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Assessment of Drinking Water Quality of Sheikhupura City

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Abstract:

Assessment of water quality is essential to get rid of water borne diseases not only for humans but also for other organisms. Production of healthy grains is largely dependent upon provision of high-quality water to seasonal crops. A study was carried out to assess the drinking water quality of district Sheikhupura. The water samples were collected from twenty-one different locations of the city. The areas of the city where population density was higher more than one water samples were collected from there and after analysis most polluted areas were highlighted. Sixteen physiochemical parameters (pH, taste, odor, color, temperature, turbidity, total dissolved solids, total hardness, calcium, magnesium, alkalinity, chloride, electrical conductivity, arsenic, iron, fluoride and sulphate) and one biological parameter (total coliform) were tested for each sample site and the results were compared with World Health Organization (WHO) predefined standard of drinking water to highlight the vulnerable sites having water quality below WHO standards. Based on physiochemical parameter results, the water samples of ten different locations were found unfit for human consumption and for agriculture as well. The presence of brown and green particles were found in two samples, whereas the value of total dissolved solids was higher than the permissible limit at five sample site and the value of arsenic was higher than the limit at three different sites. Only one water sample which was collected from Housing Colony was found biologically fit whereas other thirty-one samples were found biologically contaminated. The possible cause of this contamination was the mixing of wastewater with ground water. It is recommended that the water should be used after boiling or compulsory chlorination should be performed to eliminate biological contamination.

Keywords: Drinking water quality, Sheikhupura city, physical parameters, chemical parameters, biological parameters.

Introduction.

Clean water is required for drinking and preparation of food . A report issued by World Health Organization in 2017 [1] defined safe drinking water as the one which "does not represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages".

Many studies have been conducted worldwide to assess water quality with special concern to arsenic, manganese and chromium e.g., E. Inam Ullah and A. Alam (2014) [2] collected water samples from Peshawar for assessment of drinking water quality using biological analysis, testing of physico-chemical parameters and exploring the quantity of trace elements/heavy metals in collected samples. Results were compared with World Health Organization (WHO) drinking water quality standards which showed that most of the drinking water was contaminated before reaching households. E. Inam Ullah and A. Alam (2014) [2] explained that 84% of the samples collected from households were found fecal contaminated. Physico chemical parameters as well as heavy metals concentration were mostly found to be within permissible limits [3,4]. However, Pb concentration was found in 34% household samples and Mn concentration of three household samples were exceeding the WHO limits. Moreover, water of one location was found hard because of exceeded amount of dissolved salts.

Ilyas et al (2017) [5] analyzed drinking water quality and health risk evaluation in Dir Pakistan. The study was conducted for exploring the characteristics related to physicochemical, light and heavy metal quantity in drinking water of the areas selected in Lower Dir, Pakistan. About 22 water samples were collected and analyzed for various parameters e.g., pH, temperature Dissolved Oxygen (DO), Electrical Conductivity (EC) and salinity while other chemical parameters e.g., alkalinity, total dissolved solids (TDS), hardness, chlorides (Cl-), and sulfates were also analyzed by Ilyas et al (2017) [5]. Light metals such as magnesium (Mg+2), calcium (Ca+2), sodium (Na+), and potassium (K+) and heavy metals included lead (Pb), chromium (Cr), nickel (Ni), and zinc (Zn) were analyzed. The results of this study showed that all the parameters were within the permissible limits set by World Health Organization (WHO) and Pakistan Environmental Protection Agency (Pak-EPA) except hardness which was (351.44 mg/L). The light metals were within the permissible limit except Mg+2 (308.60 mg/L) that exceeded the permissible limits of WHO and Pak-EPA, while Ca+2 (53.71 mg/L) exceeded the permissible limit of WHO. The heavy metal results showed that all the metals were within permissible limit except Cr (0.18 mg/L) and Pb (0.04 mg/L). The health risk assessment like Average Daily Dose (ADD) and Hazard Quotient (HQ) were calculated for heavy metals. All heavy metals in drinking water samples indicated no health risk (CDI and HQ<1).

Khalid et al (2011) [6] analyzed drinking water samples of 15 sites to develop a database on the quality of water being consumed in different areas of Abbottabad district. The qualitative and quantitative analysis of water samples was conducted by various researchers to determine the vulnerable sites regarding water pollution [7, 8, 9, 10, 11, 12, 13]. Water samples were taken from the area with high population density of humans. A large number of people were found under water borne diseases therefore Abbottabad district was observed not suitable to be declared as safe water zone due to presence of various microbial organism which were harmful for humans to intake.

This study mainly focused on the assessment of physical, chemical and biological parameters of the drinking water and provided recommendations to improve the water quality especially in residential areas. This research work was carried out with following objectives: (i) to collect and assess water quality of water samples taken from different areas of Sheikhupura city (ii) to compare the results of physical, chemical and biological parameters (iii) and to check the contamination level against National Environment Quality standards (NEQs) and World Health Organization (WHO) standards.

Material and Methods.

Investigation site.

Sheikhupura is an agro-industrial city of Punjab Province. It is located about 40 km in northwest of Lahore [14]. The total population of the district Sheikhupura was 3.46 million in 2017 [15]. A large number of population of Sheikhupura is deprived of clean drinking water. Sheikhupura city is located at 31.7167° N, 73.9850° E. It has 51 union councils. The map of study area is presented in Figure 1,

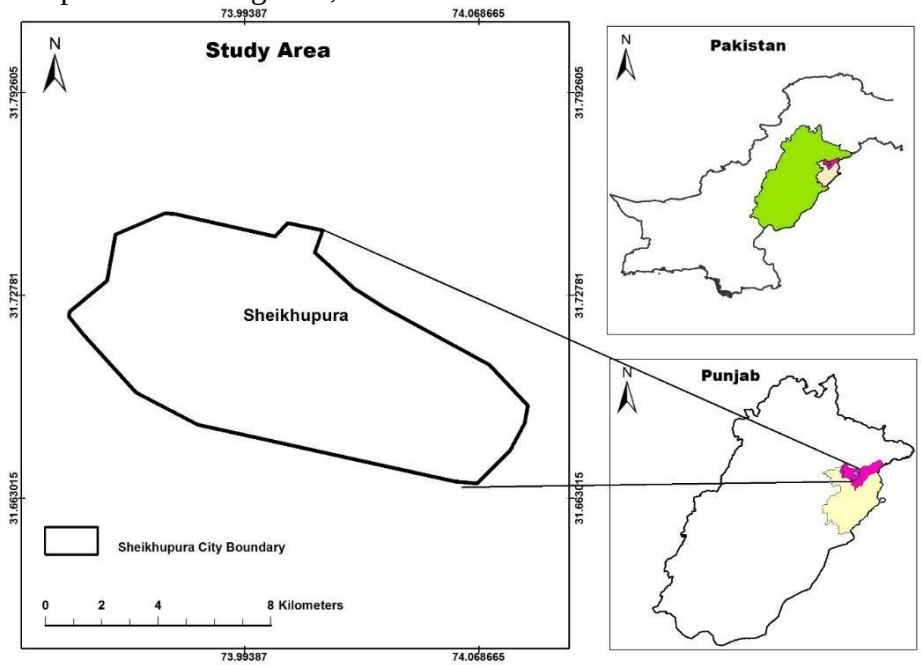

Figure 1. Map of Study Area

Water samples were collected from twenty-one locations and the number of water samples were thirty-two. The spatial location of sample sites is listed in Table 1,

Table 1. Number of Water Samples from Different Locations

Sr. No	Locations	No. Of Samples	Coordinates
1	Rasool Nagar	2	31°43’16” N, 73°58’02”E
2	Civil Lines	1	31°43’01” N, 73°58’10”E
3	Gloriya Colony	1	31°43’15” N, 73°58’02”E
4	Sultan Pura	2	31°42’24” N, 74°00’04”E

5	Muslim Ganj	3	31°42’10” N, 73°58’23”E
6	Shareef Colony	3	31°42’51” N, 73°57’20”E
7	Nabi Pura	1	31°43’07” N, 73°57’12”E
8	New Civil Lines	2	31°43’01” N, 73°56’54”E
9	Jinnah Park	1	31°42’32” N, 73°58’45”E
10	Bhatti Dhilwan	1	31°41’24” N, 74°04’31”E
11	Saleem Kot	1	31°41’42” N, 74°01’55”E
12	Gulistan park	1	31°42’07” N, 74°59’46”E
13	Mohalla Bal	1	31°41’01” N, 74°03’53”E
14	Dosahra Ground	1	31°42’51” N, 73°59’11”E
15	Bhati Harya	1	31°41’40” N, 74°03’08”E
16	Zafar Abad	1	31°41’06” N, 74°03’34”E
17	Jahangir Abad	1	31°41’13” N, 73°58’55”E
18	Housing Colony	2	31°41’59” N, 74°02’35”E
19	Old City	2	31°42’48” N, 73°59’27”E
20	Rehmat Colony	2	31°42’48” N, 74°00’00”E
21	Habib Colony	2	31°42’33” N, 73°59’40”E

Sampling Methodology

Water bottles of 500 ml were used for sample collection. These bottles were washed with boiled water and dried [16,17]. Water samples were collected from different sources such as tube wells, houses, water supply and water filters. It was kept in mind that the water bottle should not be overflowed and the bottle was properly sealed and labelled [18,19]. The water sample was stored in a cold place and was delivered to laboratory within 24 hours of the collection.

Parameters Tested

Total seventeen drinking water quality parameters were tested including sixteen physiochemical and one biological parameter. Physical parameters include color, taste, odor, temperature, pH and turbidity. According to WHO standards, good quality water should be colorless and odorless [20]. The pH value should fall within 6.5-8.5 and turbidity should be less than <5NTU. The chemical parameters tested includes Total Dissolved Solids (TDS), total hardness, calcium, magnesium, alkalinity, chloride, electrical conductivity, arsenic, iron, fluoride and sulphate whereas the biological parameter included coliform [21]. High value of arsenic was due to mixing of industrial wastewater with the water supply lines especially the areas which were located near any industry.

Interpolation

Interpolation technique is used to identify the unknown values on the basis of known values [22]. Arc Map provides basically three types of interpolations including Krigging, Inverse Distance Weightage (IDW) and Spline. We used IDW for mapping the concentration of chemical and biological parameters in the study site.

Result and Discussion.

Taste and Odor

The taste and odor of all thirty-two water samples were tested. The results showed that the water was tasteless and odorless at all test sites and was in accordance with drinking water standard of WHO.

Color

During color testing of water, it was assessed that the thirty water samples were colorless whereas in two water samples, the presence of green and brown particles were detected. These green particles were detected in the water sample taken from Sultan Pura. The possible reason of green particles was the presence of algae in the water samples as Sultan Pura is located in residential area and there is tyre manufacturing industry on the north eastside and agricultural land on the North-West and in south side. The brown particles were detected in water samples of Muslim Ganj. The possible reason was the use of old iron pipes for water supply and due to corrosion of these pipes that produce brown particles in water. The drinking water from these two locations was not fit for consumption.

pH

The value of pH from all thirty-two locations was found within the permissible limit of WHO and National Environment Quality Standards (NEQS). The maximum value of pH was 7.9 at Rasool Nagar and at old city location. The minimum value of pH was 7.1 at Saleem Kot and Dosahra Ground locations. Saleem Kot was located in the agriculture area having paper mills, chemical manufacturing and glass industries in the vicinity whereas Dosahra Ground was located in residential area of the city. The pH concentration is shown in Figure 2

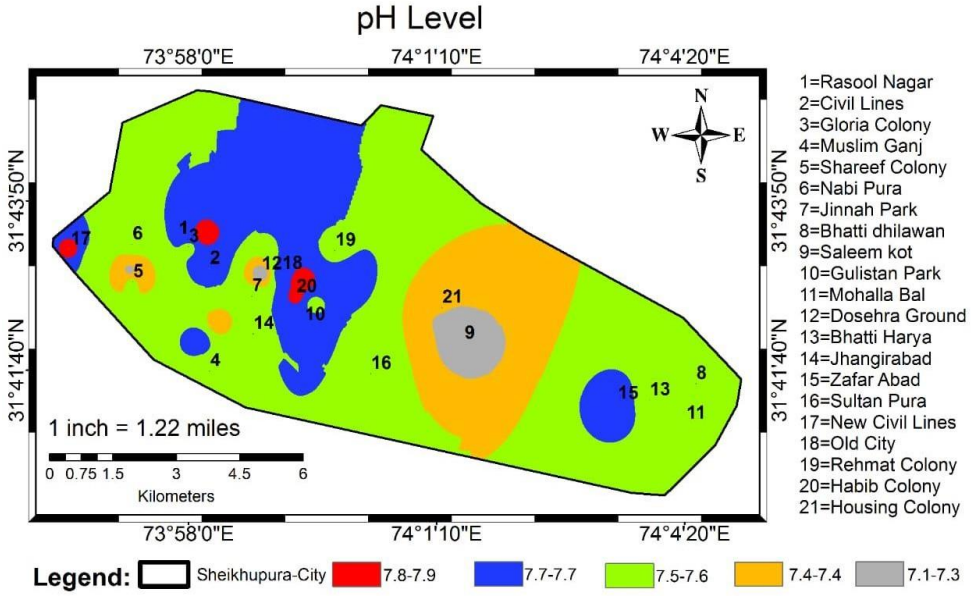

Figure 2. pH Concentration Map

Turbidity

The value of turbidity from all thirty-two locations was found within the permissible limit of WHO and NEQS i.e. <5NTU. The maximum value of turbidity was 5 at Rasool Nagar which is a residential area. The minimum value of turbidity was 0.2 at Muslim Ganj location and Shareef Colony. Muslim Ganj and Sahreef Colony are residential areas of the city but there was agriculture area in the south of Shareef Colony. The map of concentration of turbidity is shown in Figure 3.

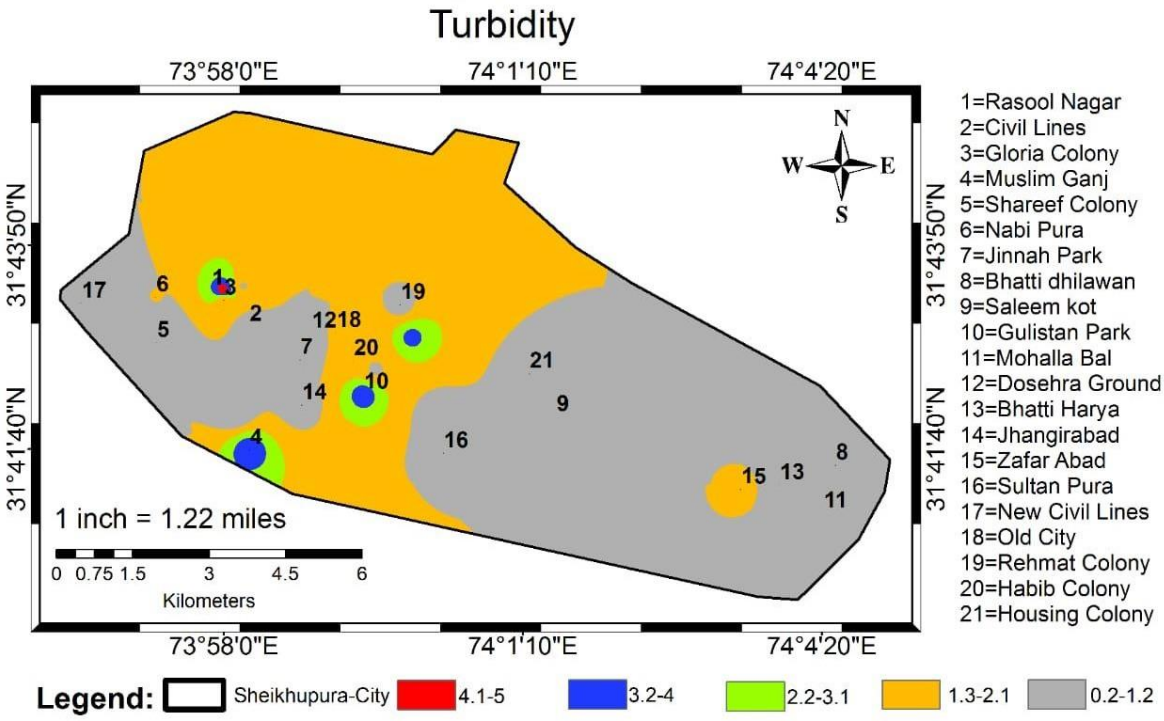

Figure 3. Turbidity Concentration Map

Total Dissolved Solids (TDS)

The permissible value of TDS was 1000 mg/l according to WHO. At twenty-seven locations, the TDS values were within the permissible limits whereas at five locations the values were higher than this limit. The value of TDS at (i) Gulistan park was 1526 mg/l (ii) at Zafar Abad was 1299 mg/l (iii) at Rehmat Colony was 1126 mg/l (iv) at Habib Colony location1 was 1287 mg/l and (v) at Habib Colony location2 was 1512 mg/l. Gulistan Park was comprised of both residential and agriculture area. Zafarabad was comprised of agriculture and industrial areas. Rehmat Colony was a residential area and on its South side there was agriculture land and small industry whereas Habib Colony was a residential area. The possible reason of high values of TDS at some locations could be due to mixing of wastewater into the main water system as a result of weak or loose joints. The concentration map of TDS is presented in Figure 4.

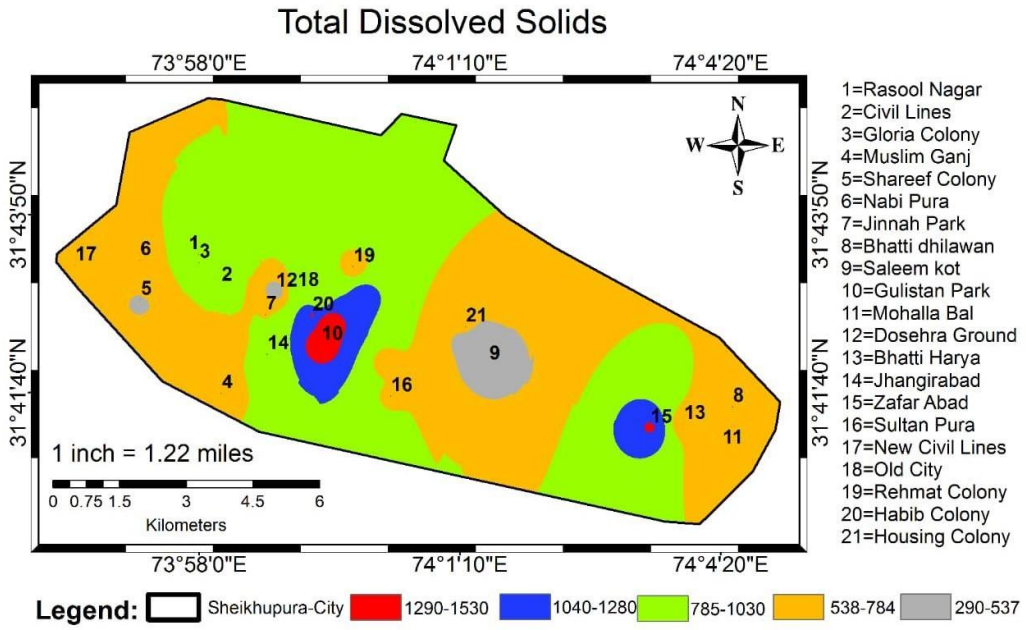

Figure 4. Total Dissolved Solids (TDS) Concentration Map

Total Hardness

The permissible value of total hardness was declared as 500 mg/l according to WHO. At thirty-one locations, the total hardness values was found within the permissible limits whereas at one location the value was higher than the permissible limit. The value of total hardness at Gulistan Park was 520 mg/l and the minimum values was 40 mg/l noted at Saleem Kot. Gulistan Park was comprised of both residential and agriculture area which was located on the Southern side of Saleem Kot. The concentration of total hardness is mapped in Figure 5

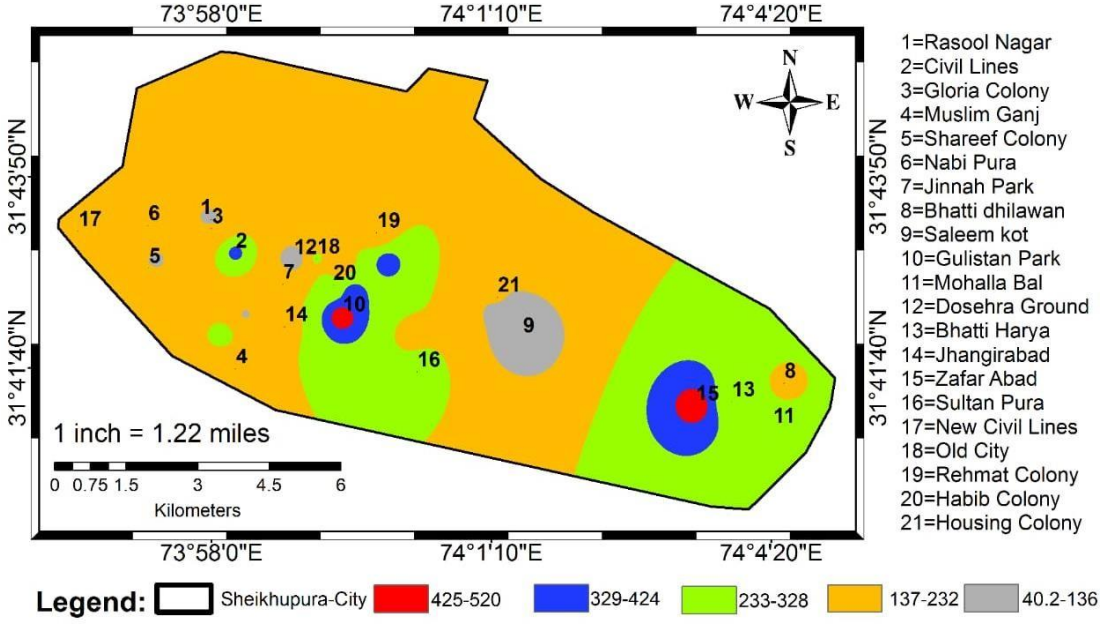

Figure 5. Total Hardness Concentration Map

Calcium

The permissible value of calcium was declared as 200 mg/l according to WHO. The values of calcium at all thirty-two locations were within the permissible limit. The maximum value of calcium was 124 mg/l observed at Civil lines and minimum value was 12 mg/l observed at Rasool Nagar location. Civil Lines and Rasool Nagar were residential areas of the city. the concentration of calcium is mapped in Figure 6,

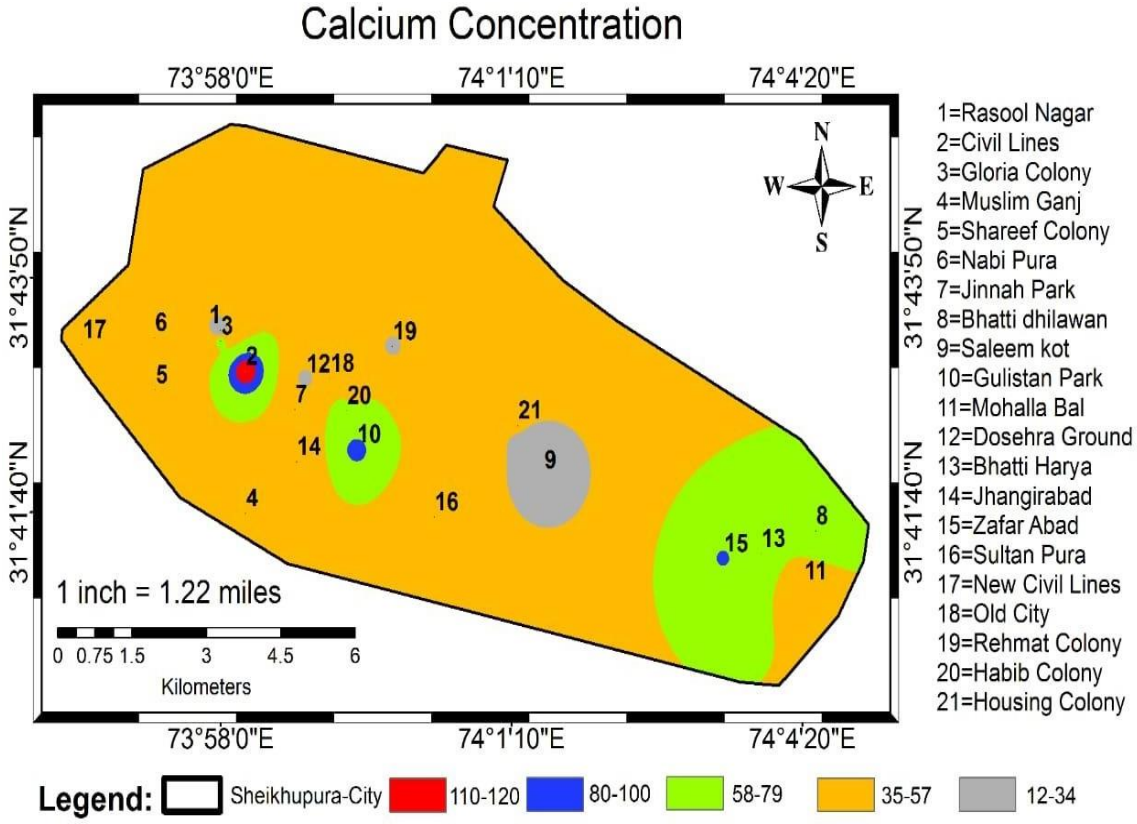

Figure 6. Calcium Concentration Map

Magnesium

The permissible value of magnesium was 150 mg/l according to WHO. The values of magnesium at all thirty-two locations was within the permissible limit. The maximum value of magnesium was 75 mg/l observed at Gulistan Park and minimum value was 3 mg/l observed at Muslim Ganj location and Dosahra Ground. Gulistan Park was residential and agriculture area was located on the Southern side of it. Muslim ganj and Dosahra Ground were located in residential areas of the city**.** Figure 7 showed the magnesium concentration in the city.

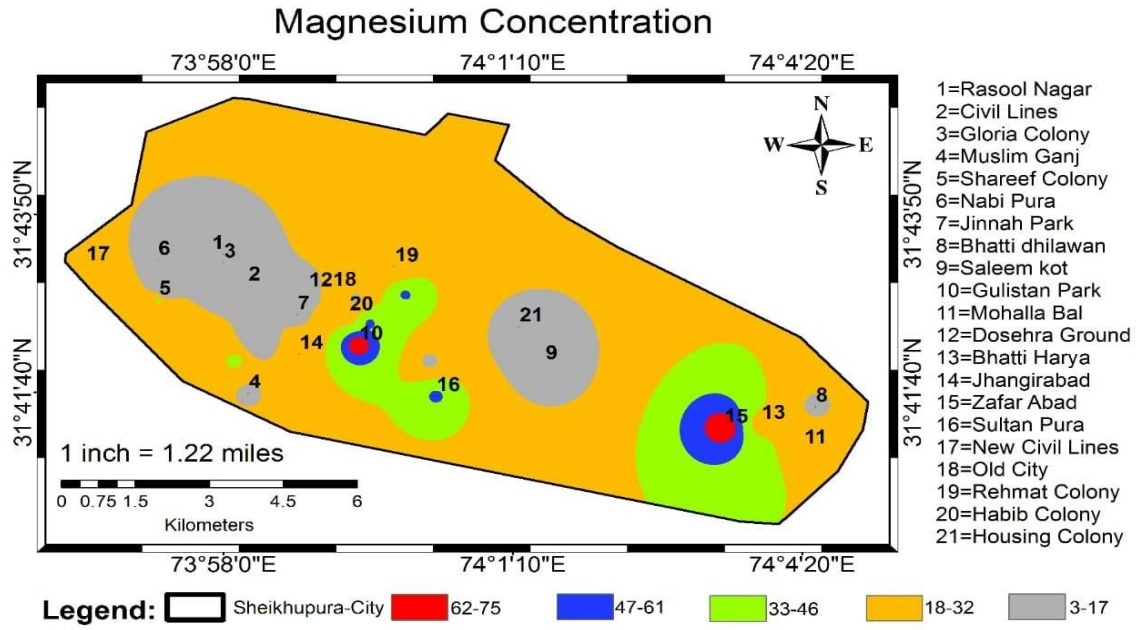

Figure 7. Magnesium Concentration Map

Alkalinity

There is no permissible limit defined for alkalinity in WHO standards. The maximum value of alkalinity was 469 mg/l observed at Rasool Nagar location and minimum value was 84 mg/l observed at Shareef Colony location. Rasool Nagar and Sahreef Colony were residential area of the city located in the south side. Figure 8 showed the concentration of alkalinity.

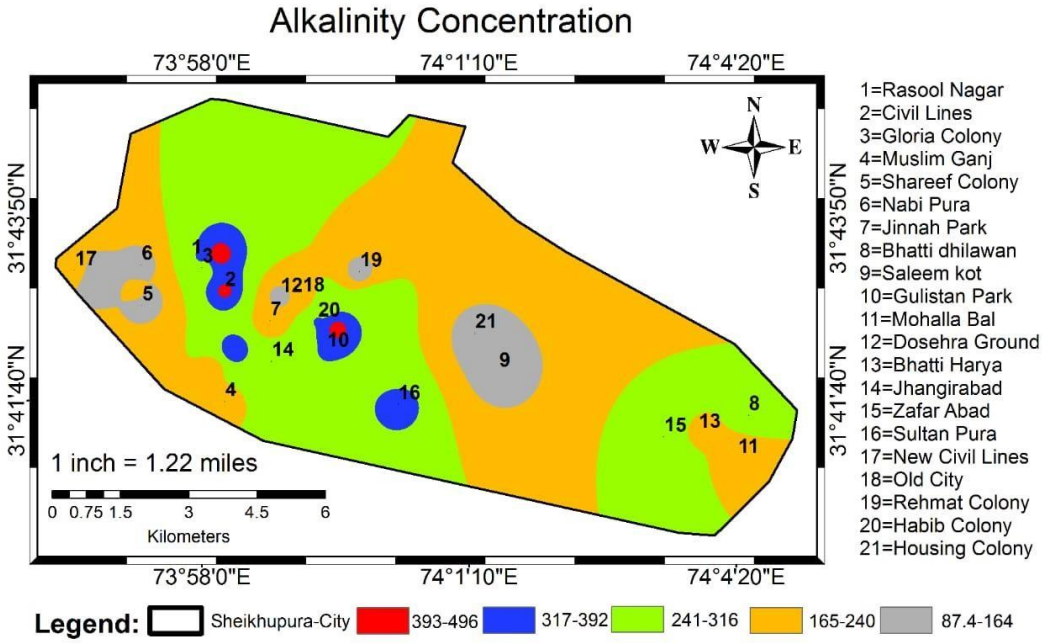

Figure 8. Alkalinity Concentration Map

Chloride

The permissible value of chloride was 250 mg/l according to WHO. The values of chloride at all thirty-two locations were within the permissible limit. The maximum value of chloride was 95 mg/l observed at Zafarabad and minimum value was 23 mg/l observed at Shareef Colony, Saleem Kot, Mohalla Bal, Dosahra Ground and Housing Colony. Zafarabad was surrounded by the agriculture, industrial and residential area. Chloride concentration map is presented in Figure 9.

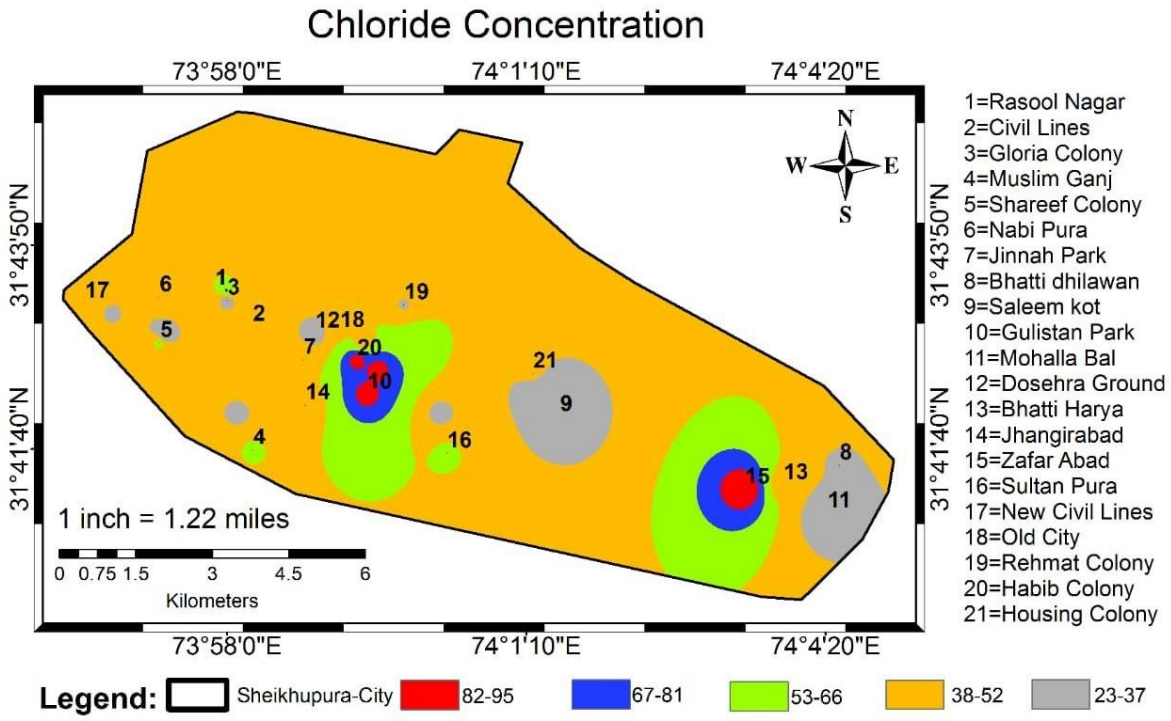

Figure 9. Chloride Concentration Map

Electrical Conductivity

The maximum value of EC was 2774 observed at Gulistan Park and the minimum value was 501 observed at Saleem Kot and Dosahra Ground. EC concentration map is presented in Figure 10.

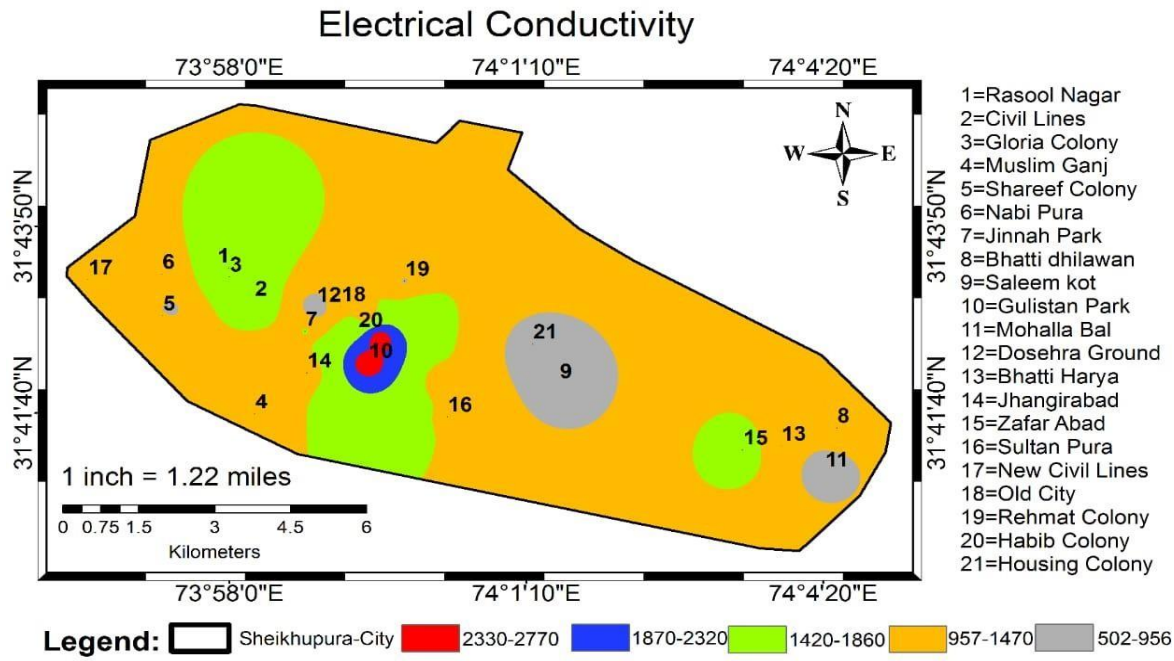

Figure 10. Electrical Conductivity Concentration Map

Arsenic

The permissible value of arsenic was 50ppb. The water samples from Sheikhupura city were collected in two rounds for analysis of arsenic. The arsenic parameter was tested for sixteen locations out of which, the value of arsenic was higher than the permissible limit at three locations. These locations included Mohalla Bal 100 ppb, Bhati Harya 90 ppb and Housing Colony 85 ppb. At these three locations, the water was not safe for drinking. Whereas at other thirteen locations the values were within the permissible limit as per standards defined by WHO. On the Wetern Side of Mohala Bal, there was industrial area and on southern side there was agriculture land. Bhati Harya was surrounded by the Industrial area from eastern and western sides whereas the Housing Colony was completely a residential area. The Industrial wastewater contributed in polluting ground water of these areas. Concentration of arsenic is mapped in Figure 11.

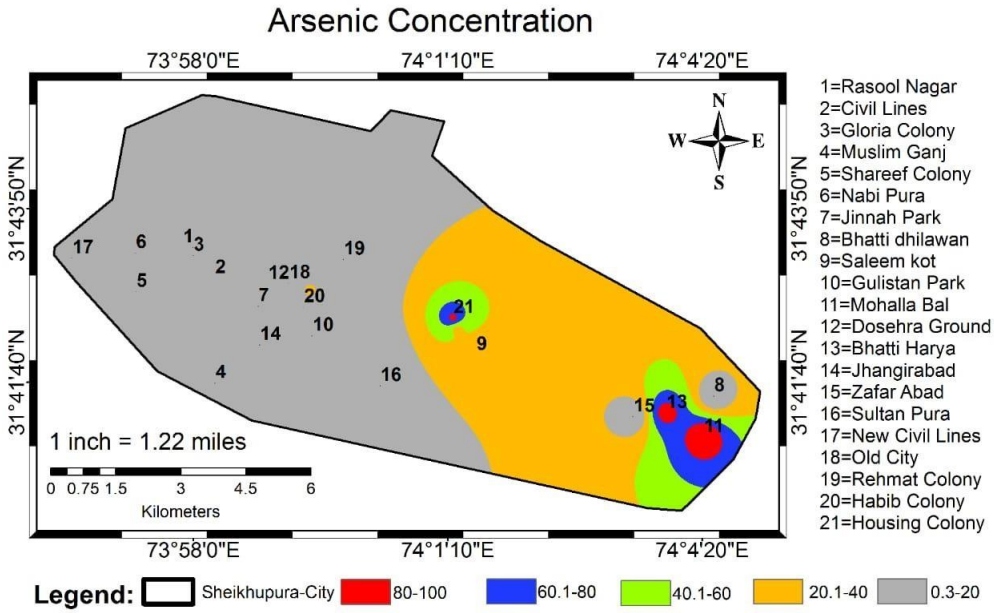

Figure 11. Arsenic Concentration Map

Iron

The permissible value of iron was 1.00 mg/l according to WHO standards. The iron was tested for sixteen locations only. The value of iron at sixteen locations was within the permissible limit. The maximum value of iron was 0.96 mg/l observed at New Civil Lines and the minimum value was 0.01 mg/l observed at Rasool Nagar. New Civil Lines is comprised of both residential and agriculture land. Iron concentration map is mapped in Figure 12.

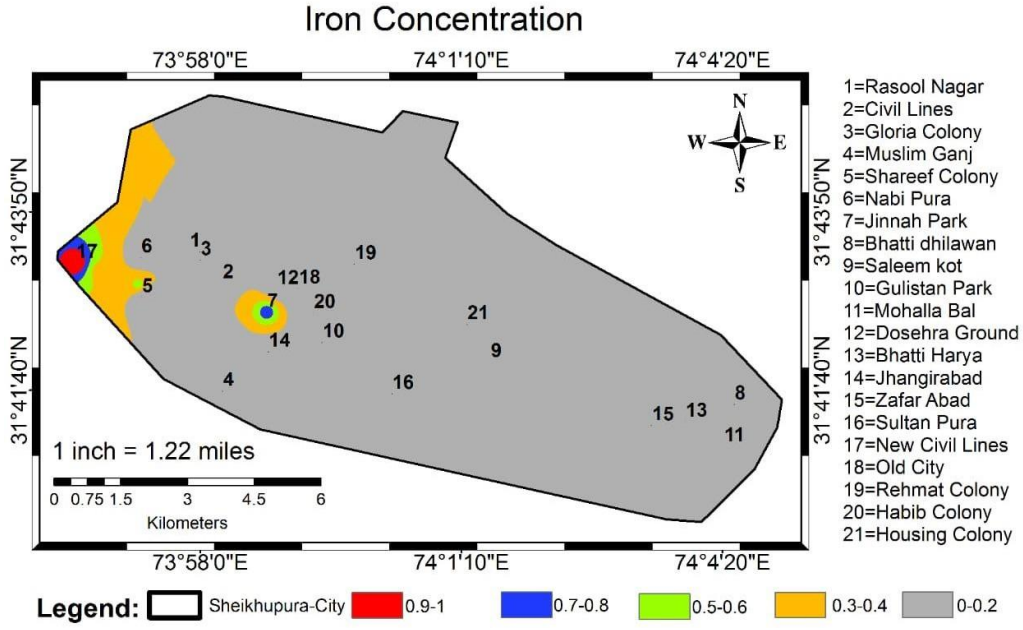

Figure 12. Iron Concentration Map

Fluoride

The fluoride was tested for sixteen locations. The value of fluoride was within the permissible limit of 1.50 mg/l. The maximum value of fluoride was 1.30 mg/l observed at New Civil Lines and minimum value was at Gloriya Colony and Jinnah Park. New Civil Lines is comprised of both residential and agriculture land located on the southern side of study area whereas Gloriya Colony and Jinnah Park were residential areas. Flouride concentration map is presented in Figure 13.

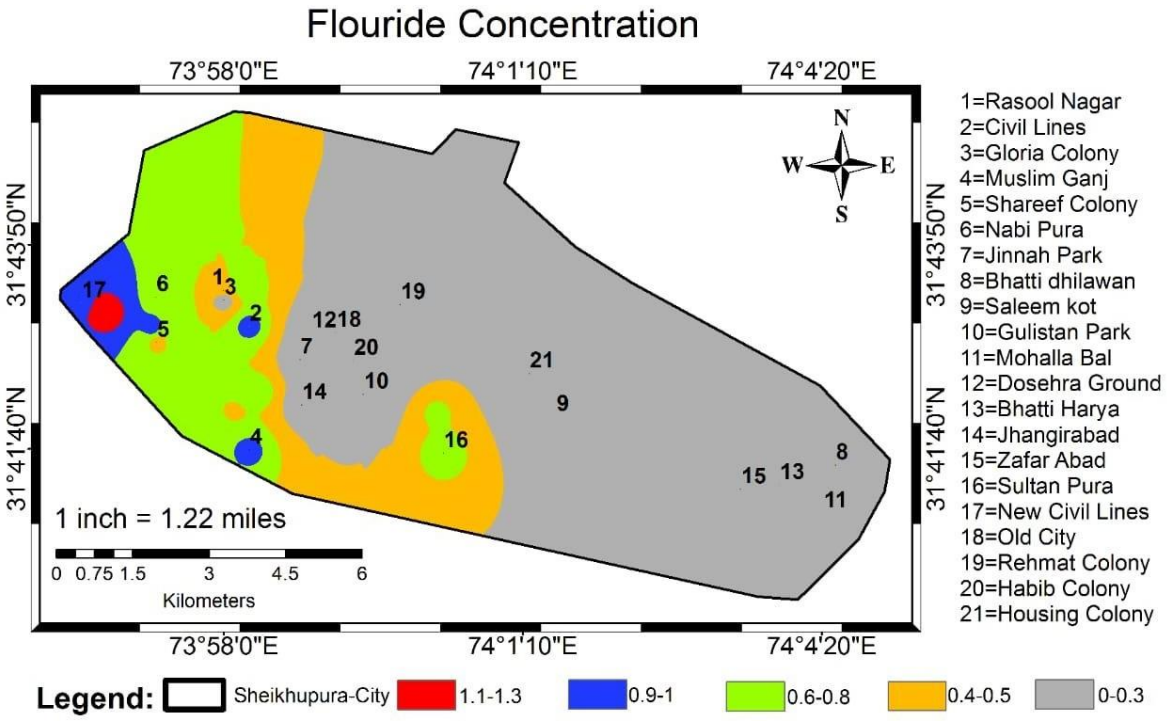

Figure 13. Fluoride Concentration Map

Sulphate

The values of sulphate at all thirty-two locations were within the permissible limit i.e. 250 mg/l. The maximum value of sulphate was 120 mg/l observed at Gulistan Park, Habib Colony and Rehmat Colony and the minimum value was 25 mg/l observed at Shareef Colony. The locations where the maximum value of sulphate were observed were residential areas and the agriculture area was located on the Southern side of Rehmat Colony. Shareef Colony was comprised of both residential and agriculture land. The concentration map of sulphate is presented in Figure 14.

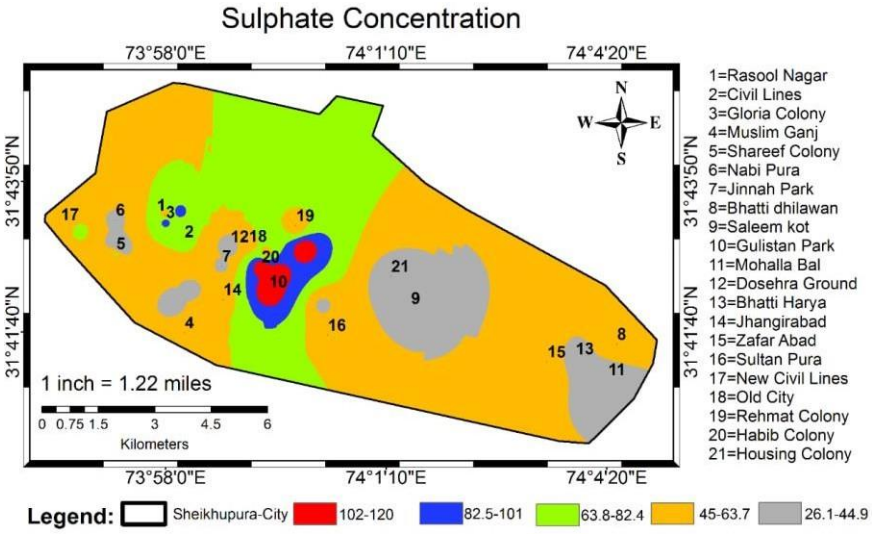

Figure 14. Sulphate Concentration Map

Total Coliform

The permissible value of total coliform was 0 per 100 ml sample. The value of total coliform at thirty-one locations were above the permissible limit. The presence of total coliform bacteria at most of locations was unfit for human consumption. Housing Colony was observed safe within permissible limit and water was fit for human consumption regarding total coliform. The presence of total coliform in the drinking water indicates that the water is mixing with waste water. Therefore, it is expected that there will be an enhanced chance of water borne diseases at all thirty one locations where the value of total coliform was exceeded. The locations where the value of total coliform was above the limit were residential areas, agriculture and industrial areas. The map showing total coliform concentration is presented in Figure 15.

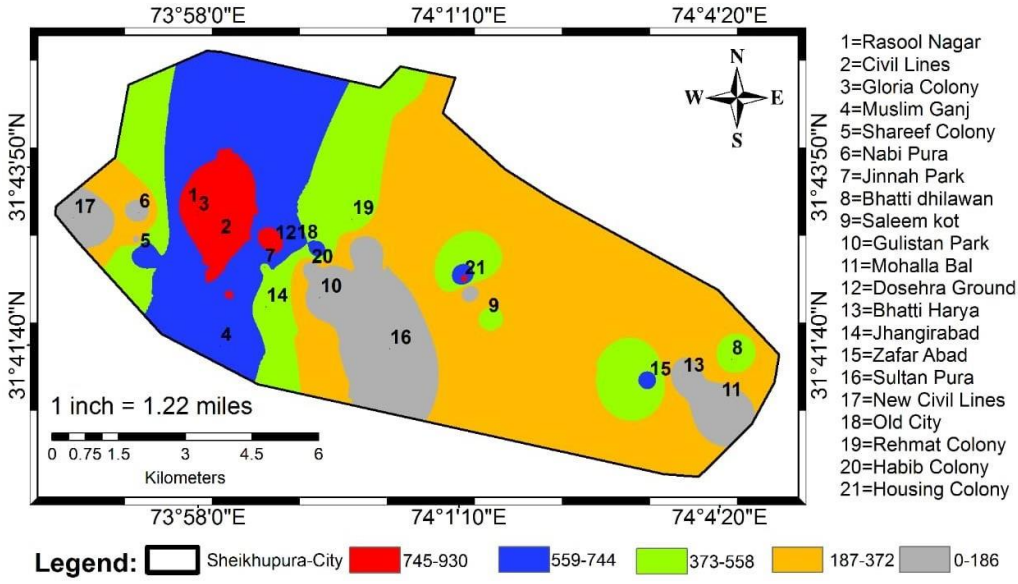

Figure 15. Total Coliform Concentration Map

Conclusion.

Ten spatially distributed sites of city Sheikhupura were unfit for human consumption based on the physical and chemical analysis of drinking water. The presence of green and brown particles, higher value of total dissolved solids and higher value of arsenic made these samples not good for human consumption. One out of thirty-one sample sites was confirmed fit for consumption of water and rest of thirty sites were unfit due to presence of coliform in drinking water on biological grounds.

Author's Contribution. All authors contributed equally.

Conflict of interest. We declare no conflict of interest for publishing this manuscript in IJIST.

Project details. NIL.

References:

1. Guidelines for Drinking-water Quality (PDF) (Report) (4 ed.). World Health Organization. 2017. p. 631. ISBN 978-92-4-154995-0.
2. InamUllah, E. and A. Alam, (2014) "Assessment of drinking water quality in Peshawar, Pakistan". *Bulg. J. Agric. Sci.*, 20 (NO 3), 595-600.
3. Daniel (2015) "Assessing Drinking Water Quality from Point of Collection to Point of Use in Rural Nepal". MSc Thesis ES 15.13.
4. Jassam Gzar Lafta (2015), "Analysis of water quality using chemical-physical-biological parameters of the kinds of water used for drinking in the Baghdad Province- Al Adhamiya City". Chemistry and Materials Research, ISSN 2225-0956, Vol7, No 12, 2015.
5. Muhammad Ilyas, Sardar Khan, Anwarzeb Khan, Rohul Amin, Asif Khan and Muhammad Aamir (2017) "Analysis of drinking water quality and health risk assessment- A case study of Dir Pakistan". Journal of Himalayan Earth Sciences Volume 50, No. 1A, 2017 pp. 100-110.
6. Anwar Khalid, Amir Haider Malik, Amir Waseem, Shazmeen Zahra and Ghulam Murtaza (2011), **"**Qualitative and quantitative analysis of drinking water samples of different localities in Abbottabad district, Pakistan". International Journal of the Physical Sciences Vol. 6(33), pp. 7480 - 7489, 9 December, 2011.
7. Chonde Sonal G., Mohite Ashwini S. and Raut P. D. (2014) "Studies on drinking water quality at public transport stations from Kolhapur and Sangli city". Advances in Applied Science Research, 2014, 5(2):316-327.
8. Dhanaji Kanase G, Shagufta Shaikh A, Pramod Jagadale N (2016), "Physico-Chemical Analysis of Drinking Water Samples of Different Places in Kadegaon Tahsil, Maharashtra (India)". Advances in Applied Science Research, 2016, 7(6):41-44, ISSN 0976-8610.
9. Premlata, Vikal, (2009), "Multivariant analysis of drinking water quality parameters of Lake Pichhola in Udaipur, India". Biological Forum, Biological Forum- An International Journal, 1(2), pp 97-102.
10. Sharma, Madhvi, Ranga, M. M., Goswami, N. K., (2005), Study of groundwater quality of the marble industrial area of Kishangarh (Ajmer), Rajshthan, Nature Environmental and Pollution Technology, 4(3), pp 419-420.
11. Patil. P.N, Sawant. D.V, Deshmukh. R.N (2012), " Physico-chemical parameters for testing of water – A review". International Journal of Environmental Sciences, Volume 3, No 3, 2012. ISSN 0976 – 4402.

12. Saravanakumar, K. and R. Ranjith, Kumar, (2011), Analysis of water quality parameters of groundwater near Ambattur industrial area, Tamil Nadu, India, Indian Journal of Science and Technology, 4(5), pp 1732-1736.
13. Mehwish Rani , Muhammad Mushahid Anwar , Rab Nawaz, Asad Aziz , Najam Zaheer , Nusrat Ehsan , Muhammad Umair (2016), "Level of Arsenic in Ground Water and Its Impact on Human Health: A Case Study of Bahawalpur City, Pakistan". Journal of Biodiversity and Environmental Sciences (JBES) ISSN: 2220-6663,Vol. 8, No. 6, p. 197-204.
14. https://en.wikipedia.org/wiki/Sheikhupura_District
15. Haydar, S., Arshad, M., & Aziz, J. A. (2009), "Evaluation of Drinking Water Quality in Urban Areas of Pakistan: A Case Study of Southern Lahore". Pakistan Journal of Engineering & Applied Sciences, 5, 16-23.
16. Chadetrik Rout , Arabinda Sharma (2011), "Assessment of drinking water quality: A case study of Ambala cantonment area, Haryana, India". International Journal of Environmental Sciences, Volume 2, No 2, 2011.ISSN 0976 – 4402.
17. Dr. K. Chandrasekhar Reddy (2017), "Assessment of Ground Water Quality and Its Suitability for Drinking Purposes in the Koduru Mandal." International Journal of Advance Engineering and Research Development, Volume 4, Issue 10, ISSN (P): 2348-6406.
18. Mohamad Sapari Dwi Hadian, Fikri Noor Azy , Irda Krismadiyanti, Dwi Lucia Arfani, Emma Trinurani Sofyan and Tantowi Eko Prayogi (2015), "Groundwater Quality Assessment For Suitable Drinking And Agricultural Irrigation Using Physico-Chemical Water Analysis In The Rancaekek-Jatinangor District, West Java, Indonesia." 6th International Conference on Environmental Science and Technology Volume 84 of IPCBEE (2015).
19. Abdulrasoul Al-Omran, Fahad Al-Barakah, Abdullah Altuquq, Anwar Aly and Mahmoud Nadeem (2015), "Drinking water quality assessment and water quality index of Riyadh, Saudi Arabia." Water Quality Resarch Journal of Canada 50.3.
20. Saroj Gyawali, Kuaanan Techato and Chumpol Yuangyai (2012), "Effects of Industrial Waste Disposal on the Surface Water Quality of U-tapao River, Thailand." International Conference on Environment Science and Engineering, IPCBEE vol.3 2(2012).
21. M. Anwar Hossain, M. Khabir Uddin, A. H. Molla, M. S. I. Afrad, M. M. Rahman and G. K. M. M. Rahman (2010), "Impact of Industrial Effluents Discharges on Degradation of Natural Resources and Threat to Food Security." The Agriculturists 8(2): 80-87 (2010), ISSN 1729-5211.
22. Pratiksha Tambekar, Pravin Morey, R. J. Batra and R. G. Weginwar (2012) "Quality assessment of drinking water: A case study of Chandrapur District (M.S.)" Journal of Chemical and Pharmaceutical Research, 2012, 4(5):2564-2570.