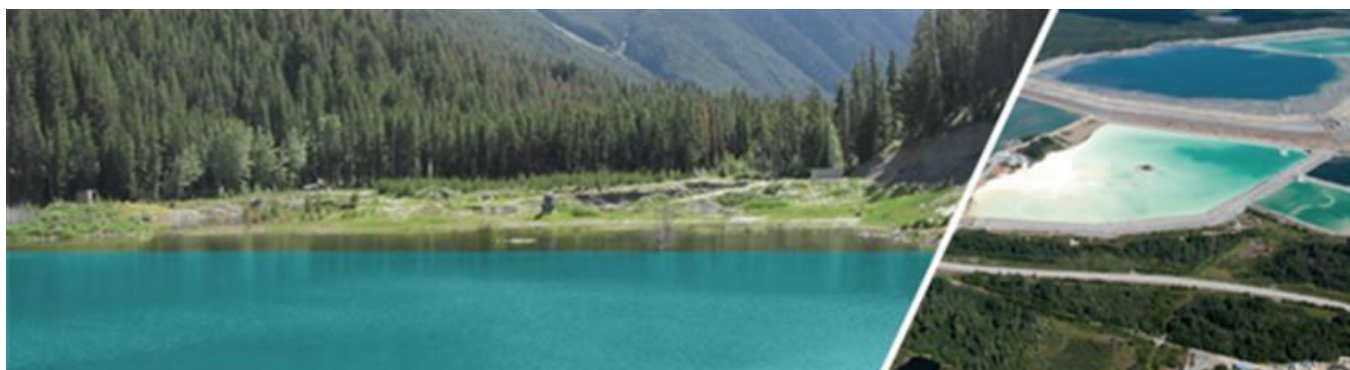


Physio-Chemical assessment of water sources for drinking purpose in Badin City, Sindh Province, Pakistan, (Water Supply Schemes and Hand Pumps)



Original Research Article

ISSN : 2456-1045 (Online)

(ICV-ENV/Impact Value): 63.78

(GIF) Impact Factor: 4.126

Publishing Copyright @ International Journal Foundation

Journal Code: ARJMD/ENV/V-29.0/I-1/C-7/SEP-2018

Category : ENVIRONMENTAL SCIENCE

Volume : 29.0 / Chapter-VII/ Issue-1(SEPTEMBER-2018)

Journal Website: www.journalresearchijf.com

Paper Received: 23.09.2018

Paper Accepted: 02.10.2018

Date of Publication: 10-10-2018

Page: 38-44



Name of the Author(s)

Manzoor Ahmed Sanjrani¹,
Hafeez Ahmed Talpur^{2*},
Shakeel Ahmed Talpur³

¹School of Resource and Environmental Engineering, University: Wuhan University of Technology, Wuhan, P.R. China, 430070

²Center for Environmental Sciences University: University of Sindh, Jamshoro, Pakistan

³School of Environmental Studies University: China University Geosciences Wuhan, China

Citation of the Article

Sanjrani MA; Talpur HA; Talpur SA.(2018) Physio-Chemical assessment of water sources for drinking purpose in Badin City, Sindh Province, Pakistan, (Water Supply Schemes and Hand Pumps).; *Advance Research Journal of Multidisciplinary Discoveries*.29(7)pp. 38-44

ABSTRACT

Recently, water bodies contain several types of chemicals and the quantity is more than there were couples of years ago. Clean and safe drinking water is one of the basic needs of life and society. Pakistan is the country will all types of water resources, around the country, water quality is crossing the limit above WHO level standard for the drinking water of different big regions. Study area of this study is Badin city, Sindh province, Pakistan. Present study focused on “Physio-Chemical assessment of water sources for drinking purpose in Badin City, Sindh Province, Pakistan”. Ten sites from Badin city were decided for sampling to assess the drinking water from different water bodies, the areas names are: Canal Water (Jamali Village), Hand Pump (Jamali Village), WSS Pond By Pass, Hand Pump (Laghari Village), Tap Water (Chandia Nangar), WSS Pond (Ward No-04), Filter Plant (Bilawal Park), Civil Hospital Badin, Iqra School Badin, Akram Canal etc. The Different physio-chemical parameters of water samples i.e. TDS, EC, color, temperature, odor, and pH of water samples were analyzed during sampling and further analyses of Hardness, chloride, nitrate, Bicarbonate, Sulfate and heavy metals such as Fluoride, Arsenic and the essential metal ions (Calcium, Potassium, Magnesium, and Sodium) was conducted in the lab “Pakistan Council for Research in Water Resources, Pakistan. Water sample from the Hand Pump (Laghari Village) and Hand Pump (Jamali Village) have been found contaminated above standard water quality, Samples from different sites showing different results and not suitable for drinking without proper treatment specially Hand Pump (Laghari Village) and Hand Pump (Jamali Village). To get clean safe drinking water, the concepts of house hold sand filter and innovative biosand filter is recommended and can be successfully applied as low cost techniques.

KEYWORDS:

Physiochemical evaluation, sources, water quality, drinking water, Badin

I. INTRODUCTION

Generally considering that after the great Industrial Revolution, several water bodies around the industries or even far away got many-more chemicals than several years ago. This number of chemicals increases as a result of rapid growth of population, increased urbanization, increasing of industrial activities, changes in agricultural activities, exploitation of natural resources, extension of irrigation and lack of environmental regulations [1]. These chemicals are very dangerous enough because they include heavy metals, ammonia, different types of chloride, and phosphorus generating from either several industrial or agriculture activities (fertilizers, and pesticides), also can be different a variety of sources such as trash and roads and brought chemicals into water bodies (rivers and lakes) by rainwater while washes over towns and farms.

Obviously heavy metals and other pollutants change the both physical and chemical properties of water, which makes water contaminated so it is inappropriate for plant growth and other activities and also harmful for human beings. Physico-chemical factors which affect the relationship between microorganisms and toxic metals are pH, temperature, Organic matter, clay minerals, redox potential, and interrelationships between heavy metals. A number of studies have been conducted to document the physio-chemical properties of water from different Rivers, Dams, Wells and Tube wells etc around the world [2-5].

Pakistan as a country has been blessed by natural resources of water bodies such as surface and groundwater resources but sudden revolution in industrialization, urbanization, and rapid population growth have brought huge stress on water resources. In Pakistan large number of population belongs to rural areas and communities are mostly using groundwater and somehow surface water for drinking and other daily life purposes. It is reported that the current water supply is about 79% in Pakistan. Because of Improper and poor water supply, it is documented that Pakistan is at high-risk to be affected by water pollutant such as heavy metals and other dangerous chemicals; it is so far to get clean and safe drinking water. In most of the cities the ground water supply contains several pathogens including many bacterial, viral, and protozoan agents causing 2.5 million deaths from endemic diarrheal disease each year, reported. [6-11]. In Pakistan, municipal sewage and industrial wastewater have been the main reasons of waterborne diseases because the waste contaminate drinking water and bring bad water quality. Pakistan ranks 80th, out of 122 nations of the world, on the basis of water quality [12-14]. It should be taken into consideration because water is one of the basic needs of life and society.

While talking about Sindh province, people of the all districts mostly use underground water for drinking purpose, except some developed towns, where the water supply schemes provide surface water for drinking. The water in the Indus basin is of variable quality depending upon the activities around there [15-17]. It is also predicted that in future Sind province will face various water challenges [18-20]. Different parts of Sindh province have been studied for drinking water; lot of work has been carried out on the quality of groundwater and surface water. Mostly the water of all the sources is a little bit polluted [13]. Around the country, water quality is crossing the limit above WHO level standard for the drinking water of different big regions including Karachi [21] Lahore [22], Peshawar (23, 24), and Tharparkar [25] and causing different types of waterborne diseases. While in Sindh province, in three districts namely Thatta, Badin, and Thar, of southern Sind Pakistan have been found serious and have very poor water quality that bring gastroenteritis, diarrhea and vomiting, kidney, and skin problems [26]. Pakistan Government has own standards for parameters which are given below in the table 1.

Table 1 Guideline/standard values for Pakistan

Guideline/standard values for Pakistan					
S/N	Property/parameter	Unit	HDL*	MPL**	WHO standard
1.	pH	---	7.0 - 8.5	6.5 - 9.2	6.5 - 9.2
2.	Electrical conductance	□S/cm3	1000.00	1200.00	1200.00
3.	Total solids	mg/L	1000.00	1500.00	1000.00
4.	Total dissolved solids	mg/L	1000.00	1500.00	995.00
5.	Total suspended solids	mg/L	05.00	05.00	05.00
6.	Total hardness as CaCO3	mg/L	200.00	500.00	500.00
7.	Calcium hardness as CaCO3	mg/L	75.00	200.00	250.00
8.	Magnesium hardness as CaCO3	mg/L	30.00	150.00	150.00
9.	Total alkalinity as CaCO3	mg/L	400.00	500.00	500.00
10.	Chloride as Cl-1	mg/L	200.00	600.00	250.00

* Highest desirable level; ** maximum permissible level.(Reference: [27])

As Badin city is enlisted in risky area in the future but no any reasonable work is reported on the quality of water of Badin city. The water we drink should meet some national and international standards as groundwater and surface water is important. The object of this study is: “Physico-Chemical assessment of water sources for drinking purpose in Badin City, Sindh Province, Pakistan, (Water Supply Schemes and Hand Pumps)”. Many physical and chemical parameters such as EC, TDS, phytoplankton and temperature all have influences on water that bring problems to life so it is convenient and essential to analyze the physical and chemical properties of water from different resources. The aim of research work was to analyze the physiochemical characteristic of water from different resources in the Badin city, Sindh province, Pakistan.

II. STUDY AREA

The study area is the Badin city, it is located in Sindh province, Pakistan, it is at the distance of 210 km from Karachi (the main city of Sindh province). Badin city was known to be the center of ancient Indus Valley civilization because it is near to the Indus River (east side of the Indus River). The climate of Badin district is mostly moderate and sea breeze flows almost whole year and makes the city climate pleasant. Badin District comprises five Talukas Viz: Badin, Talhar Shaheed Fazal Rahu, Matli, and Tando bago [28-30]. In the fig 1, Badin city is marked in red circle shows its position in Sindh province. Ten sites from Badin city were decided for sampling to assess the drinking water, the areas names are: Canal Water (Jamali Village), Hand Pump (Jamali Village), WSS Pond By Pass, Hand Pump (Laghari Village), Tap Water (Chandia Nangar), WSS Pond (Ward No-04), Filter Plant (Bilawal Park), Civil Hospital Badin, Iqra School Badin, Akram Canal etc.

ADVANCE RESEARCH JOURNAL OF MULTIDISCIPLINARY DISCOVERIES



Figure 1 Study area: Badin City, Sindh Province, Pakistan Reference: [31]

III. MATERIALS AND METHODS

3.1 Sampling

Survey of study area was carried out around the areas of Badin city to identify the source of drinking water. Samples of water were collected from randomly selected 10 sites from Badin city, namely Canal Water (Jamali Village), Hand Pump (Jamali Village), WSS Pond By Pass, Hand Pump (Laghari Village), Tap Water (Chandia Nangar), WSS Pond (Ward No-04), Filter Plant (Bilawal Park), Civil Hospital Badin, Iqra School Badin, Akram Canal etc from different sources of drinking water in pre-sterilized, very clear, clean and dry polyethylene bottles, they first were washed with taken sample water twice before the collection of samples. All reagents used there were of analytical grade and the double distilled water was used to wash the glass ware before use. Washed vessels for water samples were used and filled in such a way that no air bubbles were left behind in the bottles and placed in air tight bags for further various quality parameters analysis. Features like color, odor were noticed at the time of sampling at the site, furthermore, EC, temperature, pH of water samples were also analyzed at the site while the remaining characters were studied in lab. GPS was used to get latitude and longitude for sample location.

3.2 Determination of Physicochemical parameters:

The Different physico-chemical parameters of water samples i.e. TDS, EC, color, temperature, odor, and pH of water samples were analyzed during sampling and further analyses was conducted in the lab "Pakistan Council for Research in Water Resources, Pakistan". Highest pH was found in the sample from WSS Pond By Pass area pH: 8 and lowest pH: 6.8 was found in the water sample from the Hand Pump (Laghari Village) while TDS of that area was found 1315 (mg/l) shown in fig 2 and EC also higher 2630 $\mu\text{S}/\text{cm}$. Different site samples showing different results while water sample from the Hand Pump (Laghari Village) and Hand Pump (Jamali Village) have been found contaminated above standard water quality. Further results are given below in the fig: 2, 3 and in the table 2.

3.3 Detection of Chemical Parameters

Hardness, chloride, nitrate, Bicarbonate, Sulfate and heavy metals such as Fluoride, Arsenic, were determined in the laboratory of Pakistan Council for Research in Water Resources, Pakistan. Hand Pump (Laghari Village) and Hand Pump (Jamali Village) have been found at risk. Arsenic is dangerous elements in the water but in this study, arsenic has been found nil and Fluoride is also in under range. Further results are given below in the table 3 and 4.

3.4 Detection of Metallic Ions

The essential metal ions (Calcium, Potassium, Magnesium, and Sodium) were determined in the laboratory of Pakistan Council for Research in Water Resources, Pakistan. Results show that ions are exceeding limits in some of water samples specially water samples collected from Hand Pump (Laghari Village) and Hand Pump (Jamali Village). Further results are given below in the table 3.

IV. RESULT AND DISCUSSION

The results of survey and analysis of water samples collected from ten different areas of Badin are presented in graphical form also in tabulation form to show the status of water quality which is being consumed by communities for the drinking purpose and domestic use compared to National level and WHO standards because if exceeds the limits can lead to water related diseases. So, the present investigation was conducted to determine the physico-chemical parameters to bring awareness in communities belong to the city and to represent the results to higher authority and policy makers to take steps for providing safe drinking water. All the physiochemical characteristics of different water samples from Hand Pump (Laghari Village) and Hand Pump (Jamali Village) are in variation and water is contaminated with different contaminant shown in Table 2. Luckily, arsenic is nil in the city drinking water. Furthermore, fluoride is also under WHO standard that also bring high risk to human health. Highest pH was found in the sample from WSS Pond By Pass area pH: 8 and lowest pH: 6.8 was found in the water sample from the Hand Pump (Laghari Village) while TDS of that area was found 1315 (mg/l) shown in fig 2 and EC also higher 2630 $\mu\text{S/cm}$. As it is stated above that water samples from Hand Pump (Laghari Village) and Hand Pump (Jamali Village) have such chemicals bring waterborne diseases. Generally different chemicals have been found in water around the world and dangerous for health, as it can be seen in the table 2, 3 and 4. While recent study shows that water is contaminated and situation will be worse if further steps are not taken. Henceforth water is not suitable for drinking purpose and other domestic and commercial uses, due to some physiochemical characteristics which are exceeding limits and F.Coliforms and T.Coliforms have been detected so it is suggested that water should be treated before drinking.

4.1. Physical parameters:

Previous study on Quality of Drinking Water in Coastal Area of Badin, Sindh, Pakistan [32] has described that 70% water samples shows that water contains several chemicals bring contamination crossing the limit above the values of WHO water quality standard.

Table 1 Physiochemical parameters

S.NO	Sample Code	EC	TDS	pH
1	Canal Water (Jamali Village)	831	418	7.9
2	Hand Pump (Jamali Village)	1355	677	7.5
3	WSS Pond By Pass	856	429	8
4	Hand Pump (Laghari Village)	2630	1315	6.8
5	Tap Water (Chandia Nangar)	935	468	7.5
6	WSS Pond (Ward No-04)	954	477	7.9
7	Filter Plant (Bilawal Park)	965	483	7.6
8	Civil Hospital Badin	857	429	7.6
9	Iqra School Badin	883	442	7.7
10	Akram Canal	839	421	7.6
WHO Permissible Limits		1000 $\mu\text{S/cm}$	500 (mg/l)	6.5-8.5

These physio-chemical parameters can make water unsafe for drinking purpose, our recent study related to different area in Badin also documents that water is not suitable for drinking and house hold purposes because each and every site is contaminated with different chemical. Physio-chemical analysis shows that pH, EC and TDS are below the values of WHO water quality standard except two sites, (i) Hand Pump (Laghari Village) and (ii) Hand Pump (Jamali Village) results is given in table 2.

4.1.1 pH of water samples:

pH in water is very important, if crossing the standard values bring health threads. According to the physical parameter analysis, water samples collected from all ten sites having pH below the values of WHO water quality standard. Here is pH of all water samples are below 8.5 standard value fig: 2 and table 2.

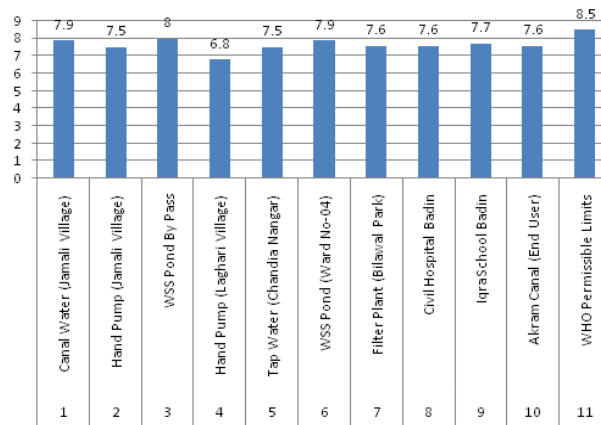


Figure 1 pH of all water samples

4.1.2. Figure 2 pH of all water samples

Study documents that study area is contaminated with various other chemicals but TDS is below the values of WHO water quality standard except only two sites (a) Hand Pump (Laghari Village) and (b) Hand Pump (Jamali Village). Water sample from the Hand Pump (Jamali Village) show TDS 677 and the Hand Pump (Laghari Village) shows TDS 1315 (mg/l) as exceeding standard value as shown in fig 3 and in table 2

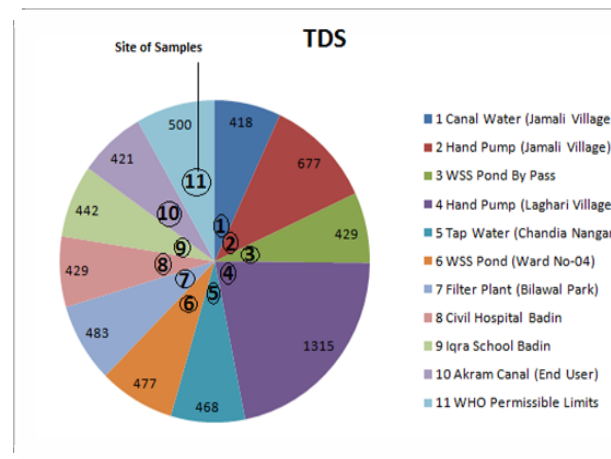


Figure 3 TDS of water samples

4.2. Figure 4 TDS of water samples

Chemical analysis was conducted in the lab “Pakistan Council for Research in Water Resources, Pakistan”. Metallic ions and heavy metal is given in the table 3 and table 4.

Table 2 Chemical parameters

S.NO	Sample Code	Sodium	Potassium	Hardness	Chloride	Magnesium
1	Canal Water (Jamali Village)	88	7	215	135	18
2	Hand Pump (Jamali Village)	145	17	340	248	40
3	WSS Pond By Pass	100	7	200	133	19
4	Hand Pump (Laghari Village)	229	12	800	355	102
5	Tap Water (Chandia Nangar)	107	8	225	156	23
6	WSS Pond (Ward No-04)	113	8	220	156	22
7	Filter Plant (Bilawal Park)	110	7	230	156	24
8	Civil Hospital Badin	97	7	210	133	22
9	Iqra School Badin	102	7	210	134	22
10	Akram Canal	95	7	200	133	19
WHO Permissible Limits		200 (mg/l)	12 EU	500 (mg/l)	250 (mg/l)	150 (mg/l)

4.2.1. Metallic Ions

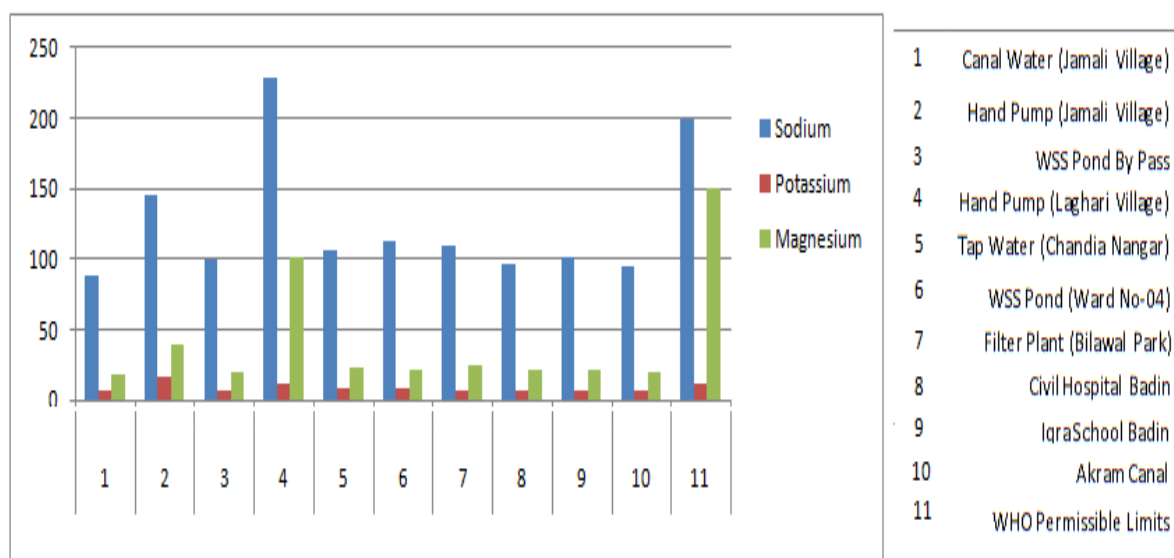


Figure 5 Metallic Ions

Study describes that water of the city is somehow polluted with different chemicals, study results show that water is contaminated above WHO standard level. Result from the laboratory is shown in the table 3 and fig 4.

4.2.2 Heavy Metals

Arsenic and fluoride have been documented as dangerous to human health, especially cancer related diseases. According to results from the study fluoride is present in all water samples below the who standard level while arsenic is nil in all water samples of ten sites as shown in table 4.

Table 3 Heavy Metals

S.NO	Sample Code	Fluoride	Arsenic
1	Canal Water (Jamali Village)	0.38	Nil
2	Hand Pump (Jamali Village)	1.04	Nil
3	WSS Pond By Pass	0.69	Nil
4	Hand Pump (Laghari Village)	1.09	Nil
5	Tap Water (Chandia Nangar)	0.67	Nil
6	WSS Pond (Ward No-04)	0.37	Nil
7	Filter Plant (Bilawal Park)	0.77	Nil
8	Civil Hospital Badin	0.47	Nil
9	Iqra School Badin	0.87	Nil
10	Akram Canal	0.6	Nil
WHO Permissible Limits		1.5 (mg/l)	10 (ppb)

V. CONCLUSION AND RECOMMENDATION

The study was conducted in order to assess the physiochemical properties of water samples collected from various sites in Badin city, Sindh province, Pakistan. From the results of physiochemical analysis of water samples from the selected sites, it can be concluded that the water of studied areas is not suitable specially water samples from Hand Pump (Laghari Village) and Hand Pump (Jamali Village) show that water is contaminated above WHO standard level as the values of all parameters are not within the permissible range as we can see from the table 2, 3 and 4, highest of TDS from the Hand Pump (Laghari Village) is 1315 (mg/l) as exceeding standard value as shown in fig 2 and EC also higher 2630 µS/cm. Other Chemicals, metlic ions are also exceeding the WHO standard level. Water samples from those sources are not well protected and are thus polluted by several means.

Previous studies and recent studies results show variations in water quality. It is suggested to develop an alternative plans like as rain harvesting and micro filtration treatment for improvement of water quality hence need to work out detail plan for sustainable schemes of safe drinking water to the local communities belong to Badin city. Henceforth, it is suggested that water should be treated before drinking.

REFERENCES

[1]. Mehedi, M.Y., D. Kamal, K. Azam and Y.S.A. Khan, 1999. Trace metals in coastal water along the ship breaking area, Chittagong, Bangladesh. *Khulna Uni. Studies*, 1: 289-293.

[2]. S.C.Shukla, R. Kent and B.D. Tripathi, " Ecological investigation on physico-chemical characteristics and phytoplankton productivity of river Ganga at Varanasi.Geobios", 16:20-27, 1989.

[3]. G.S.Singh and A.S. Singh , "variation and Correlation of Dissolved oxygen with effluent quantity and stage of river Ganga at Varanasi (India)", *Journal Environment and Health*, Vol. 36, pp. 79-83, 1994.

[4]. B.B. Singh, "Pollution status of Rapti River at Gorakhpur", *Journal of Environment and pollution*, Vol. 2, pp. 117-120, 1995.

[5]. K.K.Saxena and R.R.S. Chauhan, "Physico chemical aspects of pollution in the river Yamuna at Agra", *Pollution Res*, Vol. 12, pp. 101-104, 1993.

[6]. B.K. Sahu, R.J.Rao and Behra, "Studies of some physico-chemical characteristic of the Ganga River (Rishikesh –Kanpur) within twenty four hours during winter," *Ecol.Env. cons*, Vo.1(1-4), pp. 35-38, 1995.

[7]. Science net, 2018, online available at, <http://sciencenetlinks.com/science-news/science-updates/artificial-wetlands/>

[8]. Z. A. Soomro, M. I. A. Khokhar, W. Hussain, and M. Hussain, "Drinking water Quality challenges in Pakistan," *World Water Day*, pp. 17–28, 2011.

[9]. P. J.Chilton et al., "Pakistan water quality mapping and management project," *Pakistan Integrated Household Survey (PIHS) Islamabad*, Federal Bureau of Statistics, Government of Pakistan, 2000.

[10]. J. A. Aziz, "National water quality strategy," Report Submitted to The Asian Development Bank as Part of Water Resources Strategy Study, ADB, TA 3130 PAK, Islamabad, Ministry of Water and Power, 2002.

[11]. M. Kosek, C. Bern, and R. L. Guerrant, "The global burden of diarrhoeal disease, as estimated from studies published between 1992 and 2000," *Bulletin of the World Health Organization*, vol. 81, no. 3, pp. 197–204, 2003.

[12]. "Chapter 2," in *Pakistan National Conservation Strategy*, p. 36, 1992.

[13]. Azizullah A, Khattak MNK, Richter P, Hader DP (2011). Water pollution in Pakistan and its impact on public health, a review. *Environ. Int.* 37:479-497.

[14]. UNESCO (2002). Water quality indicator values in selected countries. Available online at: (http://www.unesco.org/bpi/wwdr/WWDR_chart2_eng.pdf).

[15]. T. Ahmad, P. P. Khanna, G. J. Chakrapani and S. Balakrishnan, Geochemical characteristics of water and sediment of the Indus river, Trans-Himalaya, India: constraints on weathering and erosion. *Journal of Asian Earth Sciences*. Vol. 16, pp. 333-346 April–June 1998.

[16]. A. S. Qureshi, P. G. McCornick, M. Qadir and Z. Aslam, Managing salinity and water logging in the Indus Basin of Pakistan. *Agricultural Water Management*. Vol. 95, pp. 1-10, January 2008.

[17]. S. K. Jain, P. K. Agarwal and V. P. Singh, *Indus Basin*. Water Science and Technology Library Vol. 57, pp. 473-511, 2007.

[18]. WWF. Pakistan's waters at risk, Water and health related issues in Pakistan and key recommendations (2007), pp. 1–33 A special report, WWF — Pakistan, Ferozepur Road, Lahore— 54600, Pakistan.

[19]. PAK-EPA. *State of Environment Report 2005*. Pakistan Environmental Protection Agency (Pak-EPA) Ministry of Environment, Govt. of Pakistan, Islamabad, Pakistan 2005.

[20]. S. N. H. Mashadi and Muhammad A. Recharge the depleting aquifer of Lahore Metropolis, In *Proceedings of regional groundwater management seminar 2000*; 209-220 Islamabad

[21]. M. Hussain, S. A. Rasool, M. T. Khan and A. Wajid. Enterococci vs coliforms as a possible fecal contamination indicator: baseline data for Karachi. *Pak J Pharm Sci*, 20, pp. 107–111, 2007.

[22]. M. S. Anwar, N. A. Chaudhry and M. Tayyib. Qualitative assessment of bacteriological quality and chlorination status of drinking water in Lahore, *J Coll Physicians Surg Pak*, 14, pp. 157–160, 2004.

[23]. Zahoorullah, T. Akhtar and S. Zai. Quality of drinking water in rural Peshawar. *Pak J Med Res*, 42, pp. 85–89, 2003.

[24]. G. Sarwar, J. Khan, R. Iqbal, A. K. Afridi, A. Khan and R. Sarwar. Bacteriological analysis of drinking water from urban and peri-urban areas of Peshawar. *Journal of Postgraduate Medical Institute, Khyber Medical College, Peshawar*, 18, pp. 64–69, 2004.

[25]. K. D. Brahman, T. G. Kazi, H. I. Afridi, S. Naseem, S. S. Arain and N. Ullah. Evaluation of high levels of fluoride, arsenic species and other physicochemical parameters in underground water of two sub districts of Tharparkar, Pakistan: A multivariate study. *Water Research*. Vol. 47, pp. 1005–1020, March 2013.

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

[27]. Naeem Khan^{1,2*}, Syed Tasleem Hussain¹, Javid Hussain¹, Nargis Jamila³, Shabir Ahmed¹, Riaz Ullah^{1,4}, Zain Ullah⁵, and Abdus Saboor^{1,6}, 2012, Physiochemical evaluation of the drinking water sources from district Kohat, Khyber Pakhtunkhwa, Pakistan, *International Journal of Water Resources and Environmental Engineering* Vol. 4(10), pp. 302-313, October 2012 Available online at <http://www.academicjournals.org/IJWREE> DOI: 10.5897/IJWREE12.105\

[28]. *Town of Badin, 2018*, available online at <http://www.badin.org/>

[29]. *Beauty of Pakistan, 2018*, available online at <http://beautyofpakistan.com/locations/badin>

[30]. *Wikipedia, 2018*, <https://en.wikipedia.org/wiki/Badin>

[31]. *Apna Hyderabad, 2018*, available online at: <http://apnahyderabad.info/thanks-for-putting-hyderabad-sindh-on-world-map-again/>

[32]. Mahessar, A.A.1, Memon, N.A. 2, Leghari, M.E.H.3, Qureshi, A.L.4* Arain, G.M.5, 2015, Assessment of Source and Quality of Drinking Water in Coastal Area of Badin, Sindh, Pakistan, *IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT)*.

APPENDIX

Table 4 Water Quality Monitoring of Badin City Water Supply Schemes and Hand Pumps

S.NO	Sample Code	EC	TDS	pH	Turbidity	Sodium	Potassium	Hardness	Calcium	Magnesium	Bicarbonate	Chloride	Sulfate	Nitrate	Arsenic	Fluoride	F.Coliforms	T.Coliforms
1	Canal Water (Jamali Village)	831	418	7.9	68	88	7	215	56	18	100	135	108	3.5	Nil	0.38	225	327
2	Hand Pump (Jamali Village)	1355	677	7.5	0.37	145	17	340	68	40	195	248	104	6.5	Nil	1.04	2	12
3	WSS Pond By Pass	856	429	8	5	100	7	200	48	19	110	133	100	7	Nil	0.69	50	110
4	Hand Pump (Laghari Village)	2630	1315	6.8	0.02	229	12	800	152	102	465	355	318	2.2	Nil	1.09	2	9
5	Tap Water (Chandia Nangar)	935	468	7.5	9.88	107	8	225	52	23	100	156	132	2.8	Nil	0.67	213	289
6	WSS Pond (Ward No-04)	954	477	7.9	8.16	113	8	220	52	22	110	156	120	6.1	Nil	0.37	45	73
7	Filter Plant (Bilawal Park)	965	483	7.6	1.37	110	7	230	52	24	110	156	141	2	Nil	0.77	20	88
8	Civil Hospital Badin	857	429	7.6	12	97	7	210	48	22	115	133	112	2.5	Nil	0.47	231	311
9	Iqra School Badin	883	442	7.7	1.53	102	7	210	48	22	115	134	126	2	Nil	0.87	5	28
10	Akram Canal	839	421	7.6	16.18	95	7	200	48	19	115	133	108	1.2	Nil	0.6	249	336
WHO Permissible Limits		1000 μ S/cm	500 (mg/l)	6.5-8.5	5 NTU	200 (mg/l)	12 EU	500 (mg/l)	NGV S	150 (mg/l)	NGV S	250 (mg/l)	250 (mg/l)	10 (mg/l)	10 (ppb)	1.5 (mg/l)	0/100 ml	0/100 ml

Longitude and Latitude values
Table 5 Longitude and Latitude values of the sampling sites

S.NO	Sample Code	Latitude	Longitude
1	Canal Water (Jamali Village)	24.65890 N Latitude	68.83994 E Longitude
2	Hand Pump (Jamali Village)	24.69586 N Latitude	68.82761 E Longitude
3	WSS Pond By Pass	24.72220 N Latitude	68.81819 E Longitude
4	Hand Pump (Laghari Village)	24.73299 N Latitude	68.81887 E Longitude
5	Tap Water (Chandia Nangar)	24.75318 N Latitude	68.81558 E Longitude
6	WSS Pond (Ward No-04)	24.76808 N Latitude	68.81599 E Longitude
7	Filter Plant (Bilawal Park)	24.78338 N Latitude	68.81638 E Longitude
8	Civil Hospital Badin	24.79112 N Latitude	68.81656 E Longitude
9	Iqra School Badin	24.79888 N Latitude	68.81677 E Longitude
10	Akram Canal	24.80275 N Latitude	68.81685 E Longitude

Corresponding author :

Hafeez Ahmed Talpur, *

Center for Environmental Sciences University: University of Sindh, Jamshoro, Pakistan Email : hafeeztalpur[at] Hotmail.com

Publishing Copyright @ International Journal Foundation