# IMPACT OF URBAN AND INDUSTRIAL EFFLUENT OF HYDERABAD CITY ON FRESH WATER PINYARI CANAL

Ali Asghar Mahessar*, Abdul Latif Qureshi**, Kishan Chand Mukwana***, Abdul Nasir Laghari***

## ABSTRACT

**Pinyari canal off-takes from Kotri Barrage which is last structure constructed at Indus River located at latitude 25°20'36.99"N and longitude 68°24'36.17"E nearby Hyderabad city, Sindh Pakistan. This canal is non-perennial which supplies water in wet season for agriculture, industrial and domestic but in dry season only for industrial and drinking purposes to Hyderabad, Tando Muhammad Khan and Sajawal Districts. As the canal is passing across the Hyderabad city, therefore, large and small industrial enterprises, urban wastewater and solid waste are being disposed off into it. Due to the direct discharge of untreated effluent into the canal, the quality of canal water is degrading at an alarming rate and do not meet NEQS. Meanwhile, about 319 industrial units have been installed in SITE Hyderabad area that are operating without any in-house treatment plants and their effluent about 60 MGD is disposed off into the canal. Different types of highly toxic chemicals are used during manufacturing process of various items. For dyeing only leather, million tones of salts and other chemical are used. The solid waste of domestic, encroached area, hospitals and slaughterhouses, containing tissues, organs, blood, drugs and chemicals, are one of the biggest sources of pollutants and being discharged directly into canal. The contaminated water of this canal is being consumed for drinking by millions of people without any treatment because ground water of canal command is highly saline which is not fit for drinking. Hence, this situation has led to create of various water-borne diseases such as dysentery, cholera, hepatitis migraine, gastroenteritis, etc.**

***Keywords:*** *Canal water, Domestic waste, Effluent, solid waste, NEQS, MGD*

## 1. INTRODUCTION

Water is life, because it is essential for the existence of human life and this substance is found in all living things. Flora and fauna have not only been resting upon water quantum but its quality standard. Therefore, Water is precious to sustain life. It is mixture of Hydrogen and Oxygen ($H_2O$). This compound with plenty is available on the surface of earth which is major source of sustaining of environment. Presently, 90 % of the wastewater containing pollutants in high concentrations falls into Indus River and its tributaries. River water pollution has consistently increased with industrialization and urbanization [1]. Canal water is used mainly for agricultural purposes and also for drinking of human beings and domestic animals.

This effected irrigation water of the canal thus deteriorating the quality of irrigated crops [2].Water quality of many rivers in Pakistan is being spoiled due to the inflow of industrial and domestic waste water as shown in figure 1 & 2[3]. In Pakistan, surface water (such as canals, rivers, lakes) is the major source of drinking water. Urbanization is greatly polluting the rivers and canals and endangering aquatic life in Pakistan due to solid waste and effluent. Population encroachment and the pollution of rivers and canals with sewage water are not only spoiling the aquatic life [4] and damaging agricultural land, but also of public health concern. The same water is used for drinking purpose at some point and used for dish washing, laundry and recreational purposes. Faecaly contaminated water is a major source of diarrheal diseases in Pakistan [5].

Pinyari canal takes off from river Indus and passes through Hyderabad city with population of about 1.5 million. Sewage water is added to Pinyari canal by different pumping stations and surface sewerage drains, while it travels through Hyderabad city and affects its water quality [6]. Pakistan was hit by serious floods in the year 2010 which also reported to have deteriorated the quality of drinking water quality of the area [7].The continuous addition of untreated wastewater into canal; the water is no more fit either for the irrigation or for the drinking purpose. The only remedy lies in the wastewater treatment plant before the effluents are added to the

* Deputy Director, EMU, Sindh Irrigation and Drainage Authority, Hyderabad, Sindh, Pakistan
Email: amahessar@yahoo.com

** Professor, Institute of Water Resources Engineering and Management, Engineering & Technology, Jamshoro, Pakistan
Email: latif.qureshi@faculty.muet.edu.pk

*** Assistant Professor, Energy & Environment Department, QUEST Nawabshah
Email: kcmukwana@quest.edu.pk

canal. There is a need that all such industries where more water use is involved should immediately arrange for treatment of their wastewater before discharging. This will have a long term positive effect [8]. The poor water quality was found in three districts of Sind province, i.e. Badin, Thatta and Thar responsible for gastroenteritis, diarrhea and vomiting, kidney, and skin problems [9].

Industrial wastewater contains toxic chemicals. It is alarming that most industries have been started without proper planning and waste treatment plants. They just dispose off untreated toxic waste into nearby drains, canals or rivers. Lahore, Faisalabad, Karachi, Sialkot contribute major pollution loads into their water bodies [10]. As described the main source of fresh water can be attributed to discharge of untreated wastewater, dumping of effluent have adverse impact on fresh water bodies [11]. The use of reclaimed wastewater by industry is a potentially large market in developed as well as in developing and rapidly industrializing countries. Industrial reuse is highly cost-effective for industries where the process does not require water of potable quality and where industries are located near urban centers where secondary effluent is readily available for reuse [12].

Municipal sewage is a major source of pollution. About 2 million wet tones of human excreta are annually produced in the urban sector of which around 50% go into water bodies to pollute them. National Conservation Strategy (NCS) states that almost 40% of deaths are related to water borne diseases. Domestic wastewater collects on the streets and in low-lying areas. The situation is further aggravated by the addition of untreated wastes from small-scale industries [13].

Wastewater use may reduce costs, especially if it is envisaged before new treatment works are built, because the standards of effluents required for various types of use may result in costs lower than those for normal environmental protection. It also provides the possibility of recovering the resources invested in sewerage and represents a very efficient way of postponing investment of new resources in water supply [14]. However, the criteria for wastewater treatment intended for reuse in irrigation differ considerably. While it is intended that pathogens are removed to the maximum extent possible, some of the biodegradable organic matter and most of the nutrients available in the raw wastewater need to be maintained [15].

However, other research studies in the recent past demonstrated that the various quality parameters of Pakistan drinking water are not in accordance to the WHO and Pakistan standards [16]. The major sources of water pollution and ultimately of waterborne diseases are considered to be the direct discharge of domestic and industrial effluent wastes, leakage from water tanks and poor management of farm wastes [17]. Various researchers have shown that drinking water in many countries does not meet WHO standards [18].

## 2 RESEARCH AREA:

Pinyari canal is the main source of water supplying to irrigated-agriculture, municipal and industrial in the study area. The study area comprises from RD 0-RD100 of Pinyari canal which is located in the periphery of Hyderabad city. The objective of research is to determine impact of wastewater of Hyderabad city on fresh water of the canal. The left and right sides of banks of canal are completely or partially from RD 5 +0 to 60+0 under encroachment. There are many locations on the right side and the left side of Pinyari canal between RD 9 to RD 40, (RD is Reduced distance = 1000 feet) where the maximum discharge of untreated wastewater is being released into the canal as shown figure-1.


Figure-1: Pinyari, Fuleli canals and Akram wah passing across Hyderabad city

## 3 MATERIAL AND MOTHODS

### 3.1 Identification of Inlets of the Untreated Wastewater into Pinyari Canal

Deplai Colony Wastewater Pumping Station: This pumping station is situated at Deplai colony consisted on three pipes, having 24 inches diameter delivering untreated wastewater into Pinyari canal. Ponds of wastewater of Jacob Station: Ponds constructed over 25 acres are situated at back side of Agha Khan Hospital. Jacob wastewater pumping station: It is situated near Hur camp in the north of journalist colony having delivery pipe of 18'' diameter.

Figure-1 Solid waste of the city in Pinyari Canal

Figure-2 Disposal of Industrial effluent in Pinyari Canal

There are many outlets from where wastewater enters into the canal. The wastewater of Khawja Mubark Colony is being discharged into the canal from different locations through pipes. At another outlet at outfall Structure of Kari Mori Bridge open channel of 6'x 6' wastewater is being discharge into canal. The outfall structure at the upstream of railway track has been constructed for discharging wastewater. Pumping station has been established near Grid Station in the area of Miran-jo-Paro.

At Darya khan wastewater pumping station is situated about two kilometers downstream of Ghangra Mori and receiving untreated wastewater of SITE Hyderabad area and domestic wastewater of different areas of the city. There are many small locations on left and right side of the Pinyari canal where from the untreated wastewater of municipal and industrial is being discharged into the canal. Meanwhile, there are various locations along with canal where on solid waste is dumped. The untreated waste water of the 319 Industrial units is being discharged into Pinyari canal through pumping and gravitational forces at Darya khan pumping station.

### 3.2 Samples Collection and Analysis

Samples were collected from canals mentioned in table -1 where effluents water discharging points, upstream and downstream of disposal points. Composite sampling was carried out by collecting a series of 500ml sample every half hour basis for eight hours, combining them to form a composite sample. As general rule, it is best to analyze the sample as soon as possible after collection. Samples have been preserved in an icebox or $4^{o}C$ immediately after collection. Nitric acid ($HNO_3$) was added to the sampling bottles in quantities sufficient to lower the pH of the sample to just about 2, to stabilize the concentration of total and dissolved metals for a maximum of 28 days. Standard sample transfer procedures were followed to avoid confusion in sample identification, including labeling, and safe transportation to laboratory. Analysis of samples collected of wastewaters mixing with canal water of city has been carried out according to the design of research work.

**Table 1: Locations of samples collection of Pinyari Canal Water**

| Sample No | Sample Type | Location |
|---|---|---|
| 1 | Wastewater | Hur Camp pump station wastewater tank. |
| 2 | Wastewater | Khawaja Colony |
| 3 | Wastewater | Bus stand near Central Jail |
| 4 | Wastewater | Open drain just d/s of the Hala Road bridge, |
| 5 | Wastewater | Open drain just d/s of Kari Mori |
| 6 | Wastewater | Open drain just d/s of Preatabad bridge |
| 7 | Wastewater | Open drain near Preatabad bridge |
| 8 | Wastewater | Open drain (Shuhab Cinema reas). |
| 9 | Wastewater | Left side of the canal near Kachhi paro. |
| 10 | Wastewater | Open drain at u/s of the Railway Bridge, |
| 11 | Wastewater | Draya Khan pumping station. |
| 12 | Wastewater | Darya Khan Pumping Station |
| 13 | Wastewater | Waste effluent at Railway Bridge |

## 4. RESULTS & DISCUSIONS

The demand for drinking water is increasing as population of city is growing with respect time. The figure-3 shows that demand water during 2010 year was 80 MGD but it is linearly increasing with respect of temporal becomes 88 and 90 MGD in 2025 and 2030 respectively.

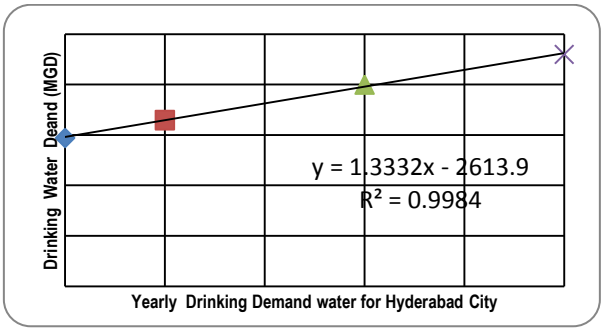


Figure-3: Drinking Water Demand

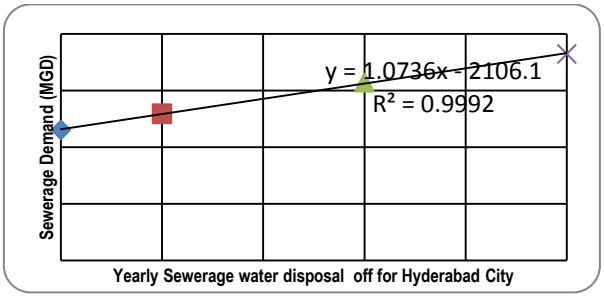


Figure-4: Sewerage water disposal demand

Hence, the figure-3 demonstrates that sewerage water disposal demand in 2010 was 50 MGD while it was increased linearly with respect of time to 62 and 72 MGD in 2025 and 2030 respectively. However, the wastewater of the city and industrial area has been discharged into Pinyari canal by pumping and gravitational flows. The field survey was carried out for identification of locations and discharge measurement wherefrom wastewater is being disposed off into canal. There are seventeen main and twenty small outlets on left side of the Pinyari canal from where untreated wastewater generated from small industries (Cottage & dyeing Ajrak) and municipal areas was being discharged into the canal. There are twenty main and many small outlet points on the right side of the Pinyari canal along wastewater generated from 319 units of SITE area as shown in Fig.4 is being released into the canal.

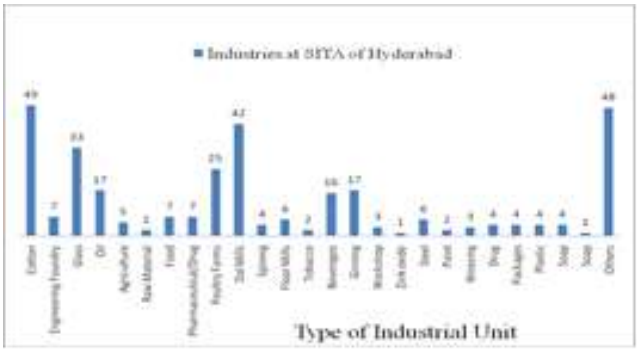


Figure-5: Different types of industries in SITE Area Hyderabad

The total estimated discharge of untreated wastewater (Industrial & Municipal) disposed off into canal is about 60 MGD. The huge volume of untreated wastewater is being released into canal without any treatment as shown in figure 5. This wastewater is polluting fresh water of canal which is used for domestic and drinking purpose at downstream of canal. This canal is non- perennial but lesser amount of water is released during dry season so that polluted water can not dilute.

There is not only wastewater discharging into canal but huge volume of solid waste is being dumped into canal. The following locations were found where solid waste is dumped on banks along with canal such as Hala road bridge on the left side of the canal; Kari Mori bridge on the left side of the canal just downstream of Pretabad bridge and Slaughter houses as shown in figre-6 and upstream of railway bridge on the right side of canal. Solid waste of burnt old batteries as shown in figure-7 after getting out lead and waste is dumped. It was amazing that lead melting process was carried out at the canal embankment and there are about 8 to 10 furnaces which are used for melting the lead from old batteries.

Figure-6: Wastewater at Kari mori Slaughter house

Figure-7: Solid waste of burnt old batteries near Darya khan pumping station

The waste material is gradually falling into the canal and polluting the canal which is very much hazardous material and dangerous for the public health and estimated quantity of solid waste is being accumulated on the embankments of the canal is about 15-20 tons per day. The huge quantum of solid waste creates slow poison in shape of leaching various chemicals permanently into canal. Moreover, there is not only problem of disposing of wastewater, sludge but waste of animals into canal. Moreover, the buffaloes farms were constructed in encroached area i.e 04 numbers of Buffalo Farms (B.F)

on left side of the canal just u/s of the Bypass bridge, each farm have 15 to 40 buffaloes; 06 numbers of B.F on right side of the canal just u/s of the Bypass bridge each farm have 10-35 buffaloes, 8 numbers of B.F on left side of the canal between Bypass road bridge and Hala road bridge each farm have 10-25 buffaloes. This is more harmful for creating water borne diseases in mankind and ecosystem which are utilizing water of irrigation canal.

For this research the samples of wastewater collected from outfall structures of wastewater into canal were analyzed from Hi Tech laboratory of Sindh University Jamshoro. The results of the physico-chemical analysis of parameters of samples are described individually.

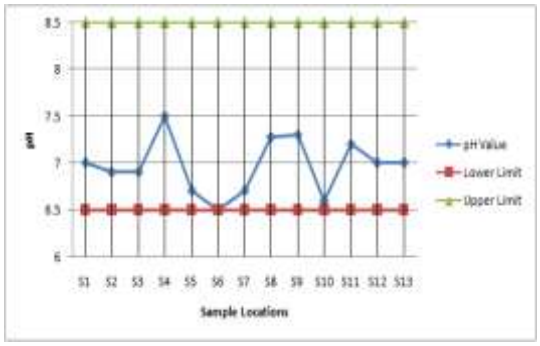


Figure-8: pH values

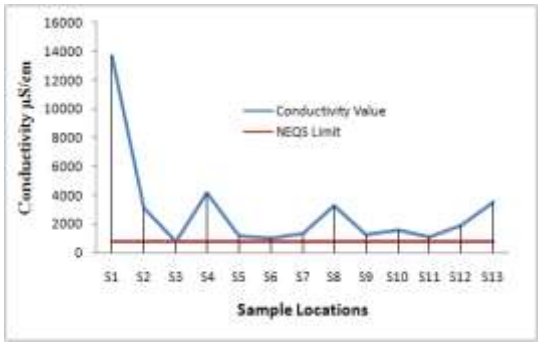


Figure-9: Conductivity values

The pH is a measure of the acidic or basic (alkaline) nature of a solution. A pH range of 6.5 to 8.5 appears to provide protection for the life of freshwater fish and bottom dwelling invertebrates. The pH values of all samples are within the permissible limits of NEQS shown in figure-8. Electrical Conductivity (EC) of water is a measure of the ability of a solution to conduct an electrical current. The salinity of treated wastewater to be used for irrigation is estimated by measuring its electrical conductivity. In most of the cases, the conductivity level exceeds than the value of NEQS (680 µS/cm) permissible within limit NEQS. The electrical conductivity of all samples ranges from 760µS/cm to 13700 µS/cm. Almost the conductivity of all samples is higher than permissible limits of NEQS shown in figure-9.

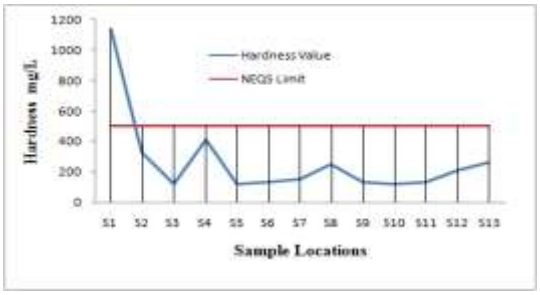


Figure-10: Hardness

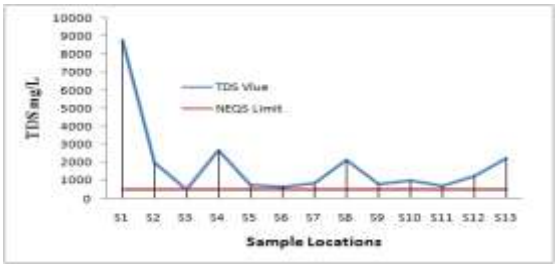


Figure-11: TDS

The hardness of all wastewater samples were within the limits of NEQS but except sample 1, and the higher value was found at location sample location S1 is due to the release of effluent from waste water ponds and industrial area shown in figure-10. A high concentration of TDS is an indicator of possibly high value of contamination. The TDS results of samples analyzed show that higher value of samples than permissible limits of NEQS in almost cases. The sample No 1 indicates that very high Total Dissolved solids available in the coming wastewater rather than the other locations. It is manifest from result that all values of TDS of all samples are higher to permissible limit of NEQS shown in figure-11.

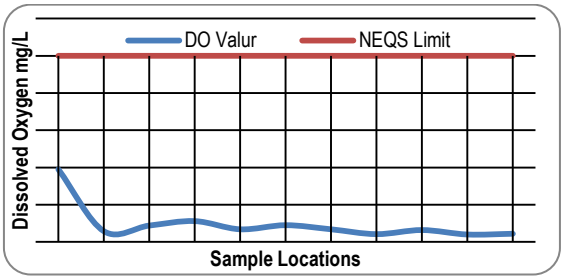


Figure-12: Dissolved Oxygen

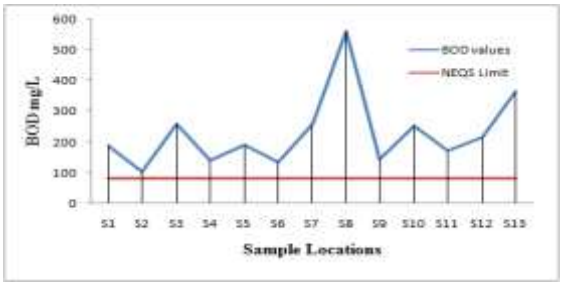


Figure-13: BOD

The Dissolved Oxygen is one of important parameter in water quality analysis i.e. index of physical and biological process going in water. The DO level in natural as well as waste water depends on physical, chemical and biological activities of water bodies. Aquatic ecosystem is totally depends on dissolved oxygen various biochemical changes. The recommended value of dissolved oxygen in normal drinking water is 8 mg/l and high dissolved oxygen was found its normal value [9]. Dissolved oxygen (DO) is an indicative of oxygen depletion shown in figure-12. The BOD has almost universally been adopted as a measure of relative pollution effect. The values of the samples of wastewater are higher values than the permissible limits in NEQS. The values of samples of surface range from 1.7 to 560 shown in figure-13. This variation is due to wastewater of industrial area.

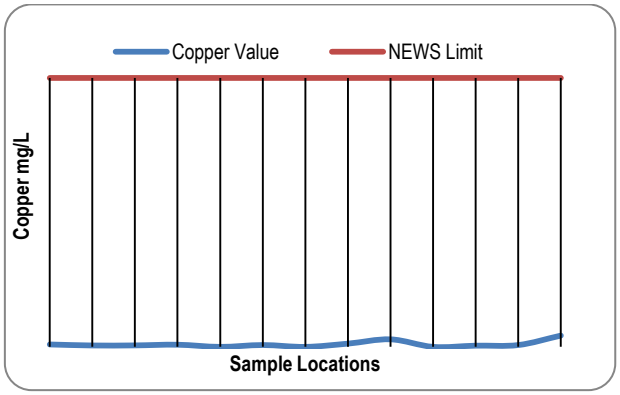


Figure-14: Copper level

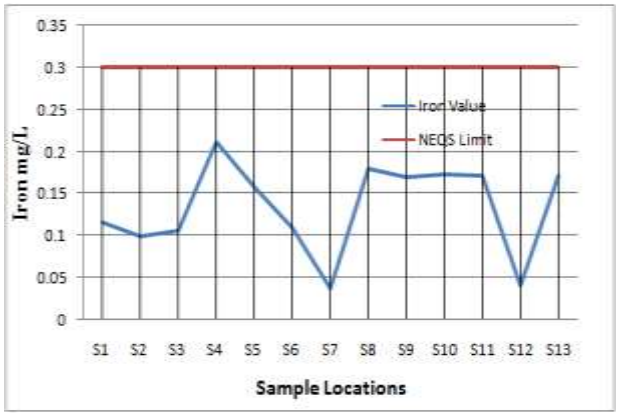


Figure-15: Iron (Fe) level

The results of all the samples indicate that they have lesser quantity of Copper (Cu) available in the wastewater as compared to the NEQS shown in figure-14. Since the availability of greater quantity is harmful for the public health, therefore it is necessary to have a continuous monitoring and testing the wastewater samples from SITE area. The results Fe samples presents the lesser quantity of Iron (Fe) is available in the wastewater coming out from domestic and the industrial units shown in figure-15.

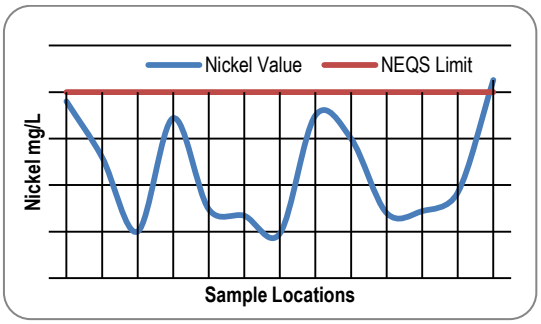


Figure-16: Nickel level

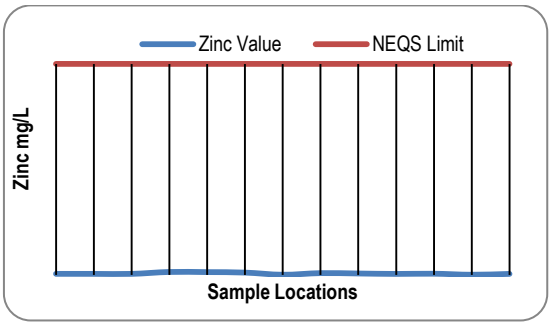


Figure-17: Zinc level

All the samples indicate less concentration of Nickel (Ni) available as compared with the NEQS as shown in figure-16, due to the poisonous metal, it is necessary to have continuous monitoring and testing of the samples at SITE area. Results of Zinc show lesser concentration of Zinc metal available in the wastewater as shown in figure-17. This might be due to non use of the ingredients containing of the Zinc metal during the manufacturing processes in the industrial units.

The major impacts of the discussed pollutants were observed on fresh canal water which is main source of drinking water of millions of people who are settled in command area of canal. However, this contaminated water leads various waterborne diseases among the masses i.e Brain damage or suffocation, Gastric and stomach cancer in human, The death and decay of vegetation and aquatic life and digestive problem for humans, Human illness and affect plant growth and fish and aquatic life, Human health and the environment, Dental, bone and skeletal problems, Typhoid fever, dysentery, viral and bacterial gastroenteritis and hepatitis as well as minor respiratory and skin diseases.

## 5. CONCLUSIONS

No arrangement of in house treatment plants has been done for treatment of the domestic and industrial wastewater by Polluters. The generated effluent caused various waterborne diseases among the local people, livestock and also flora and fauna. The results of parameters of some samples revealed that higher values

of Conductivity, TDS, Conductivity and Hardness and BOD. Whereas it is concluded that untreated wastewater coming through these locations of various municipal and industrial, encroached areas are main source of polluting of the fresh water of canal. However, Discharging of untreated wastewater (urban and Industrial units) and solid waste (municipal/domestic, agricultural and industrial) into canal must be controlled. The buffalo farms constructed on the both sides of canal may be shifted. Hence, safer disposal arrangements should be adopted by using alternate routes to dispose of the untreated wastewater. Meanwhile, awareness programmes may be arranged to the local people for safely disposal and management of wastewater for protecting various water borne diseases such as dysentery, cholera, hepatitis and migraine. The wastewater of city and industrial site should be treated and it may be released for utilization for agricultural and forestry purpose. The city government and industrial sector should be legally bound for installation of treatment plants.

Sindh EPA should play a proactive role and regularly monitor the pollution levels with coordination of the all stakeholders. The prevailing legislation be involved on all industries throwing their untreated effluent in canals. The city government of Hyderabad, Tando Muhammad Khan and Sajawal may establish working group to regularly observe water quality in the canal and take appropriate administrative decisions to address this adverse environmental issue.

Acknowledgement: The authors are thankful to Sindh Irrigation and Drainage Authority and Project Management Office, Sindh Irrigation Department for providing information and also Institute of Water Resources and Engineering Management for facilitating to complete this work.

## REFERENCES

[1] Ghumman, A. R. Assessment of water quality of Rawal Lake by long-time monitoring. Environmental Monitoring and Assessment, 2011, 180,115-126.

[2] Shakir, H. A.; Qazi, J. I. Impact of industrial and municipal discharges on growth coefficient and condition factor of major carps from Lahore stretch of River Ravi. Journal of Animal and Plant Sciences, 2013, 23(1), 167-173.

[3] Aziz, J. A. Management of source and drinking-water quality in Pakistan. Eastern Mediterranean Journal of Health Sciences, 2005, 11(5-6), 1087-98.

[4] Ejaz, N.; Hashmi, H. N.; Ghumman, A. R. Water quality assessment of effluent receiving streams in Pakistan: A case study of Ravi River. Mehran University Research Journal of Science and Technology, 2011, 30 (3), 383-396.

[5] I.A. Ansari, V.K. Dewani and M.Y. Khuhawar, J. Chem. Soc. Pak. 21 (1999) 359.

[6] Baig SA, Mahmood Q, Nawab B, Shafqat MN, Pervez A, Zeb BS (2011), "Improvement of drinking water quality by using of plant biomass through household bios and filter-A decentralized approach", Ecol. Eng. 37(11):1842-1848.

[7] M.H.S.Watoo,F.H. Watoo,T. G. Kazi, S. A. Tirmizi, M. I. Bhanger, R. B. Mahar and J. Iqbal, (2004), Quality Characteristic of Phuleli canal Water for irrigation Purpose" NCLEAM, ISSN 0029- 5698, 41 (1-4) 2004 : 69-75.

[8] Memon M, Soomro MS, Akhtar MS, Memon KS (2011), "Drinking water quality assessment in southern Sindh" (Pakistan). Environ. Monit. Assess. 177:39–50.

[9] M.A. Saleemi, Environmental Pollution Unit, WWF-Pakistan. 1993.

[10] Sohag M.A. and Mahessar A. A. Pollution of Indus Waters and the Drainage system of Sindh, published paper in proceedings of Environmentally Sustainable Development in International Conference, held by Department of Environmental Sciences, COMSATS Institute of Information Technology Abbotabad. (2005).

[11] WHO/FAO/UNCHS/UNEP Regional Workshop for the Americas on Health, Agriculture and Environmental Aspects of Wastewater Use. Jiutepec, Morelos, Mexico, 8-12 November, 1997, Institute Mexicano de Tecnologia de Agua (IMTA), Jiutepec, Mexico.

[12] WWF-, Environmental Pollution Unit, WWF- Pakistan. 2000

[13] Laugeri, L. Economic aspects of wastewater reuse. Unpublished document. World Health Organization, Geneva. 1989.

[14] Crook, J., Ammermman, D.K., Okun, D.A. and Matthews, R.L. 1992 Guidelines for Water Reuse. Camp Dresser & McKee, Inc., Cambridge, Massachusetts.

[15] Rahman AU (1996), "Ground water as Source of contamination for water supply in rapidly growing mega cities of Asia:" Case of Karachi, Pakistan. Water Sci. Technol. 34(7-8):285-292.

[16] Chilton PJ, Jamieson D, Abid MS, Milne CJ, Ince ME, Aziz JA (2001), "Pakistan water quality mapping and management project. Scoping study, Draft final report", W ater engineering and development centre, Loughborough University & London School of Hygiene & Tropical Medicine, W ELL Task 568. Loughborough, UK.

[17] Malana MA, Khosa MA (2011), "Ground water pollution with special focus on arsenic", Dera Ghazi Khan. Pakistan. J. Saudi Chem. Soc.15:39–47.

[18] Farid S, Baloch MK, Ahmad SA (2012), "Water pollution: Major issue in urban areas", Int. J. Water Res. Environ. Eng. 4(3):55-65.