ASSESSMENT OF GROUND WATER QUALITY AND ITS IMPACT ON HUMAN HEALTH (A CASE STUDY OF SHORKOT CITY), (JHANG) PUNJAB, PAKISTAN

M Azhar[*1], M Mobeen[2], M Mohsin[3], T Aziz[4], A Rehman[5], M Sajid[6]

[1-2-4-5]Department of Earth Sciences, University of Sargodha, Sargodha, Pakistan
[3]Department of Geography, Government Sadiq Egerton Graduate College, Bahawalpur, Punjab, Pakistan
[6]Department of Geography, Government College Chowk Azam, Layyah, Punjab, Pakistan
Correspondence Author Email: hmazharkharal@gmail.com

ABSTRACT: Achieving resourceful, beneficial and cost-effective water purification techniques for the public is the important to human existence and growth, because the management of water at present is a global issue. Water is the main resource vital for supporting all human actions, so its provision in preferred quantity and quality is of highest significance. Water contamination effects drinking water quality which subsequently damages health of humans. The current research mainly focuses on evaluating the drinking water quality in Shorkot City of Jhang district and its potential effects on human health. The objective of the research was to find out the spatial distribution of water contaminants and their concentration in the ground water quality and analyze the impact of drinking water on the health of humans of study area besides to identify the main waterborne diseases. Different analyses comprising of physical, chemical and microbiological examinations were performed on the water samples collected from 45 areas of the study area. Locations of these samples were noted with the help of Global Positing System (GPS). Data was presented by Geo Statistical Analysis technique in ArcGIS10x. The interpolation of the consequences of drinking water sample points was observed by Inverse Distance Weighted (IDW) methods. The concentration of TDS 62%, Alkalinity 12%, turbidity 6%, calcium 62%, magnesium 6%, hardness 44% and chloride 28% values exceeds as compared to WHO proposed standard limit. Similarly, the value of PH 100% remains under the permissible limit and Electrical conductivity 100% values exceed as compared to WHO proposed standard limit values. Survey results showed that higher concentration of calcium, TDS, chloride, magnesium, turbidity, Alkalinity, Electrical conductivity and hardness cause Dysentery, Typhoid, Cholera, Diarrhea, Gastroenteritis, Hepatitis, Scabies, Kidney stone, Asthma, Cancer, Heart diseases. Quality of water becomes worse due to agricultural substances, untreated industrial discharge and urban effluent that effect on their health. It is hoped that, results of this research will provide worthwhile perceptions for safe water provision for the people of the study area and justifiable management of resources of drinking water to decrease the human health risks.

Keywords: Water Quality, Human, Drinking Water, Diseases, Water Contamination.

(Received 16.01.2021 Accepted 27.03.2021)

INTRODUCTION

Groundwater is one of the most significant means that performs a crucial role in our life and sustenance besides in economic progress of a state like Pakistan. Water quality is influenced by change in land use (Rehman *et al*, 2018). Usually, the drinking water quality relies on the presence and absorptions of numerous chemical constituents, which are influenced by the replenish and geological quality of the particular aquifer (Parameswari *et al*, 2018). Furthermore, groundwater can also be polluted by several trace elements derived from the erosion and weathering of some rocks, wastewater percolation and agrarian actions (Ahmed *et al*., 2019). A lot of researches on the quality of groundwater and its associated health risks have been examined and evaluated all over the world (Zhang *et al*. 2018). Environmental contamination and groundwater contamination may be associated to human health. As this problem has been spread widely in the arid and semi-arid areas world (Adimalla *et al* 2018). That is why, the quality of the groundwater is heavily diminishing because of the incredible environmental changes and quickening anthropogenic activities, which results in a high effect on human health by in taking of adulterated water. Groundwater pollution has been increased in this modern age (Narsimha *et al*, 2018). Information of the ingredients of these trace elements in the water and its related health effects are necessary for efficacious water resource monitoring systems, its management and consolidation. That is why, the human health risks examination is very significant means towards sustainability of these aims. Assessment of the water resources, health examination and enumerates the potential effect of water

contamination on health of human beings on the basis of standards of water quality is very crucial (Zhu *et al*. 2017). Groundwater has been overdrawn in some regions to compete the augmented water desire (Li *et al*, 2019). Polluted drinking water poses many health risks for human beings in many developing countries like Pakistan (Mohsin *et al*., 2013; Mohsin *et al*., 2019; Ali *et al*. 2019). Many researchers in previous studies explored about the possible human health hazards initiated from the groundwater pollution in various rapidly urbanizing like Pakistan (Tabassum *et al*., 2019; Mohsin *et al*., 2019).Though, certain trace components are vital for human health, but huge intakes of such elements may outcome in deleterious health effects for example; difficulty in breathing, cancer, increased tension, diseases related to vascular and lungs diseases (Nkpaa *et al*., 2018). Ingesting of Fluorides from the groundwater may have both constructive and destructive impacts on the health of the humans, which are chiefly obtained from fluorides bearing minerals (Mohanta *et al*., 2020).Need for water is increasing quickly along with yearly incremental degree of extraction of groundwater mainly because of development of the cities areas and population explosion (Rahman *et al*., 2016). Safe drinking water quality is highly indispensable for the sustainability of human health. Impurity of drinking water provisions presents several threats for human beings (Egbueri *et al*, 2019). Additionally, the studies have revealed that heavyweight metal contamination in water bodies can also be attributed to numerous anthropogenic aspects comprising the overdue use of chemical fertilizers and substances used as pesticides and unprocessed industrial garbage (Ukah *et al*. 2019). When such diversified processes emit trace constituents in the water bodies then another significant indicator which determines the effect upon these metals to have the water quality soluble (Wagh *et al* 2018). Still, Due to the nonstop growth of population and accelerated economic advancement, the desire and need for clean and fresh water have been enlarged and water crisis are arising (Su *et al*. 2019). Arsenic is hazardous to human health as it can cause irreparable loss to the human bodies (He and Li 2020). Skin diseases are caused by drinking arsenic water, besides it also affects the digestion system and cancer. Water weighs for two-third of our human bodies mass. It shows that water is an indispensable element for human survival of the human beings; therefore proper consideration to mitigate water pollution is very significant (Aghalari *et al*, 2020). Data was collected in the forms of the collection of designated water quality samples from the selected points. Eleven parameters were chosen for testing of ground water of study zone in this examination work like Temperature, pH, Total Dissolved Solids (TDS), NTU, Alkalinity, Calcium, Magnesium, Hardness, EC (Electric Conductivity), Chloride and Arsenic. Chosen parameters are imperative for the evaluation of water quality. Geographic Information System (GIS) based programming Arc 10.2 is utilized as a part of examine to map. A questionnaire was formulated to assess the water quality of drinking water to explore the prevalent diseases due to contaminated water. The study is very helpful for town planners, new dwellers in the area.

MATERIALS AND METHODS

The word Shorkot got from Shor, urdu importance word saltiness and water logging. It is the capital city of tehsil Shorkot in Jhang District. Shorkot city is located on $30^0$30' N to 72^0 24' E. Shorkot city is situated on Multan-Jhang road at a distance of 56 kilometer from Jhang in its South while Toba Tek Singh is situated in the North- East at the separation of 35 kilometer. It is elevated from sea level of 131 meters (433ft). A Railway station is situated at Shorkot cant for the number of inhabitants in contemplates territory.

Shorkot city was a Town council before 2001, after this the city has been given the title of a Tehsil Municipal Administration (TMA). Ahmad Pur Sial and Gargh Maharaja were two other urban units of this tehsil which are situated at the edge of stream Chenab. Presently Ahmad Pur Sial is isolated from Tehsil Shorkot and it has been given the status of Tehsil. Geography of Tehsil Shorkot is a flat and has a characteristic waste framework. Geographically alleviation distinction is 113mm which patterns to south westerly. The normal incline of the range is 0.37 meter for each kilometer over the 390 kilometer length of doab diminishes around 25% in the lower level. This region has not adequate legitimate common surface waste, and a few contrasts in rises for the running of water amid the period of storm. The seepage troubles are additionally escalated by foundation development like railroads, streets, channels framework and surges dike. The ground water development in the subsurface of this zone is confined because of level geology. So ponding of framing land, following high rainstorm, with result property and harvests have turned into a repetitive wonder in numerous regions of this area. The range of Tehsil Shorkot is 2013 square kilometers and aggregate population of Tehsil is 670,255 people. The TMA Shorkot contain of 16 Unions (1Urban and 15 rural) with just co-unit named Shorkot.

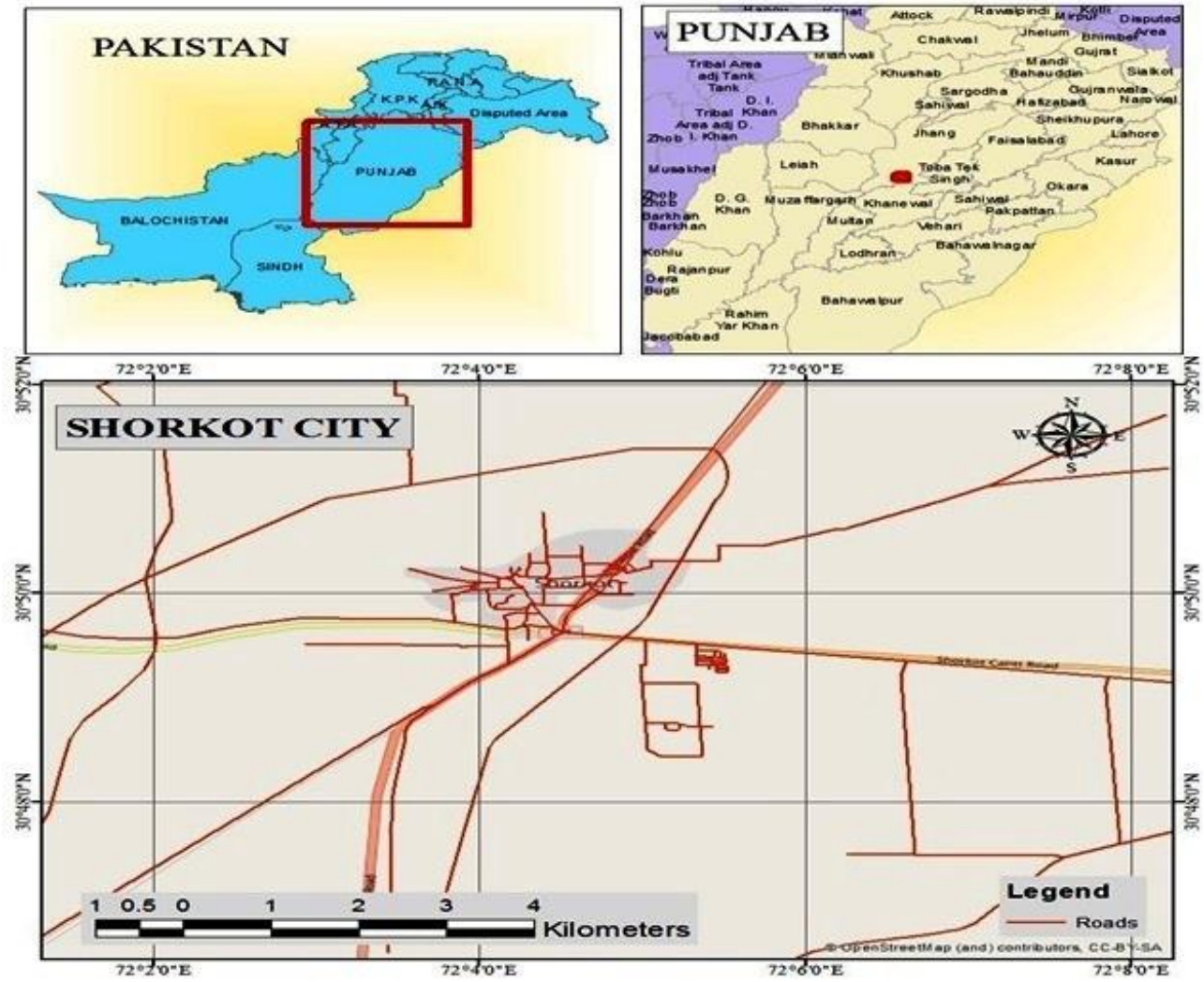

Figure: 1.1 Study Area Map.

Data Collection: In the present research work water samples in polyethylene bottles of one liter were collected through random sampling method. Study area samples locations were noted through Global Positioning System (GPS). Geographic Information System (GIS)programming is utilized for the planning of spatial circulation maps of water contaminants in think about study zone. The after effects of ground water tests were appeared on maps through utilizing Inverse Distance Weighted (IDW) Technique. Kriging, Inverse Distance Weighted (IDW) systems and Arc delineate were utilized for geo-factual examine the consequences of ground water which were gathered from Shorkot city and encompassing zones.

Analysis: Analysis were performed in Hi-tech lab and 45 samples were collected from various areas. Collected Water samples were tested for different physical and chemical parameters like Hardness, Total Dissolve Solids (TDS), Magnesium, Calcium, pH, Electric Conductivity (EC), Arsenic, Temperature and metals. These results were compared with World health organization standards, Pakistan Environmental Protection Agency (PEPA) and United States Environmental contamination Agency (US-EPA).

RESULTS

According to results, the quality of water is very contaminated at the eastern side of study area. The table 5.1 describes to the composition of study area ground water which is indicated by the different parameters values conducted from various areas in the study area. The following parameters have been tested for the examination of ground water drinking quality, like Hardness, Total Dissolve Solids (TDS), Magnesium, Calcium, and pH, Electric Conductivity (EC), Arsenic and Temperature. Those samples were collected from the study area and examined by lab proved for the presence

of contaminants in the water. The presence of various contaminants in the specific parts of the areas was higher than the WHO permissible standard.

To understand the comparison between health issues and water quality of the research, a field survey was also conducted among the local residents of the research area. Arc GIS 10.2 software was used to analyze the results of spatial data modeling. Water sample points were examined by Inverse Distance Weighted (IDW) method. The level of various contaminants and their mean values which were obtained from the different areas are as under pH 7.46 ppm, Total Dissolved Solids 1733.2 (TDS) ppm, Alkalinity 427.4 mg/l, NTU 2.24, Calcium 104.1 mg/l, magnesium 67.1 mg/l, Hardness, 544.4 mg/l, Temperature16.52 Celsius, Chloride 203.2 mg/l, Electric Conductivity 2145.5. Calcium, Magnesium, Chloride, Hardness and Temperature patterns were found higher in the Cant area than main city of Shorkot. The quantity of all the impurities has been found higher according to acceptable parameters of (WHO) in study area. pH is the measurement of basic quality of water as it is acidic or alkaline. Basically it is the indicator of existence of biological life. World Health Organization (WHO) mentioned a standard of pH concentration in drinking water is 6.5-8.5. The value of pH at all 45 sample locations is presented in table 5.1 and figure 5.2. & 5.3. Total mass of dissolved constituent, (cation and anions) in water mean TDS. Dissolved solids in water impart taste. It has either positively charged ions or negatively charged ions. . Figure 5.4 and 5.5 are also representing the concentration the TDS values of samples. The sample number 42 shows the highest concentration of TDS value in area of Shorkot cant road which is 3222 mg/l. The lowest concentration is 745 mg/l in the area of Dabkalan. WHO standard for TDS in drinking water is 1000 mg/l. Only 17 samples (38%) results of ground water are in limits and remaining 28 samples (62%) are out of limit. Alkalinity is also referred to the as "carbonate hardness. According to this result, only 5 samples (12%) results of ground water are out of limits and remaining 40 samples (88%) are in limit shown in figure 5.6 & 5.7. Turbidity is the assessment of the water clarity and it is measured by NTU. The study findings illustrate thatonly 1 sample (6%) results of ground water are out of limits and remaining 44 samples (94%) are in limit shown in figure 5.8 & 5.9. Calcium is analysis from collected from 45 selected areas of Shorkot city shows that the sample number 38 demonstrates the higher concentration of calcium in area of cantonment Chock road which is 210 mg/l. The lowest concentration is 30 in the area of Basti Hyderabad. WHO standard for calcium of drinking water is 75 mg/l. In the study area, 28 (62%) sample points calcium value exceeded as compared to WHO proposed standard limit while remaining locations have normal range. is shown in figure 5.10 & 5.11 Magnesium water samples were collected from 45 selected areas of study area. The sample number 29 describes the maximum concentration of Magnesium in zone of Khumanawala which is 160mg/l. The minimum value is 10mg/l in the zone of central Shorkot city. WHO standard for Magnesium of drinking water is 150mg/l. In the study area, 1(6%) sample point Mg value exceeded as compared to WHO proposed standard limit while remaining locations have normal range is shown in figure 5.12 & 5.13. Hardness values of samples which were collected from 45 different locations of study area. The sample number 38 shows the highest concentration of Hardness value in area of cantonment chock road which is 1162. The lowest concentrate on is 235 in the area of central Shorkot city. WHO standards for Hardness of drinking water is 500mg/l. Only 20 samples (44%) results of ground water are out of limits and remaining 25 samples (55%) are in limit. All the study area ground water may not be found fit for drinking purpose is shown in figure 5.14 & 5.15 Chlorides the sample number 26 shows the highest concentration of Chloride value in area of 1Ghagh which is 290 mg/l. The lowest concentration is 90 in the area of Hassuwali. WHO standards for Chloride of drinking water is 250 mg/l. Only 13 (28%) ground water samples were exceeded the permissible limit set by WHO and remaining samples were within limit are shown in figure 5.16 & 5.17. E.C the sample number 42 shows the highest concentration of Electric Conductivity value in area of Shorkot cant road which is 4738(µS/cm). The lowest concentration is 1095(µS/cm) in the area of Dabkalan road. WHO standards for EC in drinking water is 1000 µS/cm. In the study area, all selected area EC value exceeded as compared to WHO proposed standard limit. All the study area ground water may not be found fit for drinking purpose has been shown in figure 5.18 & 5.19. Temperature the sample number 2 and 17 show the highest concentration of temperature in area of central Shorkot city which is 16.8 degree Celsius. The lowest concentration is 16.3 in the area of Aqsa masjid, Bhango Pul and 1Ghagh has been shown in figure 5.20 & 5.21.

Table 5.1, Ground water Quality results of the Study area.

Sample	Location	pH	TDS	EC	Ca	Mg	Depth	Alkalinity	Turbidity	T. Hardness	Chloride	Temperature
SR 1	Khalid bin valid rd	7.7	792	1164	56	32.5	40	400	1.22	274	160	16.7
SR 2	Woman college	7.68	914	1344	66	37	45	430	1.21	318	163	16.8
SR 3	Aqsa masjid	7.63	870	1280	78	40	35	350	1.54	360	140	16.3
SR 4	Masjid sidiqua	7.21	840	1235	71	38	40	370	1.31	333	179	16.5
SR 5	Masjid ahlhadis	7.25	875	1286	90	28	45	420	1.23	340	168	16.6
SR 6	Imam bargah	7.24	920	1352	40	33	40	390	1.21	235	158	16.6
SR 7	Kachiabadird	7.49	956	1405	55	45	40	425	1.43	322	175	16.4
SR 8	Bhir	7.52	948	1394	74	42	40	430	1.17	357	136	16.7
SR 9	Darbarrd	7.23	890	1308	67	32	45	460	1.16	300	168	16.5
SR 10	Shahidshaheedrd	7.7	992	1458	58	36	35	390	1.23	293	185	16.5
SR 11	TMA office	7.65	846	1244	84	65	40	430	0.44	477	150	16.6
SR 12	Housing colony	7.66	1325	1948	76	27.5	45	345	1.54	303	162	16.4
SR 13	THQ	7.62	956	1405	44	62.5	40	500	2.16	367	110	16.5
SR 14	Karachi hotal	7.65	1025	1507	75.5	28	40	348	1.5	304	128	16.6
SR 15	High school	7.3	1703	2504	152	77.5	40	610	2.43	728	164	16.7
SR 16	Basti Hyderabad	7.7	1005	1477	30	40	45	400	0.28	240	180	16.4
SR 17	Usmaniard	7.63	984	1447	80	10	35	429	0.43	241	176	16.8
SR 18	Ghazi peer	7.49	1108	1629	76	27.5	40	500	0.82	303	179.8	16.4
SR 19	Bhangu pul	7.79	1158	1702	72	35	45	578	0.67	324	162.4	16.3
SR 20	Bank alfalah	7.67	1205	1772	76	27.5	40	348	1.58	303	119.8	16.5
SR 21	Bhangusharqi	7.33	2123	3122	140	100	40	420	2.07	761	295	16.3
SR 22	Shufewala	7.34	2260	3323	141	103	40	472	2.11	775	310	16.4
SR 23	Tahliwala	7.33	2315	3304	136	98	45	470	4.06	743	328	16.5
SR 24	Nawankhoo	7.34	2346	3450	142	102	35	475	4.02	773	260.4	16.6
SR 25	Kikarwala	7.33	2412	3542	140	100	40	470	3.8	760	230	16.5
SR 26	1 ghagh	7.12	2206	3245	131	111	45	360	5	784	290	16.3
SR 27	Khumanawala	7.16	2645	3838	160	132.5	40	450	2.59	945	280.7	16.4
SR 28	Khumanawalachok	7.21	2437	3583	180	151	40	600	1.44	810	205.9	16.5
SR 29	Khumanawalard	7.13	2866	4214	200	160	40	710	3.34	1156	210	16.5
SR 30	Khumanawala school	7.19	2523	3710	128	110	45	390	1.66	772	210	16.5
SR 31	Khumanawalat	7.42	2579	3792	140	141	35	310	2.21	930	220	16.5
SR 32	Kashmir sugar mil	7.39	1756	2582	85	97	40	300	2.17	611	164.1	16.6
SR 33	Kot Muhammad yar	7.69	1684	2476	96	25	45	450	4.19	343	260	16.5
SR 34	Quim bharwana	7.48	2488	3658	88	75	40	730	0.66	528	260	16.6
SR 35	Main bazaar	7.7	1045	1536	58	33	40	430	1.22	280	187	16.5

SR 36	7 Ghagh	7.11	2370	3485	156	126	40	500	3.42	908	240	16.7
SR 37	Cantonment rd	7.33	3120	4288	140	98	45	420	6.06	754	310	16.5
SR 38	Cantonment chok	7.19	3170	4641	210	155	35	465	4.66	1162	300	16.7
SR 39	Cantt mahalrd	7.3	3214	4726	190	110	40	320	4.69	927	280	16.4
SR 40	Cantt mandird	7.49	3123	4592	175	90	45	315	4.6	807	244	16.4
SR 41	Cantonment park	7.27	3210	4720	160	85	40	350	2.59	750	260	16.5
SR 42	Shorkot cantt	7.59	3222	4738	100	92	40	340	5.23	628	260	16.6
SR 43	Dubkallanrd	7.82	745	1095	84	15	45	310	1.61	271	110	16.5
SR 44	Dubkallan bus stop	7.81	846	1245	85	16	45	312	0.41	278	112	16.6
SR 45	Hasuwali	7.77	976	1435	82	17	40	308	2.58	275	90	16.5

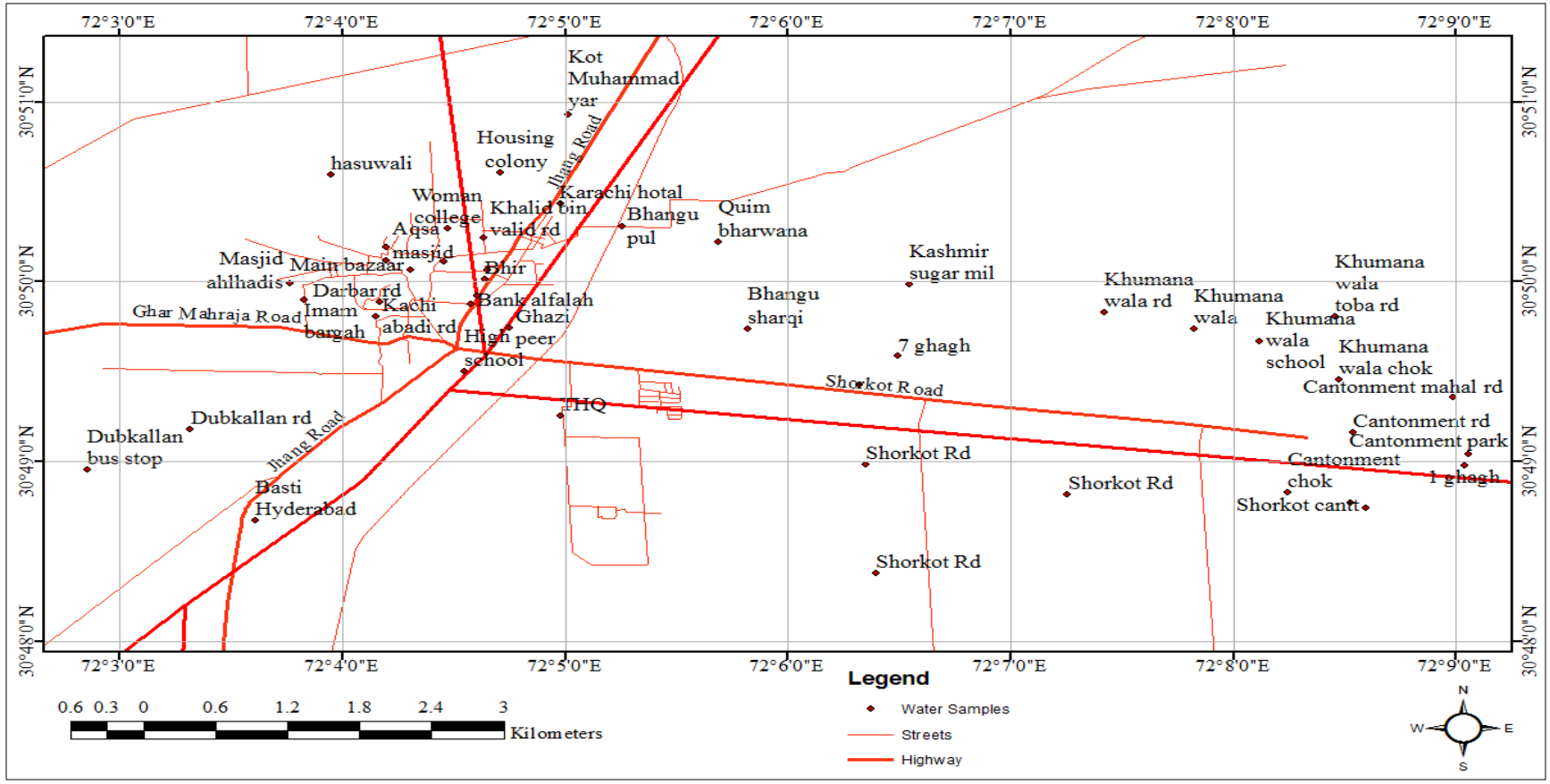

Figure: 5.1 Ground water samples location map of the study area

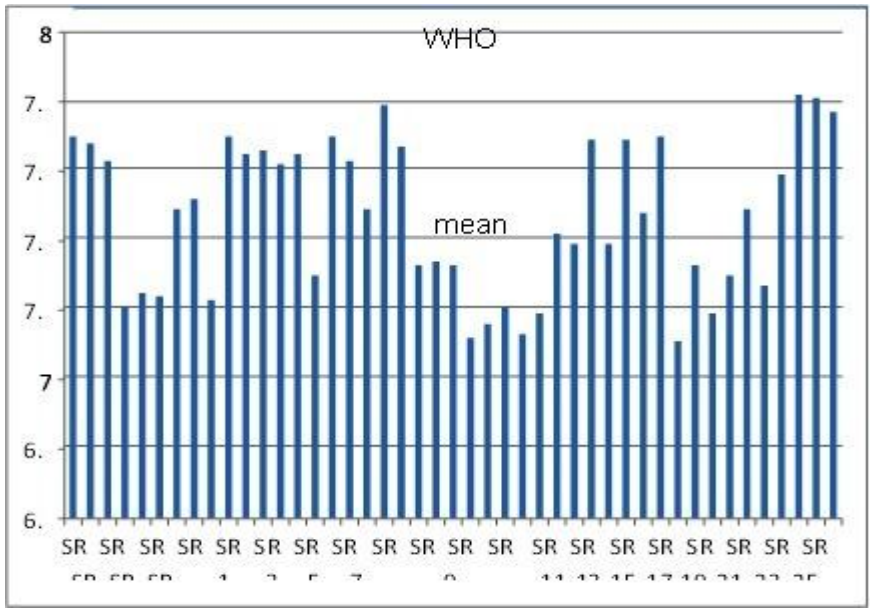

Figure 5.2. Representation of the pH values in the Ground water of Shorkot.

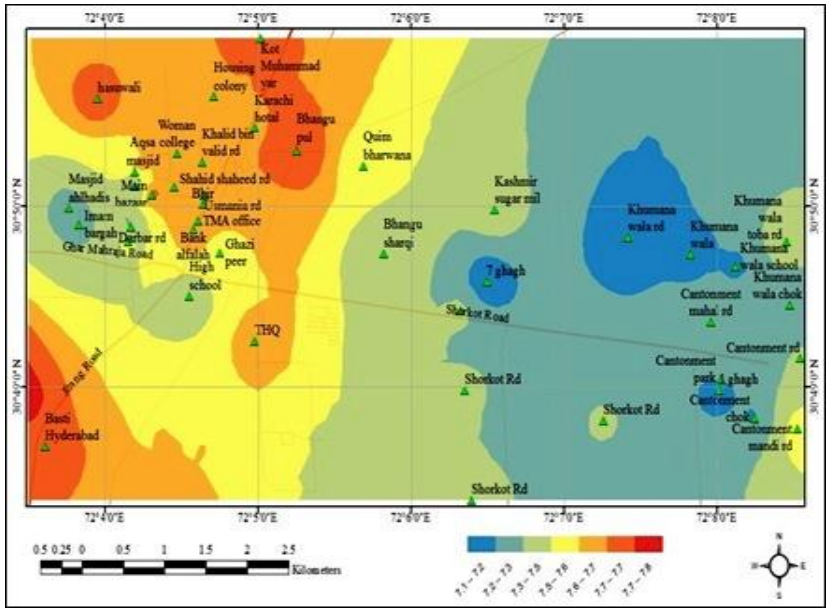

Figure 5.3. Representation of the pH values in the Ground water of Shorkot

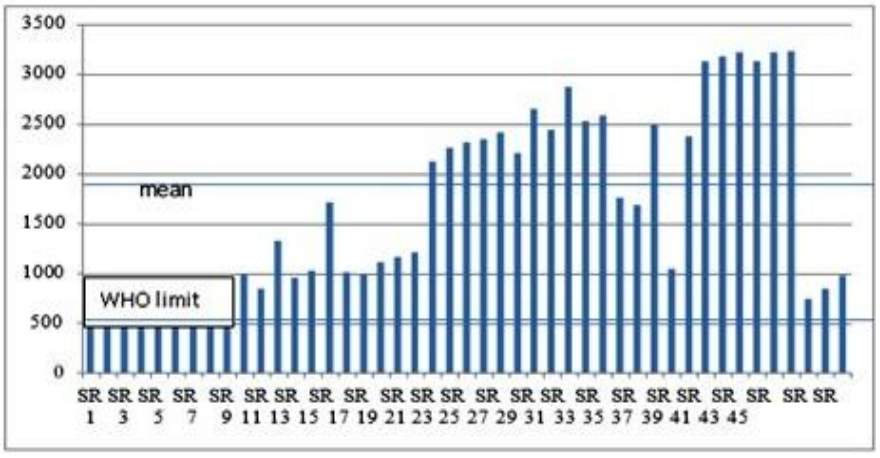

Figure 5 4. Concentration of TDS in the Ground Water and WHO Standards

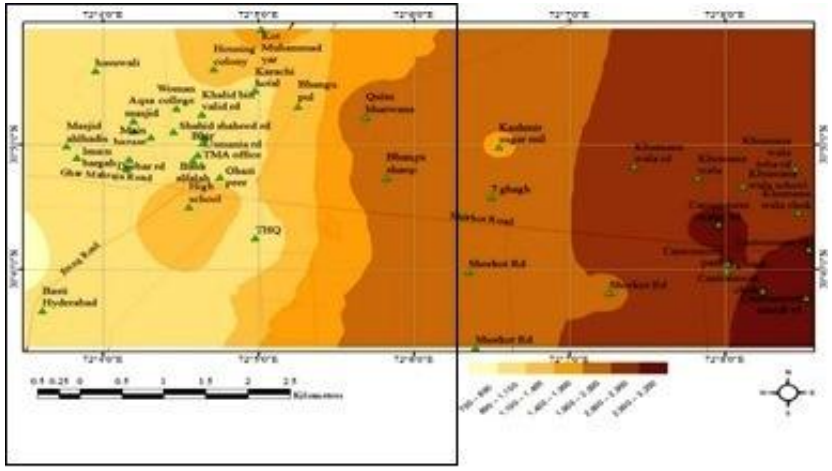

Figure 5.5. Concentration of TDS in the Ground Water of Shorkot

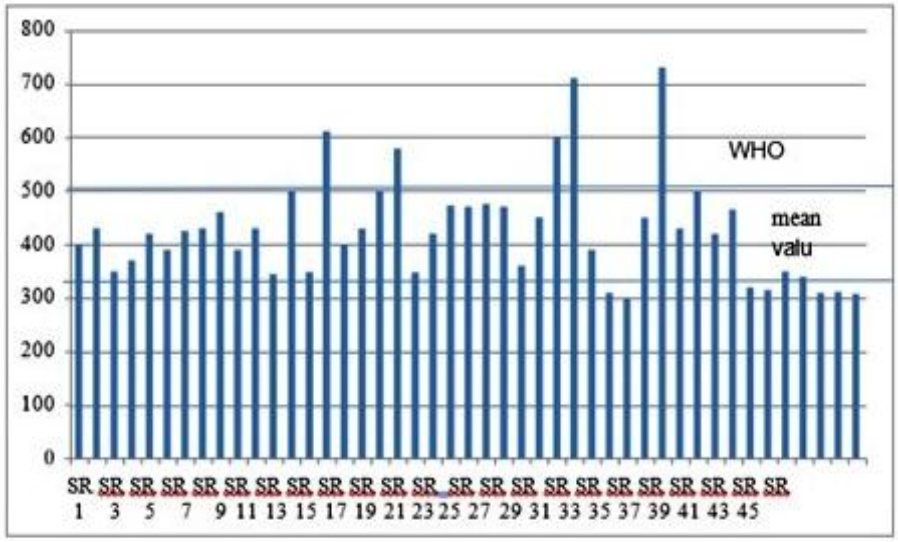

Figure 5.6. Concentration of Alkalinity in the Ground Water and WHO Standards

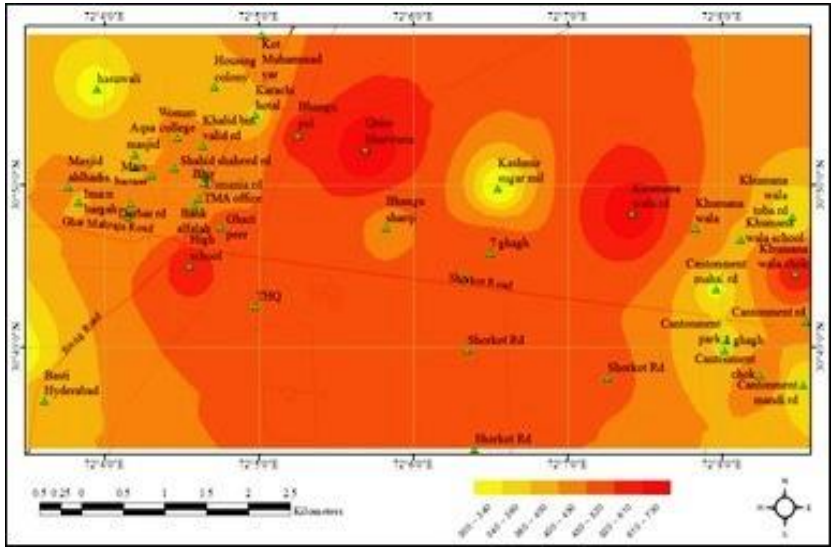

Figure 5.7. Concentration of Alkalinity in the Ground Water of Shorkot

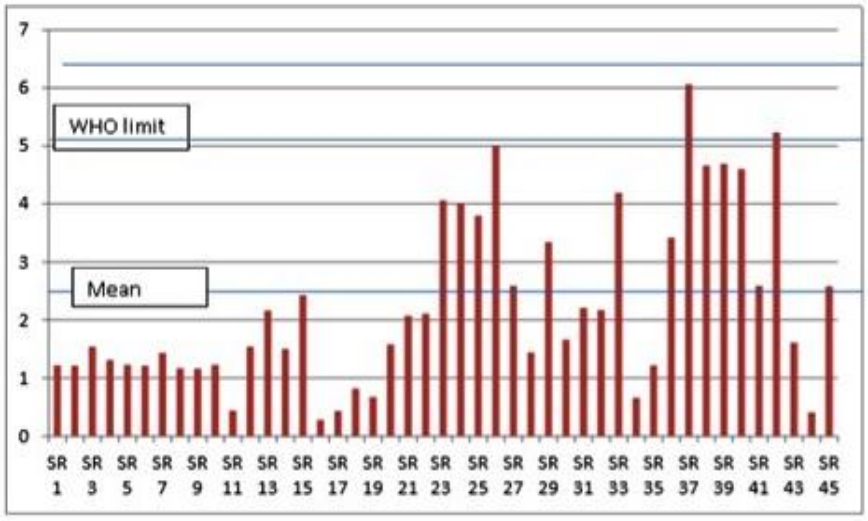

Figure 5. 8. Concentration of Turbidity in the ground water and WHO standard

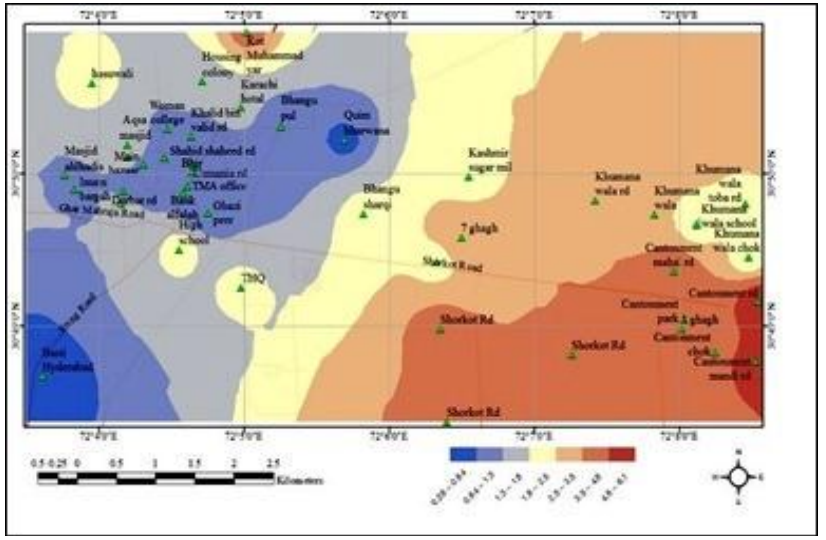

Figure 5. 9. Concentration of Turbidity in the ground water of Shorkot

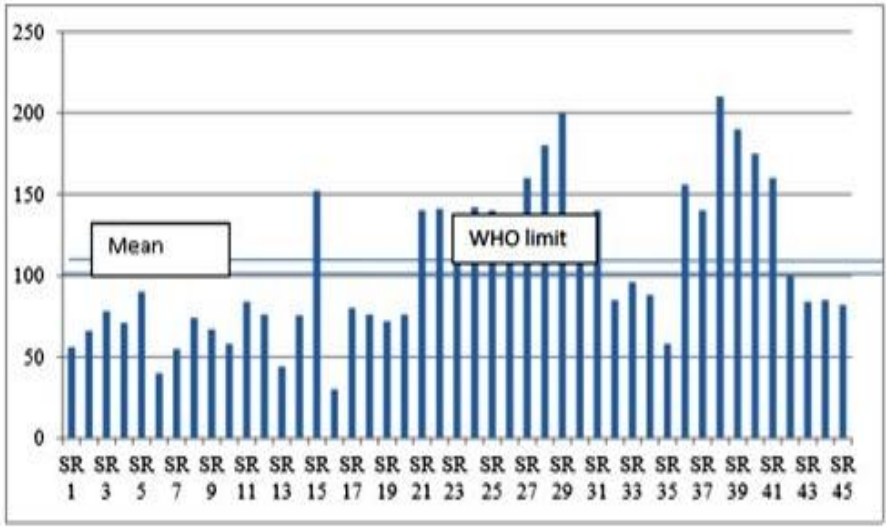

Figure 5.10 Concentration of Calcium in the ground water & WHO standards.

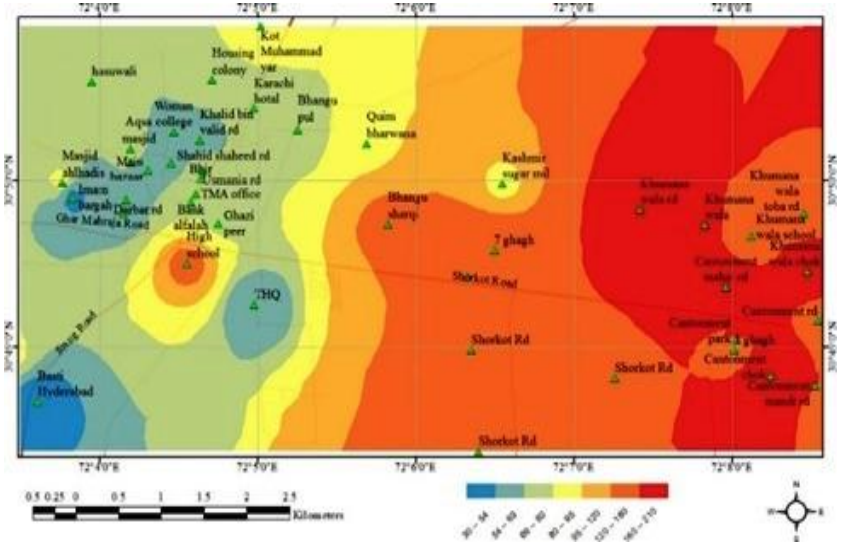

Figure 5.11. Concentration of Calcium in the ground water & WHO standards

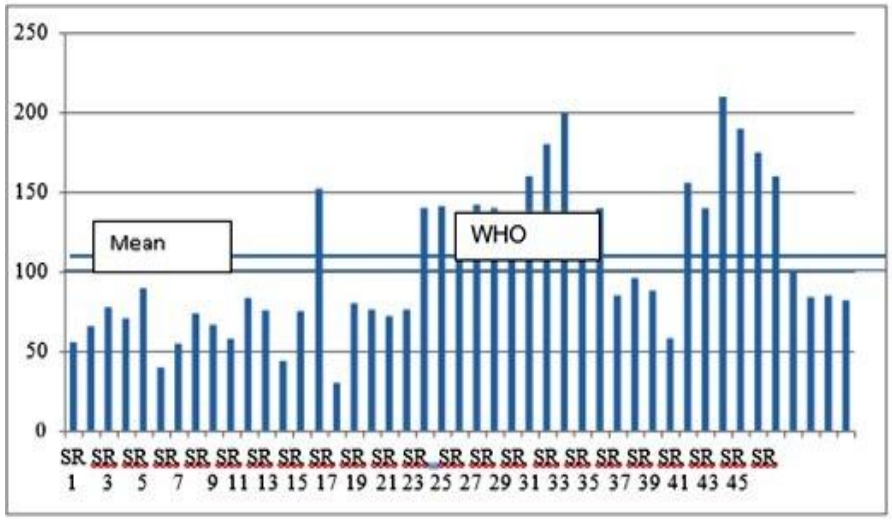

Figure 5.12. Concentration of Magnesium in the ground water of Shorkot

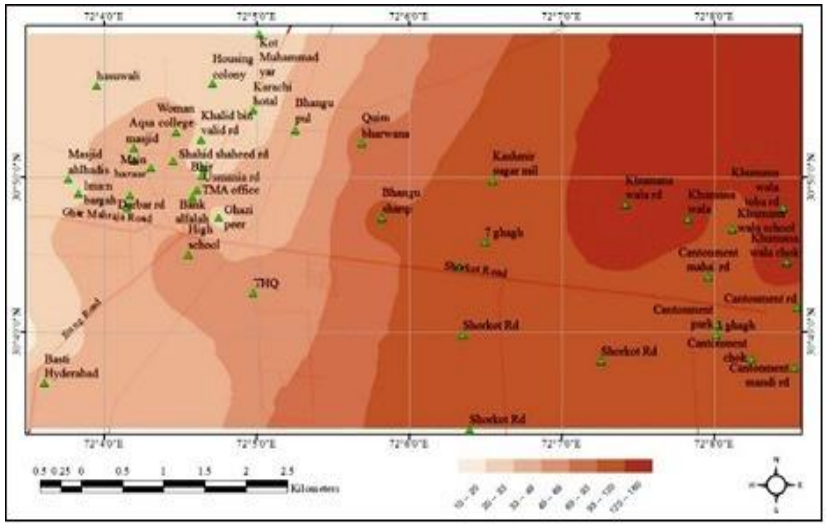

Figure 5.13. Concentration of Magnesium in the ground water of Shorkot

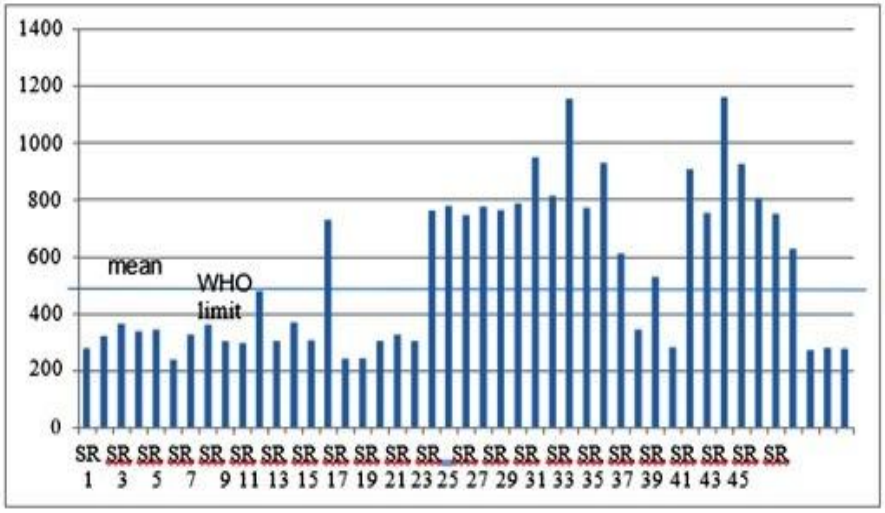

Figure 5.14. Concentration of Hardness in the ground water and WHO standards

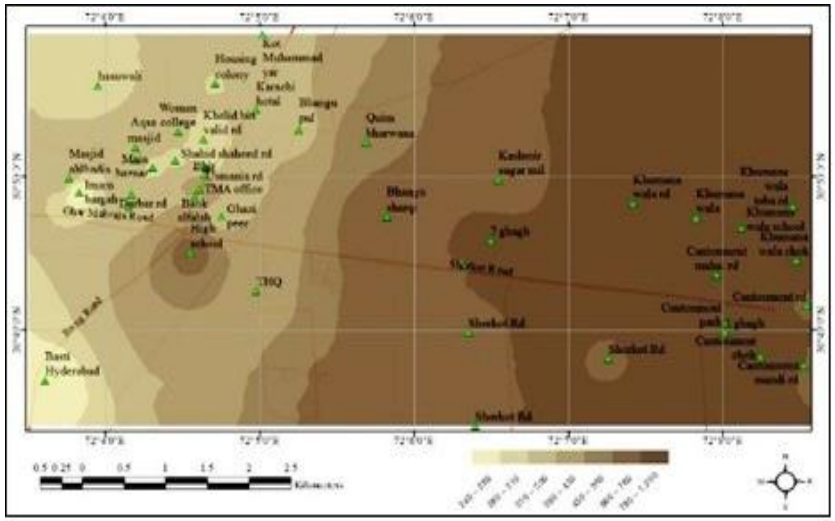

Figure 5.15. Concentration of Hardness in the ground water of Shorkot.

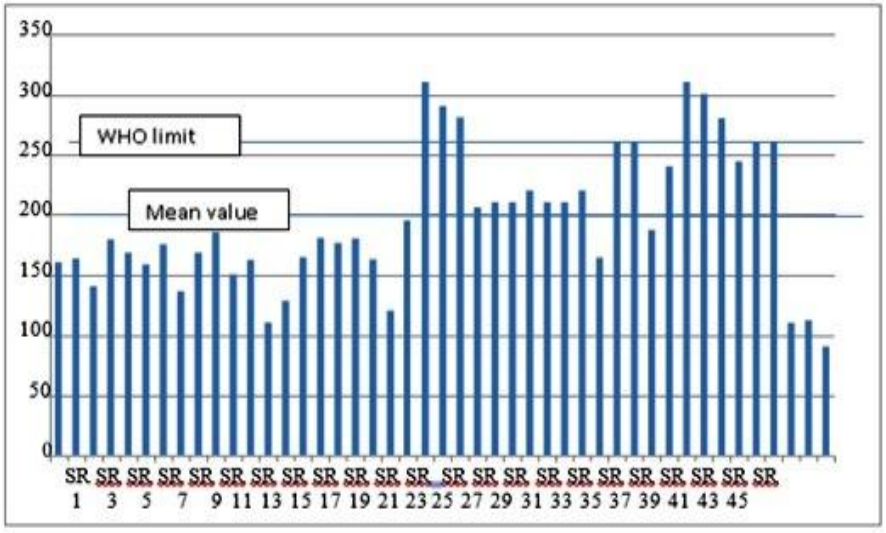

Figure 5.16. Concentration of Chloride in the ground water and WHO standards

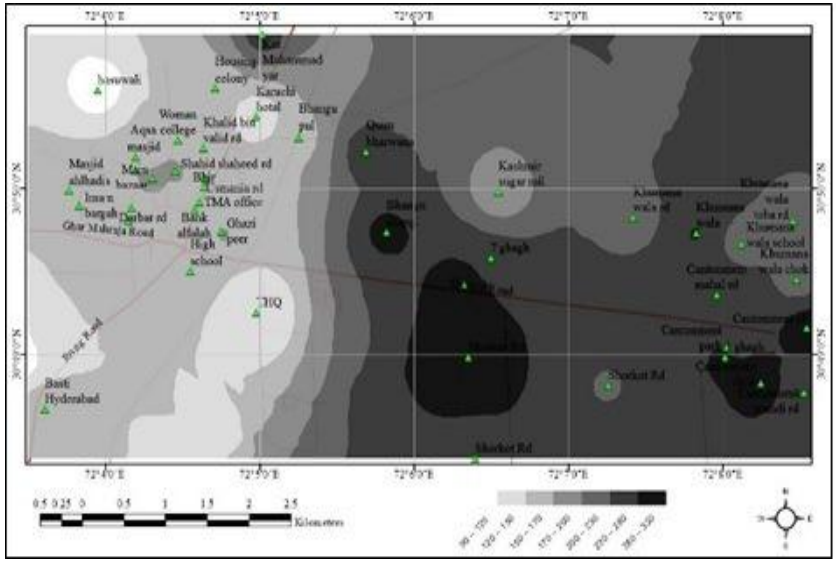

Figure 5.17. Concentration of Chloride in the ground water in Shorkot

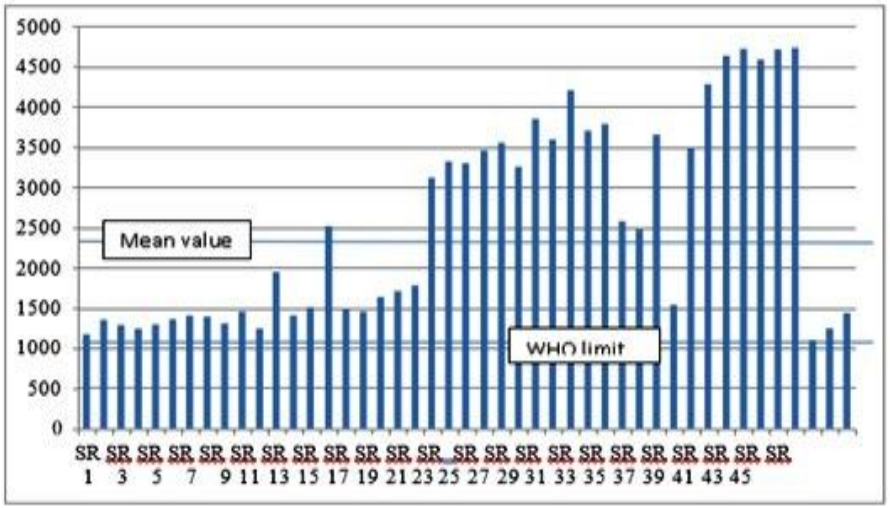

Figure 5.18. Concentration of EC in the ground water and WHO standards

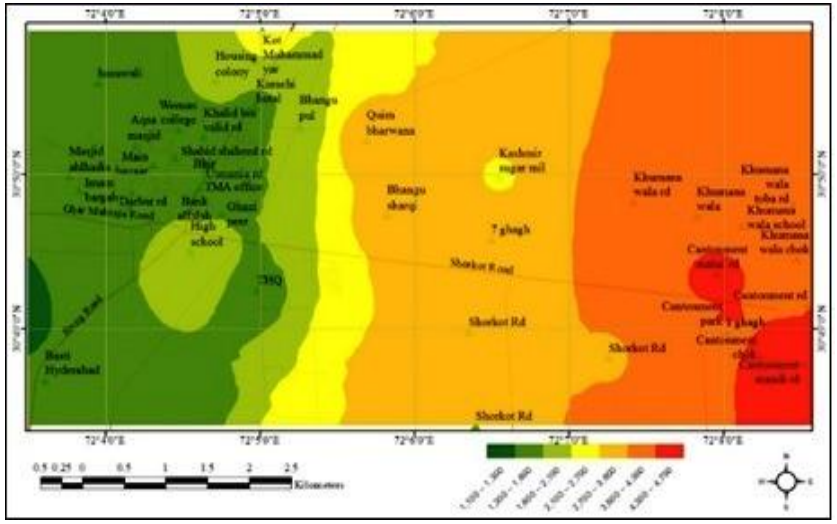

Figure 5.19. Concentration of EC in the ground water and WHO standards

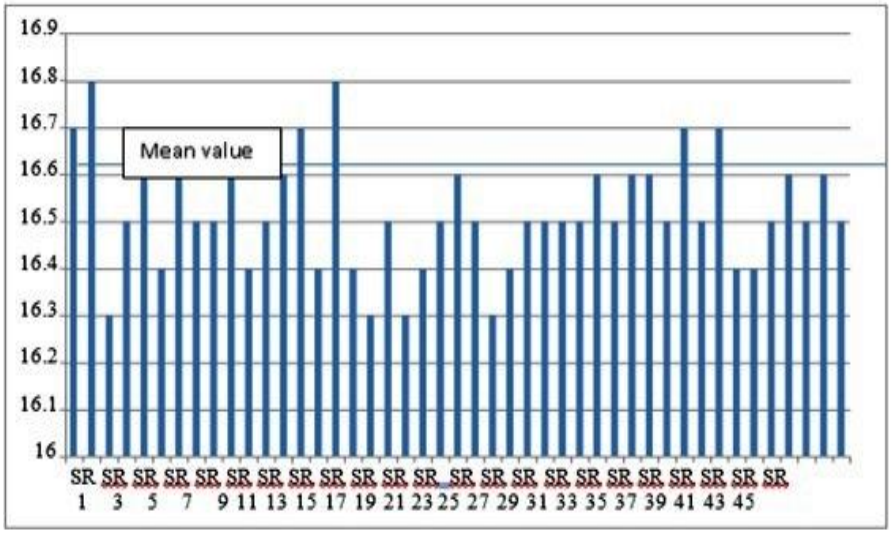

Figure 5.20. Concentration of Temperature in the ground water and WHO standards18.

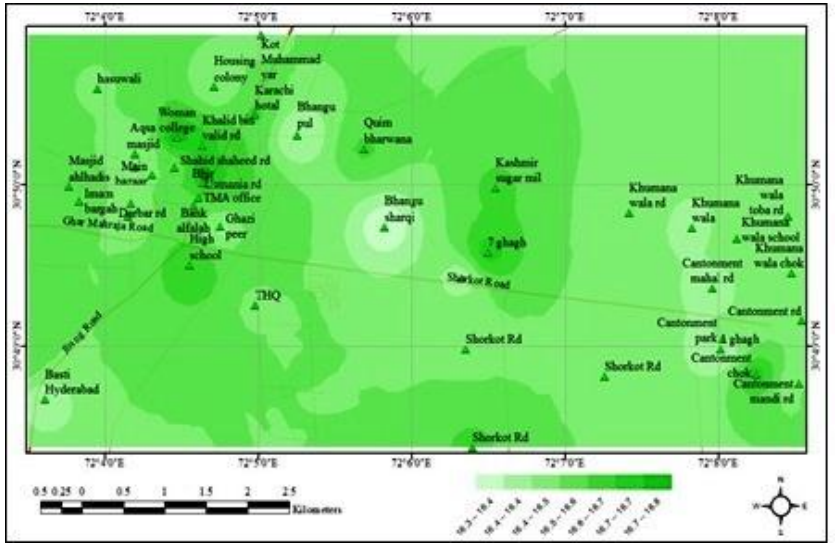

Figure 5.21. Concentration of Temperature in the ground water of Shorkot

Water and Diseases: Point of view of residing population about the relationship between spreading of disease and ground water quality was also searched in this survey. A large portion of population which was 21% said that the Diarrhea was spreading due to the usage of poor ground water quality, 21% repliers said that the polluted water was cause of Gastroenteritis. According to 12% people opinion, Hepatitis, problem of kidney stone and Dysentery diseases were spreading due to poor drinking water quality. 6% residing population tell the spreading of Cholera is caused by polluted water.8% population connected the relationship between water and heart diseases in this study. The opinion about typhoid and scabies were two percent in this survey. Only one percent people said that the polluted water was the reason of cancer in study area.

Table 5.2. Response of respondents to spreading diseases due to ground water.

Sr. No.	Diseases	No. of Respondents
1.	Dysentery	15
2.	Typhoid	02
3.	Cholera	08
4.	Diarrhea	29
5.	Gastroenteritis	27
6.	Hepatitis	16
7.	Scabies	03
8.	Kidney stone	16
9.	Asthma	03
10.	Cancer	01
11.	Heart diseases	10
12.	**Total**	**135**

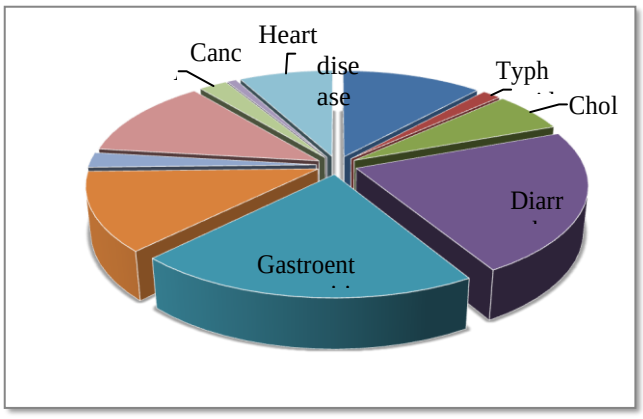

Figure 5.22. Public perception about spreading the diseases due to drinking of water.

DISCUSSION

Water is the major component on Earth planet. It is not only the major component for man, it is important for all existed fauna and flora on the earth. Whenever we see the dry and wet portion of the earth we come to know that water is dominating our earth with 71% and dry portion consist of 29% of the whole sphere. Water contamination has become dangerous everywhere throughout the world. Ground water is one of the biggest sources of drinking water in the study area (Shorkot city). The quality of the drinking water is become worse because of human activities like agricultural activities, industrial waste, salinity and urban waste.

Conclusion: The main objective of the research is to find out the basic parameters of the groundwater in shorkot city. Moreover the basic purpose of the research is to investigate the impacts of contaminated water on human health in shorkot city. To achieve these targets a sampling was done and water sample were evaluated as per recommended standards. The concentration of TDS 62%, Alkalinity 12%, turbidity 6%, calcium 62%, magnesium 6%, hardness 44% and chloride 28% values exceeds as compared to WHO proposed standard limit. Similarly the value of PH 100% remains under the permissible limit and Electrical conductivity 100% values exceed as compared to WHO proposed standard limit values. Survey results show that higher concentration of calcium, TDS, chloride, magnesium, turbidity, Alkalinity, Electrical conductivity and hardness cause Gastroenteritis 21%, Hepatitis 12%, Diarrhea 22%, Dysentery 12%, Scabies 2%, Asthma 2%, Cancer 1%, Typhoid 2%, Cholera 6% and kidney stone 12% diseases. The survey was also verified during the interaction with people residing in the study area. According to public view quality of water become worse due to agricultural substance, untreated industrial discharge and urban effluent that effect on their health.

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