Assessment of Physicochemical Parameters for the Drinking Water Quality in the Vicinity of Nawabshah City, Sindh, Pakistan

Sajjad Ali Mangi[1], Samiullah Sohu[1], Faheem Ahmed Soomro[2], Abd Halid Abdullah[3], Sasitharan Nagapan[3]

[1]PhD Scholar, Faculty of Civil & Environmental Engineering, UTHM Malaysia
[2]Assistant Engineer, Khairpur Medical College, Khairpur Mirs
[3]Associate Professor, Faculty of Civil & Environmental Engineering, UTHM Malaysia

Abstract: Quality of water may differ according to the geography of the region, due to that the quality of water is big concern worldwide, because majority of disease caused by the poor quality of drinking water. Subsequently realizing the significance of drinking water quality with in the central part of the Sindh province, this research work was carried out to assess the drinking water quality within the Nawabshah city, where the single source of supply water is the Gajrawah after the conventional treatment through the open ponds. In this study seven physicochemical parameter were investigated and laboratorial investigations demonstrated that the pH values were found with the WHO limits, TDS & EC values were found within the acceptable limits, except in one residential area, Turbidity was also high at all the locations only one area (Marium road colony) was found within the standards, furthermore, the hardness was present in all the samples at all the locations, which indicate that the water supplied to public was hard in nature. In addition to that Temperature and Dissolved Oxygen were found safe and within the limits and it was concluded that the water supplied to residents of the inspected areas were found not fit for drinking and it is suggested that the water supply, should be improved and essential steps should be taken to treat the water.

Keywords: *Water Quality, Public Health, Gajrawah, Physicochemical, Nawabshah.*

1. Introduction

Nowadays safe drinking water is a major issue mostly in developing countries like Pakistan, where drinking water is a leading concern and the supply of fresh drinking water has remained a challenge for the Authorities, due to rapid increase in population reduction in the quality of drinking water. The supply of water through pipes and pumps is around 66 percentage. It is expected that 30 percentage of all diseases and 40 percentage of all life losses are due to poor water quality [1]. Furthermore, all over the world approximately 800 million peoples not getting adequate water supply. Due to lack of filtration of water contaminated water supplied to peoples, which affected severally and diarrhea is common in Pakistan due to utilizing contaminated water [2].

Particularly the Peoples of the Sindh also facing the shortage of safe drinking water for the survival. Particularly in the Sindh province, the Indus River plays a vital role in the supply of fresh water. Indus River is required primary and secondary treatment to make it fit for drinking, so that safe supply of water to the people may be guaranteed. Over these years some work has been done on the evaluation of physicochemical parameters of Indus River (water) for the agricultural purpose, during the literature review the limited studies were found on physicochemical parameters of drinking water quality in the Nawabshah city. It has also been reported by Jabbar Kandhro *et al,* (2015) that the groundwater of Nawabshah city is not considered to be safe for dinking purpose.

2. Related Work

Diarrhea is very common in Pakistan due to utilizing contaminated water. Water which safe for drinking purpose called potable water. Water gets polluted by two major sources i.e. point sources and non-point sources [2]. According to the Wali M. Daudpota *et al*, (2016) Poor water quality is responsible for the death of an estimated 5 million children in the developing countries and particularly in Pakistan, water is a major source for sustaining wellbeing of its citizens. Water shortage and its use for multiple uses has adversely affected the quality of water, consequently, water pollution has become an alarming problem in Pakistan.

To realizing the significance of water quality issue of local peoples, the necessary physiochemical parameters were checked to evaluating the quality of water. Furthermore, this research study will be more useful for the professional working in the field of water quality and this study may also be used as a reference for the drinking water quality particularly related to the city of Nawabshah.

3. Research Methodology

To assess the quality of water of Nawabshah city, six appropriate locations has been finalized as mentioned in Table-1, these specific location of the city have been receiving water from the Gajrahwah canal which is the main source of supply.

Table 1. Details of water sample collection

S.NO.	LOCATION	NO. OF SAMPLES COLLECTED
01	Raw Water Source (Gajrawah)	05
02	Water Ponds (Conventional treatment)	05
03	Ali Raza Shah Colony	05
04	Christian Colony	05
05	Mariam Road Colony	05
06	Railway Colony	05
Total Samples collected		**30**

From each location five samples were collected, after five days interval and total 30 samples were collected as mentioned in Table 1. Samples were collected in plastic bottle of 1000ml. each sample was marked with location name date and time. Standard methods were adopted in the sample collection for water quality testing. Following seven parameters were checked through digital equipment available in the laboratory.

Table 2. Details of Parameters & Equipment used

S.NO.	PARAMETERS	EQUIPMENT USED
01	pH	pH meter (Levi bond company)
02	Total Dissolved Solids (TDS)	Conductivity meter
03	Electro Conductivity (EC)	Electro conductivity meter (Levi bond company)
04	Turbidity	Nephelometer or Turbidity meter
05	Hardness	Hardness meter.
06	Dissolved Oxygen (DO)	DO meter
07	Temperature	Temperature meter

Table 3. World Health Organization (WHO) and Pak-National Standards for Drinking Water Quality Guidelines (NSDWQ) for drinking water

S.NO.	PARAMETER	WHO STANDARD	NSDWQ
01	pH	6.5-8.5	6.5-8.5
02	Total Dissolved Solids (TDS)	< 1000 mg/l	< 1000 mg/l
03	Electrical Conductivity (EC)	<1000 μS/cm)	--
04	Turbidity	< 5NTU	< 5NTU
05	Total hardness as CaCO3	--	< 500 mg/l
06	Dissolved Oxygen (DO)	--	---
07	Temperature ^{o}C	--	--

Figure 1. Performing pH, Temperature, EC meter, and TDS test through digital equipment

Figure 2. Performing hardness and turbidity test through digital equipment

4. Results and Discussion

4.1 pH

It was observed from Fig.1 that the values of pH at the different locations are within the WHO limitations but in test five pH value in ponds were observed more than the limits which indicates improper treatment and the addition limits forward by the WHO i.e. 6.5 – 8.5 [9]. The main cause of destabilized pH values is the absence of sand filters.
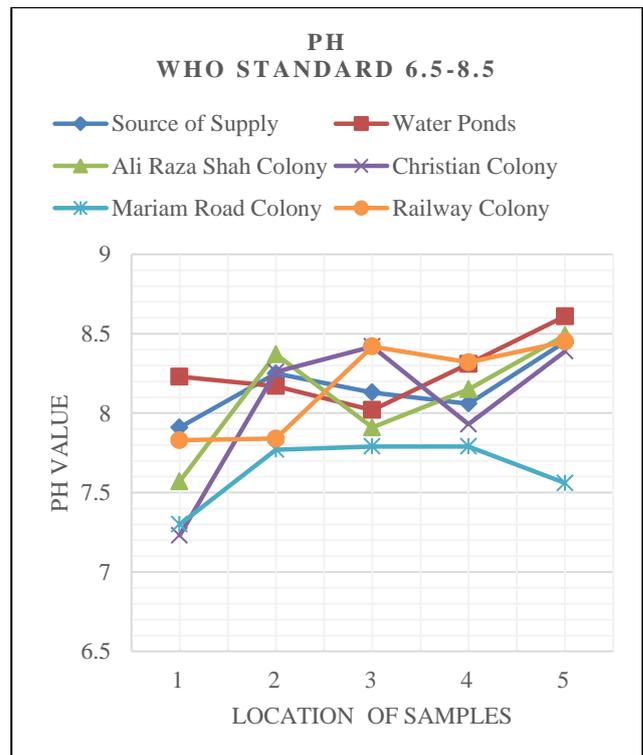

Figure 1. Variation in pH value at different locations

4.2 Total Dissolved Solids (TDS)

TDS test is the representation of quantity of dissolved solids in water sample.
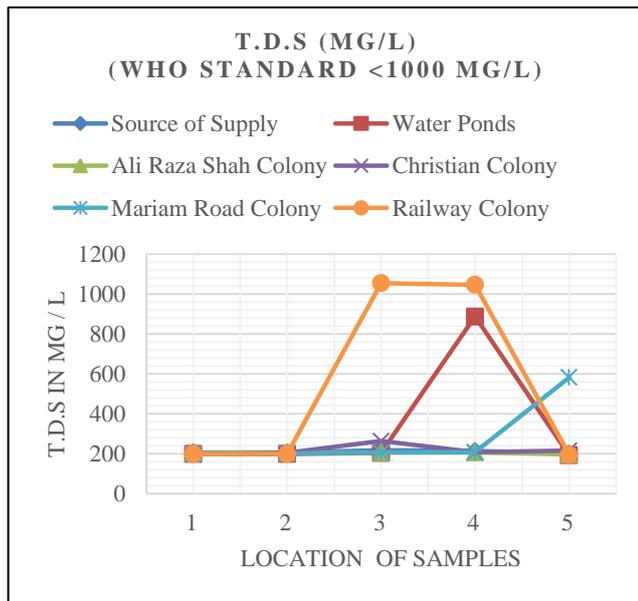

Figure 2. Variation in TDS value at different locations

From the laboratory results TDS values were found at location Railway colony is very high and beyond the limitations but at other locations the value of TDS is within the WHO standard limit.

4.3 Electrical Conductivity (EC)

The TDS represents the total ions in solution. Whereas, E.C is the real measure of ionic activity of a solution in term of its capacity to transmit current. In dilute solution, T.D.S and E.C are almost same.
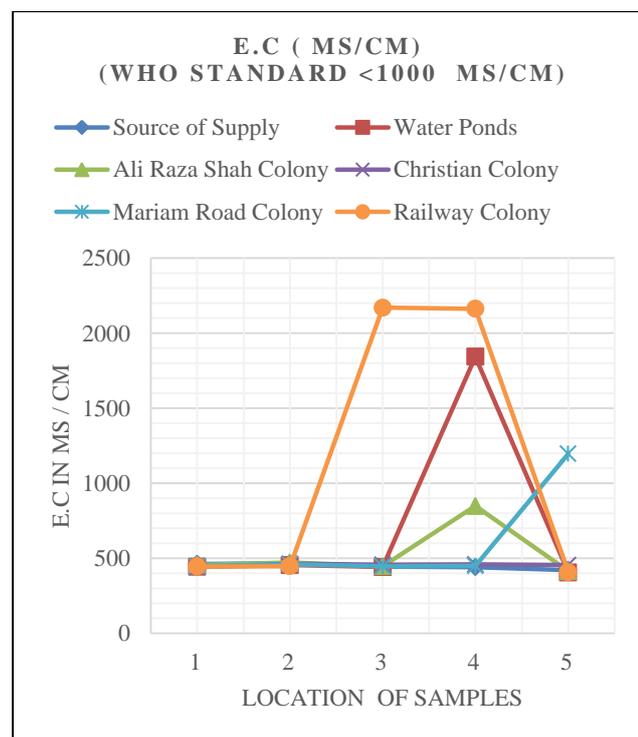

Figure 3. Variation in EC value at different locations

The T.D.S of a water represented sample based on the measured E.C value can be achieved from formula, T.D.S (mg/l) = 0.5 * 1000 x EC (μS/cm) and from the laboratory analysis it was observed that E.C value was very high at three locations, at Railway colony, in conventional water treatment ponds and at Mariam road area.

4.4 Turbidity

Turbidity was found high in the raw water source (Gajra wah) which depends on the discharge of Indus River.
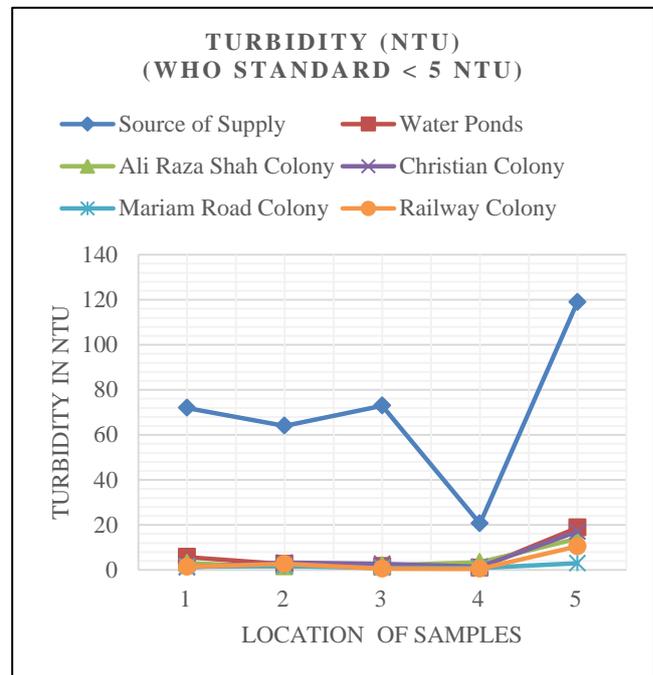

Figure 4. Variation in Turbidity value at different locations

Increase in turbidity is a sign of increase in discharge of river, since the increased discharge causes excessive erosion and less silting [11], and opposite is the case in times of low discharge. Therefore, it was found that high turbidity values in raw water source but at other locations were also beyond the WHO guidelines. Only one site (Mariam colony) was found within the limits in all five tests.

4.5 Hardness

The hardness is the measured to assess the capacity of water to respond with the detergent, hard water required the significantly extra detergent to generate lather. The hardness is frequently indicated in milligrams of calcium carbonate equivalent per liter. The water having calcium carbonate at concentrations below 60 mg/l is generally considered as soft; 60–120 mg/l, moderately hard; 120–180 mg/l, hard; and more than 180 mg/l, very hard. The natural sources of hardness in water are the dissolved polyvalent metallic ions from sedimentary rocks, seepage and runoff from soils [13]. Particularly in this case the laboratory analysis, the Hardness were observed in all the samples and at all the locations. Unfortunately all samples found over range quantity of Hardness and digital equipment were given output as OR (Over Range) which indicate the water available at all locations are called very hard water.

4.6 Temperature

There are no any health based guidelines available regarding the temperature of drinking water, because temperature does not bear a direct relationship to health but it effects on chlorination and coagulation efficiency and the effect on the survival of micro-organisms are the most important to health.in addition to that the temperature values was found around similar at all the locations.
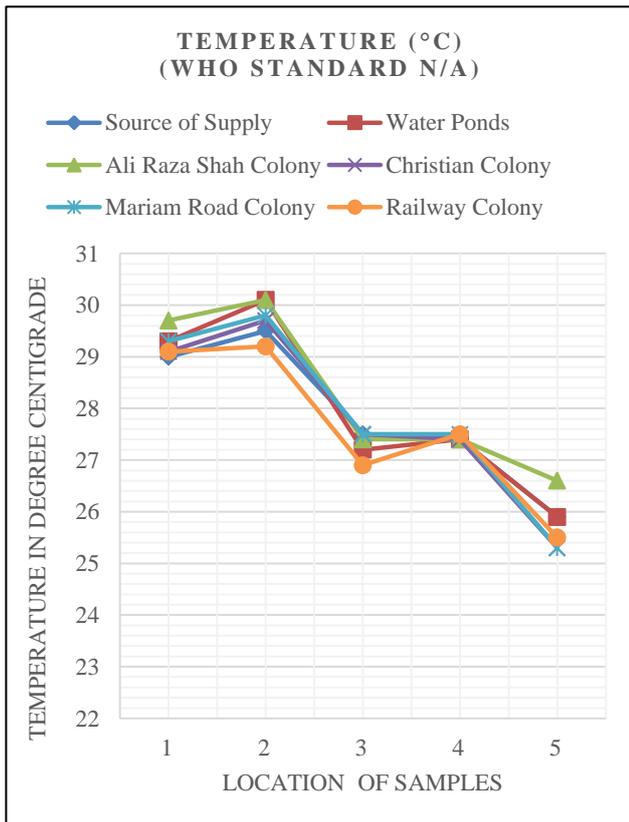

Figure 5. Variation in Temperature value at different locations

4.7 Dissolved Oxygen (DO)

The D.O of water may differ according to the source of water, mostly raw water contains lower temperature and when it process through chemical and biological treatment it may deplete the concentration of D.O which may also takes place in the network of water supply. D.O reduction in water supplies can boost the microbial reduction of nitrate to nitrite and sulfate to sulfide. It can also rise in the concentration of ferrous iron in solution, with subsequent discoloration at the tap when the water is aerated. No health-impact guideline value is suggested. However, very high levels of D.O may exacerbate corrosion of metal conduits.

It was observed from results shown in Fig.6 that the Dissolved Oxygen values at all the different locations are within the range. WHO guidelines are not available for the DO values. Meanwhile, from the literature review it was observed that generally acceptable limit for DO in freshwater from 4 to 5 mg/l. and all the samples were meet that criteria.
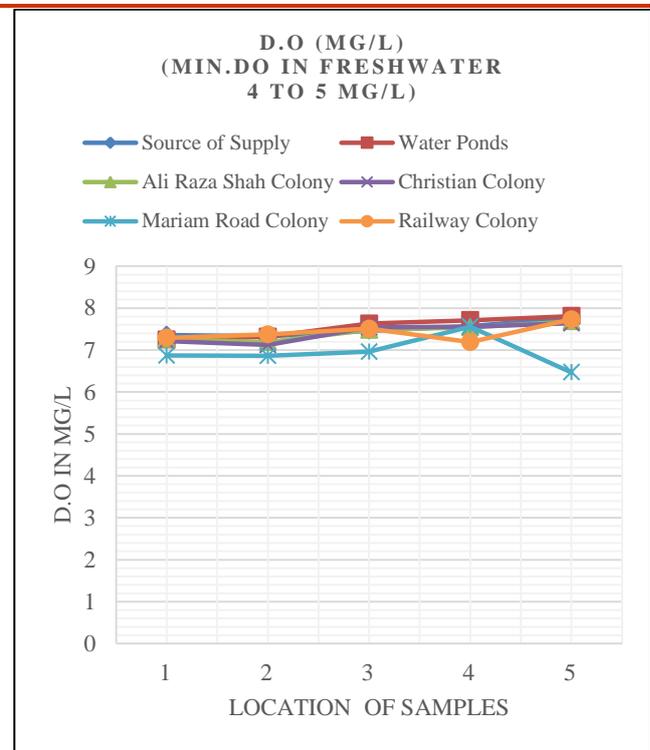

Figure 6. Variation in Dissolved Oxygen value at different locations

5. Conclusion

After the comprehensive laboratory based study regarding the assessment of the drinking water quality in the Nawabshah city, where raw water source is the Gajrawah canal, which provide potable water after the conventional treatment through open ponds, from the analysis of seven physicochemical parameter, pH were found with the WHO limits 6.5-8.5, TDS & EC were found within the acceptable limits except in one residential area (Railway colony), Turbidity was also high at all the locations only one location (Mariam Colony) was found within the range, furthermore, Hardness was present in all the samples at all the locations, which indicate that the water supplied to public was hard in nature. In addition to that Temperature and Dissolved Oxygen (DO) were found safe and within the limits but Temp. & DO are not the health based criteria, therefore, it was concluded that the drinking water supplied to residents of Nawabshah city under the investigated area was observed not fit for drinking and it is highly be recommended that the water supply system should be improved and necessary steps should be taken to treat the water. The water received from ponds must be treated through slow sand or rapid sand filters and necessary chlorination may be applied. Otherwise public may suffer through several health problems and ultimately people living in the vicinity of Nawabshah may lose their lives.

6. Acknowledgment

References

[1] Haydar. S, *et al*, "Evaluation of Drinking Water Quality in Urban Areas of Pakistan: A Case Study of Southern Lahore" Pak. J. Engg. & Appl. Sci. Vol. 5, July 2009 (p. 16-23)

[2] Jabbar Kandhro.A *et al*, "Physico-Chemical Assessment of Surface and Ground Water for Drinking Purpose in Nawabshah City, Sindh, Pakistan" American Journal of Environmental Protection 2015; 4(1): 62-69

[3] Wali M. Daudpota *et al*, "Determination of Ground Water Quality for Agriculture and Drinking Purpose in Sindh, Pakistan" Sci.Int.(Lahore),28(1),701-704,2016

[4] Mangi S.A, *et al*, "Surface Water Treatment is A Big Challenge for North Sindh - A Case Study Of 18mgd WTP Numaishgah, Sukkur" AJETR Vol.1, Issue 1 – 2016

[5] Igbinosa E.O, *et al*, "Assessment of physicochemical qualities, heavy metal concentrations and bacterial pathogens in Shanomi Creek in the Niger Delta, Nigeria"

African Journal of Environmental Science and Technology Vol. 6(11), pp. 419-424, November 2012

[6] Zahoorullah, *et al*, "Quality of drinking water in rural Peshawar". Pak J Med Res, 42, pp. 85–89, 2003.

[7] Azizullah.A, *et al*, "Water pollution in Pakistan and its impact on public health" A review. Environment International. Vol. 37, pp. 479–497, February 2011.

[8] Khan A.R, *et al*, "Quality characteristics of potable water of Mardan city" J.Chem. Soc. Pak. 22, pp. 87 -93, 2000.

[9] Guidelines for drinking-water quality; 3rd edition, volume 1. World Health Organization (WHO), Geneva, (2004)143-220.

[10] Guidelines for drinking-water quality, 2nd edition, volume 2. World Health Organization (WHO), Geneva, (1996)991.

[11] S. K. Garg. Irrigation Engineering & Hydraulic Structures, Water Resources Engineering, Volume 2, 24th edition, 2011.

[12] Government of Pakistan Pakistan Environmental Protection Agency (Ministry of Environment) - National Standards for Drinking Water Quality (NSDWQ), June 2006.

[13] Hardness in Drinking-water Background document for development of WHO Guidelines for Drinking-water Quality: World Health Organization 2011

About author

Sajjad Ali Mangi is an assistant professor at the Department of Civil Engineering, Mehran University of Engineering & Technology, SZAB Campus Khairpur Mir's. Presently he is doing his PhD at UTHM Malaysia. Mr. Mangi has bachelors in Civil Engineering from QUEST, Nawabshah and a Masters in Environmental Engineering from NED University, Karachi. He has been involved in local and international research projects. He has also participated in national and international conferences and has been awarded as life time member of EWT Islamabad. His research interests lie in the field of Civil and Environmental Engineering.