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Patterns of GroundWater Pollutions along Charrar Drain in Lahore - Pakistan

Abstract

In 21st century, poor drainage system mainly exists because of the increasing population and urbanization which is associated with deterioration in sanitation and environmental health conditions. The aim of the present study is based on the analysis of groundwater pollution along Charrar drain and its impact on health of local residents. A total of eleven (11) water samples were gathered from various locations along drain. Different Physical (PH, temp, TDS, TSS), Chemical (BOD, SO4, CT, PO_4) micro biological (total coliform, Fecal coliform, E.coli) and Metals (Cr, Cd, Pb and Fe) were analyzed in order to determine water quality. The spatial distribution of water quality parameters was presented using geospatial techniques. Logistic regression model was applied to check relationship between distance from drain and disease. The deduced results revealed elevated values of Total coliform (7.8-11.0 MPN/ 100ml), Fecal coliform (4.5-

7.8 MPN / / ml) and E-coli (2.02-4.5 MPN/ 100 ml), while Physical and Chemical were parameters were within permissible limits of (WHO, 2011). Several water borne diseases reported among children were Cholera (8%), diarrhea (11%), hepatitis A (32%), Malaria (20%), Typhoid (22%) and eye allergy (7%). The model revealed 34.7% (Nagelkerke R^2) of variance in disease and classified 80% of cases.

1. Introduction

The major source of drinking water for the people all around the world is groundwater. About 2 million tons of domestic, agricultural and industrial effluents dispose of in water bodies without proper check and balance on daily basis [1]. Throughout the world especially in Asian countries most of the agricultural fields are directly receiving wastewater which in result damage to the agricultural products. This waste water is directly being pumped into the river channels, drains and water bodies from the industrial and the human settlements. Several natural water bodies have been contaminated worldwide by minerals, heavy metals and organic waste imposed by sewage and other domestic waste [2].In poor sanitation and drainage area, water runs over the ground during rainstorms, picks up faces and contaminates water sources. This contributes a pivotal role in the spread of diseases such as cholera and typhoid, and may increase the likelihood of infections from soil contaminated feces.

In Pakistan water pollution is one of the major threats to public health in Pakistan. 40% of all diseases in Pakistan were attributed to inferior water quality [3, 4].In Varanasi, India it was identified that the repeated accumulation of the trace elements in soil has the ability to enter the food chain when absorbed by plants. This contamination have identified in Varanasi, India. The research was conducted at three selected sites which were irrigated either by applying treated or untreated wastewater. The selected sites were tested for several parameters including Cd, Cu, Zn, Pb, Ni. The results revealed extreme impacts of waste

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water on vegetables which were detected with the higher concentration of Ni, Pb and Cd [5].

All drains in Punjab, carrying saline water is due to high values of Total Dissolved Solids (TDS), Sodium Absorption Ratio (SAR), chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) [6].There is no proper and regular monitoring system for the separation of municipal wastewater from industrial effluent in Lahore, Pakistan They directly flow into open drains/Nallas, which then flow into nearby natural water bodies [7].This study highlights the impact of Charrar drain on groundwater and its adjacent areas due to the direct discharge of industrial effluents and sewerage of different housing societies.

2. Materials and methods

2.1 Study Area

Charrar drain of Lahore-Pakistan is selected study area for this research study. It starts from Barki Road, Baowala Pind near Allama Iqbal International Airport (31.534°N 74.435°E) and eventually drops into the biggest Hudiara drain (31.396°N- 74.366°E) which ultimately joins River Ravi.

2.2 Choice of the study area

Groundwater along Charrar drain is extremely contaminated due to industrial effluents discharging from local chemical industries. Several manufacturing Industries along with various houses are found adjacent to the Chararr drain. The inhabitants living around Charrar drain mainly depend on groundwater, thus the groundwater being part and parcel of our lives, was focused for this research study. Due to assimilation of the contaminated water into the groundwater the quality of groundwater near Charrar drain sampling sites are affected badly and slowly becoming unhealthy for drinking purposes. Such contaminated groundwater quality is a substantial risk to not only the surrounding natural environment but also health of local residents who are constantly using groundwater for drinking and domestic purposes.

Fig 1 Location of Sampling sites in the Study Area Sampling

Random sampling procedure was adopted for the selection of sample sites. Eleven (11) water samples were taken to study the physical, chemical and microbial parameters in which three (03) water samples were collected from drain. These were selected from the starting point of the drain, midpoint and the end point of the drain and eight (08) water samples were collected from different houses located along the drain.

Drain Water Sample Points	
Sample 1:	Baowala near Barki road Lahore
Sample 2:	DHA phase 8
Sample 3:	Nishtar Colony near Hudiara Drain
Drinking Water Sample Points	
Sample 4:	Elahi trading company salt factory Baowala
Sample 5:	Defence phase 8 Numberdar Chauhdry Shaukat Ali House
Sample 6:	House no. 40 street 2 M.Pura G road Lahore
Sample 7:	DHA MT workshop S block
Sample 8:	Gullugran
Sample 9:	Fallak Textile Pvt. Ltd.
Sample 10:	Innovative Apparels
Sample 11:	Darul-Hikmat Degree Colleges.

Table 1: Sampling sites of study area

The parameters of water samples were analyzed at PCSIR (Pakistan Council of Scientific and Industrial Research) Chemistry and CEES laboratory (College of Earth and Environmental Science) in the University of the Punjab by using standard methods [8, 9].To evaluate the social economic conditions and sources of water being used by the residents along study area, a formulated questionnaire was designed for this purpose. A total of 100 questionnaires were administered, 42 questionnaires were filled by the females while 58 were filled by the males. Various questions were asked from the target population about the quality of their drinking water, socio-economic information and reported waterborne diseases.

Table 2: Instruments / procedures used for the analysis of effluents of the drain water

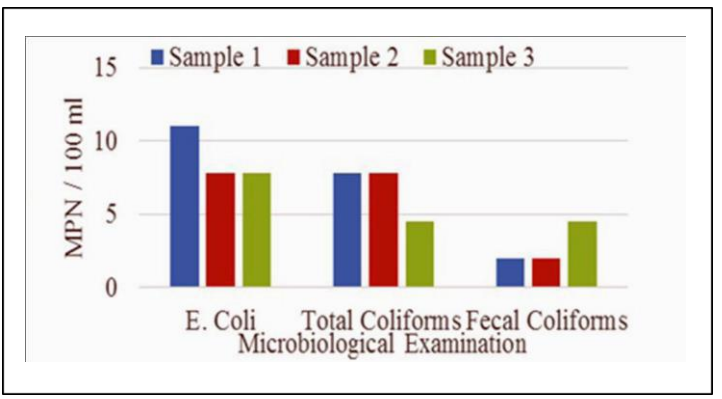
Sr.	Parameter	Instrument/Procedure
1	Temperature	Thermometer
2	pH	pH meter
3	TSS	Filtration/USEPA 8158 &8164
4	TDS	TDS meter F200 (6032M.N)
5	Electric Conductivity	EC meter(H198303 HANA)
6	BOD	DO- AD630 ADWA
7	Heavy metals (Cadmium, Chromium, Lead)	Atomic absorption Spectrometer (Perkin Elmer100)
8	Iron.	Atomic absorptionSpectrometer.
9	Chloride, Sulphate and Phosphate	T90+ UV/VIS Spectrometer PG instrument limited.

3. Results and discussion

The processing of data was done using Arc GIS 10.2, Microsoft Excel and SPSS 18" and to provide comprehensive understanding of the nature, rate, trends and location of Groundwater pollution. In order to show spatial patterns of Groundwater pollution, interpolation technique was employed. The analysis of data is a significant step of scientific research method as it leads towards final results. The main abnormalities found were the high concentration of Coliform and E.coli which increased the prescribed limits [8].These abnormalities were more associated with the drinking water lying within the distance of 1-30 feet from drain.

The micro biological analysis generated from the gathered results revealed the severe impact of Groundwater pollution on human health along study area. This was mainly due to the high concentration of microbial parameters including E. coli ranged from (2.0 to4.5 MPN/100ml), Total Coliform (ranged from 7.8- 11.0 MPN/100ml) and fecal Coliform ranged from (4.5 to 7.8 MPN/100ml) as shown in figure 2,3 ,4 and 5 respectively.. The sources for coliform are fecal material of human and other animals (Doyle, 2006) .Coliform cause water borne pathogenic diseases including dysentery, typhoid fever and hepatitis A (Fresno, 2009). It shows an alarming stage especially for the local residents who are using the water.

Besides microbial, the results of the physical and chemical parameters lie with the



permissible limits of (NEQS, 2000) limit. The field survey report revealed cholera (8.1%), Diarrhoea (10.8%), Hepatitis A (32.4%), Malaria (20%), typhoid (21.7%) and skin allergy (7%) as shown in figure 6**.**

Fig. 2 Microbiological Examination of Charrar Drain

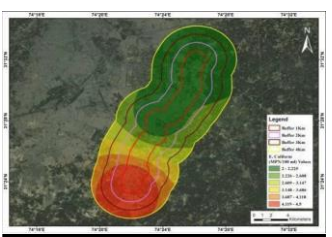


Fig 3: E.Coli

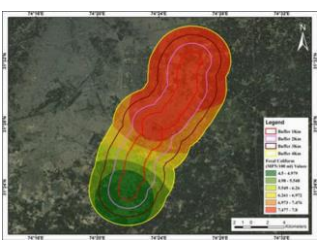


Fig 4: Fecal Coliform

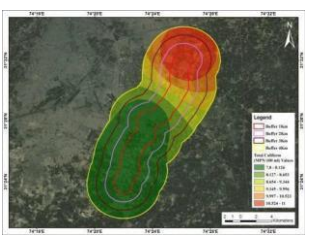
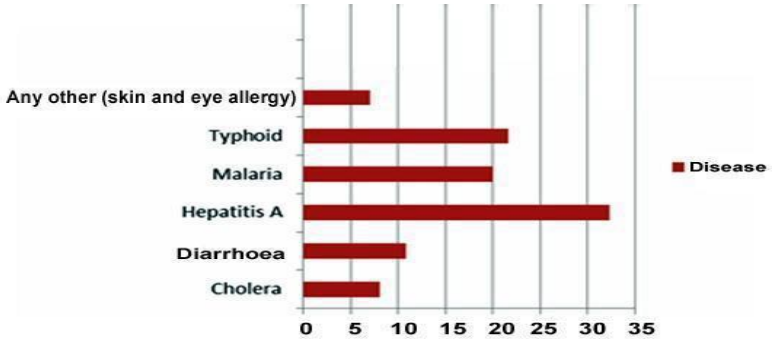


Fig 5: Total Coliforms



This situation was found to be quite alarming for the local residents who are living in the vicinity of drain area. A great correlation was found in distance factor from drain and diseases of the people. The inferior biological quality and concentration of the pathogenic bacteria in the Groundwater samples confirmed the substandard of Groundwater quality and their possible health risks metal contamination was also evaluated to check the level of Iron, Cadmium, lead and Chromium in which only iron was deducted at few sample sites because of high intensity of bulk industrial effluents coming directly without proper treatment [11].Main health issues found among the local residents of the study area were water borne diseases including diarrhea, typhoid, dysentery, skin allergy and hepatitis A. Thus the water quality was found to be unhygienic therefore effecting the health of residents leaving near Charrar drain. It is also discussed in detail the statistical analysis of the acquired results of water quality gather from different laboratories

4. Statistical analysis

A logistic regression analysis was conducted to predict the chance of getting diseases in the area around a drain using distance from the drain as predictor. This model indicates that the predictors as a set reliably distinguished between disease and distance from drain (chi square = 24.972, $p < .001$ with df = 2). Cox & Snell R square = 0.219 indicated a relationship between prediction and grouping. The distance from a drain made a significant contribution to disease (p

= .000). The model analysis revealed 34.7% (Nagelkerke R^2) of the variance in disease and correctly classified 80.0% of cases. Shortest distance is associated with an increased likelihood of disease. The findings of this research study elaborate that among heavy metal contamination, the presence of iron was found to be exceeded in three drain water samples and drinking water sample which was mainly due to the direct discharge of industrial effluents coming out from Falak textile Industry and affecting the surrounding Groundwater while Cadmium, Chromium and lead were undetectable [12]. The analysis generated from the result lead us to conclude that metal contamination is very low which has not severe impact. The results of the present study showed a relationship between the drain water, Groundwater pollution and human health issues. For the purpose of statistical analysis eight (08) water samples were collected from different locations along Charrar drain for the analysis of chemical, physical and microbial parameters as shown in table 3.

Table 3: Distance (Binned)* Distance Cross Tabulation

			Diseases		Total
			No	Yes	
Distance (Binned)	1-15 Feet	Count	1	20	21
		% within Diseases	1.8%	46.5%	21.0%
	16-30 Feet	Count	30	16	46
		% within Diseases	52.6%	37.2%	46.0%
	31-45 Feet	Count	18	6	24
		% within Diseases	31.6%	14.0%	24.0%
	46-60 Feet	Count	8	1	9
		% within Diseases	14.0%	2.3%	9.0%
Total		Count	57	43	100
		% within Diseases	100.0%	100.0%	100.0%

According to the findings of the present research study it is observed that the people using frequently tap water for domestic use are caught by different diseases such as allergy, dysentery and Hepatitis A. Moreover it is also observed that people living along the nearest location of Charrar drain are more vulnerable to diseases as compared to those residents who are living far away as shown in figure 4. It is also observed that most of the farmers take their cattle inside the drain for bathing purpose. The intake of dirty water by the cattle is very harmful for the people who are using their milk.

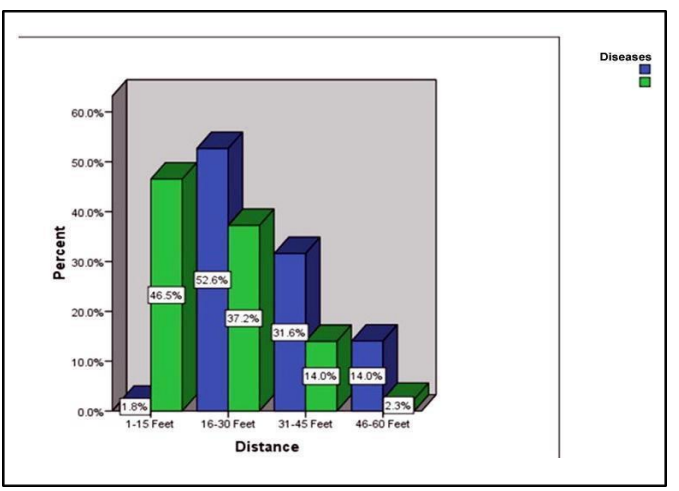


Fig 7 Relationship between distance and drain

The massive urbanization in Lahore city through unlimited commercial and industrial regions, infrastructure and uncontrolled housing colonies especially along drain areas are becoming a great matter of concern today as this unchecked population expansion leads to irregular settlements along drain water gradually leading to Groundwater pollution and waterborne diseases.

5. Conclusion

From gathered results it can be clearly demonstrated that expansion of groundwater pollution is more along Industrial area as compared to agricultural and residential zones. The findings of the study elaborate that the gradual increase of industries along Charrar drains along with housing schemes are the major factors leading to high intensity of water contamination. Finally we need to recognize that this research finding on groundwater pollution along Charrar drain and their impact on human health are specific [13]. This research study may be much helpful for the planners and the decision makers to focus on the negative aspects of the drain water on groundwater, surrounding environment and related human diseases.

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