Journal of Asian Scientific Research

journal homepage: http://aessweb.com/journal-detail.php?id=5003

SHALLOW GROUNDWATER QUALITY OF MIRPUR CITY ALONG THE UPPER JHELUM CANAL

Muhammad Ayyaz

Lab Engr. MED MUST Mirpur A.K

ABSTRACT

The present study was conducted along the upper Jhelum Canal to evaluate the shallow ground water quality of Mirpur city aquifer by assessing the physical (color, odor and turbidity), chemical (pH, TDS, Cl, F, NO_3, Cu, Zn, Ni and Pb) and bacteriological (E.coli) parameters of fifteen shallow ground water samples. The samples were collected during November 2011 to March 2012, with 2_ month interval from five sites along the upper Jhelum Canal, which include, Bong village (50 feet, depth), Lehri Village (45 feet, depth), Chechian (70 feet Depth), Pothi village (80 feet depth) and District Courts Mirpur Building (150 feet depth). It was observed that color of shallow ground water samples varied from colorless to yellowish, odor varied from odorless to objectionable (OB) and turbidity varied from 2 to 4 NTU. The pH, TDS, Cl, F, NO_3, Cu, Zn, Ni and Pb levels ranged from 7.2 to 7.8, 250 to 1099 ppm, 21.2 to 173.2 ppm, 0.14 to 0.68 ppm, 0.4 to 28.7 ppm, (BDL) Below Detection Level to 0.08ppm, 0.06 to 0.18 ppm BDL to 0.07 ppm, BDL to 0.11 ppm respectively. E coli were present in all shallow ground water samples except at District Court Mirpur Building. The turbidity, TDS (except at Lehri and Bong) Cl, F, NO_3 , Cu and Zn levels were found within the permissible limits of WHO, US- EPA, Pak- EPA for drinking water quality. The Pb, Ni, and E coli (Except at District Courts Mirpur Building) levels exceeded the limits set for drinking water quality by WHO, US- EPA, Pak- EPA. The study also recommended various measures and practices for control and mitigation of shallow ground water contamination.

Keywords: Shallow ground water quality, Mirpur city aquifer, WHO, US- EPA, Pak- EPA, drinking water, Permissible limits, Control, Mitigation, Shallow ground water contamination.

INTRODUCTION

Ground water being a significant nonrenewable resource on the earth is a primary source of drinking water in the world. Groundwater is not only used for domestic purposes but is also used for irrigation, industries and municipalities. The groundwater gets contaminated naturally (such as weathering of rocks and soils) and by anthropogenic activities (such as wastes disposal practices,

storage and transport of commercial materials, mining operations and agricultural activities). The chances of contamination from natural sources are less as compared to anthropogenic sources.

In Pakistan, most of the groundwater resources occur in Indus Plain which extends from the Himalaya foothills to the Arabian Sea. The water is stored in the alluvial deposits under unconfined conditions covering about 21 Mha. The Pakistan groundwater resource is divided into five zones: i.e. (i) sweet groundwater areas; (ii) areas where canal or river water is a real alternative; (iii) mountainous and hilly areas where spring water is available; (iv) the eastern desert belt where groundwater is available at increasing depth; and, (v) coastal areas where the groundwater is saline. In Punjab Province and some areas of AJ& K, the fresh water is available in about 79% area while the highly saline water is present in south and desert areas. The disposal of untreated municipal and industrial effluents and agricultural wastes into surface water bodies contaminates both the surface water and groundwater. In Mirpur Upper Jhelum Canal gets contaminated due to the disposal of huge quantities of pollution from municipal, industrial, and agricultural activities which in turn deteriorates the quality of groundwater [8 & 5]. The present study was carried out to evaluate the shallow groundwater quality of Mirpur City aquifer lying in close vicinity of Upper Jhelum Canal for drinking purpose.

MATERIALS AND METHODS

A total of fifteen shallow groundwater samples were collected from hand pumps and motor pumps at five sites including District Court Mirpur Building, Lehri, Chechian, Bong, Pothi as shown in Figure 1 at depths of 150, 45, 70, 80, 50 feet respectively as shown in Figure-1.

The samples were taken from November 2011 to March 2012 after every 2- month interval. The collection and preservation of samples was done according to standard methods prescribed by Greenberge, Clesceri et al. (1992). The physical (color, odor and turbidity), chemical (pH, TDS, Cl, F, NO_3, Cu, Zn, Ni, &Pb) and bacteriological (E Coli) parameters were evaluated. Color and odor were measured by sensory tests or general observations, TDS were determined by multiplying the electrical conductivity (EC in dS/m) values with 640 and E. coli were measured by Bacti kit. The other parameters were analyzed according to standard methods prescribed by Greenberge, Clesceri et al. (1992). The values of physical, chemical and bacteriological parameters were compared with WHO, US- EPA and Pak-EPA drinking water criteria to determine the drinking water quality status of shallow groundwater samples (Table-1).

RESULTS AND DISCUSSION

Physical Parameters Evaluation

Color and Odor: the color of water samples varied from colorless to yellowish while the odor of water samples varied from odorless to objectionable (OB) (Table-2). The presence of color and

odor indicates the leaching of agricultural wastes, domestic sewage and industrial effluents through surface water to the shallow groundwater which makes water unhygienic.

Turbidity: The turbidity levels in shallow groundwater sample ranged from 2 to 4.5 NTU (Figure-2) with the minimum level at District Courts Mirpur Building and the highest level at Lehri. The turbidity level of shallow groundwater samples was within the permissible limits for drinking water quality (turbidity < 5 NTU).

Chemical Parameters Evaluation

pH: pH levels in the shallow groundwater samples ranged from 7.2 to 7.8 (Figure- 3) with the minimum value at District Courts Building Mirpur while the maximum value was noted at Lehri . The pH levels at all the sampling sites were within the permissible limit for drinking water quality (pH: 6.5 – 8.5).

Total Dissolved Solids (TDS): The TDS levels in the shallow groundwater samples ranged from 250 to 1099 ppm (Figure-4) with the minmum value at Chechian and maximum at Bong. TDS levels in all water samples (except at Bong) were within the permissible limits for drinking water quality (Table-1).

Chloride (Cl): The chloride concentration in the shallow groundwater ranged from 21.2 to 173.2 ppm (Figure-5) with the minimum value at District Courts Mirpur Building and maximum value at Lehri. The chloride levels at all sampling sites were within the permissible limits set for drinking water quality (Table-1).

Fluoride (F): The fluoride level in the shallow groundwater samples ranged from 0.14 to 0.68 ppm (Figure-6) with the minimum value at District Courts Building Mirpur and maximum at value at Lehri. The fluoride levels at all sampling sites were within the permissible limits for drinking water quality (Tble-1).

Nitrate (NO_3): The nitrate concentrations in the shallow groundwater samples ranged from 0.4 to 28.7 ppm (Figure-7) with the minimum value at District Courts Mirpur Building maximum value at Lehri. The nitrate levels at all the sampling sites were within the permissible limits set by WHO, Pak-EPA, and US-EPA (except at Lehri where it was high for standards set by US-EPA) for drinking water (Table-1).

Copper (Cu): The copper level in the shallow groundwater samples ranged from Below Detection Level (BDL) to 0.09 ppm (Figure-8) with the minimum copper level at District Courts Mirpur Building and maximum at Lehri. The copper levels at all sampling sites were within the permissible limits for drinking water quality (Table-1).

Zinc (Zn): The zinc concentrations in the shallow groundwater samples ranged from 0.06 to 0.19 ppm (Figure-9) with the minimum value at District Court Mirpur Building and maximum value at Bong. The zinc levels at all the sampling sites were within the permissible limits for drinking water quality (Table-1).

Nickel (Ni): The nickel level in the shallow groundwater samples ranged from BDL to 0.08 (Figure-10) with the minimum level at District Court Mirpur Building. The maximum nickel levels were noted at Lehri and Bong. In the shallow groundwater samples the nickel levels were exceeding the permissible limits for drinking water quality (Table-1) at all sampling sites except at District Court Mirpur Building and Chechian. The presence of nickel in water samples indicated the contamination of shallow groundwater with industrial effluent generated from oil and Ghee industries, electroplating workshops and dying units.

Lead (Pb): The lead level in the shallow groundwater samples ranged from BDL to 0.12 ppm (Figure-11). The minimum lead levels were found at District Court Mirpur Building and Chechian while the maximum level was noted at Lehri. The Lead Levels in the shallow groundwater were exceeding the permissible limits for drinking water quality (Table-1) at all sampling sites except at District Court Mirpur Building and Chechian. The presence of lead in water samples indicated the contamination of shallow groundwater with industrial effluent generated from batteries manufacturing units and paint and coating industries.

Bacteriological Parameters Evaluation

E. coli: E. coli were present in all shallow groundwater samples except at District Court Mirpur Building. The presence of E. coli in water samples indicated the contamination of shallow groundwater source due to disposal of agricultural, domestic and animal wastes into surface water of Upper Jhelum Canal. The E. coli levels at all sites except at District Court Mirpur Building were exceeding the permissible limits for drinking water quality (Table-1).

CONCLUSIONS AND RECOMMENDATIONS

The conclusions derived from the present study include:

- The color of water samples varied from colorless to yellowish, odor varied from odorless to OB and turbidity varied from 2 to 4.5.
- The pH, TDS, Cl, F, NO_3, Cu, Zn, Ni and Pb levels of shallow groundwater samples ranged from 7.2 to 7.8, 250 to 1099ppm, 21.2 to 173.2ppm, 0.14 to 0.68 ppm, 0.4 to28.7 ppm, BDL to 0.09 ppm, 0.06 to 0.18 ppm, BDL to 0.06 ppm, BDL to 0.11 ppm, respectively.
- E. coli were present in all shallow groundwater samples except at District Court Mirpur Building.

- Turbidity, pH, TDS, NO_3, Cl, F, Cu and Zn levels of water samples were within the permissible limits of WHO, US-EPA and Pak-EPA for drinking water quality. The Pb, Ni (except at District Court Mirpur Building and Chechian) and E. coli (except at District Court Mirpur Building) exceeded the levels exceeded the permissible limits of drinking water quality.
- The shallow groundwater at some sites showed the presence of color and odor. The yellowish color was observed in the shallow groundwater at Lehri, Bong and Pothi, while both yellowish color and odor was found at Bong.

The shallow groundwater was found contaminated with lead and nickel. Nickel was found at Lehri and Bong. Lead was found at Lehri, Bong and Pothi. The concentrations of both metals (Pb& Ni) were exceeding the WHO, US-EPA and Pak-EPA permissible limits for drinking water quality.

RECOMMENDATIONS

The recommendations emerged from the present study include:

- The groundwater quality needs to be monitored regularly by following effective enforcement of water quality laws and regulations.
- Nickel and lead filters may be installed where groundwater s used for drinking purposes.
- An effective public awareness raising campaign needs to be launched in the study area to create sensitivity among groundwater users about bad quality of groundwater, adverse impacts of its use on human health and adoption of measures, practices and technologies to improve drinking water quality.
- The implications of contaminated groundwater on human health need to be investigated through comprehensive studies.

REFERENCES

Greenberge, A. E., L. S. Clesceri, et al. (1992). Standard Methods for the Examination of Water and Waste Water, American Public Health Association, Washington, D.C., USA.

BIBLOGRAPHY

Liu, D. H. F. (2000). Groundwater and Surface Water Pollution, Principles of Groundwater Contamination, CRC Press LLC.

Ministry of Environment (2007). Damage Control through Environmental Improvement of Polluted Ravi River near Lahore, Draft Report, Introduction.

Ministry of Water and Power (2002). Pakistan Water Sector Strategy, National Water Sector Profile, Water Resources Status.

The World Bank. (2006). South Asia Environment and Social Unit, Pakistan Strategic Country Environmental Assessment, Water Supply and Sanitation, Protecting Sources and Safeguarding Supplies, USA.

Todd, D. K. (2004). Groundwater Hydrology, John Wiley and Sons (Asia) Pte Ltd.

Figure-1. Map showing location of study sites

Table-1. Drinking Water Quality Criteria

	TDS (ppm)	Cl (ppm)	F (ppm)	NO_3 (ppm)	Cu (ppm)	Zn (ppm)	Ni (ppm)	Pb (ppm)	E. coli
WHO Criteria	<1000	250	1.5	50	2	3	0.02	0.01	0 in 100 ml
Pak- EPA Criteria	<1000	<250	<1.5	<50	2	5	<0.02	<0.05	0 in 100 ml
US-EPA Criteria	1000	250	2	10	1	5	-	0.015	-

Table-2. Color and odor analysis of water samples

Sr.#	Study Site	Color	Odor
1	District Court Mirpur Building	Colorless	Odorless
2	Lehri	Yellowish	Odorless
3	Chechian	Colorless	Odorless
4	Bong	Yellowish	OB
5	Pothi	Yellowish	Odorless

Figure-2. Turbidity levels of water samples

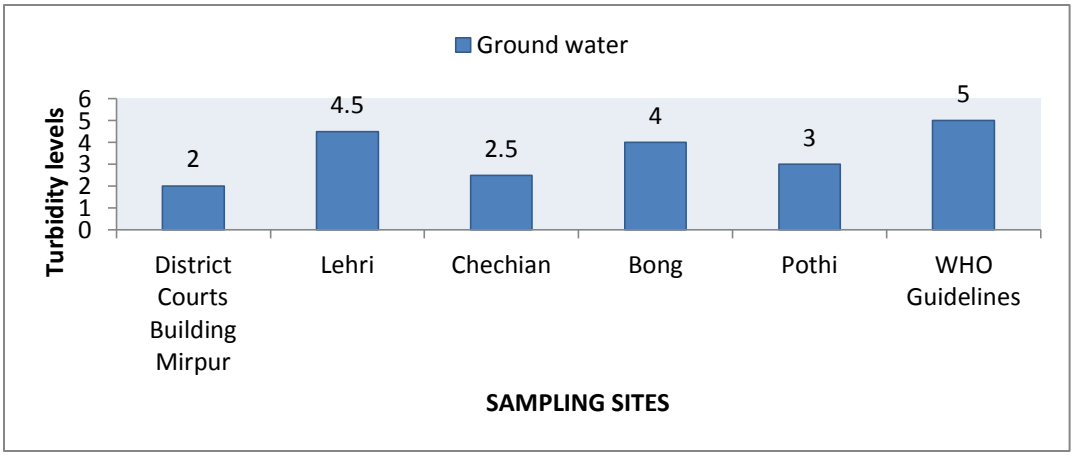

Figure-3. pH levels of water samples

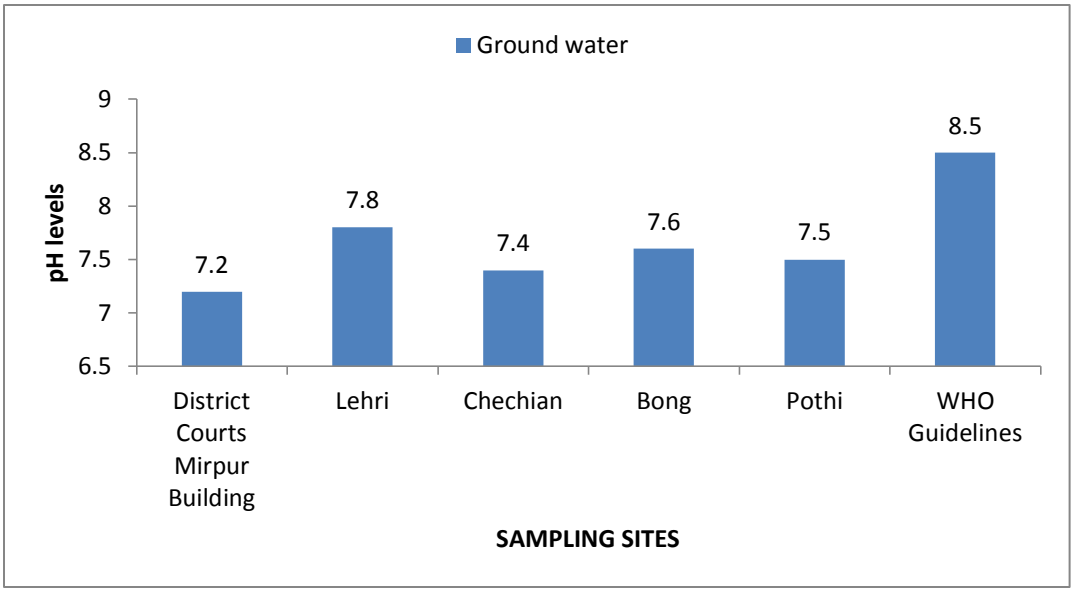

Figure-4. TDS values of water samples

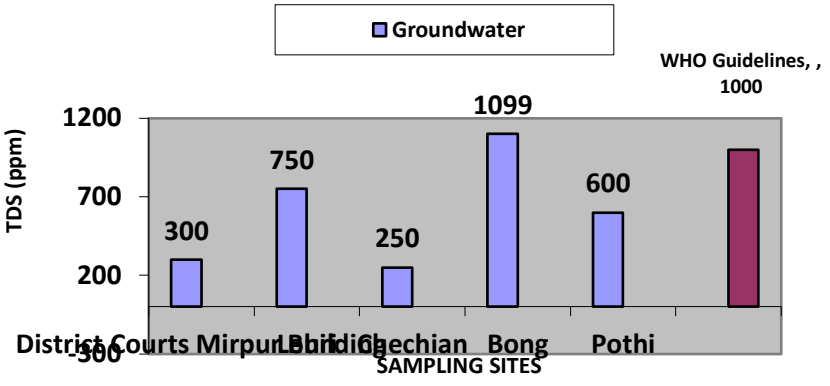

Figure-5. Chloride levels of water samples

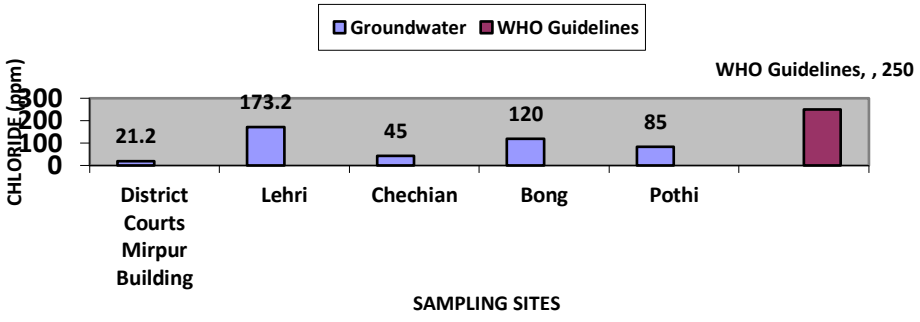

Figure-6. Fluoride levels of water samples

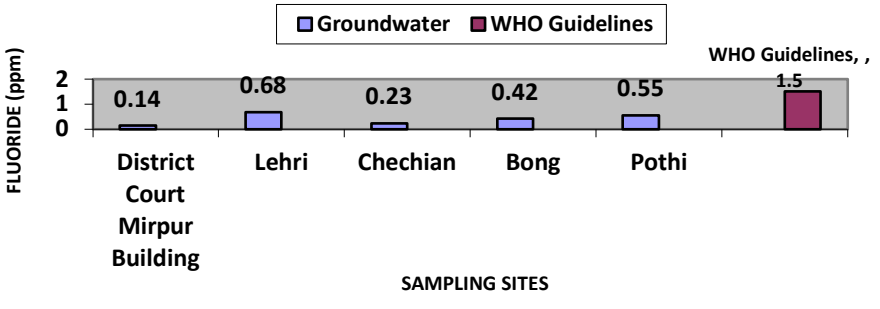

Figure-7. Nitrate levels of water samples

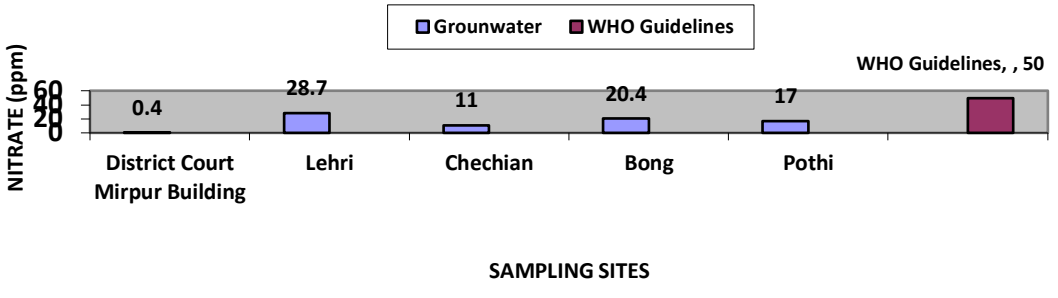

Figure-8 Copper concentrations of water samples

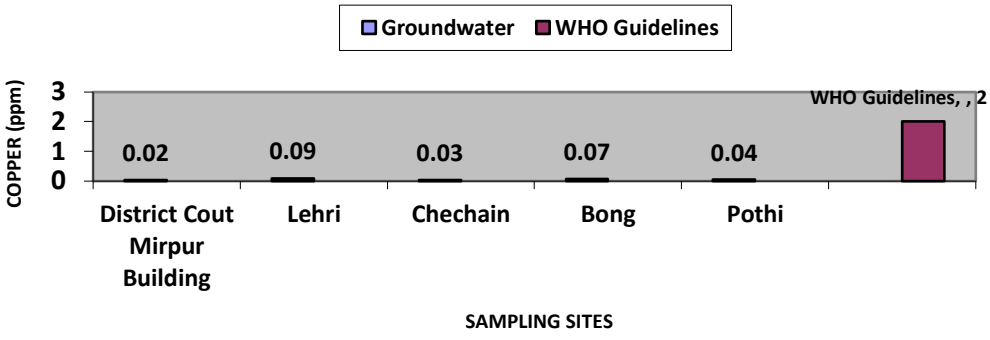

Figure-9 Zinc concentrations of water samples

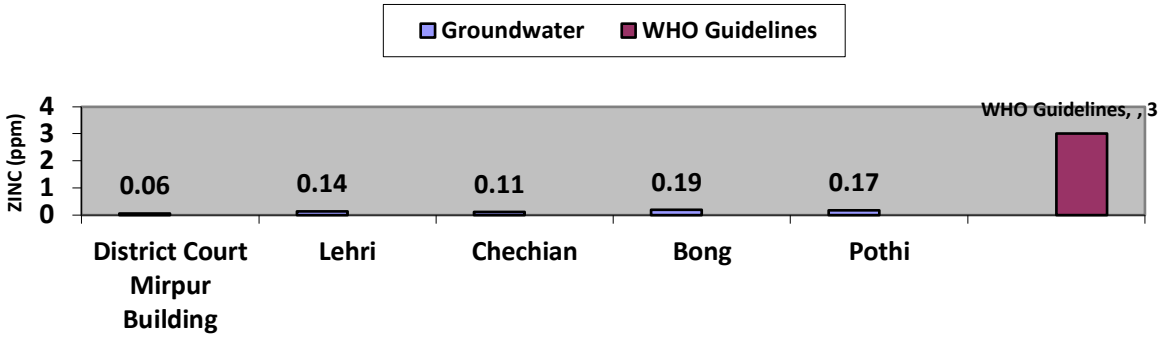

Figure-10 Nickel levels of water samples

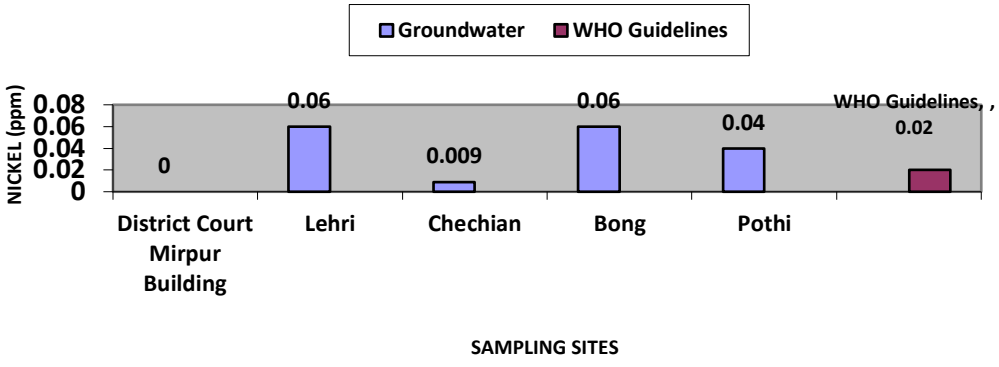

Figure-11 Lead levels of water samples