QUANTITATIVE ASSESSMENT OF WATER SAMPLES FROM DIFFERENT SOURCES OF DISTRICT ATTOCK AND ITS IMPACT ON AGRICULTURE

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ABSTRACT: Available water resources are getting depleted and water quality is deteriorating due to rapid increase in population to meet the need of human, industrial and irrigational consumption. The study was conducted to analyze the water quality of district Attock for irrigation. The measurement of water quality parameters were found in the ranges such as pH 7.15-7.97, conductivity 452-1750 µs/cm, total dissolved Solids 357-1225, total hardness 100-490, total alkalinity 240-720, chloride 28-387, sulphate 13-140, nitrate 0.02-0.07, nitrite <0.01, iron <0.01and sodium absorption ratio 0.302-1.691 ppm respectively. Concentration of essential metal ions including Na^+, K^+, $Ca^{2+}$and Mg^{2+} was found to be in range of 55-472, 4-6, 18-148 and 6-46 ppm respectively. Results of present study were compared with World Health Organization and other water quality standards.

Key words: District Attock, Water Quality Parameters, Water, Essential metal ions and irrigation water

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INTRODUCTION

Industry, agriculture and sewage are among major pollutants of water (Steduto *et al.,* 2007; muchuweli *et al.,* 2006; Afsaneh *et al.,* 2009). According to WHO, 60% disease in the Asian countries were water borne (Kneis *et al.,* 2009; Anikwe *et al.,* 2006). WHO recorded 315 cases of water borne diseases out of 100,000 in the world (Nwachuku *et al.,* 2005). The anions of nitrates and sulphates are very important both from environmental and industrial point of view (loos *et al.,* 2009). The pH, alkalinity, TDS, nitrate and sulphate etc. are important in determining the water quality (Mahdieh and Amirhossien, 2009). Pollution and waste due to industrial exploitation and over-population are serious threats to fresh water resources (Amany and Daboor, 2009).

Excessive research is carried out to study the quality of fresh water in various countries such as Nigeria (Agbogu *et al.,* 2006), Saudi Arabia (Al Harbi *et al.,* 2006). In Pakistans, about 30% of all sickness and 40% of deaths are due to water borne diseases (Khan *et al.,* 2005). Similarly, studies on physiochemical investigation of water quality from the various areas such as Karachi (Langha *et al.,* 2008), Dianchi Lake (Liu *et al.,* 2010), Balochistan (Chandio *et al.,* 2015), Skardu Northern Area (Lodhi *et al.,* 2003), Dawarka, India (Rawat *et al.,* 2015), Honghe river water shed, China (Yan *et al.,* 2015), Tamil nadu, India (Jasmine *et al.,* 2014), Tigris river, Turkey (Varol *et al.,* 2012) and Dir (Shakirullah *et al.,* 2005) have been previously reported.

The concentration and composition of dissolved salts in water determines its quality for drinking and other purposes. If water contains excess of soluble salts it is harmful for digestive system, also unfit for laundries and steam engines. If the irrigation water contains excessive salts the plant feels difficulty in extracting water from saline solution due to increased osmotic pressure.

The purpose of this work was to access the drinking quality as well as agricultural impact of water from different sources of district Attock.

MATERIALS AND METHODS

Eighteen water samples were collected from different areas of district Attock, directly from the source i.e. two samples from springs, one sample from tube well, five samples from wells and ten samples from hand pumps. Different physiochemical parameters of water samples were measured in the laboratory. A pH meter was used to measure pH of water samples. Electrical conductivity was measured with Jenway 4320 conductivity meter. TDS was determined by heating the sample at 105 ^{0}C until complete evaporation. Total hardness, Calcium and Magnesium hardness as $CaCO_3$ were determined by complexometric EDTA titration using Eriochrome Black T and Petton and Reeders as indicators. Chloride contents were determined by titration with Silver nitrate solution using Potassium chromate as an indicator (Vogel, 2003). Nitrate, Nitrite, Phosphate and Iron contents were determined by spectrophotometric method. Sulphate contents were determined by

turbidimetry as $BaSO_4$. Essential metal ions Sodium and Potassium were determined by Flame Photometer. All the measurements were made in triplicate to ensure accuracy and precision in the data. Analytical values were statistically evaluated according to Duncan's multiple range test at $P \leq 0.05$ (Steel and Torrie, 1996).

RESULTS AND DISCUSSIONS

Assessment of water quality by its chemistry included measures of many elements and molecules dissolved or suspended in water.

Commonly measured parameters included pH, conductivity, total dissolved solids, hardness, alkalnity, chloride, sulphate, sodium, potassium, nitrate, nitrite, iron etc. The concentration and composition of dissolved salts in water determines its quality for drinking and other purposes. The quality of drinking water has pronounced effect on human health. In the past few years, a number of cases were reported in which several people died due to use of contaminated water in Peshawar (Khan *et al.,* 2008).

The present work focuses on the characterization studies of water from different 18 sources of district Attock (Table-1). The test results showed that all the water samples were odourless. pH values of all the samples were in the range from 6.82-7.91. Water with the pH value lower than 4.0 had sour taste and above 8.5 alkaline had bitter taste. Water with pH lower than 6.5 caused the corrosion of pipes and was considered as a source of some toxic metals like Zn, Pb, Cd, Cu etc. (De, 1987). The World Health Organization (WHO) recommended permissible limit for pH as 7.0-8.5. Results indicated that all the samples were within permissible limits of WHO and other standards except the sample 13 having pH 6.85.

Conductivity values of all the samples were in the range of 452-1448 µs/ cm. The range of TDS was from 435-1225 ppm. All the values were found to be within the WHO maximum permissible range i.e. 1500 ppm. The total hardness as $CaCO_3$ ranged between 100-490 ppm. Maximum allowable range for total hardness is 500 ppm. Total alkalinity estimated as $CaCO_3$ was in the range of 240-720 ppm.

Various cations such as Ca^{2+}, Mg^{2+} and anions like Cl^{1-}, SO_4^{2-}, NO_3^{1-} etc. were also determined from the water samples respectively. The concentration of Ca^{2+}, Mg^{2+} was found to be in the range from 18-148 ppm and 6-46 ppm respectively (Table-1). The results indicated that both the cations were well within the WHO permissible limits.

The chloride contents of all the samples were in the range between 28-387 ppm. The maximum value of chloride was found in Dhok Lari, Hand pump and Chura Sharif Spring samples (Table-1). These results showed that chloride concentration was quite high/low as compared to standards limits. The samples with higher chloride contents had toxic effect to health (Majidano *et al.,* 2008).

Sources of sulphate in surface and subsurface water were mainly calcium sulphate and sodium sulphate. Concentration of SO_4^{2-} in water sample ranged from 13-140 ppm. Sulphate in water caused noticeable taste at a concentration above 250 ppm and contributed to the corrosion of water distribution system and permanent hardness. Water containing high sulphate level also caused laxative effect (Khan *et al.,* 2005).

Commonly known forms of nitrogen were nitrates, nitrites, ammonia and organic nitrogen. The presence of nitrogen in water was caused by the decomposition of proteinous compounds in waste water (Voznoya, 2008). The concentration of nitrates in surface wss changeable and depended upon the seasonal functions which were related to activity of microbes as nitrate concentration was greater in winter season compared to summer. Nitrates in drinking water could become a cause of cyanosis (Mathaemoglobinaemia) in babies (Ahmad *et al.,* 2003). Nitrate content of all the samples was in the range between 0.02-0.12 ppm (Table1). The maximum value of nitrate was found in Kot Chhajii, Hand pump sample. Nitrate value of all the samples was within WHO maximum allowable range.

Sodium was present in all natural waters. The high concentration of sodium imparted taste to water and made it unfit for daily use, which led to cardiovascular diseases and high blood pressure (Poverty and Kopka, 1991). Concentration of sodium in water samples was in the range between 5-472 ppm (Table-1).

Potassium plays an important role in the metabolism process in animals and it was an important micronutrient for living organism. Concentration of potassium in water samples was in the range from 2-6 ppm (Table-1).

Sodium absorption ratio (SAR) was calculated to check the suitability of water to be used for irrigation purposes (Table-1). Concentration of SAR in water samples was in the range between 0.018-2.453 meq/lit.

Table: 1 (a). Chemical analysis of the collected water samples.

Water Quality Parameters	Unit	Jasian, Spring (S-1)	Sanjwal-Cantt, Well (S-2)	Attock Mohalla Shed, Hand Pump (S-3)	GC Attock, Tube Well (S-4)	Kamra, Well (S-5)	Kamra, Hand Pump (S-6)	Domal, Hand Pump (S-7)	Dhok Lari, Hand pump (S-8)	Bhall, Well (S-9)
Taste	--	Non-objectionable								
Odour	--	Odourless								
Turbidity	NTU	5.0	5.6	5.4	6.0	4.9	6.0	6.0	5.6	6.4
pH	--	7.3	7.15	7.02	7.05	7.02	7.5	7.97	7.65	7.7
Conductivity at 25 ^{0}C	µS/cm	1318	801	1030	780	972	825	680	1448	1256
Total dissolved solids	ppm	923	561	721	546	680	577	476	1014	879
Total suspended solids	ppm	None								
Total hardness as CaCO3	ppm	280	190	290	240	270	180	100	200	280
Calcium as $CaCO_3$	ppm	180	100	160	150	140	120	70	60	110
Magnesium as $CaCO_3$	ppm	100	90	130	90	130	60	30	140	170
Calcium as Ca^{2+}	ppm	72	40	64	60	56	48	18	24	44
Magnesium as Mg^{2+}	ppm	20	18	26	18	26	12	06	28	34
Total alkalinity as $CaCO_3$	ppm	480	240	360	240	360	360	240	480	600
Bicarbonate as $CaCO_3$	ppm	480	240	360	240	360	360	240	480	600
Carbonate as $CaCO_3$	ppm	None								
Bicarbonate as HCO_3^{1-}	ppm	586	293	439	293	439	439	293	586	732
Carbonate as CO_3^{2-}	ppm	None								
Chloride as Cl^{1-}	ppm	248	245	230	220	199	135	174	387	156
Sulphate as SO_4^{2-}	ppm	60	50	60	85	55	13	Nil	28	27.5
Sodium as Na^{1+}	ppm	279	5	5	146	194	173	175	389	259
Potassium as K^{1+}	ppm	4	5	5	5	4	5	4	6	4
Iron as Fe^{2+}	ppm	< 0.01								
Nitrite as NO_2^{1-}	ppm	< 0.01								
Nitrate as NO_3^{1-}	ppm	0.07	0.06	Nil	Nil	Nil	Nil	Nil	Nil	0.02
Sodium absorption ratio (SAR)	Meq/lit.	1.025	0.022	0.018	0.579	0.726	0.793	1.076	1.691	0.952

Table: 1(b). Chemical analysis of the collected water samples.

Water Quality Parameters	Unit	Saghri, Hand Pump (S-10)	Kot Chajji, Hand pump (S-11)	Dhok M. Khan, Well (S-12)	Kundrola, Hand pump (S-13)	Rangli, Hand pump (S-14)	Bhattiara, Hand Pump (S-15)	Jand, Well (S-16)	Darbar chura Sharif, Hand pump (S-17)	Chura sharif, Spring (S-18)
Taste	--					Non-objectionable				
Odour	--					Odourless				
Turbidity	NTU	5.0	5.6	5.4	6.0	4.9	6.0	6.0	5.6	6.4
pH	--	7.3	7.4	7.37	6.82	7.55	7.4	7.75	7.2	7.54
Conductivity at 25 ^{0}C	µS/cm	674	921	664	622	1750	954	452	1113	510
Total dissolved solids	ppm	472	645	465	435	1225	668	316	779	357
Total suspended Solids	ppm					None				
Total hardness as CaCO3	ppm	180	100	180	180	140	140	180	490	420
Calcium as $CaCO_3$	ppm	120	70	90	120	60	110	80	370	190
Magnesium as $CaCO_3$	ppm	60	30	90	60	80	30	100	120	230
Calcium as Ca^{2+}	ppm	48	28	36	48	24	44	32	148	76
Magnesium as Mg^{2+}	ppm	12	06	18	12	16	06	20	24	46
Total alkalinity as $CaCO_3$	ppm	240	360	240	240	720	360	240	540	510
Bicarbonate as $CaCO_3$	ppm	240	360	240	240	720	360	240	540	510
Carbonate as $CaCO_3$	ppm					None				
Bicarbonate as HCO_3^{1-}	ppm	293	439	293	293	878	439	293	659	622
Carbonate as CO_3^{2-}	ppm					None				
Chloride as Cl^{1-}	ppm	128	99	155	128	234	121	28	57	387
Sulphate as SO_4^{2-}	ppm	55	110	22	20	120	110	22	110	140
Sodium as Na^{1+}	ppm	134	233	136	119	472	230	55	109	357
Potassium as K^{1+}	ppm	4	6	4	2	6	4	2	6	4
Iron as Fe^{2+}	ppm					< 0.01				
Nitrite as NO_2^{1-}	ppm					< 0.01				
Nitrate as NO_3^{1-}	ppm	0.1	0.12	0.03	Nil	0.02	0.02	Nil	Nil	Nil
Sodium absorption ratio (SAR)	Meq/lit.	0.614	1.432	0.623	0.545	2.453	1.195	0.252	0.302	1.071

Conclusion: From the overall analysis it was concluded that quality of water from different areas of Attock district was better for its domestic as well as agricultural use.

To prevent further contamination of water, proper sewerage system and sewerage plant should be installed otherwise sewerage keeps on seeping into ground water ultimately will cause pollution.

REFERENCE

Agbogu, V.N., V.J. Umoh, C.A. Okuofu, S.I. Smith and J.B. Ameh (2006). Study of the biological and physiochemical indicator of pollution of surface waters in Zaria, Nigeria. Afr. J. Biotech. 5(9):732-737.

Afsaneh, S and E.S. Abbas (2009). Ground water quality assessment in North of Iran: A case study of the Mazandaran province. World Appl. Sci. J. 5: 92-97.

Al Harbi, O.A., G. Hussian, M.M. Khan, M.A. Moallin and I.A. Al-Sagaby (2006). Evaluation of Ground water quality and its recharge by isotopes and solute chemistry in Wadi malal, Al-Madina Munawara, Saudi Arabia. Pak. J. Bio. Sci. 9 (2): 260-269.

Ahmad, M., M.Y. Kalim and M. I.A. Khan (2003). Survey of Nitrates in Drinking Water. J. Chem. Soc. Pak. 25(1): 49-50.

Aman, T., A.A. Kazi, M.U. Sabri and Q. Bano (2008). Potato peels as solid waste for the removal of heavy metal Copper (II) from waste water/ Industrial effluents. Colloids Surf. B. 63(1): 116-121.

Amany, M.H. and S.M. Daboor (2009). The role of different macrophytes groups in water quality, sediment chemistry and microbial flora of both irrigation and grainage canals. World Appl. Sci. J. 6 (9): 1221-1230

Anikwe, M.A.N. and K.C.A. Nwobodo(2006). Long term effect of municipal waste disposal on soil properties and productivity of sites used for urban agriculture in Abakaliki, Nigeria. Biores. Technol. 83: 241-251

De, A.K. (1987). Environmental Chemistry Wiley Eastern Ltd., New Dehli, Pp: 158.

Chandio, T.A., M.N. Khan and A. Sarwar (2015). Fluoride estimation and its correlation with other physiochemical parameter in drinking water of some areas of Balochistan-Pakistan. Environ. Monit. Assess. 187(8): 531.

Jasmine, I. and P. Mallikarjuna (2014). Physiochemical quality evaluation of ground water and development of drinking water quality index for araniar river basin, Tamil Nadu, India. Eviron. Monit. Assess. 186 : 935.

Khan, A., R. Mumtaz, Y.S. Min, G.A. Marwat and M. Riaz (2005). Potable water quality characteristics of urban areas of Peshawar (Pakistan) Part 2: Well water. J. Chem. Soc. Pak. 27(3): 239-245.

Khan, H., S. Haider, K. Saeed and N. Ali (2008). Assessment of potable water quality of kohat division and its impact on health. J. Chem. Soc. Pak. 30(2): 246-250.

Kneis, D., S. Foster and A. Bronstert (2009) Simulation of water quality in a flood detention area using models of different spatial discretization. Ecol. Modell. 220: 1631-1642.

Langha, A.A., K. Mahmood, Q. Haque, S. Perveen and Z. Ullah (2008). Physical and bacteriological analysis of drinking water of karangi, Landhi and Malir Town of Karachi, Pakistan. J. Chem. Soc. Pak. 30(2): 315-322.

Liu, J.T., J.F. Gao and J.H. Jiang (2010). Application of different fuzzy method for water quality assessment in Dianchi lake. Environ. pollut. Control 32 (1): 20-25.

Lodhi, Z.H., M. Akif, and U. Kalsoom, (2003). Evaluation of drinking water from different sources in Skardhu Northern area with special reference to heavy metals. J. Chem. Soc. Pak. 25(2): 110-113.

Loos, R., B.M. Gawlik, G. Locoro, E. Rimaviciute, S. Contini and G. Bidoglio (2009). EU- wide survey of polar organic persistent pollutants in European river water. Environ. Poll. 157(2): 561-568.

Majidano, S.A., A.A. Majidano and M.Y. Khuhawar (2008). Physiochemical study of surface and ground water of Taluka Nawabshah district Pakistan. J. Chem. Soc. Pak. 30(6): 950-953.

Muchuweti, M.J., J.W. Birkett, E. Chinyanga, R. Zvauya, M.D. Scrimshaw and J.N. Lester (2006). Heavy metal content of vegetables irrigated with mixture of waste water and sewage sludge in Zimbabwe: Implication for human health. Agri. Ecosyst. Environ. 112: 41-48.

Nwachuku N., C.P. Gerba, A. Oswald and F.D. Mashadi(2005). Comparative inactivation of Adenovirus serotypes by UV light disinfection. Appl. Environ. Microbiol. 71(9): 5633-6.

Poverty , J.H. and R. J. Kopka (1991). Change in Al, Mn and Fe from sediments and aquatic plants after Lake draw down. Water Air Soil Pollut. 57(1): 399-410.

Rawat, K.S. and V.K. Tripathi (2015). Hydrochemical servey and quantifying spatial variation of ground water quality in Dwaka, India. J. Inst. Eng. India Ser. A. 96 (2): 99-108.

Shakirullah, M., I. Ahmad, K. Mahmood, A. Khan, H. Rehman, S. Alam and A.A. Shah (2005).

Physiochemical study of drinking water from Dir Districts. J. Chem. Soc. Pak. 27(4): 374-387.

Steduto, P., T.C. Hsiao and E. fereres (2007). On the conservative behavior of biomass water productivity. Irrig. Sci, 25: 189-207.

Steel, R.G.D., and J. H. Torrie, (1996). Principle and mathematics of statistics: A biometrical approach, MC Graw-Hill, New York.

Varol, M., B. Gokot, A. Bekleyen and B. Sen (2012). Water quality assessment and apportionment of pollution sources of Tigris river (Turkey) using multivariate statistical technique- A case study. River Res. Applic. 28 (9): 1428-1438.

Voznaya, N.H. (1981). Chemistry of Water and Microbiology, Moscow, Mir Publishers, Pp: 347.

Vogel, (2003). Text Book of Quantitative Chemical Analysis. 6th Ed., Longmans, Green and Co. Ltd., Pp: 401.

Yan, C., W. Zhang, Z. Zhang, Y. Lin, C. Deng and N. Nie (2015). Assessment of water quality and identification of polluted riskey region based on field observation & GIS in Honghe river water shed, China. PLoS One. 10 (3): e0119130.