EQA - International Journal of Environmental Quality
ISSN 2281-4485 - Vol. 62 (2024): 55-68
Journal homepage: https://eqa.unibo.it/

published by

Appraisal of piped water quality supplied to Liaquatabad Town, Karachi by using Water Quality Index and Geospatial Assessment

Aamir Alamgir*, Noor Fatima, Shah Noor Khan, Aliza Naseer, Aliza Khan, Muhammad Noman Siddiqui, Fahim Jafri

Institute of Environmental Studies, University of Karachi, Karachi, Pakistan

* Corresponding author E-mail: aamirkhan.ku@gmail.com

Article info

Received 22/4/2024; received in revised form 14/5/2024; accepted 9/6/2024

DOI: 10.6092/issn.2281-4485/19413

Abstract

In 2022, 23 piped water samples from Liaquatabad town were examined study for pH, TDS, turbidity, chloride, hardness, nitrate, and sulphate. Majority of these indicators, with the exception of TDS, hardness, and sulphate, complied with the standards given by WHO and NSDWQ. Ca > Mg > Pb > Fe > Ni > Cr > As were metals that were found in that order. *E. coli* was found in about 74% of the samples while MPN Technique's microbial assessment, which found that more than 70% of the samples were contaminated with faecal matter. Despite having adequate physico-chemical properties in 95.6% samples, the Water Quality Index (WQI) showed that they were unsafe for drinking due to metal contamination. The samples' microbiological quality was good in just 26% of them. Untreated sewage discharge, cross-contamination and presence of faeces were all blamed for the pollution in the samples and responsible for serious health dangers.

Keywords

piped water, WQI, metals, contamination, Karachi.

Introduction

Clean drinking water is an essential requirement that is vital to the well-being and survival of human beings (Li et al., 2022). Quality of drinking water is influenced by the type of water sources, the state of the water supply, the level and effectiveness of the treatment process. Pakistan's drinking water supplies are becoming increasingly contaminated, which has negative consequences on both the human health and environment. One of the main threats to public health in a country is water pollution. Monitoring and management of water quality are ineffective. In drinking water sources around the country, including surface and groundwater, pesticides and toxic metals have been detected (Azizullah et al., 2011). A number of WHO drinking water quality standards are also often broken. Only 1% of the industrial wastewater in Pakistan is thought to be treated before discharge (MOE-PAK, 2005a). Consequently, wastewaters with potentially hazardous substances are disposed of without considering the risks they pose to the environment. Different companies in Pakistan discharge a daily average of 40 $x10^9$ litres of wastewater into water reservoir (Saleemi, 1993). These pollutants do not just stay in water on the surface; they also contaminate groundwater aquifers through soil percolation. In Pakistan, more than 44% of the residents are unable to acquire to safe drinking water, with 90% of rural inhabitants without such access and depending on contaminated water, which is to responsible for 60% of the country's fatalities (UNSP, 2003). Due to the presence of pathogens,

DOI: 10.6092/issn.2281-4485/19413

about 88% of the current water supply systems are unsafe for consumption of human (PCRWR, 2012). In Pakistan, poor quality of water is to account for 40% of all fatalities and 30% of all diseases. The most frequent reason for death is diarrhoea, particularly in children and every fifth individual suffers a water-borne disease as a result of polluted water (Kahlown et al., 2006). The largest city in Pakistan is Karachi, situated along the coastline of the Arabian Sea. Its average population is over 16 million and changes by around 2% annually. Within the next 15 years, the population of Karachi is projected to experience a significant increase, reaching an estimated 23 million people (Fazal and Hotez, 2020). The Hub Dam (30-50 MGD) and River Indus (645 MGD) provide water to Karachi. Hub Dam's water supply is irregular because it depends on rain. KWSB (Karachi water & Sewerage Board) claimed that a total of 650 MGD of water is available for supply to Karachi, although this amount rarely suffices. Moreover, KWSB stated that the city's water needs would be roughly 1080 MGD, leaving a shortage of 430 MGD if the per-person water consumption was 54 GPCD. KWSB asserted that the city's water demand was 1242 MGD in 2015, resulting in a 600 MGD shortage. Hence, 100 MGD of extra water could be needed every five years under the current circumstances.

Materials and Methods

Study Area

Liaquatabad town in Karachi is positioned within the Central district, with coordinates ranging from approximately 24.8880° to 24.9223° N latitude and 67.0177° to 67.0644° E longitude. With a dense population of 985,581, it is primarily a residential region distributed over an area of 11.28 sq. Km (KSDP, 2007). There are middle class and lower middle class residents in the study area. Orangi nala bordered Liaquatabad town in the west and Lyari river in the south. Correspondingly, In the middle of Liaquatabad town, the Gujjar Nala flows. These receives untreated domestic and industrial effluents

Sampling

In all 23 piped water samples were collected from Liaquatabad Town, Karachi. Fig. 1 and Table 2 indicate the locations for sample collection. Separate samples were collected for bacteriological and chemical analyses. Bacteriological analysis samples were collected in pre-sterilized glass bottles, while samples for chemical analysis were collected in clean plastic containers. To maintain their integrity, the samples were stored in an ice box at low temperatures during transportation to the laboratory.

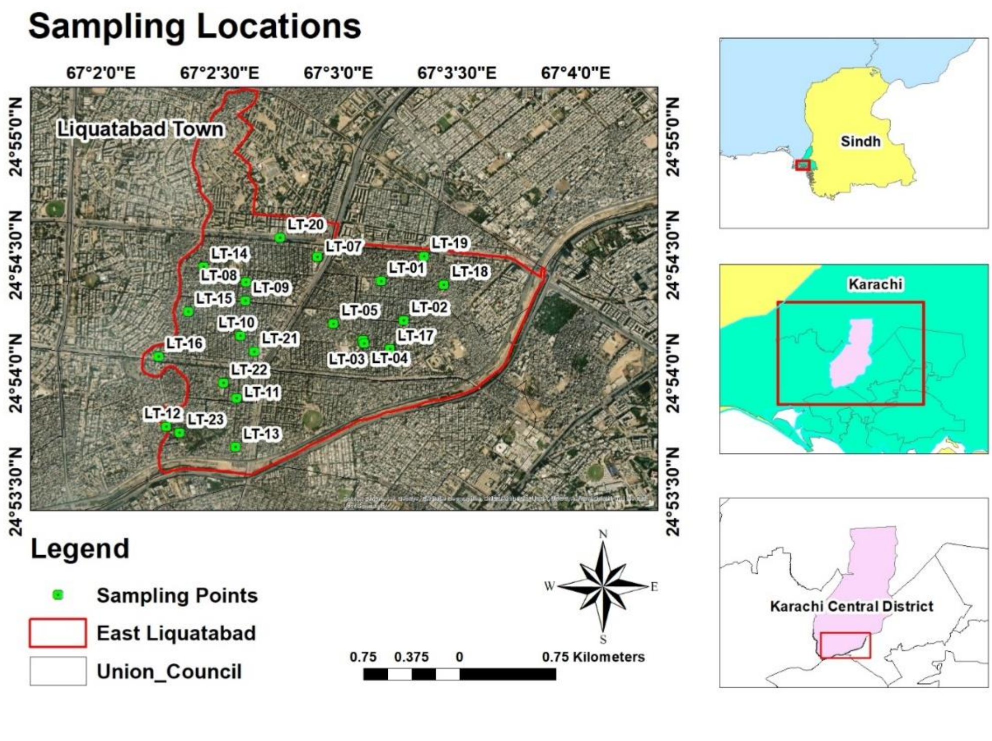

Figure 1.
Sites for sample collection

DOI: 10.6092/issn.2281-4485/19413

Physico-chemical Analysis

Sample pH and Turbidity were examined onsite using HANNA potable pH meter (Model # HI98107) and Turbidity meter (TN-100; EUTECH). Gravimetric analysis was used to determine TDS (Total Dissolved Solids) and sulphate levels of the samples. Chloride was estimated using an argentometric method, and hardness (as $CaCO_3$) was estimated using an EDTA titration method. Nitrate was assessed by bruccine-reagent method. The procedures outlined in APHA (2005) were used to examine the aforementioned parameters.

Metal Analysis

As, Pb, Ca, Cr, Fe, Mg and Ni were the heavy metals that were examined using apposite Kits from Merck NOVA 60, Germany.

Bacteriological Analysis

The water samples were analyzed for Total aerobic count (TAC), Total coliforms count (TCC), Total fecal coliforms (TFC) and Total fecal streptococci (TFS) to ascertained the public health quality of water samples. The samples were processed in laminar flow hood using sterilized bacterial culture media. TAC was determined using single and double strength tubes of nutrient broth (Merck, Germany). TCC was examined using lactose broth (Merck, Germany) of single and double strength. Coliform positive tubes were subsequently used for the estimation of FC using EC broth (Merck, Germany). TFS were ascertained using Sodium azide broth. The above-mentioned parameters were estimated by Most Probable Number (MPN) technique (APHA 2005). The MPN index/100 ml was determined from standard MPN table (Eaton et al.1995). *E. Coli* was examined using Florocult Media (Merck).

Statistical Analysis

A statistical programme (STATISTICA version 10, Tulsa, Oklahoma) was used for data analysis collected by physico-chemical and metal analysis in order to determine descriptive statistics for each variable. The software stated above was used to carry out principal component analysis (PCA) and cluster analysis. Cluster analysis made use of Ward's approach,

Water Quality Index Model

In this work, the water quality metrics and their pertinent WHO standards were used to compute the WQI model. The literature (Sener et al., 2017; Shabbir and Ahmad, 2015; Ketata et al., 2012; Sahu and Sikdar, 2008) indicates that physico-chemical, metal and microbiological characteristics were given a weight (w_i) from 1 to 5 based on their significance in the evaluation of water quality for human health. As, Pb, Cr, Ni, and microbial characteristics received the maximum weight of 5 in this study due to their greater influence on human health (Table 1). There were 3 steps in the WQI calculation. Equation 1 was used to calculate the relative weight (W_i) in the first stage (Ketata et al., 2012).

$$W_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \quad [1]$$

where W_i, w_i and n were the relative weight, each parameter's assigned weight, and a total number of observed parameters respectively, while the water quality rating scale (Q_i) for each of the observed water quality parameters was calculated using Equation [2]

$$Q_i = \frac{V_o}{V_s} \mathrm{X}\ 100 \quad [2]$$

where V_o and V_s represent the observed and WHO threshold levels, respectively, for each parameter. Equation [3] was ultimately used to determine the WQI.

$$WQI = \sum_{i=1}^{n} W_i \mathrm{X}\ Q_i \quad [3]$$

According to the WQI, water is often divided into 5 groups, as illustrated in Table 2 (Shabbir & Ahmad, 2015; Ketata et al., 2012; Sahu & Sikdar, 2008). Unfit for drinking (WQI > 300), very poor (WQI 200–300), poor (WQI 100–200), good (WQI 50–100) and Excellent (WQI 50) are the different water quality classifications.

Results and Discussion

Results of physic-chemical, microbiological and metal analyses of piped water samples taken from Liaquatabad Town, Karachi are shown in Table 1.

Water Quality Profile

In this study, mean pH value of all the samples was observed to be 7.35 with a range of 7.19 (LT-8) and 7.54 (LT-4) respectively. This indicates that the samples are neutral to faintly basic yet within the WHO limits (2011).

DOI: 10.6092/issn.2281-4485/19413

Turbidity values ranged from 0.52-122 NTU with a 7.5 NTU mean value. Only two samples collected from LT-2 (122 NTU) and LT-11 (10.61) exceeded WHO limit. Shittu et al. (2008) claim that turbid water frequently promotes the multiplication of numerous bacteria that cause disease as well as other parasites. In addition, TDS value ranged between 694.35 (LT-7) to 1124.51 (LT-4) with a mean value of 868.537 mg/l (Table 1). Based on WHO guidelines TDS should be less than 1000 mg/l. Every sample was within the allowed range set by WHO (2011) except two samples collected from LT-2 and LT-4 having TDS 1041.28 mg/l and 1124.51 mg/l respectively. During this study, mean Chloride and Hardness levels were found to be 120.8 mg/l and 318.347 mg/l. Chloride and Hardness were found to be at their highest and lowest points at LT-4 and LT-12 respectively.

In terms of chloride, all samples were within the safe WHO standard, however for water hardness, just one sample (LT-4) exceeds the limit. Sulphate contents fluctuated from 242 to 354 mg/L while nitrate contents fluctuated from 0.56 to 1.22 mg/L with mean contents of 294.91 mg/L and 0.89 mg/L respectively.

Heavy metals

During this study, the overall mean metal content in all the water samples was in the order of Ca>Mg> Pb > Fe>Ni > Cr >As (Table 1). From Table 1, it was noticed that all the water samples were not met the WHO standards in terms of Pb, Ni and Fe while Ca and Mg were found in amounts that were within the guidelines. In addition, 78.27 % of the water samples had high As content, while only 2 water samples cros-

Table 1. *Descriptive statistics of tap water collected from Liaquatabad Town, Karachi*

Nature	Parameters	Unit	Min	Max	Mean	Median	Std. Dev.	Skewness	Parameters for WQI calculation		
									WHO Guidelines 2011	Weight (w_i)	Relative weight (W_i)
Physico-chemical	pH	-	7.19	7.54	7.35	7.35	0.11	0.32	6.5-8.5	3	0.107143
	Turbidity	NTU	0.52	122	7.50	1.97	25.03	4.75	<5	3	0.107143
	TDS	mg/L	694.35	1124.51	868.54	855.26	100.8	0.74	<1000	3	0.107143
	Chloride		103	142	120.87	121	11.84	0.09	<250	3	0.107143
	Hardness		220	508	318.35	300	72.55	1.03	<500	2	0.09524
	Sulphate		242	354	294.91	287	33.22	0.32	250	3	0.107143
	Nitrate		0.56	1.22	0.89	0.88	0.16	0.19	12	4	0.19048
										$\sum w_i = 21$	$\sum W_i = 1$
Metals	As	mg/L	BDL	0.092	0.04	0.04	0.03	0.20	0.01	5	0.20833
	Pb		0.635	1.852	1.11	1.09	0.28	0.86	<0.01	5	0.20833
	Cr		0.036	0.227	0.12	0.10	0.06	0.27	0.2	4	0.1667
	Ni		0.5411	1.174	0.93	0.99	0.20	-0.66	0.03	4	0.1667
	Fe		0.530	1.580	1.05	1.04	0.30	0.12	0.3	2	0.0833
	Ca		40.28	69.74	50.56	50.69	9.29	0.76	150	2	0.0833
	Mg		28.99	81.07	46.65	42.43	12.20	1.16	100	2	0.0833
										$\sum w_i = 24$	$\sum W_i = 1$
Microbiological	TAC	MPN/100ml	<3	≥2400	1605.47	2401	1067.14	-0.740	2	5	0.25
	TCC		<3	≥2400	1284.87	1100	1065.68	-0.047	2	5	0.25
	TFC		<3	≥2400	759.22	210	952.793	1.034	2	5	0.25
	TFS		<3	93	20.74	7.0	28.685	1.648	2	5	0.25
										$\sum w_i = 20$	$\sum W_i = 1$

DOI: 10.6092/issn.2281-4485/19413

sed the safe limit of Cr set by WHO. Since these metals are known to affect the body after ingestion by food, drink, or skin contact, higher quantities are likely to result in health issues.

Microbiological examination

Table 1 represents the descriptive statistics of microbiological analysis. In this study, almost 74 % percent of samples have ≥2400-1100 (MPN/100ml), 26 % have <10 (MPN/100ml) of Total Aerobic Count and Total Coliform count is detected in 60.8% samples of ≥2400-1100 (MPN/100ml), 8.9% have <1100-460 (MPN/100 ml), 4.39% have <460-210 and 26% have <10 (MPN/100ml). Similarly, 34.7% of samples have ≥2400-1100(MPN/100ml), 13.5% have <1100-460, 13% have <460-210, 8.69% have <150-10 (MPN/100ml), and 30.4% have 10 (MPN/100ml) contamination with Total faecal coliforms, but Total Faecal Streptococci have 43.4 percent <150-10 (MPN/100ml), and 56.5% have 10 (MPN/100ml). *E. Coli* is found in about 74% of the piped water samples from Liaquatabad town.

Water Quality Index

In this study, 23 piped water samples were used to calculate WQI in 3 groups, including physico-chemical, metals and microbiological parameters. Table 1 provides an illustration of the weight of the parameter used in the WQI calculation. Table 2 shows that, with the exception of LT-02, all water samples have adequate physico-chemical characteristics. In contrast, all piped water samples were found to b metal-contaminated and unfit for human consumption. WQI in context of microbiological analysis of piped water is shown in Table 2. It was observed during the determination that 74% of the samples were not fit for drinking. The samples collected from LT-2, LT-7, LT-10, LT-20, LT-22 and LT-23 are of good quality (WQI = 100). Alamgir et al., (2021) stated that the WQI of the Tanker water available in Karachi city was not satisfactory, particularly due to anthropogenic sources of pollution. In context of WQI, metals and a high bacterial load present a potential for adverse health effects (Alamgir et al., 2021, Fatima et al., 2022).

Statistical Analysis

PCA. Using normalized data, PCA was used to investigate the effect of physico-chemical, metal and microbiological parameters on the piped water quality in Liaquatabad Town. The first three fundamental components are shown in Table 3 together with their eigenvalues, variances, and cumulative percentages. Figure 2 also provides a three-dimensional (3D) ordination for PCA analysis of physico-chemical, metals and microbiological characteristics in the piped water samples.

According to Table 3, the first, second, and third main components together accounted for 68.13458% of the total variance and explained 28.70831, 26.80869, and 12.61759% of it. Ca, Pb, hardness and Fe all play major roles in the first component while the second component is primarily governed by pH, TFC, TFS and TCC. The third component is mostly influenced by NO_3, Turbidity, Fe and Pb, Table 3 and Figure 2 show the three-dimensional PCA design. Basically, the 3-dimensional ordination separates out the sites having common characteristics.

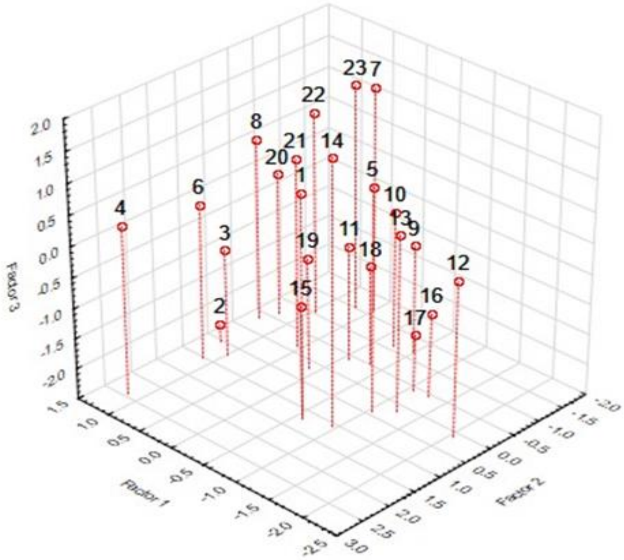

Figure 2. *Principal component analysis ordination (3D) of physico-chemical, metal and microbiological analysis of piped water samples collected from Liaquatabad Town, Karachi*

Cluster analysis. Cluster analysis and the Ward's technique-created dendrogram revealed that the sampling locations could be split into two major groups (Fig. 3) using physicochemical, metal, and microbiological data. Ten samples from Group 1 demonstrate that all sampling sites have similar features. Group 1 members are characterized by medium to high pH, high turbidity and SO_4, medium

DOI: 10.6092/issn.2281-4485/19413

Table 2. *Water Quality Index Scores*

Sampling Details			Physico-chemical		Metals		Microbial	
Sample Code	Latitude	Longitude	WQI	Remarks	WQI	Remarks	WQI	Remarks
LT-1	24.906472N	67.052975E	60.904	Good	3087.797	UFDP	91163	UFDP
LT-2	24.903705N	67.054549E	405.670	UFDP	3157.396	UFDP	100	Good
LT-3	24.902309N	67.051689E	67.255	Good	2820.131	UFDP	35863	UFDP
LT-4	24.902075N	67.051761E	65.765	Good	2322.482	UFDP	90800	UFDP
LT-5	24.90348N	67.049624E	57.349	Good	2832.903	UFDP	90488	UFDP
LT-6	24.908952N	67.049504E	61.633	Good	2711.117	UFDP	73888	UFDP
LT-7	24.908199N	67.048507E	53.132	Good	2506.973	UFDP	100	Good
LT-8	24.906426N	67.043474E	59.534	Good	2513.05	UFDP	17200	UFDP
LT-9	24.905078N	67.043418E	56.4	Good	3121.188	UFDP	30263	UFDP
LT-10	24.902618N	67.043097E	57.835	Good	2735.131	UFDP	100	Good
LT-11	24.898217N	67.04282E	85.856	Good	2868.025	UFDP	20325	UFDP
LT-12	24.896214N	67.037896E	61.125	Good	3994.149	UFDP	90488	UFDP
LT-13	24.891598N,	67.040121E	55.874	Good	3525.68	UFDP	73888	UFDP
LT-14	24.907502N	67.040512E	59.499	Good	3074.143	UFDP	91163	UFDP
LT-15	24.904315N	67.039434E	65.01	Good	4513.528	UFDP	74238	UFDP
LT-16	24.901143N	67.037337E	62.736	Good	3857.709	UFDP	46463	UFDP
LT-17	24.901684N	67.053582E	62.534	Good	3277.502	UFDP	49550	UFDP
LT-18	24.90623N	67.05738E	61.977	Good	3450.395	UFDP	46400	UFDP
LT-19	24.908215N	67.055985E	59.054	Good	3107.359	UFDP	66238	UFDP
LT-20	24.909536N	67.045879E	65.253	Good	2217.925	UFDP	100	Good
LT-21	24.901527N	67.044039E	61.332	Good	2269.361	UFDP	65838	UFDP
LT-22	24.899307N	67.0419E	65.012	Good	1775.312	UFDP	100	Good
LT-23	24.895785N	67.038826E	61.180	Good	2361.252	UFDP	100	Good
	Min		53.13245	-	1775.312	-	100	-
	Max		405.6705	-	4513.528	-	91163	-
	Mean		77.04025	-	2961.5439	-	45863.3	-

UFDP: Unfit for drinking purpose

DOI: 10.6092/issn.2281-4485/19413

TDS, Ca and Mg but low in As, Cr and NO_3. In contrast, Group 2 consists of 13 samples and further divided into two multiple sub-groups (2a and 2b). Group 2a consists of 4 samples while Group 2b consist of 9 samples. Group 2a sites are characterized by low pH, As and Cr, medium to high TDS, Chlorides, hardness and Pb with elevated levels of Turbidity, Ni, Ca and Mg. Group 2b sites possess high pH, turbidity, TDS, SO_4, Pb and Cr but low As, Mg and Ca and low to medium NO_3 and Ni.

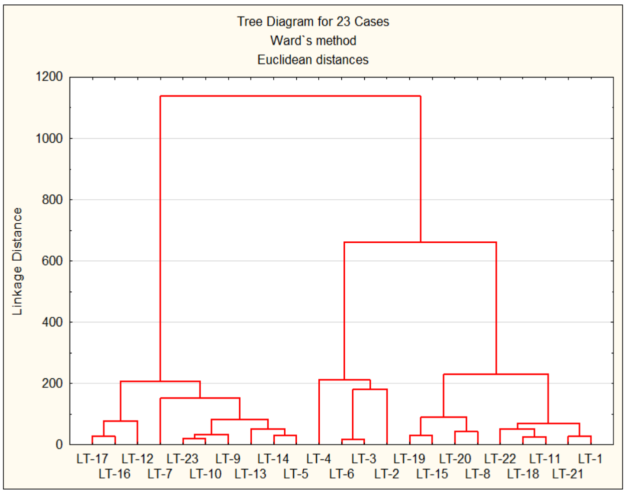

Figure 3. *Dendrogram derived from Ward's method between 23 sites based on physico-chemical, metal and microbiological analysis of piped water samples collected from Liaquatabad Town, Karachi*

Geospatial distribution by Inverse Distance Weight (IDW) unterpolation

Geospatial distribution of physico-chemical, metals and microbiological characteristics of piped water is illustrated in the Fig. 4, 5 and 6, respectively.

The spatial distribution of physico-chemical parameters (Figure 4) indicated that most of the town has a neutral to alkaline pH value except for the northern part, which had partially lower pH values, however turbidity is slightly high in the piped water samples from the eastern to southern eastern part. The northern and eastern part showed elevated pattern of spatial distribution in terms of TDS, while the southern part showed a lower TDS. High chloride values were observed from the north-west to the north east, while hardness levels were increasing from the east to the south part of the town. Sulphate levels were increasing from the south-western part to the western part of the town, while a lower nitrate pattern was observed from the eastern to the southern-east part.

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The majority of the sampling locations are signify-cantly metal-polluted, which poses a serious threat to human health; nevertheless, As, Pb, Ni, and Cr pose the greatest risk to humans. From Figure 5, As concentrations in piped water were higher in the western part while lower at north eastern part of the town. Minimum Ca and Mg values were observed at the southwestern part, while higher Cr values were increasing from the northwestern side to the northern part. Higher Fe levels were distributed from the north-eastern part to the eastern and southern parts. In piped water samples, Ni concentrations were higher from the western side to the eastern part. Some samples collected from the northern and northwestern parts possess the highest Ni concentration. Higher and lower Pb values were observed in the western and northern parts of the town. The spatial distribution of the microbiological parameters in the piped water samples shows that TAC, TCC, TFC and TFS are present in higher concentrations at the eastern, western, north eastern and north eastern parts of the town (Fig 6).

Fig. 7 illustrates the spatial distribution of WQI based on physico-chemical, metals, and microbiological characteristics. physico-chemical characteristics of all water samples are good throughout the town except a sample collected from southern part which possess poor water quality. Due to leakage and cross-contamination from untreated domestic and industrial wastewater, it has been noted that the WQI values of all piped water samples were unfit for human use throughout the town in terms of metal and microbiological characteristics (Fig 7) and have been confirmed to be metal and microbial contamination.

Public health issues and contamination sources

While evaluating public health issues, the health im-pacts of each parameter should be compared to the WHO recommendations (WHO, 2011, 1997). Several studies to determine the city's water quality have been conducted, and they have shown that the water is gravely chemically and biologically contaminated (Alamgir et al., 2021, 2020, 2015a, 2015b; Arain et al., 2009; Hasnie and Qureshi, 2004). Potential sources of pollution include theft, seepage and leakage from rusty and obsolete pipelines, domestic and industrial effluents from non-point sources, inappropriate water distribution, and technical issues (Alamgir et al., 2021, 2020, 2015a, 2015b; Azizullah et al., 2011; Amin et al., 2019).

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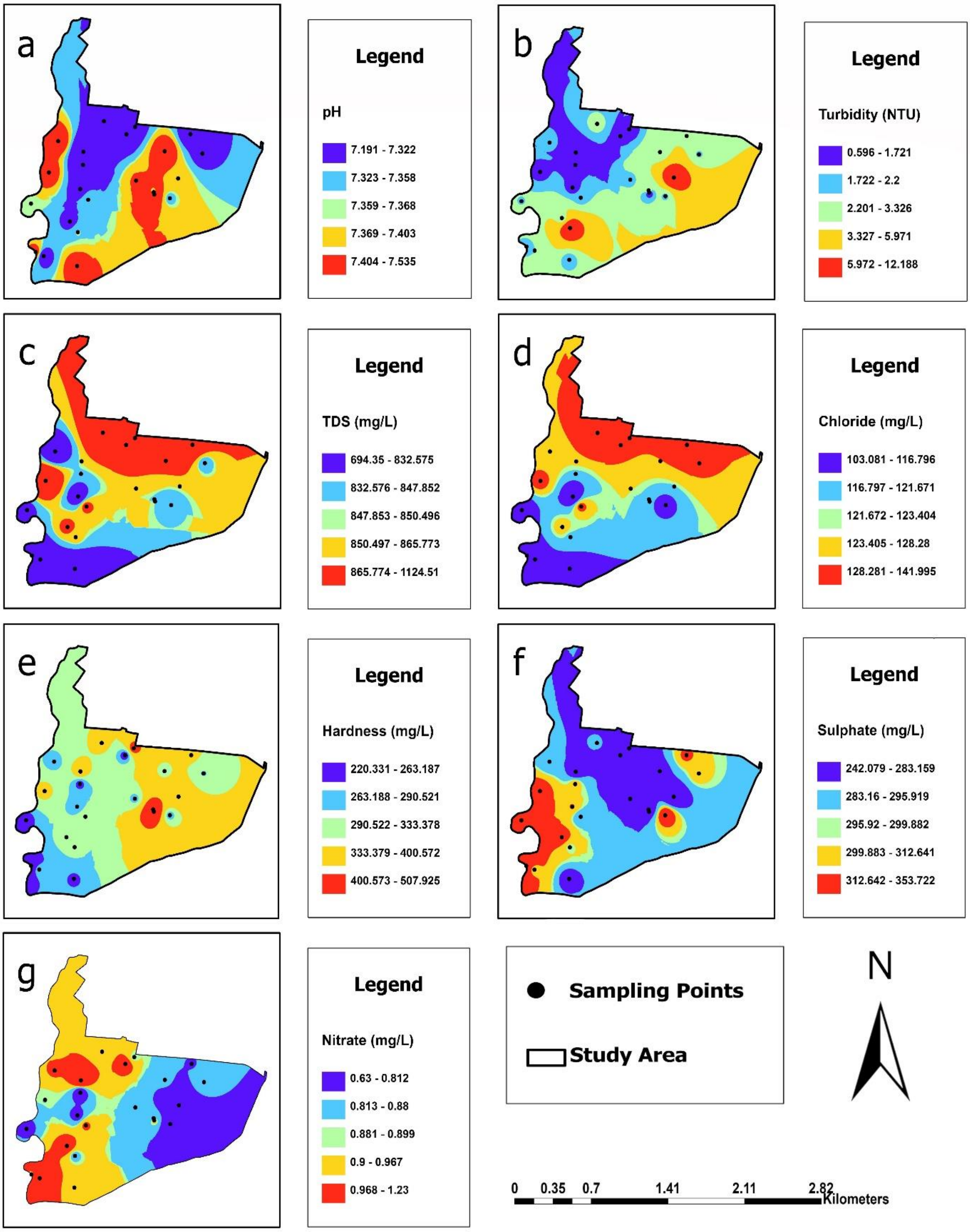

Figure 4. *Liquatabad Town piped water Quality illustrating spatial distribution of physico-chemical parameters (a) pH; (b) Turbidity; (c) Total Dissolved Solids (TDS); (d) Chlorides; (e) Hardness; (f) Sulphate; and (g) Nitrate.*

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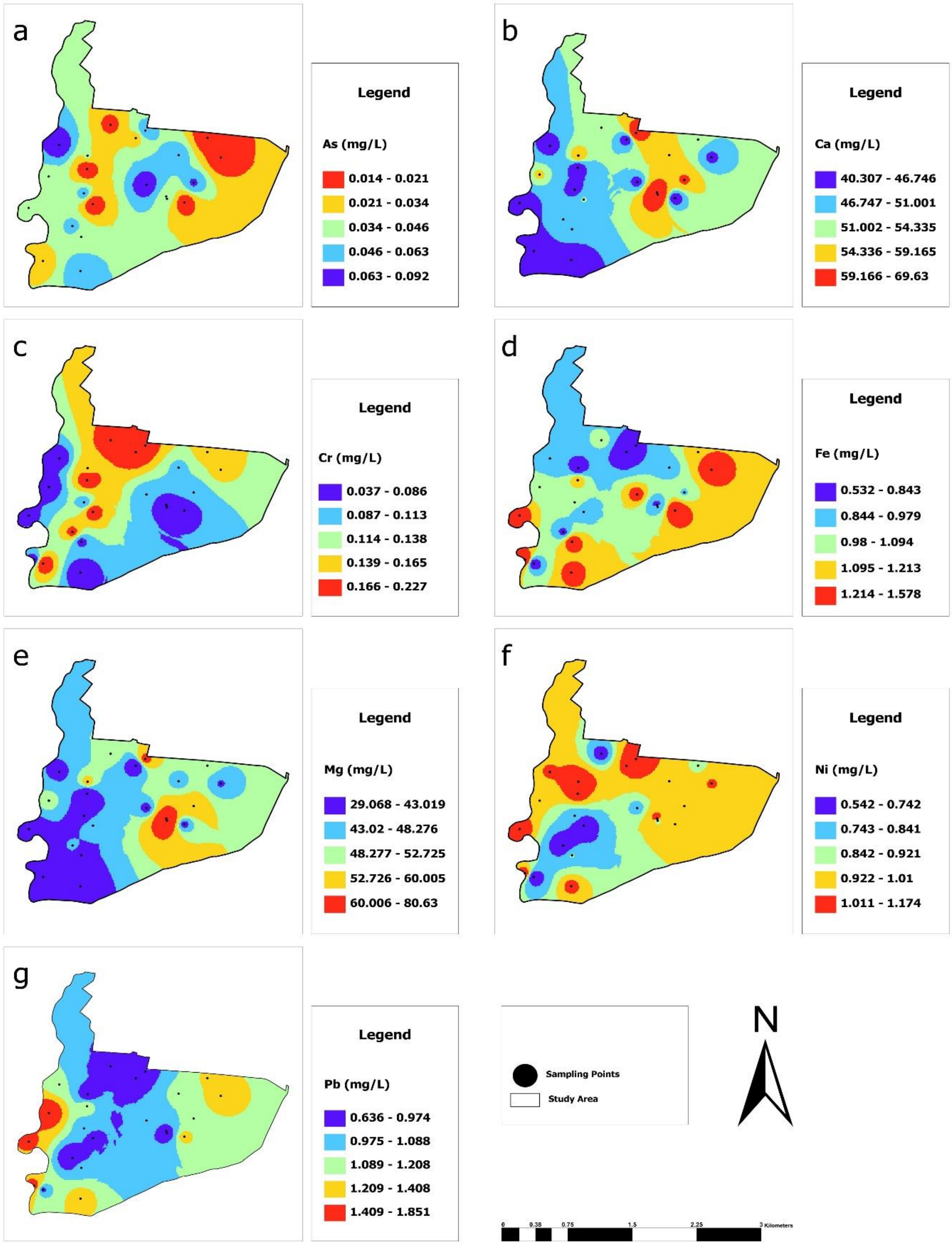

Figure 5. *Liquatabad Town piped water quality illustrating spatial distribution of metals (a) Arsenic (As); (b) Calcium (Ca); (c) Chromium (Cr); (d) Iron (Fe); (e) Magnesium (Mg); (f) Nickel (Ni); and (g) Lead (Pb).*

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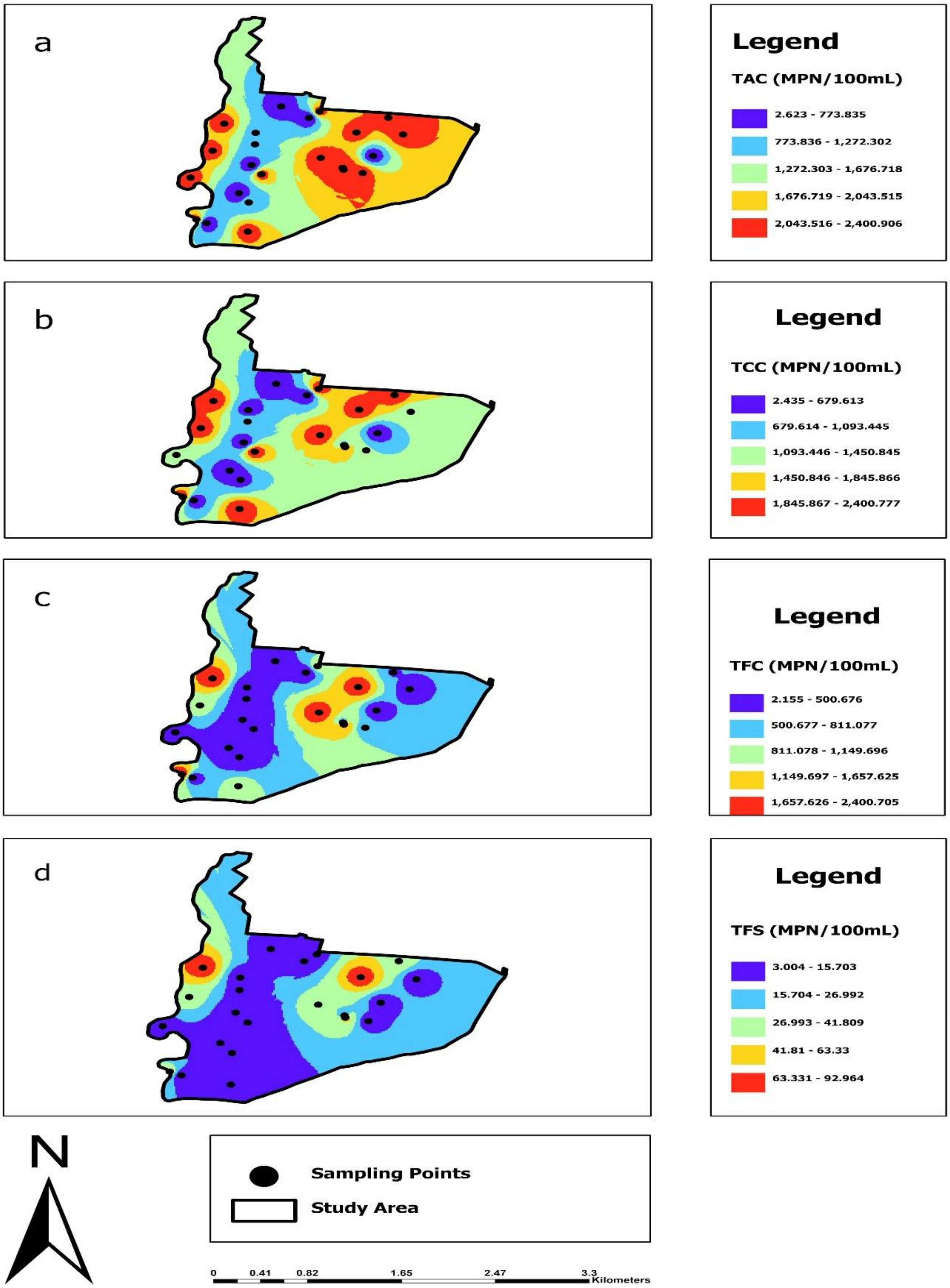

Figure 6. ***Liquatabad Town piped water quality illustrating spatial distribution of microbial parameters (a) Total Aerobic Count (TAC); (b) Total Coliform Count (TCC); (c) Total Faecal Coliform (TFC); and (d) Total Faecal Streptococci (TFS)***

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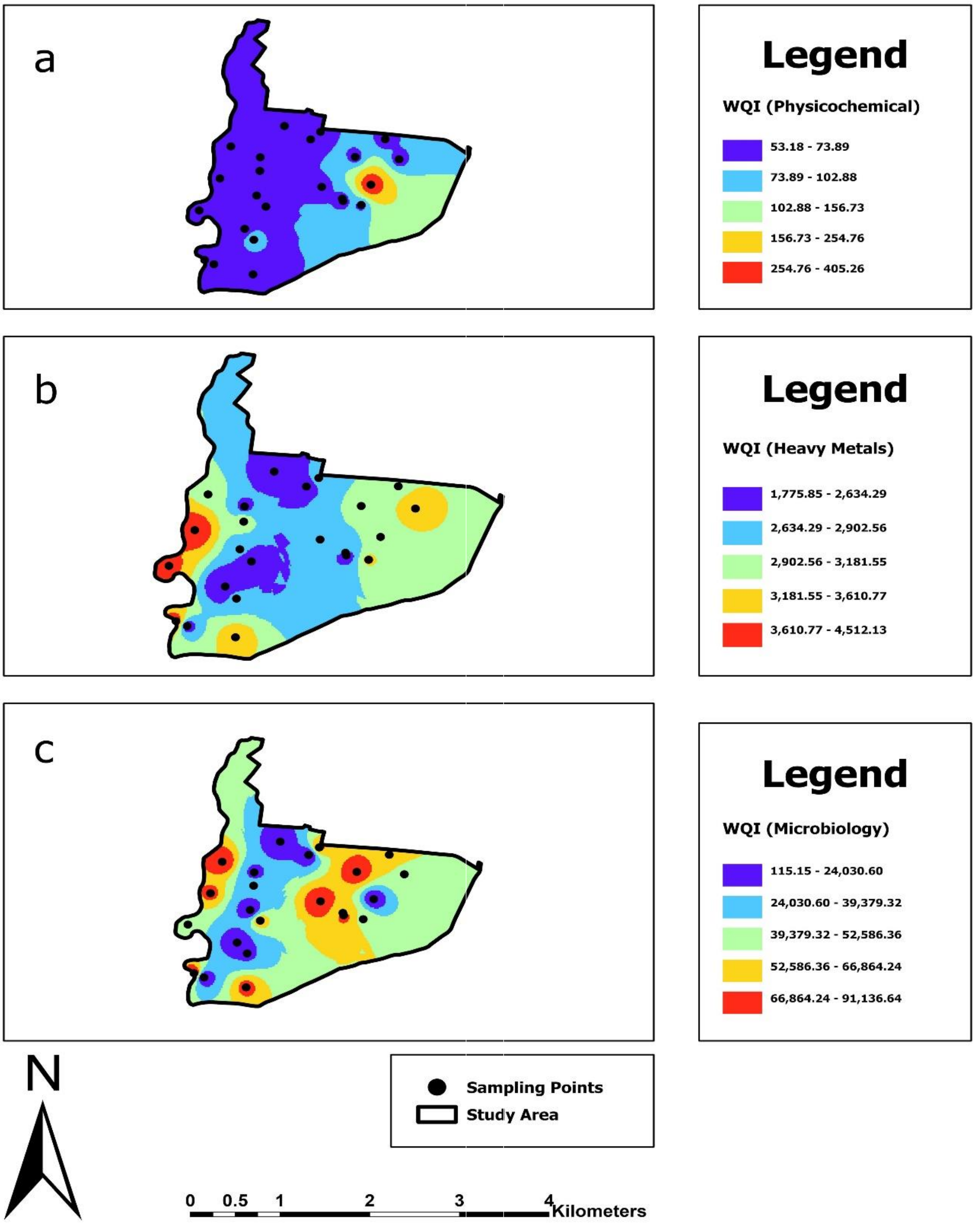

Figure 7. *Spatial distribution of Water Quality Index (WQI) based on (a) Physico-Chemical Parameters; (b) Metals; and (c) Microbial Parameters*

All of the samples used in this investigation had pH values that are neutral to slightly alkaline. High amounts of carbonate and bicarbonate lead to a pH value > 8.5. Ca and Mg ions combining together to produce insoluble minerals as the concentration of carbonates increases leaves Na ions in solution (Batool et al., 2023). Only 2 samples were excessively turbid, while the rest were only slightly turbid, providing ideal conditions for the growth of numerous pathogens and parasites. Some samples

DOI: 10.6092/issn.2281-4485/19413

have higher levels of TDS, Chlorides and Hardness which are harmful to public health and could cause bad taste, kidney stones and cardiovascular illnesses. In this study, all piped water samples had safe SO_4 and NO_3 contents as described by the WHO (2011). High SO_4 and NO_3 levels are responsible for dehydration, gastrointestinal irritability, and catharsis, all of which are caused by high sulphate levels. Similarly, bladder and ovarian cancer as well as chromosomal damage are caused by nitrates in water (Azizullah et al., 2011). Thus, consuming water that has been polluted with metals may be detrimental to public health and have adverse impacts on their cardiovascular, neurotoxic, and carcinogenic systems (Alamgir et al., 2019). The effects of high metal consumption on human health have been extensively studied and have been proved to be detrimental. Even at low levels, prolonged use of arsenic-contaminated water can result in diabetes, heart, lung, and cancer ailments (Järup, 2003). It has been shown by Hozhabri et al. (2004) and Sherlock et al. (1986) that consuming lead-contaminated water is strongly linked to higher Pb levels in the blood. Long-term exposure to lead from drinking water can result in tiredness, headaches, insomnia gastrointestinal problems, joint pain, memory loss, and nervous system dysfunction. In neonates, young toddlers, and foetuses, its high toxicity can result in miscarriage, low birth weight and overdue development (Raja et al., 2021; Collin et al., 2022). The bioavailable form of Cr, known as Cr (VI), has been found to be extremely carcinogenic when consumed. Furthermore, Cr (VI) has been connected to toxicity to both male and female reproductive systems (Tiwari et al., 2012; Marouani et al., 2015). Similarly, Nickel has adverse effects on the respiratory and reproductive systems, as well as being neurotoxic, hepatotoxic, hematotoxic, and immunotoxic (Das et al., 2008). Fe, Ca, and Mg are trace and essential metals. Long-term exposure to high Fe levels in water may result in neurological problems (Iyare, 2019). Increased Ca and Mg concentrations are detrimental for bathing, washing, and laundering. Although there are 17 samples that are unfit for human consumption, only 6 samples can cause any serious health effects. Public water supplies that are poorly managed are capable of making a majority of people sick (Dawson and Sartory, 2000). Existence of *Escherichia coli* presenting fecal contamination (Ram et al., 2009). Water delivered by pipes to District Korangi were extremely polluted with *Escherichia coli* (Alamgir et al., 2015c). *E. coli* and Fecal coliform were indicators of the occurrence of both animal and human waste in water bodies. Cramping, diarrhea, nausea, migraines, and other symptoms are just a few of the ailments that these wastes can cause. For newborns, young children, and those with extremely weakened immune systems, these bacteria may offer substantial health risks (Hasnie and Qureshi, 2004). Feces always include *E. coli*, the most of which are not pathogenic but some of which might cause diarrhea. The primary sources of fecal coliforms are untreated water supplies (Hasnie and Qureshi, 2004).

Conclusions

This study indicate that water supply and sewage infrastructure in the Liaquatabad town are inadequate, faulty and obsolete. The majority of individuals drink piped water since they can't afford to buy bottled water. In addition, the current unhealthy and unsanitary instances in the town require rapid improvement. Due to flaws in the sewerage system, contaminated water is produced when household wastewater crisscrosses into pipe water supply. The findings shows that although water is suitable for human consumption in terms of its physico-chemical features, with the exception of sulphate. The piped water are grossly polluted with heavy metals and high bacterial count. Most of the samples were severely polluted by faeces.

Authors Contribution. Dr. Aamir Alamgir and Dr. Noor Fatima have made a substantial contribution to the acquisition, analysis and interpretation of data for this study. Shah Noor Khan, Aliza Naseer, Muhammad Noman Siddiqui and Fahim Jafri have involved in sampling, analysis and revision of the article. Aliza Khan performed GIS analysis for the study.

Funding. No Funding received

Data availability Statement. The datasets analyzed during the current study are not publicly available. However, these are available from the corresponding author on reasonable request.

Declaration. All authors have read, understood, and have complied as applicable with the statement on "Ethical responsibilities of Authors" as found in the Instructions for Authors and are aware that with minor exceptions, no changes can be made to authorship once the paper is submitted.

DOI: 10.6092/issn.2281-4485/19413

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Conflicts of Interest/Competing Interests. The authors declare that they have not any financial and non-financial competing interests.

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