
Evaluation of Groundwater Quality for Drinking Purposes Using Water Quality Index in the Suburban Region of Kuala Selangor, Malaysia

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Abstract

Groundwater remains one of the principal sources of drinking and domestic water in many developing urban and suburban communities. However, inadequate public water supply systems have compelled residents to rely heavily on privately constructed boreholes, often without strict compliance with internationally accepted water quality standards and environmental safety guidelines. The consumption of untreated groundwater from poorly regulated sources may expose communities to serious public health risks associated with physical, chemical, and microbial contamination. This study was therefore conducted to evaluate the suitability of groundwater for drinking purposes in the suburban region of Kuala Selangor, Malaysia, using the Water Quality Index (WQI) approach. Water samples were collected from six existing boreholes within the study area in July 2023 and analysed for twenty physicochemical parameters following the standard procedures recommended by the American Public Health Association for water and wastewater examination. Selected water quality parameters were further utilized in computing the Water Quality Index through the weighted arithmetic method. The results revealed that the WQI values ranged from good to poor water quality categories across the sampled locations, with most boreholes exhibiting acceptable groundwater conditions for domestic purposes, while one location showed poor water quality due to proximity to drainage channels and automobile repair activities. The findings indicate that groundwater quality within the study area is moderately affected by anthropogenic activities and local environmental conditions. Although the groundwater is generally suitable for domestic use, treatment methods such as ultraviolet sterilization and chlorination are recommended before consumption to ensure public health safety.

Keywords: Groundwater quality, Water Quality Index (WQI), Drinking water, Physicochemical parameters, Borehole water, Groundwater contamination, Public health, Anthropogenic activities.

1.0 Introduction

Water is an essential natural resource required for the survival of all living organisms and for sustaining ecological balance. Chemically represented as H₂O, water is a colorless, odorless, and tasteless inorganic compound that constitutes a major component of the Earth's hydrosphere and biological systems (Ochuko, 2014). Adequate access to clean and safe drinking water is fundamental to human health, economic development, and environmental sustainability. An average adult requires several liters of water daily for drinking, cooking, sanitation, and other domestic activities necessary for maintaining healthy living conditions (Onweluzo & Akuagbazie, 2010).

Groundwater serves as one of the most reliable and accessible sources of freshwater for domestic, agricultural, and industrial uses in many developing and semi-urban regions. In several communities, boreholes and wells constitute the primary means of water supply due to inadequate public water distribution systems. However, increasing urbanization, industrial growth, agricultural practices, and other anthropogenic

activities have contributed significantly to groundwater contamination in many parts of the world. Natural environmental factors such as flooding, saline intrusion, and geological formations also influence groundwater quality and suitability for human consumption.

The rapid growth of urban settlements and poor environmental management practices have intensified pressure on groundwater resources. Improper disposal of solid and liquid wastes, poorly constructed septic systems, leakage from sewage facilities, and indiscriminate discharge of contaminants into the environment often result in groundwater pollution. In many suburban and peri-urban communities, privately constructed boreholes are frequently developed without strict adherence to environmental regulations and water safety standards. Consequently, residents may consume untreated groundwater that poses serious health risks.

Contaminated groundwater has been associated with several waterborne diseases, including cholera, typhoid fever, hepatitis, diarrhea, dysentery, and poliomyelitis (World Health Organization, 2021). The deterioration of groundwater quality therefore represents a major public health concern globally. In addition to its health implications, poor water quality contributes to economic losses, reduced agricultural productivity, increased healthcare costs, and environmental degradation. Ensuring the availability of safe drinking water remains one of the major global development priorities and is reflected in Sustainable Development Goal 6, which emphasizes clean water and sanitation for all (United Nations SDG 6, 2021).

Water quality assessment involves the evaluation of physical, chemical, and bacteriological characteristics of water in order to determine its suitability for specific uses. Since groundwater quality varies according to geological conditions, climatic influences, and human activities, continuous monitoring and assessment are necessary for effective water resource management. One of the widely accepted approaches for evaluating overall water suitability is the Water Quality Index (WQI). The WQI simplifies complex water quality data into a single numerical value that reflects the general status of water quality at a specific location and time (Adelagun et al., 2021). This method facilitates easier interpretation of water quality information by policymakers, researchers, and the general public.

International organizations and regulatory agencies such as the World Health Organization and national environmental authorities have established permissible standards for drinking water quality to protect public health. These standards define acceptable concentration limits for various physical, chemical, and microbiological parameters in potable water supplies. Water that exceeds these permissible limits may become unsafe for human consumption and domestic use.

This study was therefore undertaken to assess the suitability of groundwater for drinking purposes within the suburban region of Kuala Selangor, Malaysia, using the Water Quality Index approach. The study specifically evaluates selected physicochemical and bacteriological parameters of groundwater samples collected from existing boreholes in the study area and compares the results with internationally accepted drinking water standards. The findings are expected to provide useful information for groundwater management, environmental monitoring, and public health protection.

2.0 Materials and Methods

2.1 Study Area

The study was conducted within the suburban region of Kuala Selangor, located in the state of Selangor, Malaysia. The study area covers approximately 20 km² and comprises rapidly developing residential and semi-urban communities that depend largely on groundwater sources for domestic water supply. Several privately owned boreholes and shallow wells exist within the area due to increasing demand for potable water and the limitations of centralized public water distribution systems.

Kuala Selangor is situated in the western coastal region of Peninsular Malaysia between latitude 3° 20' N and 3° 35' N and longitude 101° 05' E and 101° 20' E. The area is characterized by relatively low-lying terrain with elevations generally below 50 m above mean sea level. The topography consists mainly of flat coastal plains and alluvial deposits, conditions that favor groundwater accumulation and exploitation.

The climate of the area is classified as tropical humid, with consistently high temperatures, abundant rainfall, and elevated relative humidity throughout the year. The region experiences two principal monsoon seasons: the Southwest Monsoon and the Northeast Monsoon, which contribute significantly to annual precipitation levels. Average annual rainfall exceeds 2,500 mm, while temperatures generally range from 23°C to 33°C with an average annual temperature of approximately 27°C. Relative humidity commonly ranges between 60% and 85%.

Vegetation within the study area is characteristic of tropical rainforest and mangrove ecosystems, although substantial portions have undergone modification due to urbanization, agricultural activities, commercial development, and infrastructural expansion. Increasing population growth and land development have contributed to environmental stress and increased pressure on groundwater resources within the region.

The combination of high rainfall, permeable sedimentary formations, and shallow aquifer systems has encouraged extensive utilization of groundwater through boreholes and shallow wells. A significant proportion of households within the suburban communities rely on groundwater for drinking, cooking, washing, and other domestic purposes.

Geologically, the study area is underlain predominantly by unconsolidated alluvial and sedimentary deposits consisting of sand, gravel, clay, and silt formations. These formations serve as important aquifer units capable of storing and transmitting groundwater. The shallow aquifers are particularly vulnerable to contamination from anthropogenic activities such as septic system leakage, improper waste disposal, agricultural runoff, automobile workshop activities, and urban drainage infiltration.

The hydrogeological characteristics of the area, combined with increasing human activities and environmental pressures, make groundwater quality assessment essential for sustainable water resource management and public health protection. Therefore, this study evaluates the physicochemical and bacteriological quality of groundwater obtained from selected boreholes within the study area using the Water Quality Index approach. Hydrogeologically, the groundwater system within the study area consists mainly of shallow and moderately deep aquifer formations composed of sand, gravel, silt, and clay deposits. Previous hydrogeological investigations in similar coastal and alluvial environments have identified three principal aquifer zones: (1) shallow sand and gravel aquifers generally occurring at depths below 100 m, (2) mixed sand and clay aquifer systems extending to moderate depths, and (3) deeper coastal aquifers associated with beach and marine sediment deposits exceeding 200 m in depth. The aquifers within the Kuala Selangor suburban region predominantly belong to the shallow and moderately deep sand-clay aquifer category.

2.2 Sample Collection

The standard procedures recommended by the American Public Health Association (APHA, 2017) for the examination of water and wastewater were adopted for sample collection and laboratory analysis in this study. Groundwater samples were collected from six (6) existing boreholes strategically distributed within the study area. Clean and sterile one-liter plastic sampling containers were used for sample collection. Prior to sampling, all plastic containers were thoroughly washed with dilute hydrochloric acid (0.05 M) and subsequently rinsed several times with distilled water to minimize contamination. The containers were then air-dried under dust-free laboratory conditions.

At each sampling location, the containers were rinsed twice with the groundwater sample before final collection. The containers were filled completely, tightly sealed, and properly labeled with the sampling location, date, and time of collection. The collected samples were immediately stored in insulated plastic coolers containing ice packs and transported to the laboratory within three hours for preservation and analysis. Upon arrival at the laboratory, the samples were refrigerated at appropriate storage temperatures prior to testing.

2.3 Water Sample Analysis

The physicochemical and bacteriological analyses of the groundwater samples were carried out following the standard analytical procedures outlined in APHA (2017). The evaluated parameters included pH, temperature, electrical conductivity (EC), dissolved oxygen (DO), turbidity, total dissolved solids (TDS), total suspended solids (TSS), total hardness (TH), biochemical oxygen demand (BOD), alkalinity, chloride, sulphate, nitrate, calcium, magnesium, sodium, potassium, phosphate, bicarbonate, iron, lead, and total coliform count. Certain conservative parameters such as temperature, pH, electrical conductivity, dissolved oxygen, and turbidity were measured in situ at the sampling locations using calibrated portable instruments. Each parameter was measured three times, and the average values were recorded to improve analytical reliability and accuracy. The remaining physicochemical and bacteriological parameters were analyzed under controlled laboratory conditions using standard analytical methods for water and wastewater examination. Appropriate laboratory quality assurance and quality control procedures were strictly observed throughout the analytical process to ensure the precision, consistency, and reliability of the obtained results.

3.0 WQI calculation

The WQI has been calculated using standards of drinking water quality recommended by the World Health Organization (WHO) and nine important parameters. The weighted Arithmetic index method was used and weights assigned to the nine chosen parameters. The WQI was eventually calculated using the Equations 1 to 3.

$$q_n = \frac{100(V_n - V_{io})}{(S_n - V_{io})} \quad (1)$$

$$W_n = \frac{K}{S_n} \quad (2)$$

And the overall WQI is calculated by the following equation.

Table 1: Water quality index and quality of water

$$WQI = \frac{\sum q_n W_n}{\sum W_n} \quad (3)$$

Where, n = water quality parameters

q_n = Quality rating for the n^{th} water quality parameter

V_n = Estimated value of the n^{th} parameter at a given water sampling station

S_n = Standard permissible value of the n^{th} parameter

W_n = unit weight for n^{th} parameter S_n = standard permissible value for n^{th} parameter

k = proportionality constant.

V_{io} = Ideal value of n^{th} parameter in pure water (i.e., 0 for all other parameters except the parameters pH and Dissolve oxygen [7.0 and 14.6 mg/l respectively]). The unit weight was calculated by a value inversely proportional to the recommended standard value S_n of the corresponding parameter. The water quality status for WQI values for human consumption according to the weighted arithmetic method are presented in Table 1 (Asuquo & Etim, 2012).

Water quality index level	Water quality tatus
0-25	Excellent water quality
25-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
>100	Unsuitable for drinking

4.0 Results and Discussion

The results of the physico-chemical and bacteriological parameters of the different samples of water collected from the six bore holes analyzed are as shown in Tables 2. The descriptive statistics and the WHO permissible standards are presented in Table 3. From the results, it can be seen that the concentrations of the respective parameters are below the WHO standards as shown in Table 4 except for some stream water samples.

Table 2: Physico-chemical and bacteriological water quality parameters

Parameters	Sample's location					
	1	2	3	4	5	6
Temp	28.85	30.60	29.20	30.70	25.20	29.00
pH	6.92	6.00	6.40	5.72	7.00	7.60
EC	492.00	554.00	46.55	612.00	30.00	244.00
TH	194.00	4.28	14.57	4.60	281.00	4.82
TSS	0.00	10.00	23.00	10.00	0.00	10.00
TDS	112.00	227.00	306.00	84.75	15.00	122.00
DO	2.06	3.10	3.10	3.20	0.70	2.10
BOD	1.40	1.50	1.54	8.52	1.30	1.30
TC	32.12	0.09	0.00	5.02	6.97	0.00
Na	1.74	0.08	0.09	1.99	0.34	0.06
K	0.79	0.71	1.62	1.18	6.73	1.19
Ca	3.21	1.18	1.61	1.04	2.11	2.40
Mg	0.67	0.09	0.12	1.24	0.56	0.43
SO ₄	0.13	8.44	14.94	0.14	0.01	2.66
NO ₃	0.32	2.38	1.98	0.48	0.00	10.72
CL	2.67	12.01	25.03	6.06	1.40	6.51
HCO ₃	2.92	35.00	32.00	3.55	20.02	18.00
PO ₄	0.07	0.30	0.59	0.28	0.97	0.93
Fe	0.25	0.32	0.39	0.34	0.00	12.00
Pb	0.01	0.00	0.02	0.003	0.00	0.03

The temperature values range from 25.20⁰C to 30.70⁰C with a mean value of 28.93⁰C. Among all the physico-chemical parameters selected for the WQI calculations, pH is an important parameter which determines the suitability of water for various purposes (Chandaluri et al., 2010). The pH values are in the range of 5.72 to 7.60 and the mean value of 6.61 which indicate that the water in the study area is slightly acidic. This could be attributed to the application of chemical fertilizers, run off from agricultural field, leaching of industrial/domestic waste and sewage inflow, the high precipitation in the study area. High pH levels are undesirable since they may impart a bitter taste to the water. Furthermore, the high degree of mineralization associated with alkaline water will result in the encrustation of water pipes and water-using appliances. The electrical conductivity (EC) values are in the range of 30.00 μ S/cm to 612.00 μ S/cm and a mean values of

329.76 μ S/cm. The EC values are within the permissible limit of 400 μ S/cm. The turbidity and the total suspended solids (TSS) which is a relative measure of the visual observable dirtiness of a water resource are found to be in the range of 0 to 0.00mg/l to 23.00 with a mean value of 8.83mg/l. The low TSS value could be due to lesser agricultural activities and self-purification process of groundwater through recharge presences of groundwater. The TDS values are below the permissible limit of 500mg/l as stipulated by WHO in all the groundwater samples having a range value of 15.00 to 306.00 and a mean value of 144.46. TDS, as it is commonly known, is the concentration of all dissolved minerals in water. It is the direct measurement of the interaction between minerals and ground water.

The concentration of TDS in groundwater could be attributed to weathering intensity and the increased amount of groundwater recharge, the addition of solids from sewage, runoff water intrusion, industrial effluents and soil disturbance within the sampling locations. Dissolved oxygen (DO) gives direct and indirect information about the water. The values of DO are found in the range of 0.70mg/l to 3.20 and with a mean value of 2.38mg/l. Water of low temperatures have higher value and percentage of dissolved oxygen while warmer, polluted waters will have lower value and percentage of DO. The test value therefore indicate presence of pollutants in the water.

The DO values are below the WHO permissible limit. This could be as a result of low dissolved oxygen levels in the groundwater which may be attributed to the effluents from industrial sources, septic tanks/soak away pits and leachate from the un-engineered waste dumps scattered within the study area. Biochemical oxygen demand (BOD) values are found in the range of 1.3 to 8.52mg/ with a mean value of 2.59mg/l. The BOD values are lower than the permissible limit of 10 mg/l as stipulated by WHO in all the groundwater samples, BOD in groundwater could be due to the percolation of leachate from solid waste dump sites and organic pollution of water body (organic wastes and sewage) and chemical pollution from industrial wastes. Chemical oxygen demand (COD) is a representative of pollution by biodegradable and chemically degradable organic matter. COD values are in the range of 1.1 to 8.9 mg/l and the values are well below the permissible limit of 10 - 20mg/l in all the groundwater samples. The Total Coliform values are in the range of 0.00 to 32.12MPN/100L with a mean value at 7.37MPN/100L. These values are higher than the WHO recommended 10MPN/100L. The high amount of coliform could be due to the fact that water availability favours the movement and reproduction of the organisms and collapsed septic tanks which occurs more in the wet season and movement of leachate from open dumpsites.

Sodium (Na) is a natural component of water had a mean value 10.34mg/l and ranged from 1.5 to 27.3mg/l. High content of sodium in groundwater may be from the release of the soluble products during the weathering of rocks and minerals. High level of Na leads to stomach cramps, vomiting and nausea. Potassium (K) had mean concentration value of 3.9mg/l and varies in ranges from 0.1 to 4.2 mg/. Potassium concentration is influenced by the cations exchange mechanism. The low values of potassium may be due to the absence of geochemical strata in the study area. Calcium (Ca) had mean values 69mg/l varying from 4.1 to 90.2mg/l. Calcium recorded in sampling stations is likely caused by oxidation of organic matter and precipitate soaps, The calcium values are within the stipulated standard by the WHO in all of the groundwater sampling locations. The Mg concentration ranged from 0.12 to 1.24mg/l with a mean concentration of 0.52mg/l. The concentration of magnesium depends upon the dissolution of the underground deposits of magnesium minerals of sedimentary rock. Sulphate (SO₄) values ranges from 0.01 to 14.94mg/l with a mean value of 4.39mg/l. This may be also due to the fact that the Deltaic plain is a sequence of sands and silt with local intercalation of peat within the geological formation and sulphur-rich clays or high-level combustion of sulphur containing hydrocarbon fuels (gaseous emissions from increasing heavy traffic flow and petroleum activities) in the study area, high temperature and evaporation during the dry season and oxidation of sulphur containing compounds after rainwater has been charged to ground water resources. The levels of Nitrate (NO₃) ranged from 0.00 to 10.72mg/l with a mean value of 2.65mg/l. Nitrate pollution is strongly associated with runoff from agricultural activities (fertilizer use), leakages from large number of septic tanks and soak pits, sewage, leachate from dump sites and erosion of natural deposits, higher animal waste, reduction in groundwater recharge resulting from low precipitation, higher temperature and evaporation during the dry

season. Chloride (Cl) had values ranging from 1.40 to 25.03mg/l and the mean concentration value stands at 8.95mg/l. The chloride values are above the standard requirement of 5mg/l by WHO. High content of chloride in groundwater may result from both natural and anthropogenic sources. Bicarbonate (HCO_3) levels ranged from 2.95 to 35.00mg/l with an average value of 18.58mg/l. Phosphate (PO_4) values are found in the range of 0.07 to 0.97mg/l and the mean value stand at 0.52mg/l. Phosphate in water could be as a result of percolation of domestic sewage, during the natural process of weathering, and agricultural inputs in the study area.

Heavy metals contamination in drinking water poses a threat to humans and is often the root cause of various severe health issues such as cancer and organs (lungs, liver, kidney, bone, blood and other vital organs) damage. They can also bring about reduced mental and central nervous functions that can lead to learning difficulties, memory impairment and behavioral issues in the form of aggression and hyperactivity. They are slow poisons to man's health as their effect is not immediate. The investigated heavy metals include: Iron (Fe) sampling location except location 6. The presence of iron in groundwater is attributed to the nature of the geological formation, from natural deposits, improper waste disposal sites, industrialization, natural water recharge, corrosion of iron containing metals which are part of distribution channel and waterlead (Pb) are below the acceptable limit of soil

Table 3: Comparison of Water Quality Parameters with (WHO) Standards

Parameter	Descriptive statistics				WHO Permissible Standards (WHO, 2011)	Remark
	Mean	Std. dev.	Min. Values	Max. Values		
Temp. ($^{\circ}\text{C}$)	28.93	2.00	25.20	30.70	25	AL
pH	6.61	0.70	5.72	7.60	6.5 – 8.5	Perm.
EC ($\mu\text{S}/\text{cm}$)	329.76	258.33	30.00	612.00	400	AL
TH (mg/l)	83.88	122.20	4.28	281.00	500	WL
TSS (mg/l)	8.83	8.50	0.00	23.00	No guideline	NL
TDS (mg/l)	144.46	104.68	15.00	306.00	500	WL
DO (mg/l)	2.38	0.97	0.70	3.20	6	WL
BOD ₅ (mg/l)	2.59	2.91	1.30	8.52	10	WL
T. (Coli.pn/100l)	7.37	12.49	0.00	32.12	10	AL
Na (mg/l)	0.72	0.90	0.06	1.99	40	WL
K (mg/l)	2.04	2.32	0.71	6.73	20	WL
Ca (mg/l)	1.93	0.82	1.04	3.21	75 - 200	WL
Mg (mg/l)	0.52	0.42	0.12	1.24	30	WL
SO_4 (mg/l)	4.39	6.10	0.01	14.94	250	WL
NO_3 (mg/l)	2.65	4.07	0.00	10.72	50	WL
Cl (mg/l)	8.95	8.70	1.40	25.03	5	AL
HCO_3 (mg/l)	18.58	13.59	2.92	35.00	125 – 350	WL
PO_4 (mg/l)	0.52	0.37	0.07	0.97	0.3	WL
Fe (mg/l)	2.22	4.79	0.00	12.00	0.3	WL
Pb (mg/l)	0.02	0.01	0.00	0.03	0.01	AL

4.1 Water quality index (WQI)

In this study, the WQI is established from Nine (9) important physico-chemical parameters such as pH, total dissolved solids, chlorides, sulphate, nitrate, calcium, magnesium and WHO) standard. From the assigned weight and the World Health Organization (WHO) standard in Table 4, the Water Quality Index

Table 5: Water Quality Index Computation and Water Quality Index Values

Water Quality Parameters	PH	TDS	CL	SO ₄	HCO ₃	NO ₃	Ca	Mg	Na
Parameter Wt.	3.7	4.5	3.5	4.0	5.0	2.3	2.8	2.3	2.3
WHO Standard (Si)	7.5	500	250	100	100	50	75	0.2	200
Relative Weight (Wi)	0.122	0.148	0.155	0.132	0.074	0.164	0.076	0.076	0.076
Sampling Location	Measured Values (Ci)								
	PH	TDS	CL	SO ₄	HCO ₃	NO ₃	Ca	Mg	Na
S1	6.92	112.00	2.67	0.13	2.92	0.32	3.21	0.67	1.74
S2	6.00	227.00	12.01	8.44	35.00	2.38	1.18	0.09	0.08
S3	6.40	306.00	25.03	14.94	32.00	1.98	1.61	0.12	0.09
S4	5.72	84.75	6.06	0.14	3.55	0.48	1.04	1.24	1.99
S5	7.00	15.00	1.40	0.01	20.02	0.00	2.11	0.56	0.34
S6	7.60	122.00	6.51	2.66	18.00	10.72	2.40	0.43	0.06
Sampling Location	Quality rating (qi) = (Ci/Si) *100								
	PH	TDS	CL	SO ₄	HCO ₃	NO ₃	Ca	Mg	Na
S1	92.27	22.40	1.07	0.13	2.92	0.64	4.28	335.0	0.87
S2	80.00	45.40	4.80	8.44	35.00	4.76	1.57	45.00	0.04
S3	85.33	61.20	10.01	14.94	32.00	3.96	2.15	60.00	0.05
S4	76.27	16.95	2.42	0.14	3.55	0.97	1.38	620.0	1.00
S5	93.33	3.00	0.56	0.01	20.02	0.00	2.81	280.0	0.17
S6	101.33	24.40	2.60	2.66	18.00	21.44	3.20	215.0	0.03
Sampling location	Parameter Index (Si) = qi * Wi								
	pH	TDS	CL	SO ₄	HCO ₃	NO ₃	Ca	Mg	Na
S1	11.26	3.32	0.17	0.02	0.48	0.05	0.39	25.46	0.07
S2	9.76	6.72	0.74	1.11	5.74	0.36	0.14	3.42	0.00
S3	10.41	9.06	1.55	1.97	5.25	0.30	0.20	4.56	0.00
S4	9.30	2.51	0.38	0.02	0.58	0.07	0.13	47.12	0.08
S5	11.39	0.44	0.09	0.00	3.28	0.00	0.26	21.28	0.01
S6	12.36	3.61	0.40	0.35	2.95	1.63	0.29	16.34	0.00
									WQI
									41.20
									28.01
									33.30
									60.19
									36.75
									37.95

The above water quality index is supported by the 9 physico-chemical parameters mentioned above.. The variations of the physico-chemical parameters observed at the six sampling locations were all within the recommended standards. The water quality index at the six (6) location shows that location 1 has WQI of 41.20 and a corresponding water status of good, location 2 has WQI of 28.01 and a corresponding water status of good, location 3 has WQI of 33.30 and a corresponding water status of good location.

5.0 Conclusions

In the study, the groundwater quality of Arho Road was assessed by testing and analyzing twenty water quality parameters of six (6) existing boreholes in the area. The results obtained, revealed that mean concentration values of most of the parameters were within WHO permissible limits. The quality of most of the groundwater samples falls within the tolerance limits stipulated by the WHO.

However, some groundwater samples revealed the presence of high microbial population including total coliform bacteria count ranging from 0.00 to 32.12 and a mean of 7.37 which is above the WHO and NSDWQ standards. WQI index is a useful tool for "communicating water quality information to the public and to legislative decision makers;" it is not "a complex predictive model for technical and scientific application". From the application of water quality index for the determination of the quality of water at different locations in the study area, it is concluded that though all the water samples analysed in this study are moderately fit and suitable for drinking and for other domestic applications, the water should be treated for few parameters above WHO standards. The source of pollution of these streams as observed at the site includes human activities as defecation and dumping of untreated waste. Groundwater could be free or level of pollution reduced if proper measures are put in place to discourage the users from polluting the water in order to bring about improved health. Government should provide adequate water supply to residents of all communities in their areas of jurisdiction. Laws to regulate the sinking of boreholes should be enacted.

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