it is un-operational since 2013 has a staff of 55 people against working quality of 34 individuals, who are all in all illustration a measure of Rs.13,20,000/ - every month as pay rates. The financial backing allotted each year for its upkeep is Rs.60,00,000/ - **(Appendix A3)** (Kalhoro, 2018)

  Mayor Karachi as well as Deputy Project Manager S-III mentioned that 7.9 billion was allocated for this new treatment plant from which 3 billion was spent and no progress has been done yet and the cost of the project increased to 42 billion rupees. Mayor Karachi indicated that there must be a clean and clear inquiry about the S-III project about how the budget was allocated and what is the working plan.

According to proclamation with these three treatment plants when they were operational fully, KW&SB had the option to filter just 151 MGD out of more than 450 MGD due to non-accessibility of needed movement framework to convey sewage up-to-the sewerage plants.

Mr Azam Khan, Chief Engineer, KW&SB accept in an interview that none of the treatment plants is working. STP-I is completely nonfunctional because of improvement and STP-III is partially operational sometimes, otherwise it is also switched-off. He also explains why sewerage treatment is poor; it is because of two main reasons. The first reason is people are not paying for water and sanitation service, they believe that water is their basic right and it is their right but KW&SB is not charging for water but the provision of water from river or ponds to your tap. The same issue is with sanitation. The second reason is that KW&SB's priority is to supply drinking water at any cost. After that operation and maintenance of water supply process to ensure water availability 24/7. After that from the remaining budget we allocate for sewerage system and its maintenance which is near to none and that is why sewerage system of the mage city is badly affected and also polluting coastal areas and harbour which leads to many negative externalities (Azam, 2019).

Further, he discussed many other issues which are hurdling the operations of the system, from which political appointments and district level politics plays a vital role. It is known that this job is completely based on relevant education and skills but due to political enforcement, some people came in a position which is not suitable for a job. Another factor is that area Nazim and UC consular promote the illegal actions for the availability of water just to make their vote bank.

Deputy Project Manager S-III/TP3 share some figures of operational inputs and outputs of sewerage water which were recorded in the partial and only running treatment plant TP3.

Parameters achieved at TP3 are pH intake is 6.9 and outlet is 7.4 which is ideal and its standard to release water in open is 9.00 temperature intake is 24.9 C and outlet is25.1 C. total suspension

(TS) inlet is 2800 mg/l and outlet is 2252 mg/l. total suspended solids (TSS) inlet is 91 mg/l and outlet is 82 mg/l. total dissolved solids (TDS) inlet is 2709 mg/l and its outlet is 2170 mg/l. Volatile suspended solids (VSS) inlet is 66 mg/l and outlet is 67 mg/l. Chemical oxygen demand (COD) and biological oxygen demand (BOD) inlet are 660 mg/l and 264.75 and outlet are 356 mg/l and 68.5 mg/l respectively and the sulfate inlet is 185 mg/l and outlet is 135 mg/l. not all the outlet meets the parameter standards but most important; pH, BOD and COD figures are under standards. In case BOD is more than 80 mg/l then it is considered untreated (Gangji, 2019).

- **Korangi Combined Effluent Treatment Plant** Aside from the treatment plant under KW&SB there is another treatment plant which is Combined Effluent Treatment Plant (CETP) at Korangi Karachi which is operated by Pakistan Tanners Association and it can treat 6 MGD.

- **3.2.2 Karachi Metropolitan Corporation (KMC)**

Since 1933, Karachi Metropolitan Corporation (KMC), the very beginning of the Municipal System, has been withdrawn on one or other guise through warnings, and so forth. subsequently denying the KMC of its principal lawful errands, which is the reason the City has progressed toward becoming chaos (Akhter, 2017)

Truly, Authority to Keep the city clean from solid waste was the authority of Karachi Metropolitan Corporation (KMC), but recently that was also transferred to the Sindh Solid Waste Management Authority (SSWMA) Under the SSWMA Act 2014 led by the Chief Minister Sindh, however there is no major job left with KMC and the cleaning staff is transferred to the Sindh Solid Waste Management Authority from almost all DMCs/KMC which in result made the city like a dumping site.

The system of sewerage and water was also a part of KMC Engineering Department since independence and then sewerage was moved to KDA in 1957 but the water supply was also a job of KMC. A body had been made in 1982 which is named as Karachi Water and sewerage

Board (KW&SB) under the leading authority of Mayor/Administrator/Nazim Karachi as its Chairman. Presently head of the Ministry of Local Government has been advised as Chairman of it under the Sindh Local Ordinance, 2013. In the past, the Planning and Development was the authority of local body/KMC, however, this was also transferred to the Sindh Government. Town planning was also a part of KMC which work under the separate name of Karachi Development Authority (KDA) as an autonomous body without any political influence, currently it was also shifted to the local government after done some amendments in legislation, now all the operational and financial control is under Sindh Building Control Authority (SBCA) under Sindh Government. While before this department was named as City District Government Karachi (CDGK) (Akhter, 2017).

Currently, KMC authorities are very limited. They look after the rain drainage system, through 13 canals (**Appendix C)**, but claimed that KW&SB illegally use these canals for sewerage water which increases the cost of cleaning these canals. KMC also look after major parks, zoological garden of the city and conventional centres like Karachi expo centre (Ahmed, 2019).

However, KMC is on its worst condition since birth. All the above-mentioned departments were separated very slightly and made them autonomous. Unfortunately, the legal war between the authorities and overlapping of work make things more complicated.

3.2.3 Sindh Solid Waste Management Board (SSWMB)

Sindh Solid Waste Management Board has been made by the approval of Sindh Assembly under Act of 2014 to set up a Solid Waste Management System in all urban areas of Sindh Province. The SSWMB is a sole authority to manage and transfer all type of solid waste under which industrial solid waste, municipal and Hospital waste included of the province. Mr Atur Das Sajnani had uncovered that Karachi produces around 12000 tons of solid waste every day and

there is no Garbage Transfer Station (GTS) is available where such garbage can be dumped and with every new day, a garbage quantity is increasing (Kalhoro, 2018).

The Board has various plans to manage and control solid waste like taking trash from the front of the premises, to make new landfills and dumping sites. Mr Sajnani also uncovered that currently DMC South and DMC East only Karachi has been moved to the board, and in these two DMCs the way toward offering has been finished and work has been granted to "M/s. Changyi Kangjie Sanitation Engineer Company Limited of China", which has imported garbage collection trucks that are presently under Custom clearance (Sajnani, 2018).

Due to the absence of GTS, some of the garbage was thrown out of the city and most of it was dumped into the open sea, which directly affects the ecology of aquaculture and also to the people living nearby areas.

3.2.4 Karachi Port Trust (KPT)

Concerning sanitation and sewage, KPT is likewise experiencing sanitation issue. The sewage originating from Lyari River and other real depletes opening into the harbour is expanding contamination in the ocean waters on everyday schedule. As per one investigation, more than 450 MGD sewage is being released into ocean crumbling marine life as well as influencing the foundation of the harbour. The unexpected diminishing of pH esteems in the harbour waters has chocked the cooling admissions of the waters for the boats and is harming propellers of the boats (Muneer, 2018).

To deal with environmental issues and other pollution issues KPT develop a Marine Pollution Control Department (MPCD) in 1996 which is responsible for the pollution control at Karachi fish harbour. They stated that strict surveillance of the harbour is carried out twice a day during which pollution status form is filled. KPT is responsible to collect debris from harbour water daily for which they assigned four boats which are working regularly, further inspection of ships,

oil spill response, environmental audit, and water quality monitoring is also their responsibility **(Appendix B)** (Karachi Port Trust, 2014).

In the long future, KPT has some projects in the pipeline which are very important to environmental perspective in which "MAI KOLACHI WETLAND PARK" with sewerage treatment plant is proposed. Establishment of this park not just save the environment but also make utilization of sewerage water for Public Park which is planned in the project. The proposed wetland park will not only save the wetland but also treat hazardous sewerage water coming from three (3) drains; Soldier bazaar drain which is approximately flowing 30 MGD wastewater daily, Frere drain (carrying 30 MGD) and Nehr Khayam drain (pouring 40 MGD) into the sea from china creek. Another proposed project which results in a saving of billions of rupees which KW&SB would be investing in their treatment plant in S-III project is treatment plant TP-V. Conceptual design study carried out by KPT and said that making of the treatment plant at boarding basin as known as board basin will decrease the cost of processing on a drastic level because of the wetland. KPT carried out a feasibility report in 2010 and offered a plan for the treatment of two drains in the first phase. Which is City Station drain and Frere drain? Which is supposed to treat 60 MGD (as per 2010). In the second phase, Nehr-e-Khayam and small tributaries falling from slums surrounding china creeks will be treated. Total of 100 MGD can be easily treated from TP-V. It just not treat the sewerage toxic water but also help to save the mangrove system which is adjoined with Karachi port (Rasool, 2019).

Proposed “Mai Kolachi Wetland Project” is expanded on 124 acre-m^2 and cost around 2.9 billion rupees was not just improve the sewage water treatment which acquires 14 acre-m^2 land but also improves the scenic view of the area(Table 3.1) (KPT, 2014)

Table 3.1: Area Distributed at Mai Kolachi Wetland after Development (Proposed in 2010)

PARAMETERS	UNIT	ACRE
Mangrove Area	Acre-m^2	28
Area of Wetland Park Development	Acre-m^2	37
Area of Treatment Plant	Acre-m^2	14
Channel and walkways	Acre-m^2	17
Wet open surface area	Acre-m^2	28
Total		**124 Acre-m^2**

Behind all the plans currently, 86% of the total sewerage water is being depleted legitimately in the premises of Karachi harbour and coastline for the most part from all six sewerage drainage channels. KPT is spending billions of rupees to keep the port and harbour clean. Such consistent progression of emanating has unfavourably influenced the ecology of aquaculture, environmental change, mangroves, and also become a source of air contamination. It has transformed natural seawater and beach sand shoreline into black misty waters with oily sand. It is causing different diseases to the general population living near the sea

3.2.5 Sindh Industrial Trading Estates (SITE)

SITE claimed that Supply water to the industries and wastewater residual from the industries have been managed and maintained through SITE Limited from its assets.

Sindh Industrial Trading Estates Limited came into existence in 1947 under the Act of Companies, 1913 (Kalhoro, 2018). Currently, SITE is managing nine estates all over the Sindh which are:

- SITE Karachi
- SITE Superhighway
- SITE Nooriabad

- SITE Kotri
- SITE Hyderabad
- SITE Tando Adam
- SITE Benazirabad (Nawabshah)
- SITE Sukkur and
- SITE Larkana.

3.2.5.1 SITE Karachi

SITE Karachi comprises of two thousand and six hundred Industrial units, and their water sources are KW&SB, and through its seepage system discards fluid waste into the Orangi Nala and Lyari River which at last winds up in the ocean. SITE Karachi is overseeing strong waste through accumulation and arranging it to the land dumping destinations through its labour and vehicles. Further SITE superhighway Phase-I & II is also getting water from KW&SB and flow residuals into Lyari River which ends into sea. Each SITE phase has 368 & 50 industries respectively.

Sindh High Court on behalf of Mr Shahab Usto made a water commission which has to analyze and evaluate the water quality of Sindh. Apart of that report, commission members collect samples of sewerage water from the different Sewerage Nalas of the Karachi city and found that samples collected from industrial zones have a high concentration of toxins in water which are beyond the recommended NEQs

The examination results for chemical oxygen demand (COD) for all the samples were found past the most extreme admissible cutoff points (150mg/l). The most noteworthy focus for COD for sample 2088mg/l was estimated for the example gathered from Industrial residual in SITE Karachi. The COD qualities estimated in the scope of 494-2088mg/l. The most noteworthy BOD esteem 740mg/l was estimated for the sample gathered in wastewater Nala in SITE Karachi. All

of the samples gathered from sewerage and industrial emanating demonstrated BOD esteems past as far as possible (80mg/l). Out of 15 tests, 13(87%) example was discovered dirtied with high TSS. The most extreme measure of TSS was discovered 2560mg/l past as far as possible 200mg/l. Five examples indicated TDS values past as far as possible (3500mg/l). The most noteworthy centralization of TDS was estimated at 6816mg/l. The unfit parameters past the prescribed qualities are featured (Table 3.2).

Table 3.2: Waste Water Quality Analysis, Samples collected from sewerage Nalas in Karachi.

Sr. No	Sample Code	TDS(mg/l)	pH	COD(mg/l)	BOD(mg/l)	TSS (mg/l)
1	KHI-01	1549	6.9	594	177	258
2	KHI-02	15232	6.9	884	96	321
3	KHI-03	5274	7.1	793	154	836
4	KHI-04	2925	7.5	613	186	495
5	KHI-05	2931	7.5	566	148	891
6	KHI-06	2765	8.2	738	396	174
7	KHI-07	33728	7.1	1326	16	922
8	KHI-08	33152	7.1	1330	22	881
9	KHI-09	2234	7.3	512	200	180
10	KHI-10	4339	6.9	740	362	2560
11	KHI-11	4506	7.5	1088	740	2316
12	KHI-12	4198	7.7	518	297	1860
13	KHI-13	4614	7.6	2088	400	1680
14	KHI-14	957	7.1	891	437	430
15	KHI-15	6816	7.6	494	130	370
NEQ Standards		3500	6-9	150	80	200

Source: Report of Commission of inquiry -- Sindh Water Commission 2018 (Supreme Court of Pakistan)

The high centralization of BOD and COD demonstrates the existence of natural and manmade substances in the sewerage and industrial profluent. The residuals from paper, material and food factories might be the significant supporters for BOD and COD. The examination aftereffects of BOD and COD demonstrate that the enterprises are discarding their profluent with no processing. Unprocessed manufacturing and local sewerage is a wellspring of genuine peril to the seaside zone of the city, which is among the most exceedingly contaminated beach front belt on the planet bringing about monstrous monetary misfortune to the nation through abatement in the fare

capability of fisheries. Heavy metals concentrations from collected samples were found within the NEQS limit (Table 3.3).

Table 3.3: Heavy Metal Analysis Results of waste water samples Collected in Karachi.

Sr. No.	Sample Code	Cu (mg/l)	Ni (mg/l)	Fe (mg/l)	Zn (mg/l)	Mn (mg/l)
1	KHI-01	0.04819	BDL	0.0414	0.01547	0.1606
2	KHI-02	0.06853	0.09578	0.1772	0.00286	0.2108
3	KHI-03	0.08461	0.04136	0.5961	0.08733	0.2166
4	KHI-04	0.04552	BDL	0.0708	0.02256	0.1839
5	KHI-05	0.02655	BDL	0.0719	0.02655	0.1945
6	KHI-06	0.05108	BDL	0.0523	0.05108	0.0901
7	KHI-07	0.00810	0.4238	0.4915	0.00800	0.1837
8	KHI-08	0.01209	0.4143	0.4737	0.01209	0.1845
9	KHI-09	0.02923	BDL	0.0683	0.02923	0.1149
10	KHI-10	0.04790	0.09656	0.2322	0.00510	0.0828
11	KHI-11	0.08207	0.13201	0.9829	0.18831	0.1435
12	KHI-12	0.03536	0.1362	1.0211	0.05909	0.2275
13	KHI-13	0.02810	0.06248	0.1768	0.01642	0.1627
14	KHI-14	0.04841	0.06035	0.8120	0.19020	0.2045
15	KHI-15	0.07625	0.1042	0.2539	0.02436	0.1011
NEQS Standards		**1.0**	**1.0**	**2.0**	**5.0**	**1.5**

Cu=Copper**, Ni=**Nickel**, Fe=** Iron**, Zn=** Zinc**, Mn=** Manganese **BDL=** Below Detection Limit

Source: Report of Commission of inquiry -- Sindh Water Commission 2018 (Supreme Court of Pakistan)

Understand that investigation consequence of some tests out of many with examination of restricted substantial metals can't guarantee that the effluents are not contaminated from overwhelming metals. For overwhelming metal examination inspecting from industrial effluent, kind of industry, testing time and recurrence of the examining is significant. The pH level and all the metals for every sample was found inside NEQS guidelines.

3.2.6 Korangi Industrial Area (KIA)

Korangi Industrial Area (KIA) is situated in [Korangi District, in Karachi, Sindh, Pakistan. It is one of the biggest modern zones of Pakistan. It houses around 4500 industries, business and trading units including material, steel, pharmaceutical, vehicle, synthetic, and building and flour plants. The Korangi Association of Trade and Industry (KATI) is delegate exchange body of this industrial estate (wikipedia, 2017).

Korangi District is a landmass of around 14,000 hectares (ha) in the thickly populated, essentially industrial zone southeast of central Karachi, limited by the Malir River toward the north and the Arabian Sea toward the south. The region comprises of two townships, Korangi and Landhi. There are about 1.3 million residents and 200,000 labourers working in 5,000 units. Development of manufacturing plants in the industrial domain began in the mid-sixties. As indicated by the Korangi Association of Trade and Industry (KATI) (World Bank, 1996).

Korangi's solitary combined effluent treatment plant was set up by the Pakistan Tanners Association, in a joint effort with the Trade Development Authority of Pakistan, the national government, the administration of Netherlands, Sindh government and the City District Government Karachi, at a complete expense of 492 million rupees. (Its patrons and administrators have plans to update it by 2020 at an expected expense of 530 million rupees.) Located close to a spot called Chamra Chowrangi, named so due to various chamra – calfskin – tanning processing plants around it, the plant was set up due to pressure from outside purchasers. The purchasers constrained nearby leather makers to make their creation forms consistent with global environmental standards (Amel & Zofeen, 2019).

The plant is undoubtedly insufficient. Korangi Industrial Area has 673 major, little and medium ventures, however, the plant treats wastewater of just around 400 processing plants — 120 of them being tanneries. Out of the rest, just 24 units have their very own wastewater treatment plants. Around 80 different tanneries and over a hundred other mechanical units discharge their untreated fluid waste legitimately into the channel which ends at sea via Korangi creek (Ali, 2019).

3.2.7 Sindh Environmental Protection Agency (SEPA)

Sindh Environmental Protection Agency has been established by the Sindh Government under Sindh Environment Protection Act, under section 5 of 2014 Act. To ensure, monitor, restore,

and improve the earth and to forestall and control contamination and to control and screen authorization of the arrangements of the Act. In the given limit SEPA needs to address ecological issues and play out its assigned responsibility, which incorporate to oversee and actualize the arrangements of 2014 Act and the important laws; to get ready natural approaches; get ready and distribute a yearly Sindh Environment Report on the condition of the earth in the region; to guarantee authorization of Sindh Environmental Quality Standards; to set up various norms for various regions for release of outflow from various sources; to build up frameworks and techniques for overviews, reconnaissance, checking, estimation, assessment, examination, research, review and review to forestall and control contamination, and to gauge the expenses of tidying up contamination and restoring the earth in different segments; to take measures to advance research and the improvement of science and innovation which may add to the counteractive action of contamination; to recognize the requirements for and start enactment in different areas of the earth; to render exhortation and help with natural issues including such data and information accessible with it as might be required for doing the reasons for 2014 Act; to help Government Agencies, neighborhood committees, nearby specialists and different people to execute plans for the best possible transfer of squanders in order to guarantee consistence with the Sindh Environmental Quality Standards; to give data and direction to general society on natural issues; to suggest ecological courses, points, writing and books for fuse in the educational plans and prospectuses of instructive foundations; to advance state funded training and attention to natural issues through broad communications and different methods including classes and workshops; to set up and look after components, including its very own site, to spread data in regards to strategies, plans and choices identifying with the earth; to attempt request or examination concerning ecological issues; set up and keep up labs to lead investigate in different parts of the earth and so on (Mughal, 2017).

The foundations for environmental deterioration in the premises are mishandling of solid waste, insufficient effluent framework and incapable or absence of processing of crude water preceding supply into open water organize all through the Sindh. The unlawful transfer of residential and modern gushing in the watercourses, through various arranged or temporary plans, is the main source of water quality disintegration.

Incompatibility of the capacities gave in the SEP Act 2014, SEPA has taken purposeful endeavours to accomplish objectives regarding Installation of Waste Water Treatment Plants in the enterprises, other than it has started acting against the industries violating of the SEP Act, 2014, and because of its implementation exercises, 75 wastewater treatment plants at different industries in Karachi and 34 in other economic zones of Sindh (Kalhoro, 2018).

SEPA is working with an intense lack of human and money related assets, thus the association is limited to play out its prime obligations i.e., Protection of Environment and implementation of SEP Act. The budgetary designation of 2016-17 for the entire arrangement of Sindh Environment Protection Agency including main office and other five side offices is Rs.168 million, out of this, workers related consumption is Rs.142 million, and remaining measure of Rs.26 million is assigned for operational use which incorporates utilities, travel and transport and so forth. During the current budgetary year, a measure of Rs.150million has been dispensed for the execution of five-yearly advancement plans tending to the preservation of regular assets (Kalhoro, 2018).

SEPA is an "Agency" and its primary job is to enforce environmental laws but in actual SEPA does not have any force which enforces the law against the disobeying actors. Whenever SEPA official visit on any premises may lead to many difficulties. Whenever SEPA file a complaint against any actor court issue a bailable warrant which makes to polluter more protective and he will pollute the environment without any fear. If we look into treatment plants in the factories,

only those who are bound with the exports regulation install the plant otherwise none of the polluter care about it and it is also not sure that those plants are operational (Mirani, 2019).

There are some other invisible hands which are directly or indirectly affect the operations of above-mentioned authorities and leads to the environmental degradation at the harbour like Sindh Building Control Authority (SBCA), Railways, Karachi Development Authority (KDA) and Defense Housing Authority (DHA). More likely it seems that authorities are unclear among the departments. Most of the time Departments blame each other for their inabilities rather than solving environmental issues in the giving resources.

CHAPTER IV

Methodology and Data Collection Techniques

This section of the study covers Data collection procedure, sampling Techniques, and empirical framework of the models which will be used in further estimations and calculations.

4. STUDY AREA

Chapter IV is defining the broad to the specific perspective of the study area in which coastline of Pakistan and then Karachi Coastline with the harbours and other important statistics are discussed. Further; questionnaire, variables and data collection and sampling technique are also discussed.

4.1 COASTLINE OF PAKISTAN

Pakistan is a natural resource-rich country and it is also rich with aqua species and has a coastline of 990 Km, divided into two coasts; Makran Coast (720 km) and Sindh Coast (270 km). The Exclusive Economic Zone (EZZ) spreads about an area of 240,000 sq. km^2. Coastal zone towards the sea is up to 12 nautical miles (NM) is within the jurisdiction of the two provinces (Sindh & Balochistan). Coastal Zone after 12 NM till 24 NM is bordering zone and after that up to 200 NM is under the authority of federal Government. Pakistan's coastline can be divided into five parts; Geographically, from the border of Iran at Gwadar bay in the west and East up to Sir Creek at Indian border (Memon & Shah, 2016):

- Gwadar Coast
- Lasbela Coast
- Karachi Coast
- Thatta Coast (From Korangi Creek to Sir Creek)
- Rann of Kutch (District Badin to Tharparkar District)

4.2 SINDH COASTLINE

Sindh Coast stretches from Indian Border at Sir Creek in the east to the Hub River besides Balochistan coast on the West, it is further sub-divided into two parts, The Karachi coast and the Indus Delta Creek System (IDCS). As per morphology (tidal creeks and mudflats occupied by mangrove vegetation and other ecological systems), IDCS covers 85% of the Sindh coast (Memon & Shah, 2016).

4.3 KARACHI COASTLINE

Karachi Coast has a coastal belt of 100 km long starts from Hub River and falls towards the Arabian Sea and in length, it ends at Korangi Creek. Karachi Coast has three major islands i) Churna Island, ii) Shams Pir, iii) Bundal Island, two ports are situated beside the Karachi coast which are Karachi Port Trust (KPT) and Port Qasim (PQ), Karachi Nuclear Power Plant(KANUPP), two harbors (Karachi fish harbor & Korangi harbor) and steel mill. Karachi coast also has a mangrove forest known as Karachi Port house mangrove forest. Five beaches for touristic importance are Hawkes Bay, Sandspit, Manora, Seaview and Clifton. Sandspit is recognized as turtle nesting sanctuary among 11 important sanctuaries in the world for turtles (Memon & Shah, 2016).

4.4 KARACHI FISHERIES HARBOR AUTHORITY (KFHA)

Karachi Fish Harbor is the biggest and oldest of its kind in Pakistan, being used by all types of fishing boats. Currently, more than 4,000 fishing craft are based on it. At present, it can be assumed that the harbour caters for the needs of near 75 per cent of the local fleet. It handles about 90% of fish and seafood caught in Pakistan and 95% of fish and seafood exports from Pakistan (KFHA, 2018).

Employment in the primary sector peaked in 1997 at 416 405 fishermen but declined to 324 489 in 2006. This declining employment is most apparent in the inland sector. The inland sector is

somewhat more labour-intensive and less productive (177,572 fishermen each producing an average of 0.80 tons per year) compared with the more mechanized marine sector (146,917 fishermen each producing 2.59 tons per year). The high annual rate of increase in production is not due to increase in labour force size but rather to more efficient fishing and greater market demand (to supply fishmeal factories in particular) (Wikipedia, 2010).

The Karachi coastline, which stretches over 135 km, is facing severe pollution due to a combination of industrial, port, municipal, and transportation activities in the area. The coastline is being overwhelmed with water-borne pollution being discharged in the shipping process into the marine environment. Marine life was contaminated with lead, which if consumed by humans through seafood, has been linked to anaemia, kidney failure and brain damage. The study also discovered that even the mangrove forests protecting the feeder creeks from sea erosion as well as a source of sustenance for fishermen are threatened by this pollution. In the Korangi Industrial Area, 2,500 industrial units including 170 tanneries dispose untreated waste into the Arabian Sea. A huge amount of toxic metals has been found in marine life. These metals include mercury, cadmium, chromium, lead, arsenic, and zinc. Most of these metals are carcinogens and can cause genetic deformities and other fatal diseases when consumed by humans (Thenews, 2015).

4.5 DATA COLLECTION PROCEDURE & SAMPLING TECHNIQUE

To achieve Objective 1 and 2: Interviews and secondary data is required from concern departments, which are; Marine Pollution Control Department (MPCD) KPT, Sindh Environmental Protection Authority (SEPA), Karachi Fish Harbor Authority (KFHA), Marine Fisheries Department (MFD), Fishermen cooperative society (FCS) Labor union of Karachi Fish Harbor, Karachi Metropolitan Corporation (KMC) and Karachi Water and Sewerage Board (KW&SB).

Data on water quality of harbour is given by the Marine Pollution Control Department (MPCD) which is working under Karachi Port Trust and Data on Sewerage Untreated Water of major sewerage streams are extracted from Sindh water commission. Data on Wastewater treatment and drainage in the sea is provided by Karachi Water & Sewerage Board (KW&SB). Key issues related to Health, injury and working environment will be discussed in interview sessions with Karachi Fish Harbor Authority (KFHA), Fishermen cooperative society (FCS) and survey base self-analysis on site.

To achieve Objective 3: Questionnaire base primary data will be collected from those workers which are working at Karachi fish harbour and deal with the fish at harbour and from the fish sellers at a wholesale market located at west wharf adjacent Karachi fish harbour.

4.5.1 Sample Size

The sample size was determined on the above-mentioned population which is 3.25 lakhs. At a 10% margin of error with a 95% confidence interval, the sample size was 97. The same sample size was taken for comparison group because the sector is informal and the population is unknown.

4.5.2 Sampling Technique.

For the pilot survey, convenience sampling technique was used in which participant is selected with convenience and no specific requirement is necessary, the reason to do a pilot survey and use this technique is to satisfy the mentioned questioned in the questionnaire after pilot survey questionnaire is finalized. For final survey multistage random sampling technique is used in which interviewee is randomly selected on the premises and data was collected in different periods. Karachi Fish Harbour is 0.5 Km long strip birth with 2 auction halls attached which is operational 24 hours in a day and 6 days a week, so data was collected in different shifts (morning, afternoon and midnight) to make sample random. In the case of a comparison group, same sampling

technique was used but data was collected in daylight because there is night shift in that sector but the sample was selected from different areas to ensure the randomization of collected data.

Questionnaire-based data is collected from two groups one is fish handlers group (Focus Group) and another one is hand cart carrier cum loader (Comparison Group) in the wholesale market of Karachi which is nearby the Karachi fish harbour. Selection of comparison is based on the common socio-demographic and economic factors between focus and comparison group.

Around 3.25 lakh people were engaged with this industry (Wikipedia, 2010) in which fishermen, net makers, boat & craft makers, fish handlers are prominent. Data about target population was gathered from different sources: Karachi Fisheries Harbor Authority (KFHA), Sindh Livestock and Fisheries Department, Sindh Bureau of Statistics, Labor union of Karachi Fish harbour are the main sources from where data was collected about the required population. After that sample size was determined.

4.6 EMPIRICAL FRAMEWORK

A questionnaire is divided into three sections. Section 1 covers the socio-demographic variables. Section 2 mainly focused on health issues or types of diseases caused by anthropogenic negative externalities like a release of untreated industrial water or dumping of solid waste. Third and last part covered a health cost spending either it is direct or indirect cost. Questionnaire-based primary data was collected for this. It covered the direct and indirect cost to treat a disease. Doctor fee (per visit) Travel cost (return) medicinal expense, Lab test or any other expense which is related to disease and respondent was questioned. The same questionnaire was circulated among the comparison group to get the difference in health cost between focus and comparison group. A comparison group was selected with the same Characteristics like; income, education

4.7 ECONOMETRIC MODEL

Measuring health cost isn't an easy task. There are so many factors which are directly or indirectly affecting the level of health. Poverty, poor administration, inexperienced doctor and nursing staff, lack of medical equipment, corruption and commissions, and there are a lot of factors which are making healthcare more difficult. In Pakistan average spending on healthcare is 33% by the public and most of the spending in Pakistan is private spending (Muhammad, et al., 2015). In brief, almost all the aspects related to human life is related to its health and by increasing health cost, poverty will lead to its peak. I cannot measure all the factors which are affecting health cost but some of the factors have more share in measuring health cost. To measure health cost we use Ordinary Least Square (OLS) method, in which health cost (in rupees) is our dependent variable and the data related to health cost is also collected through a primary survey.

4.7.1 Model Specification

The model used in the study is:

$$(\boldsymbol{OLS})\boldsymbol{HC} = \boldsymbol{\beta 0} + \boldsymbol{\beta 1 Agei} + \boldsymbol{\beta 2 MSi} + \boldsymbol{\beta 3 INCi} + \boldsymbol{\beta 4 NOEi} + \boldsymbol{\beta 5 HHSi} + \boldsymbol{\beta 6 HEDUi} + \boldsymbol{\beta 7 EXPi} + \boldsymbol{\beta 8 DUi} + \boldsymbol{\beta 9 MEATi} + \boldsymbol{\beta 10 DWi} + \boldsymbol{\beta 11 SFi} + \boldsymbol{\beta 12 ICi} + \boldsymbol{\beta 13 PSYIMPi} + \boldsymbol{\beta 14 TSi} + \boldsymbol{\beta 15 SEi} + \boldsymbol{\beta 16 INSi} + \boldsymbol{\varepsilon}$$

4.8 VARIABLE SPECIFICATION

In the study, few types of variables were used, including, count and index variables. Variables and method are adopted based on a few studies. Socio-demographic & health-related questions have been made in the highlight of the study conducted at Zagazig University, Egypt (Mahmoud, et al., 2014). Index variables related to intangible cost and psychological cost are adapted from a book on measuring and modelling health care cost (Ana, et al., 2017).

Table 4.1: Nature and Description of Variables

Dependent Variable	**Nature**	**Description**	**Expected Sign**
Health Cost	Continuous	Sum of all cost gathered through questionnaire. Direct health cost, indirect health cost, opportunity cost of illness or visit to Doctor, Medicinal cost and other medical expense within last months are added in it.	Pos./Neg. (+-)
Independent Variables	**Nature**	**Description**	**Expected Sign**
Age	Continuous	Age in Years	Negative (-)
Income	Continuous	In Rupees	Pos./Neg. (+/-)
Marital Status	Categorical	Married=1, Unmarried=0	Pos./Neg. (+/-)
Household Size	Continuous	Family members sharing kitchen	Pos./Neg. (+-)
Maximum Education in Family	Continuous	Education in years	Pos./Neg. (+-)
Nature of Employment	Categorical	Govt.=0, Self Employed=1, Daily Wages=2	Pos./Neg. (+-)
Experience	Continuous	Experience in current occupation	Pos./Neg. (+-)
Use of Safety Equipment	Categorical	If Yes=1, No=0	Pos./Neg. (+-)
Insurance or any other benefit	Categorical	List of 10 options related on insurance or compensations.	Pos./Neg. (+-)
Drinking Water Facility	Categorical	If Yes=1, No=0	Pos./Neg. (+-)
Sanitation Facility	Categorical	If Yes=1, No=0	Pos./Neg. (+-)
Drug Use	Categorical	If Yes=1, No=0	Pos./Neg. (+-)

<table>
<tr><td colspan="3">Index Variables</td></tr>
<tr><td>Treatment Satisfaction</td><td>Index Method</td><td>Composite Index</td></tr>
<tr><td>1. Satisfied With Doctor</td><td>Strongly agree = 2
agree = 1
Uncertain = 0
Disagree = -1
Strongly disagree = -2</td><td rowspan="3">$TS=\frac{\sum Sd_{i+}\sum Ns_{i+}\sum Os_i}{N}$

TS= Composite Index Variable for Treatment Satisfaction

N=Total Number of Variables</td></tr>
<tr><td>2. Satisfied With Nursing Staff</td><td>Strongly agree = 2
agree = 1
Uncertain = 0
Disagree = -1
Strongly disagree = -2</td></tr>
<tr><td>3. Overall Satisfaction with treatment</td><td>Very Good = 2
Good = 1
Average = 0
Poor = -1
V.Poor = -2</td></tr>
<tr><td>Intangible Cost</td><td>Index Method</td><td>Composite Index</td></tr>
<tr><td>1. Behavior towards age with increasing age: think more about health with increasing age</td><td>No= -1
Uncertain = 0
Yes = 1</td><td rowspan="2">$IC=\frac{\sum BI_{i+}\sum FD_i}{N}$

IC= Composite index variable for intangible cost
N=Total Number of Variables.</td></tr>
<tr><td>2. Fear of Fatal Disease: afraid of fatal disease because of nature of work.</td><td>No= -1
Uncertain = 0
Yes = 1</td></tr>
<tr><td>Psychological Suffering:</td><td>Index Method</td><td>Composite Index</td></tr>
<tr><td>1. Burden to a Family while diseased</td><td>No= -1
Uncertain = 0
Yes = 1</td><td rowspan="3">$PSYIMP=\frac{\sum Bf_{i+}\sum Sl_{i+}\sum Emb_{i+}\sum Ign_{i+}\sum Ignfam_{i+}\sum Iso_i}{N}$

PSYIMP= Composite Index Variable for Psychological Impact/Suffering

N=Total Number of Variables</td></tr>
<tr><td>2. Cannot sleep well because of disease.</td><td>No= -1
Uncertain = 0
Yes = 1</td></tr>
<tr><td>3. Feel embarrassed to let people know about disease</td><td>No= -1
Sometime = 0
Yes = 1</td></tr>
</table>

4. Ignore to be socialize because of disease	No= -1 Sometime = 0 Yes = 1	
5. Ignored by family member because of disease	No= -1 Sometime = 0 Yes = 1	
6. Gone in isolation due to disease	No= -1 Sometime = 0 Yes = 1	

- **Health Cost**

Health Cost (HC) is a dependent variable in regression and it is a sum of all sources of income of an individual respondent. In health cost direct health cost in which doctor visit, medicinal cost, Lab test cost, or any other cost which is directly paid for health service is added in it. In indirect cost; travel cost (2-way travel cost), food and drinks, communication cost and any other indirect cost is added. Cost of absent from work is also added in it by doing a simple calculation of per day wage multiply by absent in last 2 months. Same calculations had been made for both the groups.

- **Age**

Age is taken in the number of years. After a certain age limit with the increasing age, the respondent becomes less productive and more chance to get effected from disease, so the expected sign of age is negative.

- **Income**

Income (INC) is a continuous variable; data about income is collected from the respondent during questioning. Monthly income was asked and then calculated on 2 months to get the impact of income.

- **Marital Status**

Marital Status (MS) was asked to a respondent because if a respondent is married and have kids too then it might have expected that income of a respondent is higher as well as productivity too but in the same time respondent marriage factor might make a higher health cost to the respondent.

- **Household Size.**

Household Size (HHS) reflects the number of family members sharing a kitchen. With the higher household size, health cost might increase as well as the number of earners will also increase.

- **Highest Education in Family**

Highest Education (HEDU) in a family is asked from a respondent directly. Reason to ask the highest education in the family because it is no necessary that family earner is also a highly educated and to get good and proper health facility education play a role from his educated family member.

- **Nature of Employment**

Nature of Employment (NOE) is a respondent ordering authority. Either they are working for some private firm or company on wages, they own their small business or provide any kind of service or working as a Government employee.

- **Experience**

Experience defines the experience in a current occupation in which the respondent is working at the time of response. With the time, experience affects the income positively but after a certain

age, working capacity will decline due to declining health and other age factors so at that stage experience does not affect much, so the impact of experience can be positive or neutral.

- **Safety Equipment**

Use of safety equipment like gloves, long boot, face mask during work

- **Insurance or other Benefits**

In this question, 9 options have been listed which are, health insurance, life insurance, injury compensation, medical allowance, education allowance, transport allowance, interest-free loan, occasional bonus and microfinance. Open space is also made for any other benefit if the respondent get.

- **Drinking Water Facility**

Availability of filtered Drinking water facility in working premises as well as at living location.

- **Sanitation Facility**

Availability of proper washroom and bathroom in the working area as well as at home.

- **Drug Use**

Three questions were asked in Section of drug use. If a respondent agrees to be a drug user then he was asked the type of drug he uses, in which conditions he drug more (leisure or working conditions) and how much he daily spend on drugs.

- **Treatment Satisfaction**

Questions related to satisfaction during treatment, satisfaction from a doctor, nursing staff and overall satisfaction has been asked from the respondent.

- **Intangible Cost**

A psychological effect related to future outcomes based on the current income level which indirectly affects the health of respondent and effecting income in current time. Two simple questions were asked which are, respondent's health care with increasing age and fear of fatal disease or any accident are listed.

- **Psychological Suffering/Impact**

Skin diseases, open wounds and nail diseases are common like work of the respondents, this question will cover the impact of psychological suffering if a respondent is facing due to his disease. Six questions were asked in this section. If a respondent feels like a burden on a person who is taking care of him, irregular sleep because of disease, feel embarrassing in from of people, ignore to socialize, ignorance from friends and family member and feeling isolated are asked from a respondent.

Chapter V

Results & Discussion

5. Introduction

This chapter sketches respondents based on collected data. Descriptive Statistic about Socio-Demographic variables of Focus Group (Fish handlers) and comparison group (Commodity Loader) has been discussed in this chapter like age, education, household size, income into experience ratio, diseases in both groups & health statistics. The further regression analysis has also been done about the health cost of the focus group as well as of comparison group. In the last of this chapter comparison between both groups take place.

5.1 Descriptive Statistics of Socio-Economic Characteristics

Age of the fish handlers is between 14 years to 101 years. Majority of the labour at harbour is around 25 to 50 years, as per collected sample of 100 respondents 58% of respondents are aged between 26 to 43, 22% respondents are between 14 to 25 years, 19% are living around the age of 44 to 68, one respondent aged about 101 years and living healthy life and even working at harbour (Figure 5.1).

Picture of a comparison group not so much different. 52% workers are aged between 26 to 40 years which is quite similar to fisheries group, respondents age from 16 to 25 are 34% of total sample size and remaining 14% are in between 41 to 60 years. Collected data indicates that the average age of doing work is higher is fisheries as compared to a comparison group (Figure 5.1.1).

Age of Respondents (Fish handler Group)	Age of Respondents (Comparison Group)

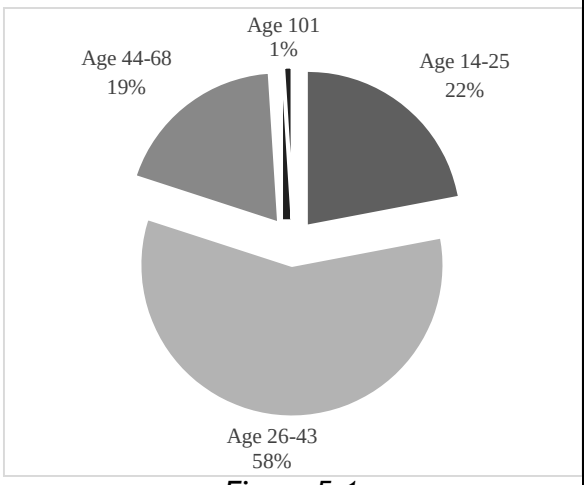


Figure 5.1

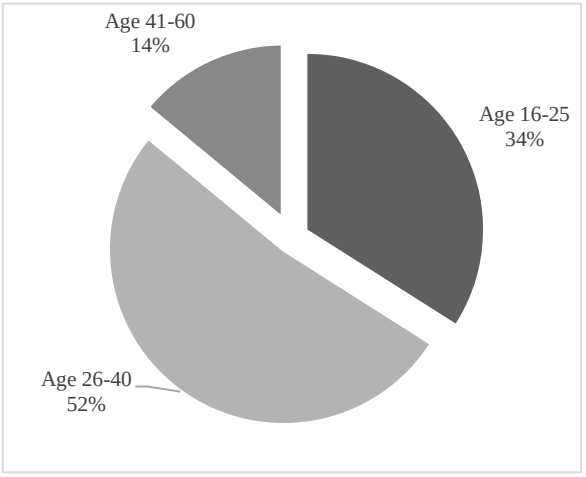


Figure 5.1.1

Distribution of data on family size shows that in fish handlers as well as in comparison group, family size is comparatively larger than average family size in Pakistan which is 6.45 as per 2017 census. 43% and 52% in fisheries group and comparison group have family size of 7 to 10 persons respectively. Family size in fish handlers gone up to 28 members which are 2% of sample size, in comparison group it maximizes to 20 members in the family (Figure 5.2 and Figure 5.2.1).

Family Size (Fish handler Group)	Family Size (Comparison Group)

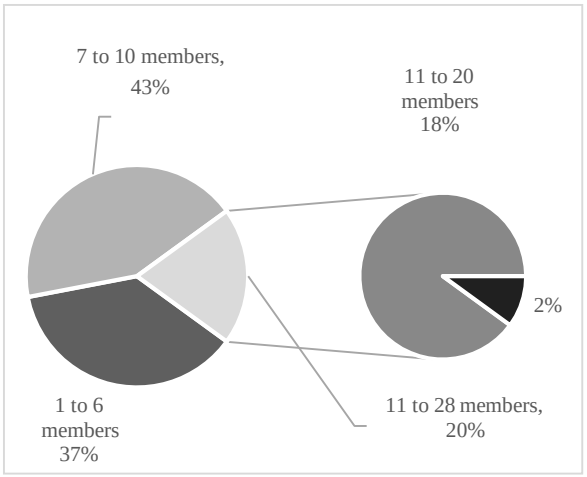


Figure 5.2

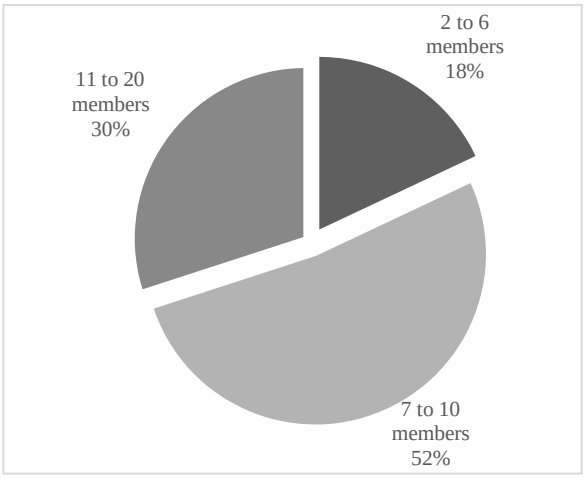


Figure 5.2.1

Lack of Education in both sectors is common, Majority of the respondents are not educated or either not cleared primary education as well. Even many of them cannot read or write their name.

In Fish Handlers or those who are working at harbour earning is prioritized on education. 54% of the total sample did not go to the 5th standard and left education before enrolled in it. 22% quit their education before the 10th standard, which means 76% of the total sample, reflecting a population which is below the secondary education level. 22% of respondents are those who are enrolled in secondary education or some of them reached to intermediate level (Figure 5.3).

In the comparison group, 71% of the total sample size did not cross the line of primary education or left school before it and from it, 44% are those who never went to school. If we look into secondary education 95% of the total sample did not succeed to get it. Only 5% of the total sample either enrolled in higher secondary or gone to college (Figure 5.3.1).

Education (Fish handler Group)	Education (Comparison Group)

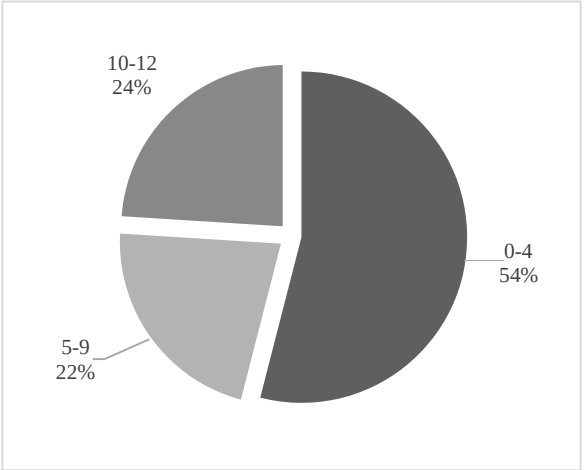


Figure 5.3

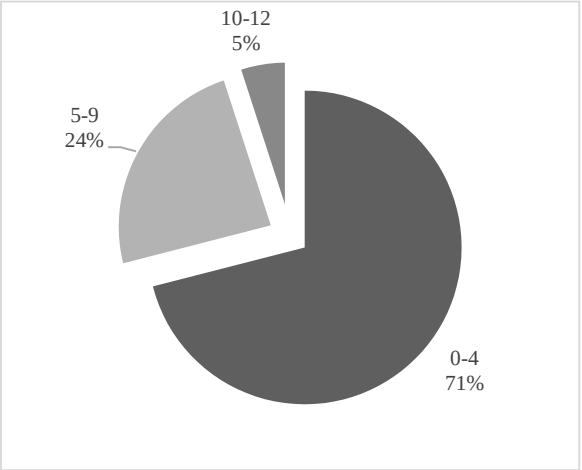


Figure 5.3.1

Education of the respondent is not the sole factor which can make a change because of awareness but education level in family can also make a difference. Overall Education in the family also can make change but unfortunately family education in both sectors are also very low. In family Education; 86% in Comparison group and 42% in Fish handlers are below the belt of Secondary

education, but overall education level in families of much satisfactory. Fish handlers are more concern about spending on family education, about 23% family members of fish handler are above 10^{th} standards and some are at 18^{th} standards and in comparison group these digits declined to 5%.

Highest Education In Family

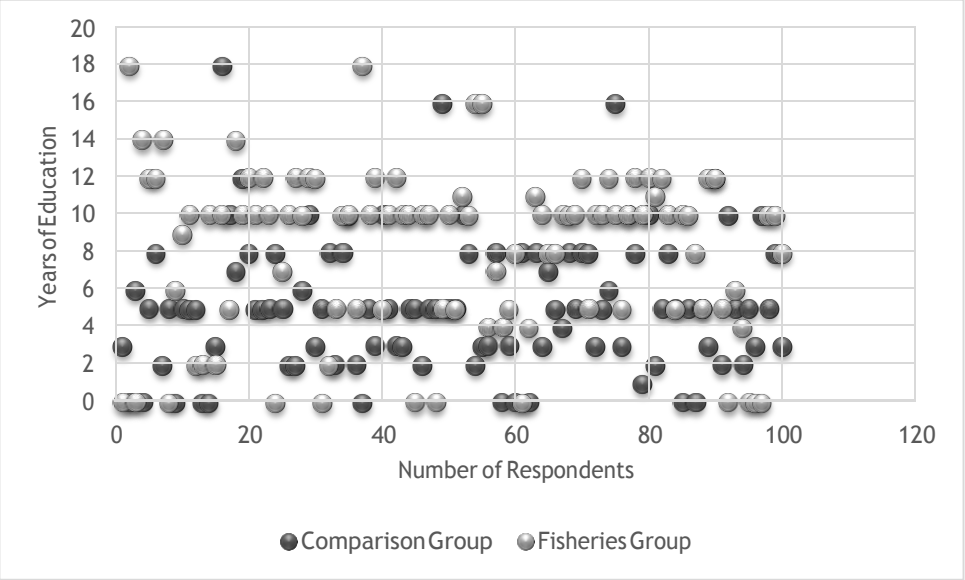


Figure 5.3.2

In the below scatter plot, it is clearly shown that there is no significant increase in wage with the increasing experience. As shown in the scatter plot some of the respondents are earning high with average experience, it is because in fish handlers group these are small sellers and in extra time they also do the job as a labour & in comparison group respondent with high wage and average experience is because of their schooling. These high wage respondents are doing math work for other labours which are uneducated and unable to do their daily calculations so they made some from them to manage their accounts and they charge for it (Figure 4).

Experience into Income ratio

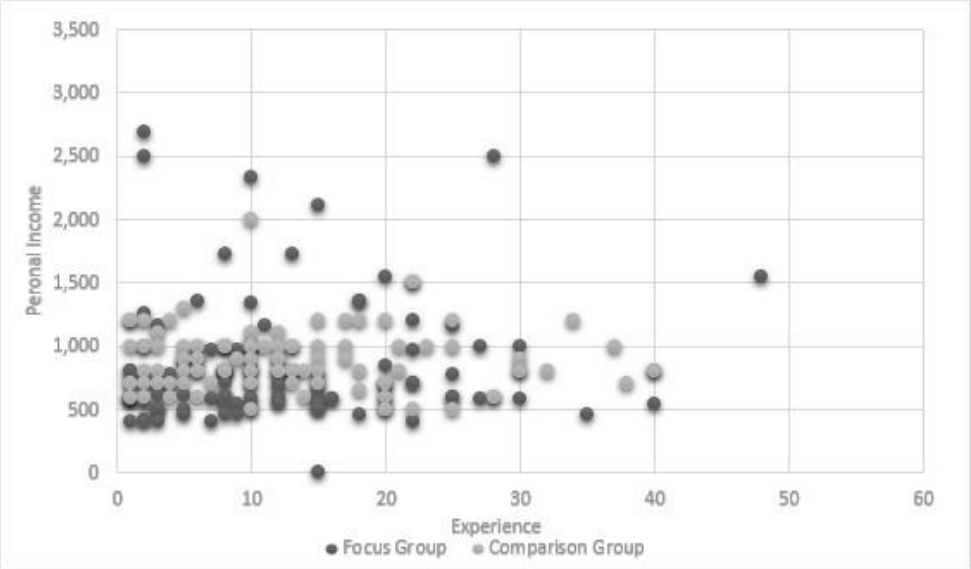


Figure 5.4

Below mentioned diseases are the most common genetic diseases which are affecting the people of Pakistan or the ratio of these diseases are much higher than others. In both groups of studies, hypertension or B.P is much higher than other diseases which are 28 % and 23% in the comparison group and fish handlers respectively. Diabetes is also very common among diseases and 9% of respondents respond positively to diabetes in each group. Kidney and Cardiovascular disease are also counted in both groups but the ratio in the sample is very low which under 5% is. In other diseases, uncommon diseases and the ratio of that disease is also very low but hepatitis is a disease which is very serious in nature and it is positive in some respondents, even their ratio is not more than 2% in each group but working and living condition matters for both groups (Table 5.1).

Table: 5.1 Descriptive Health Statistics

VARIABLE	OBSERVATION	MEAN	STD. DEV
CVD*	100	.03	.1714466
CVD**	100	.02	.1407053
HYPERTENTSION/B.P*	100	.23	.4229526
HYPERTENSION/B.P**	100	.28	.4512609
DIABETES*	100	.09	.2876235
DIABETES**	100	.09	.2876235
KIDNEY*	100	.02	.1407053
KIDNEY**	100	.04	.1969464
OTHERS*	100	.13	.3379977
OTHERS**	100	.08	.2726599

[1]*= Fish Handlers Group, **=Comparison Group

In fish handlers; the overall ratio of diseases is low as compared to a comparison group. 53% of fish handlers have no disease at all and from remaining, 23% agreed that their disease is genetic and their other family members or their parents also have that disease, but 24% also said that their disease is not related to their family or relative. The nearby situation is also with a comparison group, 55% of the respondents do not have any mentioned diseased or any other serious disease which can be genetically transferred. 25% of those which are agreed that their disease is from their ancestors and also other family members have the same disease, remaining 20% claimed that there is disease has no relation with any of its relative or family.

Disease (Fish handler Group)

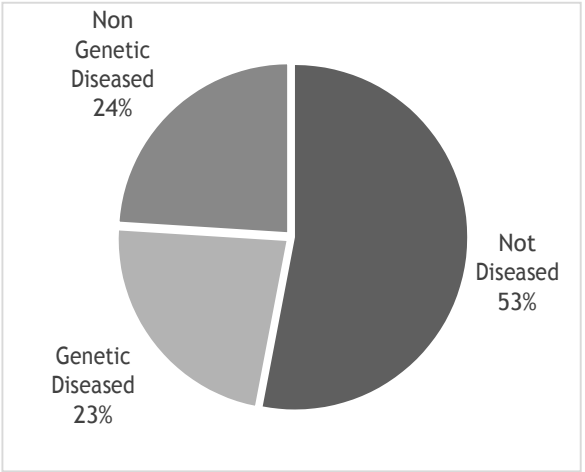


Figure 5.5

Disease (ComparisonGroup)

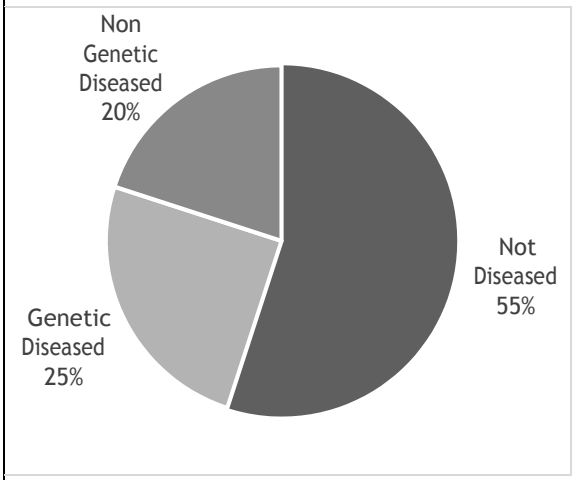


Figure 5.5.1

*= Fish Handlers Group, **=Comparison Group

5.2 ESTIMATION RESULTS AND ANALYSIS

Regression results of health cost in Fish Handlers as well as in comparison group. Variable code with FG in bracket highlights in results in fish handlers and CG indicates the condition of the comparison group (Table 5.2).

Table 5.2 Health cost of Fish Handlers (Focus Group) & Domestic market loaders (Comparison Group).

Variable Name	Coefficient	t-Value	P-Value
AGE (FG)	0.6863058	0.45	0.655
AGE (CG)	-11.9236	-0.46	0.644
MS(FG)	31.70818	0.73	0.466
MS(CG)	77.99227	0.28	0.783
INC(FG)	**0.0391473***	2.67	0.009
INC(CG)	0.0404432	0.61	0.543
NOE(FG)	**-123.0402***	-3.20	0.002
NOE(CG)	-	-	-
HHS(FG)	0.3161358	0.06	0.951
HHS(CG)	**57.40796***	2.40	0.018
HEDU(FG)	**-8.112261***	-2.06	0.043
HEDU(CG**)**	**-69.5308***	-2.79	0.007
EXP(FG)	2.429582	1.08	0.284
EXP(CG)	25.33731	0.99	0.323
DU(FG)	-7192301	-0.09	0.369
DU(CG)	35.07541	0.12	0.903
MEAT(FG)	-0.380843	1.09	0.979
MEAT(CG)	**294.6601***	4.16	0.000
DW(FG)	**-88.84068***	-2.60	0.011
DW(CG)	68.69987	0.40	0.692
SF(FG)	**-100.0698***	-3.03	0.003
SF(CG)	**-357.1641***	-2.13	0.036
IC(FG)	-45.3561	-1.55	0.124
IC(CG)	-65.64094	0.86	0.392
PSYIMP(FG)	44.79781	0.76	0.447
PSYIMP(CG)	**675.8059***	2.31	0.023
TS(FG)	**147.9009***	2.06	0.042
TS(CG)	-54.3469	-0.32	0.751
SE(FG)	20.55766	1.09	0.280
SE(CG)	-	-	-
INS(FG)	12.16819	0.13	0.900
INS(CG)	-	-	-

2 * shows the significant variable

[2] * shows the significant variable

In above regression results sixteen (16) variables are regressed on health cost from which some are indicating the impact of socio demographic variables on health and others are, food intake, drinking water, some are related to occupation like (Safety Equipment, insurance and other benefits etc.), health related variables are also included in regression which indirectly effect the health cost like (Treatment satisfaction, Intangible cost and psychological impact).

Although, in Fish Handler's group; income, nature of employment, highest education in the family, drinking water facility, sanitation and treatment satisfaction are a statistically significant impact on health cost of a fish handler. While age, marital status, household size, experience, drug use, intangible cost, psychological cost/impact, use of safety equipment and insurance or other benefits and statistically insignificant. Additionally, results in fish handlers group show that; one-rupee increase in income will increase health cost by 0.039. Nature of employment is a dummy variable and captures the effect of work on health cost. It is also known that comparatively, high earner will have sent more on health so its health cost is higher than less earner, in fish handlers case same situation is happened, those who are working on daily wages have 123 rupees' low health cost as compare to those who are doing self-owned business. Education in a family is also has a significant effect, an increase in one year of education will decline the health cost by 8.11. If the respondent gets the drinking water and sanitation facility, then its health cost will decline by 88 rupees and 100 rupees respectively. Treatment satisfaction is a compound variable and based on the number of questions, in the fish handler's treatment satisfaction increases the health cost by 147 because hospitals with more facilities have a higher cost of treatment but with that satisfaction level will also increase. Variable "IC" reflects the intangible health cost of the respondent, which is compound variable based on the number of questions although the intangible cost is not statistically significant it is more near to significance level s compare to other insignificant variables, it has a positive impact.

In the comparison group, results were regressed on sixteen (16) variables, 3 variables are omitted because of zero variation in data collected from the selected sample. From the remaining thirteen (13) variables; five are statistically significant which are household size, highest education in the family, meat intake in routine food consumption, sanitation facility and psychological cost/impact. Remaining variables like (variables; age, marital status, income, experience, drug use, drinking water facility, intangible cost and treatment satisfaction) are statistically insignificant. Omitted three variables are; nature of employment, use of safety equipment and insurance or other benefits.

Regression results show that with the increase of one person in family health cost will be increased by 57.40. in normal practice, increase in education affects the health cost downwards but in this case it has direct relation, by decreasing education by one-year health cost will also go downwards with 69.53, it might because with more education people are more health-conscious and they spent more on health. Sanitation facility also contribute to decreasing the health cost, with the availability of sanitation facility, health cost will decrease by 357.16, psychological impact/cost also has a direct relation with health cost in regression, with the increase in psychological stress by one-unit health cost will increase by 675.8, reason to regress meat consumption in food intake is because of nutrition intake variation in both groups, in comparison group meat intake in routine food consumption is drastically low so it is necessary to capture food intake effect on health, and with low intake of one unit of meat, comparison group has to bear 294 additional for health cost.

Overall summary of the regression result is that the health cost of fish handlers group is higher than the comparison group (Loaders in the domestic market). Two major factors are responsible for that is income variation in fish handlers group because they are distributed in small sellers and labour, both are included in sample and obviously small seller has high income than labour, secondly working conditions are quite different for fish handlers because they work in wet

conditions and this will expose them to more bacteria's and fungus. In long term effects, fish handler group is more diseased, in literature; the study is discussed which proves that consistent intake of fish will affect human brain, kidney, lungs and blood pressure and others, because of increasing anthropogenic pollution in open waters disease risks are getting much higher and worse.

Apart of the study examines the existence of environmental bacteria "*Erysipelothrix rhusiopathiae and Mycobacterium marinum "*. From 100 observation only 3 people were found with the symptom of mentioned bacteria in fish handlers and only 1 person is aware about the cause of it and no lab test has been conducted. Sample with positive effect is too small to regress and estimate and my main concern is to investigate the existence of environmental bacteria which is born in the untreated sewerage water and the existence of these mentioned bacteria proves that the flow of untreated sewerage water of Karachi is effecting the health of fish handlers and put its share in the health cost of fish handlers.

CHAPTER VI

Summary, Conclusion & Recommendations

This chapter has a summary of major findings of the objectives and based on findings, the conclusion is defined and in the last recommendation and policies are written.

6.1 SUMMARY

Beaches and seafronts are the gifts from nature to any country, it makes you less dependent to others as you can trade with other countries, which may lead to an economic prosperity and you can also explore your seas for food and natural resources, but if we pour toxic and hazards materials into the sea then it may become curse for a country, same is happening in the case of Pakistan.

Karachi is the 3rd largest country in the world as per population. And approximately 18 million people are living in it. More than six thousand industrial units running day and night to generate an economy of 113 billion nearly, which contributes nearly twenty per cent (20%) in Pakistan's GDP (Sawe, 2018) Cost of producing goods and services are too high in term of environmental and ecological loss. Around 450-550 MGD sewerage and industrial water generated daily in the vicinity which flows directly to the sea without any treatment, which ends at Karachi fish harbour. Additionally, Karachi also generates 12000 tons of solid waste every day and due to lack of dumping land most of the garbage end into the sea and makes the situation worse.

Multiple public sector authorities are authorized to control and manage the waste system of Karachi, but due to lack of expertise, non-serious attitude towards issue, legal and legislative contradiction among them, shortage of finance and technology, outdated infrastructure, illegal encroachment on the sewerage canals, political influence and most importantly zero public

awareness and their nil willingness to change their behavior on this issue. When these all issues are combined then it will make an issue more crucial and affects the harbour functions.

The fishing community is suffering from wastewater from very long and day by day their condition is getting worse because their fish catch is getting low due to the polluted water and secondly their fish-catching cost is getting high because more we pollute water then fish will go farther from it. Secondly, their health cost is also getting high and the reason is also the same here, which is polluted water. Their work nature is to deal with fish in water and that black muddy water with uncountable bacteria and chemicals make them suffer from different skin problems and other internal diseases and existence of environmental bacteria proves that negligence of concern departments will lead to the increase in health issues and precautionary cost.

Although the level of pollution at Karachi fish harbour is far from threshold many of the parameters are above NEQs. Effect and outcome of that violation we face in the term of decline in fish exports and discouragement and demotion in fishing families. Most of the people doing fishing from the time of their forefathers but now they strongly want to shift their children to other sectors because of the above-mentioned issues.

6.2 CONCLUSION

It had been very long ago that Karachi Fish Harbor had upgraded with the help of the European Union (EU), but with the time thing got outdated and inferior. Rest of the world move forward and make fishing more safe and modern. Made new fishing laws, safety laws, high-tech fishing vessels in which all the process can be possible from fishing to packing so the product gets more life and fishing community make more money and so on. In the case of Pakistan thing are getting worse day by day. No new advancement has been done in vessels, no new fishing laws have been made. No one thinks about the hygiene of the place where fish trade has been done. At the same time, negative actions like corruption, political influence, mismanagement and contradiction

among authorities on legal rights take place concretely and push hard towards more bad conditions.

Karachi city is generating the mass level of wastewater daily in which household waste, hospital waste and hazardous industrial waste included which is released into open waters without any treatment. Three treatment plants are documented in KW&SB's files but two exist and remaining has encroached. Multiple authorities are working on the issue but no positive effects are coming and the reason behind it is that all the authorities are playing the blame game and none of them takes responsibility for it. TP-III/S-III project is still on papers and money spent on it is more than the initial allocated budget which reflects the corruption campaign in it and the same situation is with all the other departments. Marine Pollution Control Department (MPCD) of Karachi Port Trust (KPT) is doing some actions but these are also because of the port operations which is a strict requirement of ships.

Environmental and aquaculture degradation is not the only issue but also effecting health of those people who are living near the coastal belt and more specifically fishing community, because their life is connected with harbour and its water. Among the fishermen, fish handlers are more affected because they are directly connecting to the fish with their hands and adopting minimum safety precautions, their wages are also very low, Water at the harbour is stinky, black and full of mud which travels with the sewerage water. Most of the labour at harbour earning a minimum level of income from which they cannot spend to get quality health services and it will lead to low productivity and more low wages.

During the investigation of the existence of waterborne environmental bacteria. I found that environmental bacteria exist at the harbour and coastal waters but the shocking thing is that none of the authority even think about it and its consequences.

6.3 GENERAL POLICY RECOMMENDATION

The biggest issue in the Karachi city is handling Solid waste and sewerage water and its major cause is that there is no clear authority to deals with it.

- There is no or minor communication between and among those departments which are working or responsible for the sewerage and garbage handling in Karachi. There must be a sole authority which is answerable for environmental issues.
- Local government, as well as the federal government, together must take serious note on this issue and make legislative reforms in which they combine all the action necessary for the environmental sustainability and make one authority to deal with it.
- Update Sindh Environment Protection Authority (SEPA) and made a special force to protect the environment and ecology and courts must impose heavy fines and other punishments to the lawbreakers.
- Development of the hospital, specifically for the fishing community because their diseases are quite different like they face more with skin and nail diseases as well as mental illness.
- Education plays a vital role to reduce health cost so government should allocate a budget to educate fishing community about precautionary steps and provide them skill base education and train the fishing community on new ways of fishing and handling and also make some improvements in existing auction halls and landing sites.
- Concern authorities must provide the clean drinking water and sanitation facility at work as well as the local government must install the filtration plants and design and install a proper sewerage system at residing areas fishing community.
- Estimation results shows that fish handlers are paying more to get the treatment facilities so government can provide them an good health facilities against high charges but make sure that charges must be lower than private hospitals but facilities should be equal to them
- The high-level enquiry must take place on the corruption and delay of S-III/TP-III sewerage treatment plant and also do an inquiry on the encroachment of TP-II Mahmoudabad.

Space for the improvement is also available to make things more efficient and fruitful. Above mentioned recommendations are made based on available data and fact findings, by doing more research we can make the fishing sector better and the people of the fishing community more prosper.

6.4 FUTURE STUDIES

Pakistan is a country with the bundle of opportunities to research in the field of environment and there is no detailed study has been conducted on the release of wastewater from industries (especially for the industries located in Karachi). Currently, Karachi is messed up with the garbage on streets and sewerage system of the city is choked with mud and solid waste it is all because of the negligence of the political authorities and non-serious attitude towards research base adoption of the plans. There is no data available which highlight the release of industrial wastewater from every individual industry due to that. There is a scope of research studies in waste management and there is a necessary need to know the reasons behind the lack of communication between and among departments.

6.5 CONSTRAINTS

The study is compiled on the limited sources available, part of the study is constructed based on data available on the internet which is not considered much authentic. Interviews were conducted from concern departments which are mentioned in study but no document was provided from the majorities. Measuring the health cost of fish handlers are also a part of the study which is conducted on the primary survey. There is no data compiled or available regarding health issues in the fishing community, most of the questions are made based on available literature or from the interviews during the pilot survey.

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APPENDIXES

Appendix A: Salient features of existing sewerage water treatment plant.

SALIENT FEATURES (EXISTING SEWAGE TREATMENT PLANTS)

Description	STP-I (SITE)	STP-II (Mehmoodabad)	STP-III (Mauripur)
Year of Const. / Rehab. / Up-Grad.	1964 / 1995	1963 / 1995	1998
Catchment's Areas of the Plants	Federal B Area, Liaquatabad, Nazimabad & North Nazimabad, Part of Orangi Town Areas, Pak Colony etc. (Through 02 Sewer Trunk Mains of 54" & 66" diameters)	Old City Areas, Clifton, Saddar, Society Areas, Mehmoodabad, Part of Azam Basti, Dada Bhai Centre, Society Areas (Through 03 No Rising Mains of 54" diameters).	Lyari, Jamila Pumping Station, Chakiwara Pumping Station, UC-36 Pumping Station, Tannery Pumping Station, Garden East & West, Gulshan-e-Iqbal, Partly P.I.B. Colony, Soldier Bazar, Baldia etc. (Through Lyari Trunk Sewer Box Culverts) 2x2.5x13km long.
Covered Area Treatment Plants	134 Acres	120 Acres	545 Acres
Design Capacity	51 mgd	46 mgd	54 mgd
Treatment Process	Conventional Trickling Filter	Conventional Trickling Filter	Waste Stabilization Ponds
Design Parameters of Influent	BOD 385 – 450 mg/L S.S 150 - 500 mg/L D.S 1400	BOD 385 – 450 mg/L S.S 375 - 500 mg/L D.S 1520	BOD 385 – 450 mg/L S.S 375 - 500 mg/L D.S 1550mg/L
Parameters of Effluent	BOD 80 -- 90 mg/L S.S 150 - 200 mg/L D.S 1360	BOD 80 – 90 mg/L S.S 150 - 200 mg/L D.S 1460	BOD 80 – 90 mg/L S.S 150 - 200 mg/L D.S 1890mg/L
Energy Load	812kw & 157 kw (PS-II)	450 kw & 580 kw (PS-II)	400 kw & 450 kw
Demand Load	406 kw	515 kw	425 kw
Main Pumping Station (PS-I) (Raw / Influent)	07 Nos. Pumps 90 kw. Q= 6250 GPM = 9.0 MGD	07 Nos. KSB Pumps 436 L/S, Motor 110 kw 5812 GPM = 8.37 MGD	03 Nos. Pumps 2000 L/S 180 kw Motor = 38.4 MGD
Off-Site Pumping Station	PS-II Mewashah Graveyard abounded due to diversion of sewage flow to some others trunk mains of the concerned pumps	PS-II Korangi 02 Nos. Vertical Pumps 02 Nos Submersible Pumps 2 x 85 HP = 5 MGD 2 x 63 kw = 4 MGD	06 Nos. SPS each having 03 Nos. Flygt Submersible Pumps of 44kw Motor, 400 L/S = 7.6 MGD
Treatment Units I & II	02 Units, each Unit Detroiter, Grit Collector 03 Nos. Tanks 04 Nos. Trickling Filters, 01 No. Final Settlement Tank	02 Units, each Unit Detroiter, Grit Collector 03 Nos. Tanks 04 Nos. Trickling Filters, 01 No. Final Settlement Tank	Inlet Works
Detroiter and Sludge Drying Beds	04 Digesters each contain 03 Nos. Centrifugal Pumps, 12 Nos. Re-Circulating Pumps, 192 Nos. Sludge Drying Beds & 6 No SDL	04 Digesters each contain 03 Nos. Centrifugal Pumps, 12 Nos. Re-Circulating Pumps, 192 Nos. Sludge Drying Beds & 6 No SDL	46 Nos. Sludge Drying Lagoon
Description	**STP-I (SITE)**	**STP-II (Mehmoodabad)**	**STP-III (Mauripur)**
Power Energy Consumption	Monthly Unit Consumed / Billing TP-I + Colony = 167853kw – hr Rs.979753 P.M Total Monthly Billing = 1004770	Monthly units consumed / Billing PS-II Korangi TP-II 26930 kw hr Rs.288,158/= PS-I kw – hr Rs.1116750/=	Monthly Units Consumed / Billing MPS 104466 kw – hr rs.616657/= SPS 60920 kw – hr Rs.410285/=
Present Treatment.	Averagely 10 MGD	Nil Plant operation suspended due to deteriorated condition of plant machineries and become un serviceable from the considerable time and could not be put in operation due to financial constraints in KW&SB. However its rehabilitation is included under S-III Sewage Plan which is under pipe line. About 20 to 25 MGD incoming Raw Sewage Pumped / Disposed off to safeguard the Catchments Area from overflow being the depression and low level areas and as well as non availability of any bye-pass for the sewage disposal.	Averagely 15 MGD
Total Untreated Sewage falls into the Arabian Sea through	475.5 MGD		
Effluent Outfall	Through 54" dia 1. 5 Km long Pipe line & 3.5 K.M long open channel disposes into Lyari river	Through 1500 mm dia, 560 meters long pipe line disposes into Malir river	Through Effluent weirs Effluent Disposal into

Appendix A1:

BRIEF ON TREATMENT PLANT-I SHERSHAH (S.I.T.E)

Year of Const./Rehab./Up-Grad.	1964 / 1995
Catchment Areas of Plant	F.B. Area, Liaquatabad,Nazimabad & North Nazimabad, Part of Orangi Town Areas, Pak Colony etc. (Through Two Sewer Trunk Mains of 54″ & 66″ dia)
Design Capacity	51 MGD
Present in Flows.	Avg. 30 MGD
Treatment Process	Conventional Trickling Filter
Design Parameters of Influent	BOD 385 – 450 mg/L Suspended Solid 150 - 375 mg/L D.S 1000
Parameters of Effluent	BOD 80 – 90 mg/L S.S 75-80 mg/L D.S 1000
Effluent Outfall	Through 54″ dia 1. 5 Km long Pipe line & 3.5 K.M long open channel disposes into Lyari river

Appendix A2:

BRIEF ON TREATMENT PLANT-II MEHMOODABAD

Year of Const./Rehab./Up-Grad.	1963 / 1995
Catchment Areas of Plant	Old City Areas, Clifton, Saddar, Society Areas, Mehmoodabad, Part of Azam Basti, Dada Bhai Centre Society Areas (Through 3 No Rising Mains of 54" dia).
Design Capacity	46 MGD
Present in Flows.	Avg. 30 MGD
Treatment Process	Conventional Trickling Filter
Design Parameters of Influent	BOD 385 – 450 mg/L Suspended Solid 150 - 375 mg/L D.S 1000
Parameters of Effluent	BOD 80 – 90 mg/L S.S 75-80 mg/L D.S 1000
Effluent Outfall	Through 1500 mm dia, 560 meters long pipe line disposes into Malir river

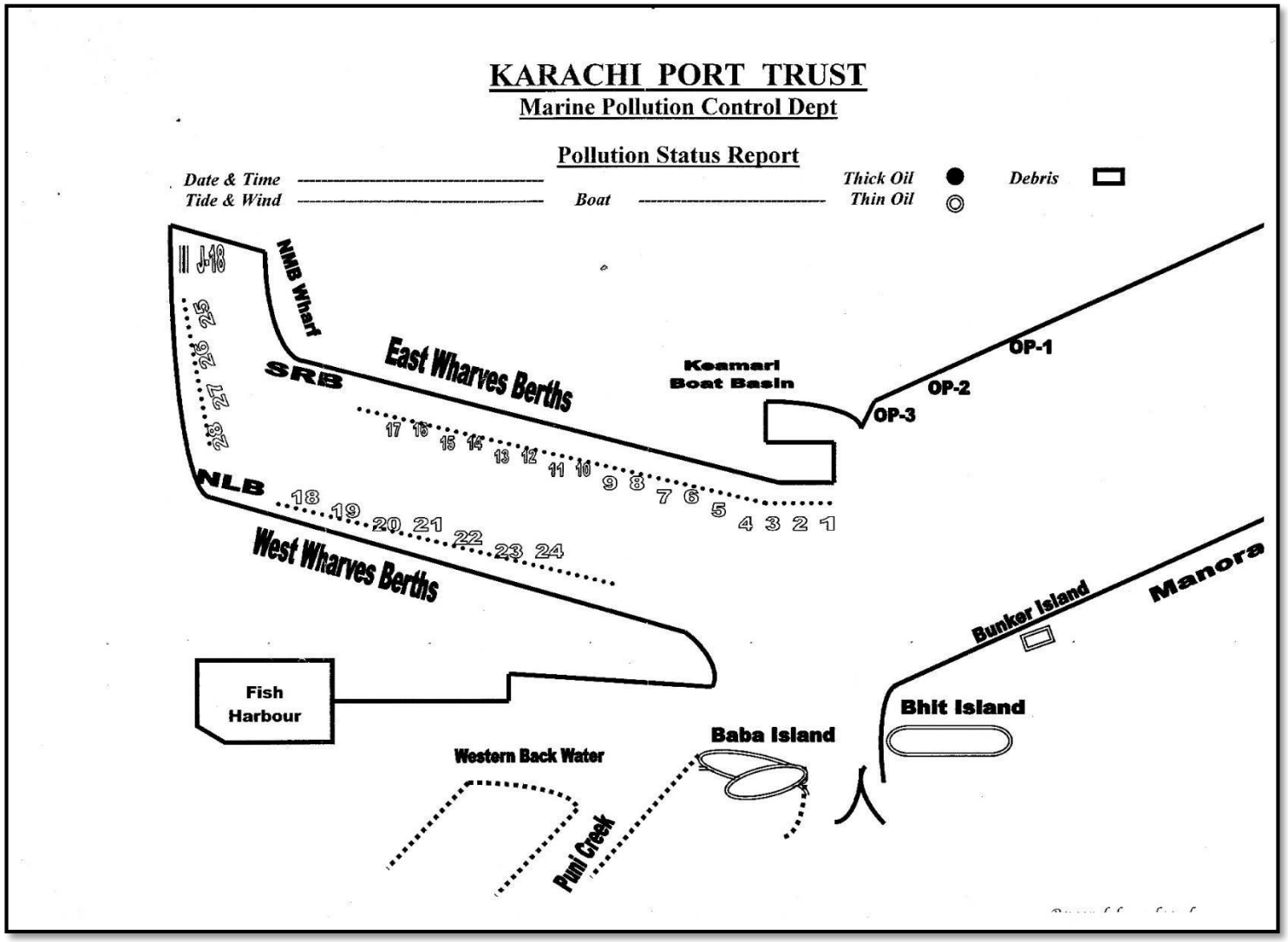
Appendix A3

BRIEF ON TREATMENT PLANT-III MAURIPUR

Year of Const./Rehab./Up-Grad.	1998
Catchment Area s of Plant	Lyari, Jamila PS, Chakiwara PS, UC-36 PS. Tannery PS.Garden East & West, Gulshan-e-Iqbal, Partly P.I.B.Colony, Soldier Bazar, Baldia etc. (Through Lyari Trunk Sewer Box Culvert) 2x2.5x13 KM long.
Design Capacity	54 MGD
Present in Flows.	Avg. 35 MGD
Treatment Process	Waste Stabilization Ponds
Design Parameters of Influent	BOD 385 – 450 mg/L Suspended Solid 150 - 375 mg/L D.S 1000
Parameters of Effluent	BOD 80 – 90 mg/L S.S 75-80 mg/L D.S 1000
Effluent Outfall	Through Effluent weirs Effluent Disposal into Arabian Sea

Appendix B:

Pollution Status Performa, Marine Pollution Control Department (Karachi Port Trust)



Appendix C:

List of Storm and Rain Water Drainage Channels of Karachi

S #	Name of Nallahs	District	Length	Width
01	Gujjar Nalla	Central	13.50 k.ms	20 ft to 80 ft
02	Orangi Nalla	Central, West	11.89 k.ms	100 ft
03	Shershah Nalla	West	1.80 k.ms	40 ft
04	Hub River Nalla Baldia	West	2.50 k.ms	8 ft to 10 ft
05	Kalri Nalla	South	2.13 k.ms	20 ft
06	Pitcher Nalla	South	4.57 k.ms	20 ft
07	City Nalla	South	0.33 k.ms	20 ft
08	Soldier Bazar Nalla	East + South	6.1 k.ms	20 ft to 70 ft
09	Frier Nalla	South	3.05 k.ms	30 ft
10	Nehr-e-Khayyam	South	2.74 k.ms	100 ft to 115 ft
11	Manzoor colony Nalla	East	3.66 k.ms	20 ft to 35 ft
12	Mehmoodabad Nalla	East	4.12 k.ms	20 ft to 80 ft
13	Zehri House Nalla	East	2.14 k.ms	20 ft to 40 ft
14	Korangi Industrial Nalla	Korangi	3.05 k.ms	10 ft to 30 ft
15	10,000 Road Nalla	Korangi	3.05 k.ms	12 ft
16	Mehran Highway Nalla	Korangi	3.66 k.ms	10 ft
17	Chakora Nalla	Korangi	7.02 k.ms	40 ft to 60 ft
18	Azeem Pura Nalla	Korangi	2.14 k.ms	20 ft
19	Pehlwan Goth Nalla	East	4.58 k.ms	20 ft
20	Songal Nalla	East	2.75 k.ms	12 ft to 50 ft
21	Haroonabad Nalla	West	3.66 k.ms	12 ft to 20 ft
22	Lalabad Nalla	korangi	2.14 k.ms	12 ft
23	Mouchko Nalla	West	7.32 k.ms	30 ft
24	12,000 Nalla	Korangi	2.14 k.ms	12 ft
25	Golden Town Nalla	Korangi	1.83 k.ms	12 ft
26	7,000 Road Nalla	Korangi	4.58 k.ms	12 ft
27	5,200 Road Nalla	Korangi	3.05 k.ms	12 ft
28	4,200 Road Nalla	Korangi	1.53 k.ms	10 ft
29	9,000 Road Nalla	Korangi	3.05 k.ms	12 ft
30	Mehran Cut Nalla	Malir		

Appendix E: OLS Estimation Regressions

Fish Handler's Group (Focus Group)

Source	SS	df	MS	Number of obs	=	100
Model	1654178.34	15	110278.556	F(15, 84)	=	4.98
Residual	1859108.88	84	22132.2485	Prob > F	=	0.0000
Total	3513287.22	99	35487.7497	R-squared	=	0.4708
				Adj R-squared	=	0.3763
				Root MSE	=	148.77

HC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	.6863058	1.530657	0.45	0.655	-2.357573	3.730185
MS	31.70818	43.34001	0.73	0.466	-54.47819	117.8945
INC	**.0391473**	**.0146373**	**2.67**	**0.009**	**.0100395**	**.0682552**
NOE	**-123.0402**	**38.47305**	**-3.20**	**0.002**	**-199.5481**	**-46.53237**
HHS	.3161358	5.09402	0.06	0.951	-9.813882	10.44615
HEDU	**-8.112261**	**3.94554**	**-2.06**	**0.043**	**-15.9584**	**-.2661231**
EXP	2.429582	2.255033	1.08	0.284	-2.054798	6.913961
DU	-71.92301	79.60926	-0.90	0.369	-230.2348	86.38874
MEAT	-0.380843	14.58067	1.09	0.979	-29.38121	28.61953
DW	**-88.84068**	**34.18413**	**-2.60**	**0.011**	**-156.8196**	**-20.8618**
SF	**-100.0698**	**33.05222**	**-3.03**	**0.003**	**-165.7978**	**-34.34187**
IC	-45.3561	29.18219	-1.55	0.124	-103.3881	12.67588
PSYMIMP	44.79781	58.59536	0.76	0.447	-71.72549	161.3211
TS	**147.9009**	**71.64867**	**2.06**	**0.042**	**5.419614**	**290.3821**
SE	20.55766	18.90907	1.09	0.280	-17.04509	58.16041
INS	12.16819	96.30401	0.13	0.900	-179.3429	203.6793
_cons	282.366	105.7355	2.67	0.009	72.09933	492.6327

Handcart Carrier Labor (Comparison Group)

Source	SS	df	MS	Number of obs	=	100
Model	30467271.1	12	2538939.26	F(12, 87)	=	4.14
Residual	53329526.3	87	612983.061	Prob > F	=	0.0000
Total	83796797.4	99	846432.297	R-squared	=	0.3636
				Adj R-squared	=	0.2758
				Root MSE	=	782.93

HC	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
AGE	-11.9236	25.68018	-0.46	0.644	-62.96573	39.11854
MS	77.99227	282.4423	0.28	0.783	-483.3924	639.377
INC	.0404432	.066229	0.61	0.543	-.0911941	.1720805
NOE	OMMITED					
HHS	**57.40796**	**23.89997**	**2.40**	**0.018**	**9.904176**	**104.9117**
HEDU	**-69.5308**	**24.96541**	**-2.79**	**0.007**	**-119.1523**	**-19.90934**
EXP	25.33731	25.46525	0.99	0.323	-25.27764	75.95226
DU	35.07541	286.856	0.12	0.903	-535.0819	605.2327
MEAT	**294.6601**	**70.91175**	**4.16**	**0.000**	**153.7154**	**435.6049**
DW	68.69987	172.7534	0.40	0.692	-274.6663	412.066
SF	**-357.1641**	**167.3438**	**-2.13**	**0.036**	**-689.778**	**-24.55031**
IC	**-65.64094**	**76.32009**	**-0.86**	**0.392**	**-217.3603**	**86.07839**
PSYIMP	**675.8059**	**292.0726**	**2.31**	**0.023**	**95.27994**	**1256.332**
TS	-54.3469	170.7334	-0.32	0.751	-393.698	285.0042
SE	OMMITED					
INS	OMMITED					
_cons	359.1084	695.0891	0.52	0.607	-1022.456	1740.673

Appendix F: Questionnaire

Environmental Degradation and its Impact on Fish Handler's Health

A Case Study of Karachi Fish Harbor.

I am Mansoor Muhammad Isani, student of MPhil Environmental Economics at Pakistan Institute of Development Economics (PIDE) Islamabad. I am doing thesis on **(*Environmental Degradation and its Impact on Fish Handler's Health*)**, as a partial fulfilment of MPhil degree requirement. I do herby request you to participate in this survey. Feel free to express whatever you feel appropriate. I assure you that you will be not to receive any suffer or loss due to what you have expressed in this survey.

Thank you!

Time:_____Date: _____

Section- I Socio Demographic Information		
Sr. No.	**Questions**	**Answers**
S1	Location: Harbor=0, Fish Market=1, Other=2	
S2	Age in years	
S3	Gender: Male=1, Female=0	
S4	Marital Status: Married=1, Unmarried=0	
S5	If married, then how much children do you have	
S6	What is your family size? (sharing Kitchen)	
S7	Education in years	
S8	Highest Education level from any person in family	
S9	Employment Status: Govt.=0, Private=1, Daily wages=2	
S10	Personal Income	
S11	Are you head of your family or not? Yes=1, No=2	
S12	How many members of your family are employed?	
S13	Total Family Income	
S14	What is your working Experience in this field? In Years	
S15	How many days in a week do you work?	
S16	How many hours in a day you prefer to work?	
S17	Do you use safety Equipment during work? (face mask, gloves , etc)	
S18	Are you getting any kind or insurance or additional benefit from Govt. or Firm for whom you are working? If yes, please specify. 1. Health Insurance [ ] 2. Life insurance [ ] 3. Injury Compensation [ ] 4. Medical Allowance [ ] 5. Education Allowance [ ] 6. Transport Allowance [ ] 7. Interest Free Loan [ ] 8. Occasional Bonus [ ] 9. Micro Finance [ ] 10. Any Other: _____	
Section- II General Health Information (Personal)		
G1	• Do you have any chronic disease Mentioned below CVD ☐ Diabetes ☐ Hypertension ☐ Kidney ☐ Obesity ☐ BP ☐	

	High Cholesterol ☐ Cancer Liver ☐ Asthma ☐ Any Other	
G2	Is yes to **G1**, is this your family disease? (yes =1 no=0)	
G3	Is yes to **G1**, since how many years you have this disease?	
G4	How do you treat your disease? 1. Traditional/Home Treatment [ ] 2. Went to hospital [ ]	
G5	If you went to hospital for treatment, then what kind of hospital you go? 1. Public Hospital [ ] 2. Private Hospital [ ]	
G6	How many times you visit in last 2 months?	
G7	For what disease you visit to doctor? (Please specify)	
G8	What is the source of first diagnosis? (in case of major disease) Self-Examination [ ] co-worker [ ] Through Doctor [ ] Blood test [ ]	
G9	Have you been admitted to hospital in last 2 months?	
G10	If yes to **G9,** for how many days you have been admitted in hospital?	
G11	If yes to **G9,** Do you have any attendant with you in hospital?	
G12	If yes to **G11**, what is the relation of attendant with you?	
G13	If yes to **G11**, what is the occupation of attendant?	
G14	If yes to **G6 or G9,** Are you completely recovered from disease?	
G15	If yes to **G6 or G9,** Are you working normal as you working before disease?	
SECTION- III FAMILY HEALTH INFORMATION		
F 1	How do you treat with disease? Overall in family 1. Traditional/Home Treatment [ ] 2. Went to hospital [ ]	
F 2	If your family member went to hospital for treatment, then what kind of hospital they go? 1. Public Hospital [ ] 2. Private Hospital [ ]	
F 3	How many times your family members visit in last 2 months to the hospital?	
F 4	For what disease your family member visit to doctor? (Please specify)	
F 5	What is the source of first diagnosis? (in case of major disease) Self-Examination [ ] family member [ ] Through Doctor [ ] Blood test [ ]	
F 6	Have your family member been admitted to hospital in last 2 months?	
F 7	If yes to **F6,** for how many days you have been admitted in hospital?	
F 8	If yes to **F6,** Do you have any attendant with you in hospital?	
F 9	If yes to **F8**, what is the relation of attendant with hospitalized person?	
F 10	If yes to **F8**, what is the occupation of attendant?	
F 11	If yes to **F3 or F6,** Are your family member completely recovered from disease?	
F 12	If yes to **F3 or F6,** Are that person doing routine work as he/she work before disease?	
SECTION- IV TREATMMENT SATISFACTION		
T1	Are you satisfied with your doctor? Agree [ ] strongly agree [ ] uncertain [ ] disagree [ ] strongly disagree [ ]	
T2	Are you satisfied nursing staff of hospital?	

	Agree [ ] strongly agree [ ] uncertain [ ] disagree [ ] strongly disagree [ ]	
T3	Overall are you satisfied with your treatment? Good [ ] V.Good [ ] Excellent [ ] average [ ] poor [ ] V.Poor [ ]	
SECTION- V FINANCIAL ASSISTANCE OR SOURCES		
F1	What is the source of financing for the cost of treatment? 1. Self [ ] 2. Pension [ ] 3. Remittances [ ] 4. Other family member support [ ] 5. Relatives [ ] 6. Private insurance [ ] 7. Health card [ ]	8. EOBI [ ] 9. Health loan on interest [ ] 10. Interest free loan [ ] 11. Savings [ ] 12. Baitul maal [ ] 13. Sadqaat [ ] 14. Sell your property or any expensive item to pay for health, if yes (specify)_____ 15. Any other (specify)_____
F2	How much do you spend on health from your disposable income? self	
F3	How much do you spend on health from your disposable income? Family	

SECTION-VI MEDICAL COST			
DIRECT MEDICAL COST (self and family)			
How much do you or your family spent on your treatment?		Self	Family
DMC1	Registration		
DMC2	Consultation		
DMC3	Lab test		
DMC4	Wounds dressing		
DMC5	Medicines		
DMC6	Any other (specify)		
DIRECT NON-MEDICAL COST			
DNMC1	Travel cost (each trip)		
DNMC2	Food and drinks during visit		
DNMC3	Communication cost (call, internet etc)		
DNMC4	Any other (specify)		
INDIRECT COST (PATIENT INDIRECT COST)			
PIC1	How many days within a month have you been absent from work because of your disease?		
PIC2	Number of visits to hospital for treatment or any other medical reason?		
PIC3	How much time it will take for a treatment in each visit? (total time from leaving home till come back)		
INTANGIBLE COST			
IC1	I am bothered by my sickness/disease(1=min, 10=max)		

1	2	3	4	5	6	7	8	9	10	

IC2	I think about my health more with increasing age Yes [ ] No [ ] Uncertain [ ]
IC3	I care more about myself after diseased 1. Yes, I care more because my family is dependent on me [ ] 2. Yes, I care but my family is not dependent on me [ ] 3. Yes , I care but I didn't take it much serious [ ] No, I don't care much about my health [ ]
IC4	I am always afraid of fatal disease because of nature of my work. Yes [ ] No [ ] Uncertain [ ]

SECTION–VII PHYSICAL & PSYCHOLOGICAL SUFFERING FROM DISEASE		
PPS1	I feel like I am burden to a person who is taking care of me (psychological suffering) Yes [ ] No [ ] Uncertain [ ]	
PPS2	I cannot sleep well because of thinking about my disease Yes [ ] No [ ] Uncertain [ ]	
PPS3	I feel embarrassed to let people know about my sickness Yes [ ] No [ ] sometimes [ ]	
PPS4	I ignore to be socialize because of my disease Yes [ ] No [ ] Sometimes [ ]	
PPS5	I feel like my family members ignore me because of my disease Yes [ ] No [ ] Sometimes [ ]	
PPS6	I feel like I am gone in isolation because of my disease Yes [ ] No [ ] Sometimes [ ]	
DRUG USE INFORMATION		
DUI 1	Do you use any kind of drug mentioned below 1. Chewing Tobacco [ ] 2. Cigarette [ ] 3. Alcoholic Drinks [ ] 4. Marijuana/ Weed (Bhang) [ ] 5. Hashish [ ] Any other (Specify) [ ]	
DUI2	If yes to **DUI1**, then at what time you use more drug During work [ ] in leisure [ ]	
DUI3	If yes to **DUI1**, how much do you spend on your drug addiction? please specify amount (Daily)	
Any of your kid are in the same profession? Yes [ ] No [ ]		
Do you promote your profession into your children or do you wish your children will come to your profession? Yes [ ] No [ ] uncertain [ ] It is up to them [ ]		
WATER & SANITATION FACILITY		
WSF1	Are you getting clean drinking water facility at work from government? Yes [ ] No [ ] Sometimes [ ]	
WSF2	Are you getting clean drinking water facility at home from government? Yes [ ] No [ ] Sometimes [ ]	
WSF3	Are you getting Sanitation facility at work from government? Yes [ ] No [ ] Sometimes [ ]	
WSF4	Are you getting Sanitation facility at home? (proper sewerage system) Yes [ ] No [ ] Sometimes [ ]	

Thank You

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