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Impact of poor institutional performance & indiscriminate disposal of untreated wastewater at Karachi fish harbor from Lyari River

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Abstract

Karachi fish harbor is the busiest harbor of Pakistan which deals with 95% of total marine fish and its products. It is also a hub of 90% of the total fish exports of Pakistan. Karachi port is adjoined with harbor which increases its economic importance as well as the risk of getting polluted. Study on institutional performance on indiscriminate disposal of wastewater was conducted. Data required in this research was collected from multiple sources such as published articles, project reports, newspapers, scientific reviews, and journal articles. Detail interviews were also conducted from the authorities of the concerned public institutions. Lyari River which ends near Karachi fish harbor, additionally, 12000 MT of solid waste is also generated daily which also ends in the sea and polluting the area. The level of pollution based on tested parameters shows that parameters are above NEQs accept the level of metals. Institutions working on environment and wastewater management are responsible for it. No fish is available in harbor water and fishermen have to travel farther for fish catch due to deteriorated water quality which increases their cost.

Keywords: Industrial waste, Water pollution, Fisheries

Introduction

Around the world, scarce natural resources are at risk because of unsustainable development and population growth. Decreasing natural resources increases the demand for them and damages ecosystem services. No doubt transforming technology, industrial advancement, and capital accumulation play a vital role to provide better environmental resources to the developed world but this privilege is only prevailing in the developed world (Dasgupta 2009). In developing countries like Pakistan, environmental issues are far beyond the priorities because in under developing and developing countries priorities are limited to manage the basic need of human existence and leftover are spent on infrastructure development.

According to Climate Change Vulnerability Index (CCVI), among the nations facing an extreme threat to climate change; Pakistan is ranked 8th in most vulnerable countries all over the world (Winges, Hutfils *et al.* 2018), the reason is lack of fundamental knowledge, poor healthcare, poverty, increasing population and political instability (Salman 2015).

Pakistan's ability to cope with Marine Pollution

All the mentioned reasons indicate that institutions are weak or ill to perform in Pakistan. Its institutional battles differ and are complex. They incorporate the politicization of the civil service, which has brought about foundations populated by unfit political nominees; a solid inheritance of military principle, which has undermined and degraded regular citizen apparatuses of administration; profound institutional dependencies on donor associations, which oblige the capacity of organizations to create long haul strategies; an absence of institutional income, thanks to some extent to Pakistan's woefully low tax base; the political class'

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inadequate enthusiasm for improving the public welfare.

The World Bank's most recent Worldwide Governance Indicators, given information from 2016, position Pakistan in the 29th, 27th, 20th, and 19th percentile for government viability, administrative quality, the rule of law, and for control of corruption, respectively (Kugelman 2018).

Pakistan is a resource-rich country with incapable leadership and poor administrative infrastructure leads to absolute economic and environmental losses and degradation. According to World Bank (2006), Pakistan is losing more than a thousand billion rupees every year just because of environmental factors which indicate that Pakistan's monetary losses in environmental, health and natural resources are at least 6 percent of GDP Karachi is the largest city of Pakistan and the sixth-largest city in the world with 16million people and according to Global Livability Index (2019), Karachi is amongst the 10 least liveable cities in the world due to living standards, transport infrastructure, crime, education, and healthcare, economic instability, and pollution (2019a). Karachi is also an economic hub of the country consists of approximately 7500 industrial units working to support and shares 25 percent of the national GDP with an average revenue collection of 65 percent of the total (Tariq 2015)but the chronic administrative infrastructure making the situation worse. All the residuals of production, as well as the city's consumption, ends in the sea without any treatment due to which marine ecology of the coastal area is degrading and its outcome can be seen in the export decline in fisheries (Kazmi 2019).1.3 Pollution at Karachi Fish Harbor

Pollution at Karachi fish harbor and in adjacent areas is a classic example of institutional failure from an environmental perspective because no authority is either aware of the severity of the issue or they are inexperienced to deal with the issue. The 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 coastal water without any treatment or partial treatment enters through Karachi Harbor via the 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 the harbor 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 harbor and adjacent waters due to which no oxygen value was found at Lyari river mouth (Adel, Hayat *et al.* 2009).

World Wide Fund (WWF) investigate the heavy metal pollution in coastal areas of Pakistan, the study was investigated the five hazardous metals (Zinc, Copper, Cadmium, Chromium, and nickel) which are dangerous for marine ecology and also for humans by consuming fish products. The study deeply examines and further concluded that Karachi Harbor is the 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. Cadmium is the most poisonous element after mercury for Aquatic life as well as for humans; this poison is also led at Karachi harbor 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 (Ibid.). Many studies were conducted on the environmental condition of port and harbor prove that harbor 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 harbor, 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).

A study on Turkey's Green port project indicates that Green Port/Eco port has extraordinary benefits for marine ecology as well as for the nation's economy because many EU countries restricted their trade with those countries which are following the ISO standards and international environmental standards(Akgul 2017).

Study Area

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 provinces further till 24 NM is bordering zone and after that up to 200 NM is under the authority of federal Government (Memon and Shah 2016).

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 harbor caters to the needs of near 75 percent of the local fleet. It handles about 90% of fish and seafood caught in Pakistan and 95% of fish and seafood exports from Pakistan (2018a).

Methodology

Data required in this research was collected from multiple sources such as published articles, project reports, newspapers, scientific reviews, and journal articles. Statistical data is mainly sourced from the food and agriculture organization's (FAO) database, the Pakistan bureau of statistics (PBS), and also from IUCN annual reports.

Detail interviews were conducted from the authorities of the concerned public institutions, some worth mentioning departments are Karachi Water and Sewerage Board (KW&SB), Marine Pollution Control Department (MPCD) KPT, Karachi Fish Harbor Authority (KFHA), Sindh Environmental Protection Authority (SEPA), Marine Fisheries Department (MFD), Fishermen cooperative society (FCS), Labor union of Karachi Fish Harbor, and Karachi Metropolitan Corporation (KMC).

Focus group discussions with fishermen and interviews from the individuals were also conducted to analyze the health issues fishermen facing due to deteriorating water quality at the harbor and adjacent areas due to untreated sewerage water flow into the sea.

Statistical data provide the patterns of production, trade, and domestic consumption of fish and fish products which indicates the patterns of growth in the fishing sector as well as exports. Interviews and focus group discussions are

focusing on the environmental issues that exist at Karachi fish harbor, it also provides us with efficiency, ability, dedication, and hurdles of the concerned departments towards environmental and ecological sustainability at the harbor.

Results and Discussion

This section covers the fish economy of Pakistan, marine pollution, and the role of different institutions in pollution and its control.

The fish economy of Pakistan

Fisheries play a crucial role in the national economy. Marine fisheries share about 504,810 tons in 2018 which is approx. 75 percent of total fish production. Fish and fish products were valued at US$ 266 million in 2010 which was around 1.2 percent of the total exports of Pakistan. In 2011 fish exports were at the highest level with a growth rate of 16 percent in terms of value and 6 percent in quantity as compared to the same period in 2010 (FAO 2019).in 2018-19 export base earning value from fish and fish products is US$ 293.887 million(2019b)

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 tons from which 52.19 thousand tons are captured and 15.74 thousand tons came from aquaculture before that it was peaked in 1999 which is 67.76 thousand tons from which 65.45 are captured fish and the remaining 23.0 thousand tons are produced from aquaculture (Figure 1) (2018b).

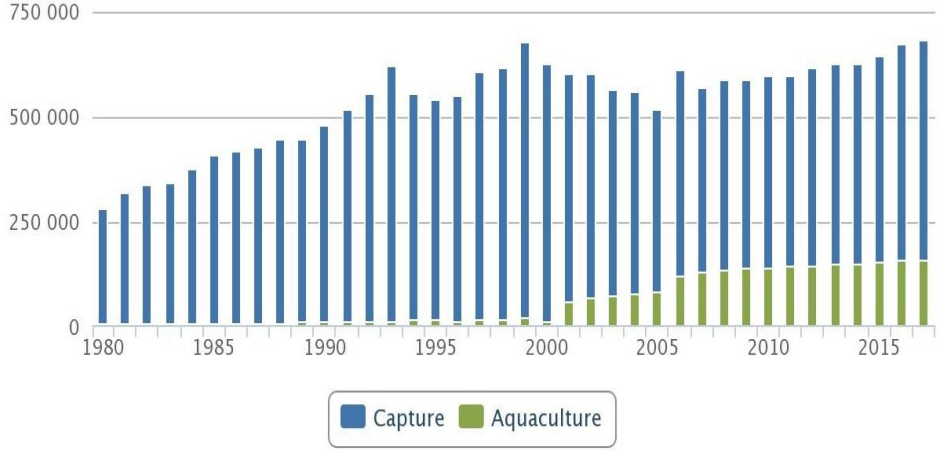

Figure I: Total capture and aquaculture production for the Islamic Republic of Pakistan (tons) **source: www.fao.org**

Marine pollution due to anthropogenic activities

Unfortunately; the only disposing source to Karachi is the sea, and every gallon of wastewater either it is municipal waste or industrial waste will end in the 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% of sewer discharge is generated by municipal sewer and the remaining is generated from industries. About 26.5% of effluent reaches the coastal waters through Gizri-Korangi creeks via Malir River and about 73.5% reaches through Karachi harbor via Lyari River (2017).

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. 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 spills 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 that broke near the Karachi port killing thousands of fish and birds in the area. The impact of the spill remains (Guriro 2016).

Institutions and their failure in sustaining coastal environment at Karachi 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.

Karachi Water and Sewerage Board (KW&SB)

The formation of the 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 every year (Kalhoro 2018).

Table 1: Overall performance of KW&SB and annual expenditure

	Type/Capacity	Operational Expense	Non-Operational Exp.	Employed /required (Staff)	Current Status
STP-I (1964)	Activation Sludge process – 51 MGD	4.7 million	2.75 million (Staff expense)	90/55	Nonfunctional since 2013
STP-II (1964)	Conventional Treatment Plant – 20 MGD	6.2 million	1.975 million (Staff expense)	72/55	Encroached since 2009
STP-III (1998)	Ponds Based – 54 MGD	6 million	1.32 million (Staff expense)	55/34	Partial/nonfunctional since 2013
KCETP	Conventional TP – 6 MGD				Operational
Total Employees: 13000					

Salary Expense: 4,825 million
Operational Cost: 462 million
Average Yearly Maintenance: 1433 million
Buildout Work: 57 million

Three sewerage treatment plants (STP) have been existing for the treatment of water but none of them is fully operational, one of the treatment plants has encroached, and the remaining two are non-operational since 2013 (Table 1) (Azam 2019).

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

Sindh Solid Waste Management Board (SSWMB) It has been made by the approval of Sindh Assembly under the Act of 2014 to set up a Solid Waste Management System in all urban areas of Sindh Province. The SSWMB is the sole authority to manage and transfer all types of solid waste under which industrial solid waste, municipal, and hospital waste are included in the province. 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, 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 (Kalhoro 2018).

Karachi Port Trust (KPT). Concerning sanitation and sewage, KPT is likewise experiencing sanitation issues. The sewage originating from the Lyari River and other real depletes opening into the harbor is expanding contamination in the ocean waters on an everyday schedule. The unexpected diminishing of pH esteems in the harbor 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 harbor. They stated that strict surveillance of the harbor is carried out twice a day during which pollution status form is filled (2014b).

Table 2: 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**

(2014a)

"Mai Kolachi Wetland Park" in 2010 with sewerage treatment plant was proposed by KPT. The establishment of this park not just saves the environment

but also makes 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 different drainage systems carrying approximately 100 MGD, which currently flows into the sea untreated. 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 to improve the sewage water treatment which acquires 14 acre-m^2land but also improves the scenic view of the area(Table 2) (2014a)

Behind all the plans currently, 86% of the total sewerage water is being depleted legitimately in the premises of Karachi harbor and coastline for the most part from all six sewerage drainage channels.

Sindh Industrial Trading Estate (SITE) Karachi comprises 2600 Industrial units, and their water sources are KW&SB, and through its seepage system discards fluid waste into the Orangi sewage rivulet and Lyari River which at last winds up in the ocean. The unfit parameters past the prescribed qualities are featured (Table 3).

Table 3: Waste Water Quality Analysis, Samples collected from Orangi sewerage drainage and Lyari river

Variable	Obs	Mean	Std.Dev	Min	Max	NEQs
TDS(mg/l)	15	8348	10719.56	957	33728	3500
pH		7.3333	.3677473	6.9	8.2	6-9
COD(mg/l)		878.333	432.4777	494	2088	150
BOD(mg/l)		250.7333	190.8685	16	740	80
TSS(mg/l)		944.9333	789.3985	174	2560	200
CU(mg/l)		.0461327	.0238056	.0081	.08461	1.0
NI(mg/l)		39.39278	152.1341	BDL(0)	589.3247	1.0
Fe(mg/l)		.36814	.3440112	.0414	1.0211	2.0
Zn(mg/l)		.0492433	.061182	.00286	.1902	5.0
Mn(mg/l)		.1641133	.0475239	.0828	.2275	1.5

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

Source: SWC 2018

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.

Sindh Environmental Protection Agency (SEPA) has been established by the Sindh Government under Sindh Environment Protection Act, under section 5 of the 2014 Act. The primary Responsibility of SEPA is to guarantee authorization of Sindh Environmental Quality Standards. There is a list of duties under SEP ACT that has to be fulfilled by the Agency but unfortunately, not a single responsibility has been completed or made progress under SEPA (Mughal 2017).

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 (Mirani 2019). It is working with an intense lack of human and money-related assets; thus the association is limited to play out its prime obligations. The budgetary designation of 2016-17 for the entire arrangement of SEPA for Province) is Rs.168million, out of this, workers-related consumption is Rs.142million, and the 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 (Ibid).

There are also some other public sectors which are neglected before or not considered responsible for choking the system and directly or indirectly affect the operations of the above-mentioned authorities and leads to the environmental degradation at the harbor like Sindh Building Control Authority (SBCA), Railways, Karachi Development Authority (KDA) and Defense Housing Authority (DHA) (Kalhoro 2018).

Conclusion

The study concluded that the level of pollution at Karachi Fish Harbor and Lyari river is above NEQ Standards, the level of metals is under NEQs and the reason for that is the nature of industries located in the SITE area. Due to the declining water quality of harbor and adjoining areas, quantity, as well as the quality of fish, is reduced and it is directly affecting the small fishermen, it is not just affecting fishermen but also declining the exports. European Union rejected a fish and fish product from Pakistan because of the level of metals and other hazardous substances were found in it which are not meeting EU's quality standards.

The performance of the institutions working on the environment is very poor it seems that there is no authority to look after the issue. It is also concluded after interviewing several authorities that there is no communication between departments and almost all authorities blame each other, further political connections between politicians and industrialists give them the leisure to violate the environmental laws under the corrupt system. Silence on the encroachment of Sewerage treatment plant (STP II Mehmoodabad) is making the picture more suspicious and the status of SEPA reflecting the willingness and seriousness of the provisional government of Sindh on environmental issues.

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