

1 **Analysis of physiochemical parameters of ground water: A case study**

2 **Abstract:** The main sources of water are rain, surface and ground water. These resources are
3 contaminated due to human and industrial activities. Both urban and rural areas ground water is
4 an eminent source of drinking water. The main objective of this study was to access the quality
5 of ground water in Faisalabad city. From twelve different colonies of the Faisalabad water
6 samples were collected to estimate their physiochemical parameters. The physiochemical
7 parameters **such as** (pH, Electrical conductivity, Total dissolve solids, Calcium, Bi-carbonates,
8 Total Hardness and chloride) were analyzed **and their values were compared with the** standard
9 values given by the WHO. **In majority of the** colonies some parameters were found within
10 permissible parameters of above standard such as pH and total hardness. But in few colonies EC,
11 TDS, Bi-carbonates and chlorides values deviated with reference to the recommended values. On
12 the completion of data physiochemical parameters of ground water, statistical analysis was
13 applied. Descriptive statistics was carried out to evaluate the significant different between means
14 of samples.

15 **Keywords:** Water quality; Groundwater; Physiochemical parameters; Analysis.

16

17 **INTRODUCTION**

18 The rain water sieve slowly through a permeable surface to down through unfilled spaces
19 (fractures, crevices and pores) engrossed in the ground, rocks, gravel, and soil states as
20 Groundwater (Miller, 2007). Through wells and tube wells, the water can be obtained that found
21 underground in the soaking coats of the rocks (Reshma and Prakasma, 2007).

22 To sustain life on earth water is one of the most essential and dynamic components. Water
23 accounts for about 70% of the total body weight almost in all organisms. The main causes for
24 quick increase in water pollution that have raise the concern over its protection and future uses
25 are rapid growth in population, fast industrialization, more increasing human requirements and
26 increase in the use of agricultural fertilizers and chemicals (Jothivenkatachalam *et al.*, 2010).

27 Groundwater have significant importance for human drinking, also give support to
28 surrounding, and it is extensively spread, renewable most essential reserve presents on earth
29 (Babiker *et al.*, 2007). Hygienic water is essential and significant for communal health and

30 sustainability of marine ecosystems so, for these reason analyzing the quality of water is
31 important (Hiyama, 2010). In different nations due to increasing living ethics and population
32 growth, the need of advanced quality of water resources for various uses such as drinking,
33 agricultural and industrial use (Rahmani, 2010).

34 Due to frequently raising quantity of soluble damaging ingredients from urban wastes,
35 industrial wastes and present agricultural activities, the threat of contamination in ground water
36 is increased. Water pollution is slightly biological, chemical and physical variation in water
37 quality that have been harmful impact on prevailing organisms or marks water unsuited for
38 desired uses. The chemical physiognomies of water can be calculated such as Dissolved oxygen,
39 Chloride, alkalinity, Magnesium, hardness, Bi-carbonates, chloride, Phosphate, BOD, Nitrate,
40 Calcium and pH, by the chemical parameters of water (Miller, 2007).

41 In Pakistan, the main reasons of surface and ground water pollution are side effect of
42 several manufacturing industries such as dyeing chemicals, cement, textile, engineering, steel,
43 pesticides, metal, power, leather, petrochemical, construction, sugar processing, mining, energy,
44 food processing and fertilizers. Due to increase in water pollution, the total dissolved solids
45 (TDS) increases, dissolved oxygen (DO) decrease, EC and Salinity also increase. Nearly 60%
46 people has no access to clean and pure drinking water in growing countries (EPA, 1996) and
47 nearly 3.4 million people decease each year in the globe due to transmitted diseases through
48 polluted water. It is assessed that unfortunately, pure drinking water is not available to people in
49 developing countries of Asia and Africa like China, Pakistan, India etc. (Anonymous, 2001). One
50 billion people from 6 billion peoples lack correspondence to harmless drinking water, and the
51 satisfactory hygiene is not managed by 2.5 billion people on the planet (TWAS, 2002).

52 The main intention to design this study was to determine the important physiochemical
53 parameters, to estimate the parameters of ground water, and to observe that whether the water of
54 these areas is suitable for domestic use and drinking purposes or not and to relate the acquire
55 values of parameters with the drinking water quality strategies of National standards and WHO.

56 **MATERIALS AND METHODS**

57 **Sample collection**

58 The present study was intended from different colonies of Faisalabad to estimate the water
59 quality parameters. From different colonies of Faisalabad and these Sites were twelve in number

60 i.e Fareed colony, Al-Najaf, Rehman town, Peoples colony, Zulfiqar colony, Bawa chak, Muslim
61 town, Gulshan colony, Bhatala colony, Awami colony, Sarfaraz colony and Dhodi-wala the
62 water samples were collected. **Sample was taken from borehole of different colonies.**

63 **Preparation of samples**

64 In clean polythene bottles the samples were collected deprived of any air foams. Before sampling
65 the containers were washed and firmly closed after collection and tagged. The temperature of the
66 samples was precisely **determined** in the field at the time of sample collection. Samples were
67 kept at 4°C in freezer.

68

69



70 **Figure 1** Sampling area location

71 **Analysis of water sample**

72 Several water quality parameters were analyzed such as Total Alkalinity, Total Dissolved Solids
73 (TDS), Total Hardness, pH, Calcium and Chlorides.

74 **Determination of water quality parameters**

75 Scholler's diagram method is most popular and extensively used for drinking water quality
76 estimation. The distinct variability of groundwater quality cannot be estimated simply and for
77 this purpose, Babiker *et al.*, 2007 had presented groundwater quality index (GQI) (Rahmani *et*

78 *al.*, 2011). The quality parameters were analyzed as follow; Total Dissolved Solids (TDS) was
 79 estimated by standard methods, pH- was measured using standard pH meter, calcium content by
 80 EDTA titrimetric method, methyl orange alkalinity, total hardness (TH) by EDTA titrimetric
 81 method, chloride content by argentometric method.

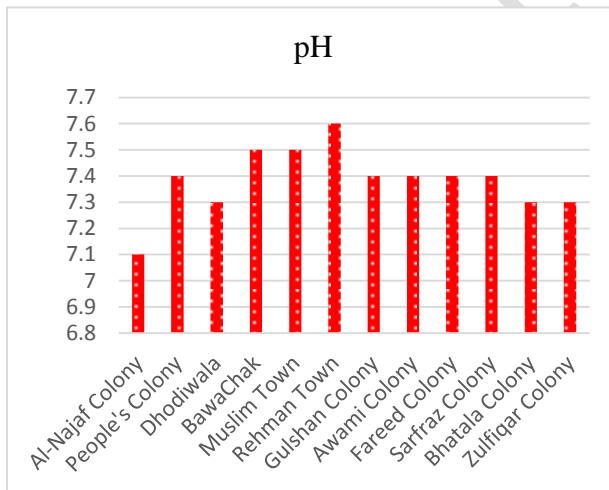
82 **Statistical Analysis**

83 On the complete data of the physiochemical parameters of ground water Statistical analysis was
 84 applied. Suitable tables were arranged, and means were assessed. Descriptive statistics was
 85 applied to check the difference at certain level.

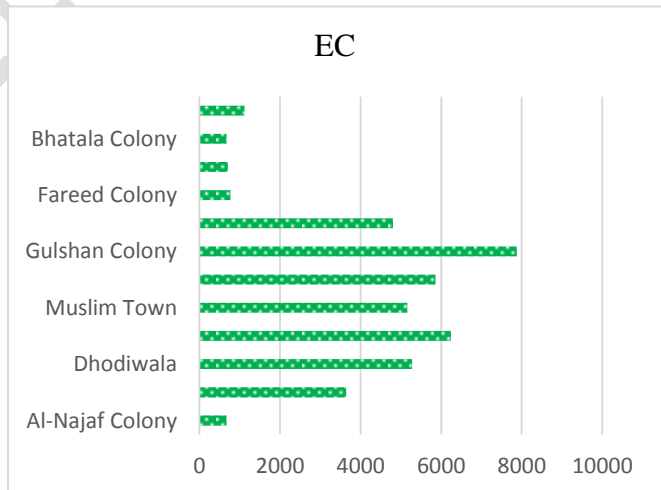
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87 **RESULTS AND DISCUSSION**

88 From different colonies of Faisalabad, the water samples were collected esteems to analyze their
 89 physiochemical parameters like TDS, EC, Ca, pH, Mg, chlorides, total hardness and bicarbonates
 90 of ground water. According to (Table 2) results has been significant by varying the values of
 91 recorded data. Mean pH value was (7.3833) which is the fair in accordance with the WHO values
 92 and EC mean is 3566 which is very high compared with the given values. Whenever, TDS
 93 showed the mean value 1765.



94 **Figure 2**



94 **Figure 3**

95

95 **Figure 2-3 Comparison of pH and EC of ground water in different colonies**

96

96 In the graphical representation (Figure 2) pH values from the water samples of all the mentioned
 97 areas are in normal range (6.5-8.5) which is given by the WHO standard and highest and lowest
 98 pH was recorded for Al-Najaf colony and Rehman Town respectively. While EC value was

99 recorded highest for Gulsan colony (7880 $\mu\text{S}/\text{cm}$) and least for Bhatala colony and Al-Najaf
100 colony (670 $\mu\text{S}/\text{cm}$) (Figure 3). Exceeding EC from the normal range reveal that water of these
101 colonies also contained contaminations which are not good for human health, whereas 58.33%
102 samples exceeds the optimum limit of EC. These results are also according with the previous
103 studies (Macka *et al.*, 1994).

UNDER PEER REVIEW

104 **Table 1:** Physiochemical Parameters of Ground Water

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Sr. No.	Identification	pH	EC	TDS	Ca⁺	Mg⁺⁺	Total Hardness	Bi-Carbonates	Chlorides
Units		--	µS/cm	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l	Mg/l
WHO Guideline		6.5-8.5	1000- 2000	1000	75-200	50-150	10-500	--	250
1	Al-Najaf Colony	7.1	670	330	51	12	172	248	70
2	People's Colony	7.4	3640	1800	53	45	312	596	464
3	Dhodiwala	7.3	5280	2620	48	45	300	1024	670
4	BawaChak	7.5	6240	3100	45	42	280	756	900
5	Muslim Town	7.5	5160	2560	24	24	156	1140	616
6	Rehman Town	7.6	5860	2910	54	72	424	680	320
7	Gulshan Colony	7.4	7880	3910	59	77	452	784	570
8	Awami Colony	7.4	4800	2370	109	84	608	584	726
9	Fareed Colony	7.4	770	370	59	18	216	248	78
10	Sarfraz Colony	7.4	700	340	118	19	220	236	84
11	Bhatala Colony	7.3	670	320	53	17	200	236	74
12	Zulfiqar Colony	7.3	1120	550	80	30	320	368	124

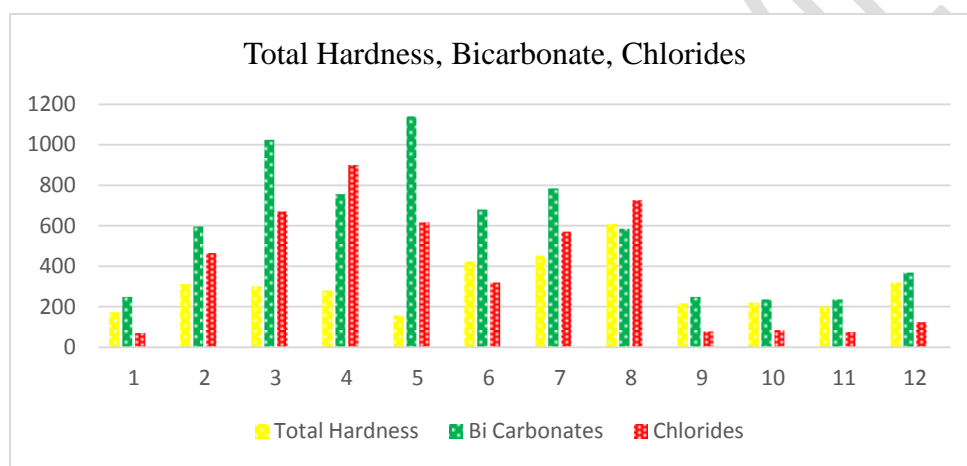
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108 **Table 2** Descriptive statistics of all parameters

Descriptive Statistics factors	pH	EC	TDS	Ca⁺	Mg⁺⁺	Total Hardness	Bi carbonates	Chlorides
Mean	7.383333	3565.833	1765	62.75	40.41667	305	575	391.3333
Standard Error	0.036584	762.8609	379.64	7.763673	7.269132	38.39231	91.09452	87.4391
Median	7.4	4220	2085	53.5	36	290	590	392
Mode	7.4	670	N/A	53	45	N/A	248	N/A
Standard Deviation	0.12673	2642.628	1315.111	26.89415	25.18101	132.9949	315.5607	302.8979
Sample Variance	0.016061	6983481	1729518	723.2955	634.0833	17687.64	99578.55	91747.15
Kurtosis	1.564827	-1.61764	-1.61945	0.914498	-0.93904	1.07347	-0.90645	-1.53211
Skewness	-0.59553	0.081998	0.082708	1.12992	0.690199	1.1376	0.452672	0.250328
Range	0.5	7210	3590	94	72	452	904	830
Minimum	7.1	670	320	24	12	156	236	70
Maximum	7.6	7880	3910	118	84	608	1140	900
Sum	88.6	42790	21180	753	485	3660	6900	4696
Count	12	12	12	12	12	12	12	12
Confidence Level (95.0%)	0.080521	1679.046	835.582	17.08773	15.99925	84.50091	200.4977	192.4522

110 Muslim Town water sample showed minimum Calcium value. But Awami colony,
 111 Sarfraz colony, and Zulfiqar colony water samples Calcium values are in normal range. In case
 112 of Magnesium, recorded highest in Awami colony and lower in Al-Najaf colony But Rehman
 113 colony, Gulshan colony, and Awami colony water shows normal value of Magnesium (Figure 4).
 114 According to value obtained from analysis of water samples, Gulshan colony water sample
 115 showed maximum TDS values while Bhatala colony water sample show minimum TDS value.
 116 Almost all samples fluctuate to normal range. The normal value for TDS is (1000 mg/L) that is
 117 given by the WHO standard and distribution of measured TDS values in the study area is shown
 118 in Table1).



127 **Figure 4** Comparison of Total Hardness, Bicarbonates and chlorides of ground water in different
 128 colonies

129 (Figure 4) shows that almost all areas have normal Total Hardness of Water sample
 130 except of Awami Colony. The water having hardness up to 75 (mg/L) arrangement as soft, 76-
 131 150 (mg/L) is respectably soft, 151-300 (mg/L) as hard and more than 300 (mg/L) as hard (Farid
 132 et al., 2013). Al-Najaf colony water shows less Total Hardness as compared to other colonies.
 133 Muslim Town water sample show highest value of Bi-carbonates but Sarfraz and Bhatala colony
 134 shows less amount as comparaed to other colonies, as previously study result (Khurshid 1999).
 135 According to values Bawa chak water shows highest value of Chlorides and Bhatala Colony
 136 shows less value as compared to other colonies water as in the previously assessment of ground
 137 water (Sajjad and Rahim 1998; Balakrishnan *et al.*, 2008).

138 In the Fareed Colony water sample, the experiential value of chlorides, Total Hardness,
139 pH, TDS, Bicarbonates and EC falls in the normal range. In most of the colonies calcium and
140 magnesium are still less than standard range. But only the experiential quantity of magnesium is
141 less than the normal range in the Sarfraz Colony water. For domestic purposes the water of both
142 colonies is useful. Due to the difference in the depth of the ground, the observed value of
143 parameters is different, where the water was reserved pollutants and it also the reason of changes
144 in the value of water parameters.

145 **CONCLUSION**

146 The assessment of the groundwater quality parameters from twelve different areas in the
147 Faisalabad city demonstrate that the total hardness and pH value are well within the permissible
148 limits while others are high or below of the WHO standard. Limited water samples of ground
149 water from these areas were useful for residential use but rather these were bad to drink uses.
150 From the results of the proposed study it may be concluded that the groundwater of Faisalabad is
151 though unfit for domestic and drinking purpose and treatments should be applied to minimize
152 the pollution particularly the TDS, alkalinity and EC. As a result of high concentration of TDS,
153 water drops its potability and decreases the solubility of oxygen in water.

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