

The evaluation of water and soil contamination and their impact on agriculture at the coastal belt of Indus Delta, Pakistan

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ABSTRACT

The Coastal belt of the Arabian Sea is under the thread of Surface Sea Water Intrusion (SSWI) since a half century, the SWI impacts on soil and agriculture, and effects are observed over all the Country as well as worldwide. The Water Rout Business (WRB) of Pakistan, India, Gulf countries including Somalia and Iran depends on Arabian Sea. The Arabian Sea is famous leeway of the third largest Indian Ocean. Except this, most populated cities Karachi and Mumbai are also situated at the coastal belts of the Sea. The Qasim Port Karachi, is one of leading Sea Port of country, the port is registered for growth of 6.44% and handled 41.350 million tons of cargo at the end of 2013-14. The liquid side, a total of 13.108 million tones liquid bulk cargo was handled. The port handled 1.591 million TEUs and ships handling has also increased by 77 ships at the close of 2013-14. Increasing of urbanization and a number of restaurants on the coast belt about 6,000 industries in Karachi release their effluent in 12 drains; which directly entered in the Arabian Sea.

The study area can be divided by two coasts, coast of Sindh and Balochistan Province, the area of Sindh Province is dominated by mangroves forests (Timour Ja Bella) and coastal Creeks. The Rehri Creek is main source of toxic pollutants (*Polluted Water*) reached at the mangrove areas. Polluted water of Karachi city especially from Industries, Cattle colonies, and domestic, effects to marine life (*fauna & Flora*) and also severely effects to Mangroves forest of Indus Delta. Except this, agricultural value of study area is also badly affected by Sub-Surface Sea Water Intrusion (SSSWI). Soils and water samples from different locations of study area were collected to analyzed pH, EC and TDS. The Laboratory examined data of Soils and water shown that TDS data ranging from 29000 to 42000 PPM. Soil, agriculture and Marine life of study area being destroyed by toxic pollutants. Except this, Indus Delta is also degraded by industrial and environmental pollutions (Paracha, et al, 2019). The Satellite images are shown that 38% of the Indus Delta and Mangroves has been removed. In this framework, aims of this paper to present an overview of all major environmental issues are being faced by research area and find out the scientific solution.

KEYWORDS: water contamination, Coastal Belt, Arabian Sea, Soil, Agriculture, environmental

INTRODUCTION

Karachi is a capital city of Sindh, Pakistan located at the bank of the Arabian Sea, with 14, 9 10,352, human populations (Pakistan Bureau of Statistics, 2017). Karachi is the among top three mega cities of the world by population and its 7th number in world as Urban sector (World Urbanization Prospects, 2009). The Karachi spread over 3527 Sq: kilometers (Karachi Gallery, 2014), as per record of the Pakistan Bureau of statistics, population density is 2852.5 persons per sq.km, The city is

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key of business of the Pakistan, which donates 43% of GDP, 72% of Income Tax Revenue except this 62% of Sales Tax Revenue of the country (The Nation, 2017).



Fig: 1: Location of study area

The coastal belt of the Arabian Sea (03Kilometers) is polluted by the Karachi Industrial Zones, Street Dump and Animal Dungs from cattle colonies etc. The drainage from Industrial Zones of Orangi, S.I.T.E area Korangi, Landhi and Karachi Export Processing Zone (KEPZ drain out into the Arabia Sea. It is reported by the Largest English Newspaper that more than 72,000 tons of animal dungs polluting the city and the Sea Water in day (Siddique, 2009). Except this, fishing trawlers, oil spills from the ships, and accidents of oil tankers are common issues at the Karachi Sea Port (KSP), so that 2003, 2010 and 2014 were accidental years for KSP. In 2003, 35,000 tons has been oil spilt in the Sea from Iranian oil tanker Tasman, and In 2014, the National Assembly of the country has taken seriously noticed that more than 550 million gallons of polluted water of city sewage in the Sea in a day, this polluted water affecting flora and fauna and degraded the environmental balance (Wells and Coeman, 1984).

A survey was conducted by daily Dawn Karachi in 2010 that at the two nautical miles from the coast of the Arabian Sea that no any type of fish found only by the human activities and non-availability of the fresh water, due to high pollutants. A part from this, a few contaminated sea food of Arabian Sea is also consumed by human, which is cause of anemia, kidney failure and brain damage also (Nasir,2010) (Daily dawn,2010).

The Delta forest is responsible to maintain the ecosystem and clear and clean the environmental .population of Karachi and surrounded cities. On the contrary, Indus Delta and Mangrove forest are facing acute shortage of fresh water in River Indus. The delta extends on 41,440 km² and contains seventeen creeks, extensive slush, with clay and silt soil (Chandio, 2011). Once the creeks were rich with fresh water of River Indus, but since last 20

years, stream flow of the river has been reduced due to construction of mega projects.

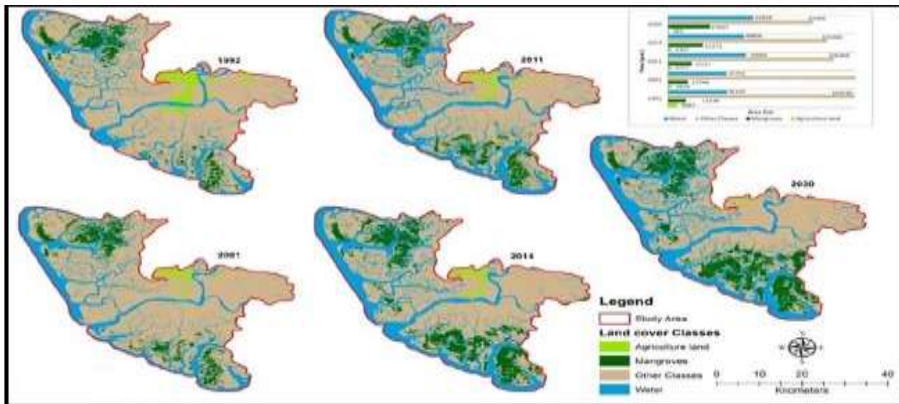


Fig.2: Degradation of Indus delta 1992-2014

Source: (Siyal, 2018).

Mangroves forest and Indus Delta are both considered as fifth the largest wetland in the world (Abbasi, 2002). Contamination at the coastal belt of the Arabian Sea near the Karachi is highly recorded, the surface and sub-surface intrusion of brackish water of the Sea in creeks is very dangerous. Coastal estuaries and creeks are an ideal place of prawn's fish and were famous as Nursery of Prawns, but due to high contaminated water, the Prawn fish is now just dream. Coastal belt of the Sea shared its significant contribution in fishing sector of Pakistani market, it contribute the 67.36 %, of total caught fish in Pakistan (Anwar and Chandio 2014). But since 1999 to 2000, the annual production of fishes from region has been reduced. Pakistan earned eight billion rupees from fishing sector from the coastal area of Sindh (Govt. of Sindh, 2009). At present Pakistan is exporting the fish more than 50 countries over all the world (Memon, 2005).

Except this, the intrusion of Sear water is observed in Sub-surface, main income source of inhabitant is fishing and agriculture, but now agriculture of the region is also facing the problems. At present, the situation is entirely changed, the soil has been change, coastal estuaries and creeks are completely filled with polluted water of the Sea. An average rate of surface/sub-surface intrusion of the Sea water towards land is 15 acres per day. Maximum pH 9.5 were recorded which will not support to any type of agriculture (Altaf et al 2019). The Provisional Government of Sindh is taking Rs: 5656.247=/million losses in a year (Govt. of Sindh, 2009) Chandio, 2014).

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METHODOLOGY

The deltaic region extended from Karachi to Sir Creek. It covered latitude $23^{\circ} 59.34' N$ and longitude $67^{\circ} 24.34' E$. For laboratory analysis, twelve (12) soil and water samples were collected from different locations to measure the three parameters. For Soils analysis, 12 holes were dug, soil samples were collected from 3 different depths:

1: 0-15cm

2: 15-30cm and

3: 30-45cm, the samples were mixed to each other with respective depths (Chandio, 2011).



Fig.3: Indus Delta, Soil and water sampling area

Source: Author 2015

The collected soil samples were covered in clean and purified bags, the samples were air dried in a room below the 200 Volts electric bulb. After a week, air dried soil samples were changed in powder form. Powder form of soil were mixed in purified distal water (26 grams of filtered soil mixed in 300 millimeters of distal water) the mixing process of soil and water was done by help of different Conical Flasks, all the Conical Flasks were fixed on Mechanical Shaker and shacked by Mechanical Shaker for 30 minutes. The main purpose of this methodology to measure the pH, TDS and Electric Conductivity of soil.

1: Soil pH was calculated by help of pH meter (Hanna Instruments HI 8014).

2: Total Dissolved Salts (T.D.S) were measured by help of TDS tester (Hanna Instruments HI 98301) and

3: Electrical Conductivity (E.C) calculated by EC tester (Hanna Instruments HI 98304) and Total

Table 1: Soil analysis

S.N	Geographical Location	pH	E.C (ds/m ⁻¹)	TDS (ppm)
01	24°48'12.27"N 67°14'22.71"E	7.9	9.0	2350
02	24°45'24.75"N 67°17'34.86"E	8.5	7.1	3900
03	24°46'21.90"N 67°21'29.22"E	8.7	9.2	3550
04	24°46'17.99"N 67°23'54.14"E	7.6	4.8	2560
05	24°44'43.69"N 67°21'56.84"E	7.9	7.2	2740
06	24°41'49.05"N 67°15'58.45"E	8.7	8.9	3200
07	24°39'39.28"N 67°12'15.93"E	7.8	8.1	3190
08	24°37'8.93"N 67°16'21.49"E	7.5	4.3	1770
09	24°42'24.49"N 67°26'56.41"E	8.1	9.0	2900
10	24°40'28.25"N 67°23'17.25"E	7.9	6.7	2930

Source: author 2015

Similarly, For the water sampling and laboratory analysis purpose about, 500 milliliters of water were collected from 2 -15 meters depth in air tight purified plastic bottles during the low tide in the winter season (industrial waste, animal dung and street dump drained during this time but during the high tide brackish water of the sea enter in creeks, so the pH, E.C and TDS were easily calculated during this time).

Immediately, the water samples were spiked with 0.1M HgCl₂ solution to avoid to any foreign organic and inorganic matter. For accurate laboratory result samples were filtered through Whitman 42 and 0.45 micro-cellulose filter paper. All water samples were analyzed at above-mentioned laboratory. Same three testes pH, TDS and EC were calculated. pH was conducted by pH meter, TDS test was conducted by TDS tester and EC test was conducted by EC meter of Hanna instruments.

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Table.2: Result of water samples

S.N	Sampling Location	pH	E.C (ds/m)	TDS (PPM)
01	Indus Delta	8.3	18.6	3500
02	Giziri Creek	7.9	12.2	2550
03	Clifton	8.2	10.1	3480
04	Manora	8.5	13.5	3700

Source: Author 2015

RESULTS

12 Soil samples were collected from the estuaries of River Indus, where River Indus ending. This area is almost filled with riverine water, the area is famous for the agriculture belt due availability of river water. All samples were totally different to those samples which were collected from the coastal belt as shown in table 1.

Agriculture:

This valuable land of the Delta is ideal for agriculture and fruit purpose, especially for the rice, wheat, barley, sugarcane, millet, banana, maize, coconut, mango and guava. From the Kotri downstream to Arabia Sea, about 16 kilometers wide coastal belt of Badin and Thatta districts are under the cultivation of different crops. But in both districts, main source for irrigation is only Indus River. Unfortunately, all crops are under crises due to shortage of fresh water. Apart from this, subsurface water is creeping towards the coastal area, so that due to creeping/intrusion of sea water the crops are decreasing productivity year by year.

Table.3.

Parameters	1	2	3	4	5	6	7	8	9	10
pH	7.5	7.4	7.5	7.1	7.1	7.3	7.2	7.5	7.4	7.2
EC (ds/m ⁻¹)	3.2	3.5	3.1	3.2	3.2	4.1	4.3	4.1	5.1	3.1
TDS (ppm)	1680	1990	2070	1850	2130	1030	1780	2190	1750	1690

Source: Author 2015.

Fig.4

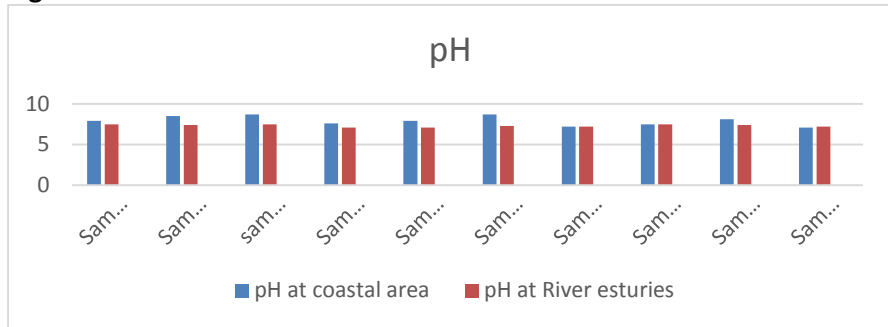


Fig.5.

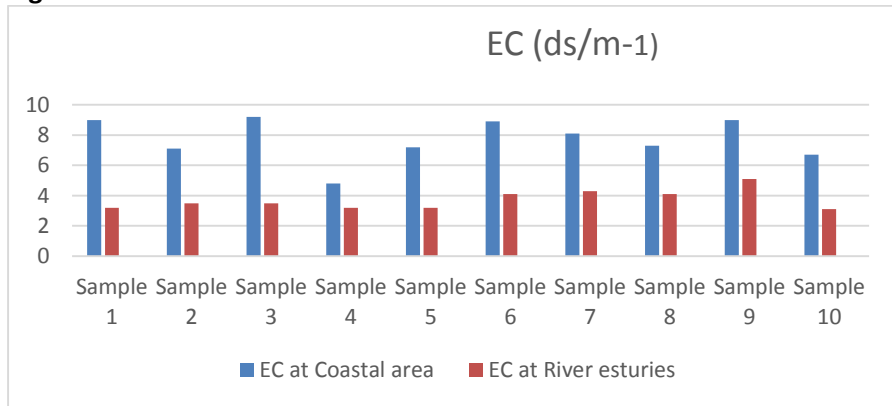
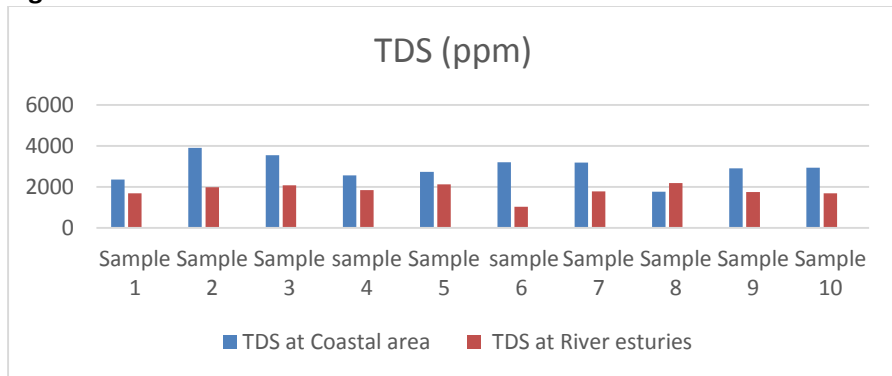


Fig.6



DISCUSSION

The study area is hazardous for marine life especially for fishing. Fishing industry is a leading and contributes a vital share in the GDP of the country. Main cause of the water contaminations at the coastal area of the Karachi is only due to industrial waste, animal dungs, untreated domestic water, agriculture run-off and oil tankers etc. This is only due to high populated concentration. The Sea water intrusion is affecting the surface soil as well as

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sub-surface. The results are showing that at present soil of the study area is not able to agriculture. Pollutant can cause chronic impacts and long term effects if the accumulation rate exceeds the natural decomposition rate. Chronic impacts are not necessarily restricted to a zone around the outfall but can occur in the whole water body near the coast. The pH values prevalent during chemical cleanings are toxic if directly rejected. The chemical mix used for local R.O plants membrane cleaning can have highly toxic local effects as well as long term impacts due to poorly degradable constituents. Furthermore, complex collaboration and cumulative effects of different pollutants add another uncertainty factor to the real extent of environmental impacts. Thus the results of present studies should be treated as a minimum impact. But the soil has ability to grow any type of the crop, vegetation and fruit. Before this, all types of the crops were cultivated at the Delta.

CONCLUSION AND SUGGESTIONS

Since last two decades the River is dry (except abnormal years), at present, salinity situation is worst in the Creeks of the delta and estuaries of the Arabian Sea. Result is showing an amount of Total Dissolved Salts (TDS) is more than 42,000 PPM. Whenever the WHO limit is 1500 PPM. But this amount is increasing day by day (Brohi, 2004). Main source of fresh water at study area is river Indus; the river can washout to contaminated water and it make fresh to the entire coastal belt of the Arabian Sea. If the flow of the river water can properly managed for the delta creeks and estuaries, the research area may free and reduce the pH, TDS and EC of delta, creeks and estuaries of the Arabian Sea.

REFERENCES

- Abbasi, A. G. N.** 2002. Restoration of Singh's Primary Rights over River Indus, 18th Convention of SANA, Cherry Hill, NJ.
- Altaf, A, S.** 2018. Climate Change: Assessing impact of sea water intrusion on soil water and environment on Indus Delta using GIS & Remote sensing tools.US. Pakistan Center for Advanced Studies in Water (USPCAS-W), MUET, Jamshoro, Pakistan.
- Altaf A, S, Ghulam S, S, and Pirah S.** 2019. Analysis of Indus Delta Groundwater and Surface water Suitability for Domestic and Irrigation Purposes, Civil Engineering Journal Vol. 5, No. 7.
- Anwar, M.M. Chandio, N.H.** 2014. Economic deprivation of Indus river delta, Sindh, Pakistan: Causes and suggestions, Research journal of *Science International Lahore*, 26(2), 885-890,

Brohi, S. 2004. Socio-economic Impact of Reduced Indus Flow on Indus Delta and Its Local Communities," National Seminar, University of Sindh, Jamshoro, January 15-16.

Chandio, N.H. 2014. Economic deprivation of Indus River delta, Sindh, Pakistan: Causes and suggestions: Science International Lahore published, Sci.Int (Lahore), 26(2), 885-890.

Chandio, N. H. 2011. Degradation of Indus River Delta, Removal of mangroves forest and its causes: A case study of Indus River delta: Sindh University Research journal: University of Sindh Jamshoro, Sindh, Pakistan: Vol: 44, no.4.

Chandio, N. H. 2011. Degradation of Indus River Delta, Removal of mangroves forest and its causes: A case study of Indus River delta: Sindh University Research journal: University of Sindh Jamshoro, Sindh, Pakistan: Vol: 44, no.4

Daily Dawn, Karachi. 2010. Poisonous waste polluting Karachi Coastal area. Government of Sindh, Irrigation department. 2009. www.sindhpn.gov.pk.

Memon A.A. 2005. Devastation of the Indus River Delta: Environment and water resources, seminar Alaska, USA.

Muhammad A, P, Mushtaq H, N, K, Muhammad L, A, Mehwish K. 2017. Degradation of Mangroves Ecosystem of Indus Delta, International Journal of Scientific & Technology research, vol. 6, Issue 02, pp-106-108.

Nasir, J. 2010. Environmental issues of Arabia Sea and role of Karachi, EPA, and the Dawn Karachi. pp 5.

Pakistan Bureau of Statistics. 2017. Government of Pakistan, <http://www.pbscensus.gov.pk/>

Siddique, A. 2009. Heavy metal toxicity levels in the coastal sediments of the Arabian Sea along the urban Karachi (Pakistan) region, Marine Pollution Bulletin 58, 1406–1419

The Nation. 2017. Karachi contributes Rs: 16 billion to GDP a day (editorial page), pp 3.

World Urbanization Prospects. 2009. Revision (online data)". Retrieved 11 May 2011. Wells, J.T and Coeman, M. 1984. Deltaic morphology and sedimentology, with special references to the Indus River delta In: Marine Geology and Oceanography of Arabian Sea and Coastal Pakistan. Von Nostrand Reinhold Company, New York, pp, 85-100.