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RESEARCH ARTICLE

ASSESSMENT OF DRINKING WATER QUALITY DISTRICT JAMSHORO SINDH PAKISTAN: A CASE STUDY

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ABSTRACT

Drinking water is important element for the continuance of human beings. An exclusive present study was carried out for the determination of five parameter of arsenic (As), pH, electrical conductance (EC), total dissolved salts (TDS) and turbidity in drinking water of Jamshoro city that purpose, total of 147drinking water samples were collected from 09Villages and three UC, Taluka Manjh and of the city Jamshoro method. Results revealed that maximum concentration of pH was found in sample no: 25, 27, electrical conductance was found in sample no: 73, total dissolved salts was found in sample no: 72, turbidity was found in sample no: 27, arsenic was found in sample no: 53, 100.While in minimum and maximum mean concentration of pH was 7.4 and 8.4 unit, EC was 497 (µg/L) and 11580(µg/L), TDS was 743 (mg/L) and 4560 (mg/L), turbidity was 1.6 (mg/L) and 34 (mg/L), arsenic was 01 (µg/L) and 250 (µg/L), respectively. The pH is moderate correlated with EC, TDS, Turbidity but negative correlate to arsenic. EC are good correlate with TDS but moderate correlate to turbidity. Total no of 147drinking water samples of Jamshoro. The pH, electrical conductance, total dissolved salts, turbidity, arsenic were within WHO limits.

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INTRODUCTION

Drinking water contamination have mostly severe environmental problems in the global. High metals concentration in water supply can becreate a risk of un favourable effect on human being health. Drinking of water inclosing major amounts of metals may cause serious health effects varying from shortness of breath to some types of cancers in human beings (Syed WS *et al*., 2014). Water is considered as critical and the basic unit of nutrient to human life and vital for human's survival and livestock, animals and crops of the world. The main role of water in the body is digestion, transportation, adsorption of food, nutrients use, as well as waste and toxin elimination from body. It also plays an essential role in preparation of foodstuffs. Therefore availability, resources, management and distribution to realize the fresh water is of fundamental. An entire resource of fresh water on earth is only 3% which are non saline. 75% of it found in ice caps and glaciers which cannot be utilized easily or inaccessible. So only 0.08% of the world's freshwater is easily accessible and exploitable by humans (Syed *et al*., 2014). Contamination of drinking water is mostly severe environmental problems in the world. Water quality is a major concern for people because it is directly associated with human well-being. It is affected by natural and human (anthropogenic) influences such as domestic, industrial activities and agricultural run-off (Simeonov *et al*., 2003; Paul *et al*., 2015). Pakistan stands 80thbetween 122 nations about quality of drinking water (Azizullah *et al*., 2011). The microbiological and physicochemical characteristics determine the quality of drinking water (Shah, Shilpakar, and Sharma, 2007), in which the main factors are responsible alone or in combination for several public health problem. The pH, temperature, total dissolved solids/salts (TDS), turbidity, alkalinity, dissolved oxygen are important physicochemical characteristics that affect the quality of water (Nduka, Orisakwe, and Ezenweke, 2008). Each water quality parameter interacts with and influences other parameters. The major source of microbial contamination is microbes from human beings or animal wastewater, in which mixture with drinking

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water by contamination of ground water from landfills, or wastewater treatment stations, causing serious health issues (Gasana *et al*., 2002; Al-Khatib *et al*., 2003). In Pakistan bacterial contamination has been considered major drinking water problem (PCRWR, 2004). Arsenic has accepted as a large threat to public health in different countries such as, India, Bangladesh, China, Nepal, Myanmar and Vietnam (Forghani, Moore, and Qishlaqi, 2012). The 16-36% percentage of Sindh, Pakistan peoples has been showing to arsenic contaminated in water with over 10–50 ppb. Manchar Lake is a largest Asian lake and highest source of water for national, fishing and irrigation purposes in Sindh Pakistan. The Highest Nara Valley Drain is a major source of Asimprovement in this lake, as reported in previous work (Sawitri*et al*., 2004).

MATERIALS AND METHODS

Present study Sampling and Study area was conducted in different villages of District Jamshoro of Sindh province of Pakistan. A total numbers of 147 water sample were collected from different drinking water source in the sterilized bottles. Water source including the hand pump, open wall and water supply schemes of more than 9 village and different houses of district Jamshoro methodologytotally 5 parameter analysis such as, pH, Electrical conductance (EC), total Dissolved salts (TDS), Turbidity, and Arsenic were determined by conductivity meter orion 115, (IncBostan, USA) and PH meter (Hanna Instruments, Hi 8417, Italy), Turbidity measured by turbiday meter (Model PC Chekit Lovibond Germany), which shows clears of water. A manageable water testing kit (DelAgua Kit) was used to check the contamination of water by the detection of Escherichia coli. Briefly, each sample of water 100 ml passed through a filtration membrane (Millipore) with 0.45 µm pore size and 47 mm diameter. Arsenic was determined by (EZ Arsenic Test Kit 2822800; USA) for 0.01-0.5 mg/L. This test generates arsenic hydride, in which reacts with the mercury bromide present in the analytical strip to form a yellow-brown miscellaneous arsenic mercury halogenide. The concentration of arsenic was analyzed through visual assessment of the reaction region of the analytical test strip with scales of fields of color (Yu, Sun,and Zheng, 2007).

Samples collection: The district Jamshoro was selected for the research work because of isolated area of Sindh Province and less investigated. The total 147 samples were collected from during January 2017 to December 2017. Representative samples were collected from taluka Manjhand and three union council such as Manjhand, Petaro, Lakha populated villages to cover most of the areas where the surface, supply and groundwater is used for human consumption. The water samples were collected in 1.5 L clean plastic sampling bottles were collected.

Statistical analysis: The basic statistical analysis such as minimum, maximum, mean and standard deviation of the parameters were calculated. Correlation coefficient (r) some parameters were calculated by using Microsoft office excel 2013. The software program SPSS 22 (SPSS Inc., Chicago, IL, USA) was used for the validation of the results. The multivariate analysis was also used for the hierarchical cluster analysis and Piper diagram drawn with help of Aquachem software. The results of analysis were used to calculate different parameters to evaluate the suitability of drinking water.

RESULTS AND DISCUSSION

The found of results in present study, the no of 5 parameters of 147 water samples collected from different villages Taluka Manjhand, union council such as Manjhand, petaro and lakha District Jamshoro are shown in the Table 1. In the present study, all water samples were colorless and odorless due to the drinking water samples. The drinking water for human consumption should be colorless, odorless and tasteless, according to the WHO standards for drinking water. The population in Pakistan more than 40%tolerate of the Arsenic contamination in water. Hence the nations of Pakistan has been highest the risk of Arsenic. In Punjab, more than 20% living public are suffering from high pollution of As in moreover ground or surface water sources but bear high quantity of As in industrial areas (Azizullah *et al*., 2011). The East Punjab is mostly affected peopleby as contamination in groundwater up to 1900 µg/L (Farooqi *et al*., 2007). In province of Sindh, people have been suffering from 16 to 36% exposed the high level of As more than 315 µg/L in different areas of surfaceand ground water (Jakhrani *et al*., 2011). In Sindh, arsenic level in ground water has pass up to 1100 µg/L above WHO limits of 10 µg/l (Islam-UlHaque *et al*., 2007). Arsenic 250 µg/L 15% samples positive for very high level and 37% water samples positive for more than 50 µg/L of arsenic in underground water of Matiari and districts Khairpur has been described (Arain *et al*., 2009). The consumptionof arsenic contaminated drinking water may cause reduction in both white and red blood corpuscles production, disrupt the cardiac rhythm, damage blood vessels and paraesthesia in hands and feet (Abernathy *et al*., 2003). Urinary bladder cancer, lung cancer and skin cancer(IARC, 2004; Khan *et al*., 2009). As well as arsenic-induced skin lesions (Fatmi *et al*., 2009).

Arsenic: The results of arsenic of present study varied from 0 to 30 µS/cm and average value was 6.66 µS/cm. The lowest concentration of Arsenic was found in sample no: 3, 4, 6, 8, 10, 28, 38, 41, 54, 55, 57, 64, 68, 75, 78, 84, 87, 92, 93, 95, 99, 103, 106, 107, 112,113, 124, 130, 131, 142 and highest concentration was found in sample no: 53, 100, as showed in Table 2. and Figure 2.

Electrical conductance: It is used as a measurement of total dissolved solids in water. Status of inorganic or organic pollution qualitatively reflects by electrical conductance (McCutcheon *et al*., 1993). The results of electrical conductivity of present study varied from 484 to 6875 µS/cm and average value was 1764.4µS/cm. The lowest concentration of EC was found in sample no: 96 and highest concentration was found in sample no: 73, in Table. 2.

Total Dissolved Solids: Total dissolved solids in health risk (TDS) did not play a direct role but high salt contained water's extended consumption of TDS can cause kidney stone when TDS is above 500 ppm. The occurrence of TDS widely reported from many parts of the country, and may also have a laxative effect mainly upon transits because of elevated concentration of TDS which increases unwanted taste and causes gastrointestinal irritations in humans (Khaiwal *et al*., 2007). The results of TDS of present study varied from 743 to 4560 µS/cm and average value was 1064.84 µS/cm. The lowest concentration of TDS was found in sample no: 96 and highest concentration was found in sample no: 72, in Table. 2, and Figure 3.

Table 1.Mean value of some parameter of drinking water samples of different villages District Jamshoro

Villages	PH	EC	TDS	Turbidity	Arsenic
Akro Sharif (n=17)	7.63	1997.50	1278.68	6.61	3.68
Bhitt Kachi (n=18)	7.77	2544.94	1463.01	14.58	7.53
Dhani Bux Machi (n=12)	7.33	1100.69	713.41	8.16	5.15
Imam Bux Shaino (n=13)	7.38	1744.92	1117.15	4.27	8.30
Mangeladho Machi (n=28)	7.33	1552.50	867.70	4.70	6.00
Mazar Machi (n=09)	7.13	1617.77	1035.55	4.11	6.11
Mehrab Machi (n=17)	7.26	1508.05	966.11	3.81	8.11
Rustam Machi (n=23)	7.33	1936.66	1273.90	5.29	8.87
Singhar Khoso (n=10)	7.55	1700.40	1085.20	5.26	4.40

Table 2. Minimum, maximum, mean and standard deviation values of parameters of Different village at Jamshoro

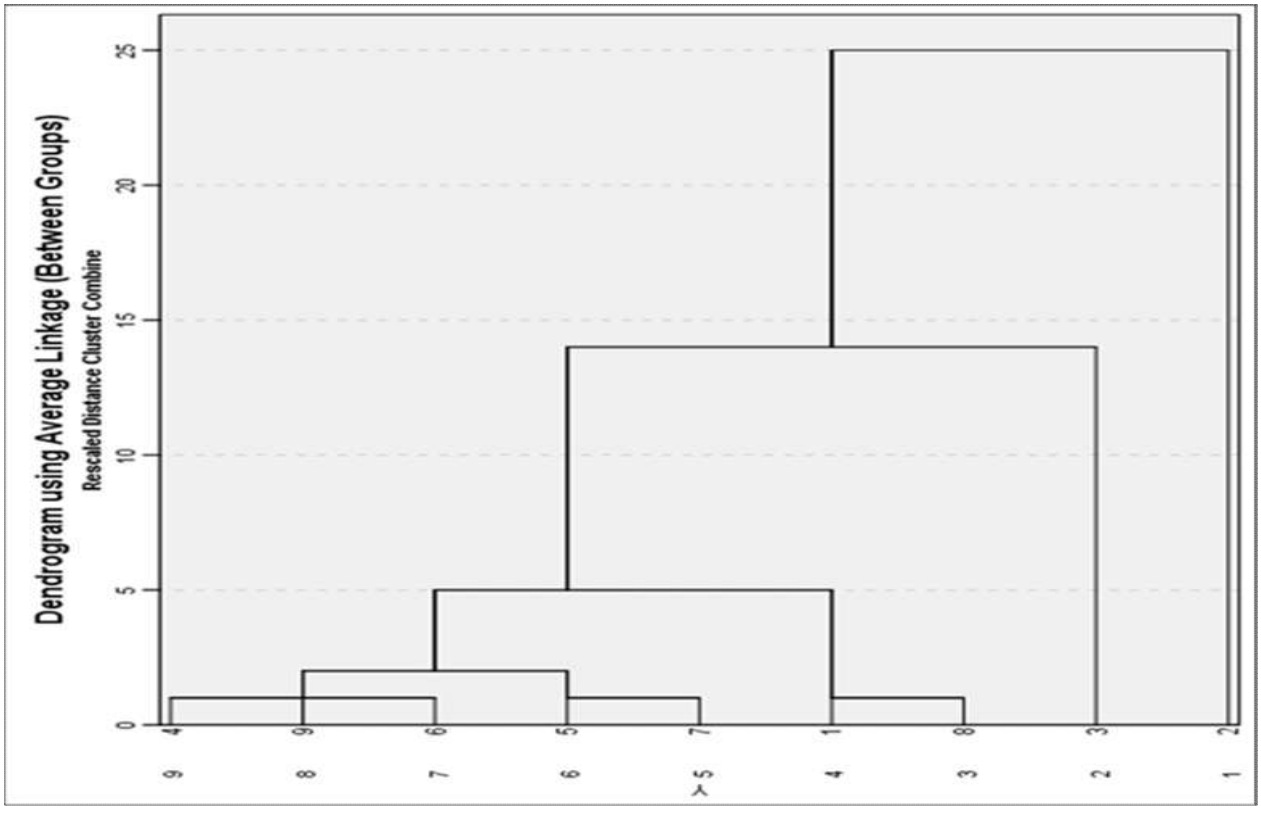
Parameters	Minimum	Maximum	Mean	Standard deviation
PH	7.4	8.4	7.41	0.34
EC (µg/L)	497	11580	1764.40	1076.64
TDS (mg/L)	743	4560	1064.84	585.85
Turbidity (mg/L)	1.6	34	6.31	5.71
Arsenic (µg/L)	01	250	6.66	6.16

Table 3. Classification of water on the basis of TDS of Different villages at Jamshoro

S:NO:	Total dissolved solids mg/L	Water samples	Number of samples 147	Percentage
1	< 1000	Non saline	90	61.22
2	1000-3000	slightly saline	49	33.33
3	3000-10000	moderately saline	08	5.44
4	> 10000	very saline	00	0.0

Table 4. Correlation coefficient of parameters of different village District Jamshoro

Correlation Matrix						
		pH	EC	TDS	Turbidity	Arsenic
Correlation	pH	1.000				
	EC	0.633	1.000	.		
	TDS	0.612	0.965	1.000		
	Turbidity	0.566	0.616	0.485	1.000	
	Arsenic	-0.444	0.323	0.325	0.069	1.000



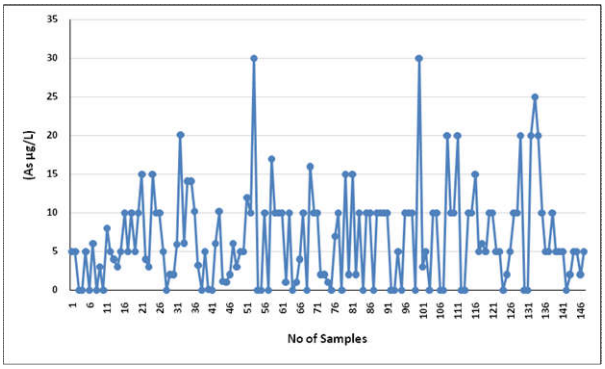


Figure 2. Arsenic (As) samples of Different Villages and District Jamshoro

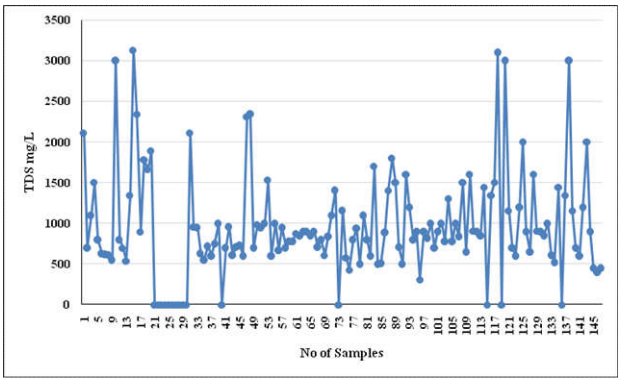


Figure 3. TDS samples of Different Villages and District Jamshoro

Turbidity: Turbidity is due to suspended solids and gauges the vagueness of the drinking water, it is generally used as a representation compute as hazards of microbial contamination and the efficiency of the treatment of public drinking water (USEPA, 1984). Planktons, industrial wastes, iron, decay organism and manganese oxides may be reasons causes colour measured as NTU Nuphelometric turbidity unit (Pierce *et al*., 1998). Sometimes turbidity gauge microbial contamination of unprocessed and treated water in several studies had shown a correlation (LeChevallier *et al*., 1993; LeChevallier *et al*., 1991). In the aged population in Philadelphia over the phase (1992–1993) create an involvement stuck between turbidity levels and hospital burden for GI illness (Schwartz *et al*., 1997). The results of turbidity of this study varied from 1.6 to 34 µS/cm and average value was 6.31 µS/cm. The lowest concentration of turbidity was found in sample no: 42 and highest concentration was found in sample no: 27, in showed Table 2.

pH: pH is a –ve log of Hydrogen ion concentration. It has effects on metal ion solubility and existence of some pathogens endurance water quality pH changes, bitter taste of drinking water attributes a high range of pH and sour taste results low pH (USEPA, 1977). The results of pH of present study varied from 7.4 to 8.4 µS/cm and average value was 7.4 µS/cm. The lowest concentration of pH was found in sample no: 80, 89 and highest concentration was found in sample no: 25, 27, in shown Table 2. The higher concentration of EC and TDS it may be due to the soluble salts and ions present in drinking water of the study area (Butt *et al*., 2012).Reported EC and TDS ranged (372 to 1543(µS/cm) and (190 to 790 mg/L) drinking water of MehmoodBoti Landfill, Lahore, Pakistan (Khuhawar *et al*., 2011).

Reported EC (239 to 13170 µS/cm) and TDS (153 to 8429 mg/L) drinking water of taluka Nawabshah. The highest mean value of pH, EC and TDS in village of Bhitt Kachi, Akro Sharif as well as other villages, and lowest value of Dhani Bux Machi and Mangeladho Machi. The highest value of turbidity in Bhitt Kachi and Dhani Bux Machi and low value of turbidity in Mehrab Machi. And other then arsenic at Mehrab Machi are highest mean value and low mean value of arsenic at Akro Sharif are showed in Table. 1. The present study maximum concentration of pH was found 8.4, EC was found 11580 µg/L , TDS was found 4560 mg/L, Turbidity was observed 34 mg/L, as well as Arsenic was found 250 µg/L with mean standard deviationas shown in Table 2. Showed in table 3. The highest percentage of Non saline (61.2%), slightly saline (33.3%), moderately (5.4%) and very saline are low percentage of TDS at Jamshoro. Correlation is used to determine the degree of closeness between the dissimilar variables (Nesrine *et al*., 2015). The (table 5) shows the correlation of parameters of taluka Majhand to each other. The pH is moderate correlated with EC, TDS, Turbidity but negative correlate to arsenic. EC are good correlate with TDS but moderate correlate to turbidity. TDS are less correlate to turbidity and arsenic, Turbidity is less correlate to arsenic. The correlation showed EC and TDS were good correlated to each other but other parameters were less correlated to each others as shown Table 4.

Hierarchical Cluster Analysis: The cluster analysis is a process which enable the combination of related locations on the basis of distance conditions and specific aggregative procedure in direction to create a topology which describe the similarities between the class and dissimilarities between the differentclasses. The value of cluster support the understanding the data and pattern. The cluster analysis is designed consecutively by opening with the related pair of objects and creating higher groups step by step going to the bottom. The hierarchical clusters are completed on the normalized data set (average value) by using wards method (Sneath and Sokal 1973). The Cluster analysis method was used for the mean values of 147 samples finally 9 samples were applied for cluster analysis taluka Manjhand, petaro, lakha samples to known the similarity among the sampling locations (Figure 1). The samples were observed to be grouped into three clusters in dendrogram. Group A is based on 6 samples with sample numbers 4, 9, 6, 5. The cluster B contain 3 samples 1, 8, 3. The cluster C contain only one sample 2. It is observed that group C samples have higher values for most of parameters than group A and B. Similarly group the group B has higher values in terms of average concentration then group A as showed in figure 1.

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Conflict of Interest: None

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