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QUALITY ASSESSMENT OF SOME GROUNDWATER WITHIN AUTOMOBILE WORKSHOPS IN IHIALA COUNCIL AREA OF ANAMBRA STATE NIGERIA

Edith Ifeoma Madukasi, Cynthia Ifunanya Odieli

Department of Environmental Management, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria

Email: ei.madukasi@coou.edu.ng, madify2002@gmail.com

Abstract

The pollution index of groundwater (borehole water) within the vicinity of automobile workshops from selected communities in the Ihiala council area was investigated. Ihiala council area is an exit and entry route to the Eastern States of Nigeria, thus witnessing an influx of vehicles daily, an attribute that boosts automobile workshops enterprise. An increase in automobile workshop enterprises within residential areas necessitates the need to investigate underground water quality in the council area. The study was carried out by collecting 10 borehole water samples from three communities in the council area with a control sample using systematic (composite) sampling techniques. Physicochemical, volatile organic carbons (VOCs) and inorganic compositions of the borehole water samples were analyzed. Data was analyzed using the appropriate statistical technique of Statistical Package of Social Sciences (SPSS), version 22.00. Wilks' Lambda showed that there was no significant difference ($p>0.05$) in physicochemical compositions of borehole water samples across the various studied communities: Wilks' Lambda=0.000, $F(14,2)=9.84$, $p=0.096$. Using a one-sample T-test, VOCs in the borehole water samples were found to be significant ($p<0.05$) within acceptable limits and there were significantly increasing levels ($p<0.05$) of acidity, alkalinity, hardness, turbidity, Iron, Cobalt, Zinc, Manganese, Chromium, and hydrocarbons when compared with the control water sample. However, the concentrations of TDS and Mn varied across the studied communities. The study echoed the growing concern about the quality of groundwater located within automobile workshop vicinities. Hence, improper disposal of automobile wastes demands attention to protect the environment and groundwater sources. The study recommends a keen consideration of sitting boreholes during development and exposing automobile workshop operators to integrated waste management. Also, automobile workshops should be assessed regularly to ensure compliance with environmental regulations relevant to the industry.

Keywords: Automobile workshops, groundwater quality, organic compounds, pollution

INTRODUCTION

Water after air is regarded as one of the most basic needs man requires for life to continue (Khalifa & Bidaisee, 2018; Enukorah & Ozuah, 2018) on Earth. Besides being a pre-requisite reactant for many biochemical reactions that occur in the human body and other living systems (Ismaila *et al.,* 2017), it is also vital for many industrial, agricultural, and recreational activities (Winifred *et al.,* 2014). Water used for the purposes above could be obtained from surface water and a hidden resource called groundwater. Although the former is readily available globally, the latter is usually the preferred source for acquiring potable water and water for use in industrial processes that require high purity. Groundwater's low tendency to be polluted as a result of its natural filtration capacity (Abadom & Nwankwoala, 2018), has made it a major source of drinking water for more than half of the global population (Ismaila *et al*., (2017). This indicates that groundwater quality is a major public health concern as it is directly interconnected with human health and well-being.

Despite the well-established importance of groundwater sources, humans mostly neglect some of the activities that take place on the land that could lead to groundwater pollution. The quality of groundwater is being modified by factors such as the geology of the environment, quality of recharge, content and quantity of waste generated on land and also methods used for its disposal (Ganiyu et al., 2016; Oniawa et al., 2002). Groundwater quality could be modified by contamination from natural sources such as the rock and soil media of the environment through which rainwater percolates to recharge groundwater, seawater intrusion, weathering of bedrocks and natural leaching of soil organic matter and minerals in rocks (Nebo *et al.,* 2018). Anthropogenic sources of groundwater pollution such as fertilizers, animal manure and metal-based pesticides on farmlands, careless disposal of hazardous industrial wastes, abattoir wastes, sewage systems, leachate from landfills and open dumpsites, as well as indiscriminate disposal of household wastes are paramount in groundwater pollution (Peter- Ikechukwu *et al.,* 2015).

In Nigeria, oil and gas exploration activities have led to an increase in urbanization with an increase in population, quest for industrialization and better life, all have culminated in inappropriate use of resources and indiscriminate dumping of both industrial and municipal wastes. One of the numerous consequences of the aforementioned is the ever-increasing demand for vehicles for commercial and private use. Most of such cars are fairly used vehicles that require regular servicing, maintenance and repair which are carried out in an automobile workshop. A common practice in most Nigerian urban areas is to allocate portions of land to be used for an automobile workshop called a mechanic village (Usman *et al*., 2013). Thus, the increase in the number of automobile workshops and activities in Nigeria due to the large inflow of fairly used vehicles into the country since the late 1990s has contributed greatly to the pollution experienced within and around these workshops. Major activities conducted in automobile workshops include the sale of automobile spare parts, engine oil, servicing and repair of various car parts, which usually involves spraying or painting, welding, soldering, battery recharging and repairs, panel beating, rewiring and other electrical works, routine servicing operations (Adelekan & Abegunde, 2011; Adisa *et al.,* 2018; Nwachukwu *et al.,*2010). The generated wastes include electrolytes, metal scraps, contaminated petrol, used engine oil, paints, lubricants, solvents, diesel, hydraulic fluids, batteries, tyres and other waste materials which may contain inorganic and micro-organic pollutants (Ibrahim et al.,2019; Owoso *et al.,*2017). Concerning the fact that there are hardly any laws regulating the management and disposal of these wastes generated from automobile activities, the operators carry out their daily activities unabated, oftentimes deliberately discarding wastes indiscriminately on bare ground. These wastes may either be washed by storm runoff into nearby water bodies or may infiltrate via the soil and eventually get to the aquifer (Adewoyin *et al.,* 2013). Leachates from indiscriminately dumped wastes also pollute groundwater with heavy metals that are venomous to human health. Ibrahim *et al.,* (2019) reported that uncontrolled handling of wastes from automobile workshops is one of the principal sources that lead to a rise in the level of heavy metals and organic compounds in the environment in most Nigerian cities. The presence of organic micro-pollutants (VOCs) and metals in the environment at levels higher than acceptable limits poses serious health risks (Srijata and Pranab, 2011).

Groundwater is a major source of drinking water for people in the study area. They gain access to this resource through hand-dug wells and major boreholes, to complement the usually unavailable pipe-borne water supply by the government. Environmental pollution with petroleum products (a complex mixture of hydrocarbon) has been recognized as a serious environmental problem, they spread horizontally on the ground surface and continue to percolate into groundwater via soil pores, air spaces and the surface of soil particles. Although some studies have been done on automobile mechanic villages in some Nigeria cities (Adewoyin, *et al.,*2013; Ganiyu *et al.,* 2016; Oniawa *et al.,*2002) limited information has been given on small springs of automobile workshops scattered around residential areas with poor regulatory provisions. Ihiala council area is an exit route and entry to some Eastern states of Nigeria. The influx of vehicles plying the council area daily is considered an attribute that boosted the springs of automobile workshops enterprise in the study area. Based on the increase in these automobile workshops especially in gateway council areas such as Ihiala LGA, there is a need to intermittently monitor underground water quality from time to time to detect areas that are at risk of high pollution to advise both the public and local authorities on the implications from the outcomes.

In addition, pollution of groundwater is difficult to detect, clean up and restore to its pristine state. Intermittent assay of automobile workshop activities' effects on groundwater within its catchment area is paramount. The study aimed to assay the quality of groundwater within automobile workshop vicinities using some selected communities in the Ihiala council area. To achieve the above aim, the following objectives were pursued:

a. To examine the groundwater quality of the selected communities
b. To compare the quality of groundwater within automobile workshop vicinities with that of a control groundwater sample (this was drawn from a borehole away from an automobile workshop in an area tagged government reserved in the Okija community).
c. To compare the volatile organic carbons (VOCs) in water samples with those in the control site.
d. To recommend the best waste management practices for the operators of automobile workshops.

Hence the hypothesis tested in the study is, ‘there is no significant environmental effect of automobile workshop activities on groundwater sources in the study area’.

MATERIALS AND METHODS

The Study Area

Ihiala local council area is one of the local government areas in Anambra State, Nigeria. It is located in the southern part of Anambra State (Figure 1). It lies approximately between latitudes 5º48′00″N and 5º′55″12N and between longitudes 6º48′60″E and 6º5′20″E and covers an area of 8.6 square kilometres. It is located 48km north of Owerri and 40km south of Onitsha. It is bounded by Ogbaru Local Government Area in the west, Ekwusigo and Nnewi South Local Government Area in the north and Imo State in the south and west (Egboka & Okpoko, 1999). The study area is made up of autonomous communities as follows: Ihiala (headquarters), Okija, Ubuluisuzor, Iseke, Orusumogho, Mbosi, Azia, and Uli (Figure 2). It lies in the agricultural belt of the state. The local economy of the council area is based on agriculture, aquaculture and trading, with a small proportion of the population working in private and public sectors, hence pollution of the groundwater source could lead to a direct health threat to the council area.

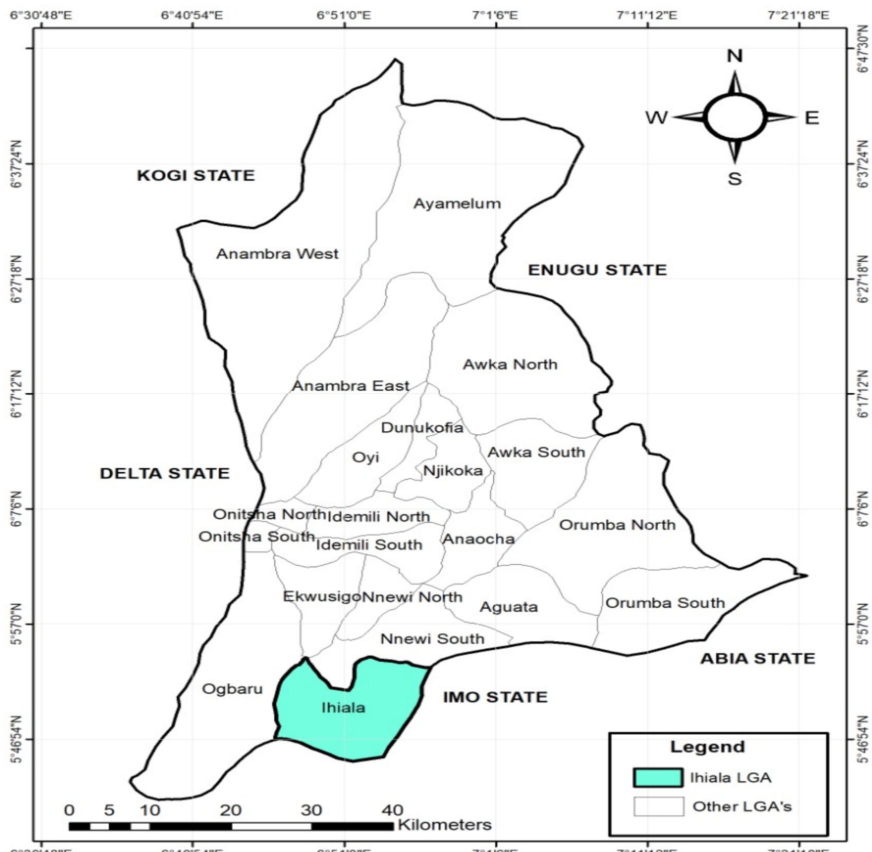


Figure 1: Location of Ihiala Local Council Area on the Map of Anambra State

Source: Splendour GIS Services, Awka, Anambra State (2023)

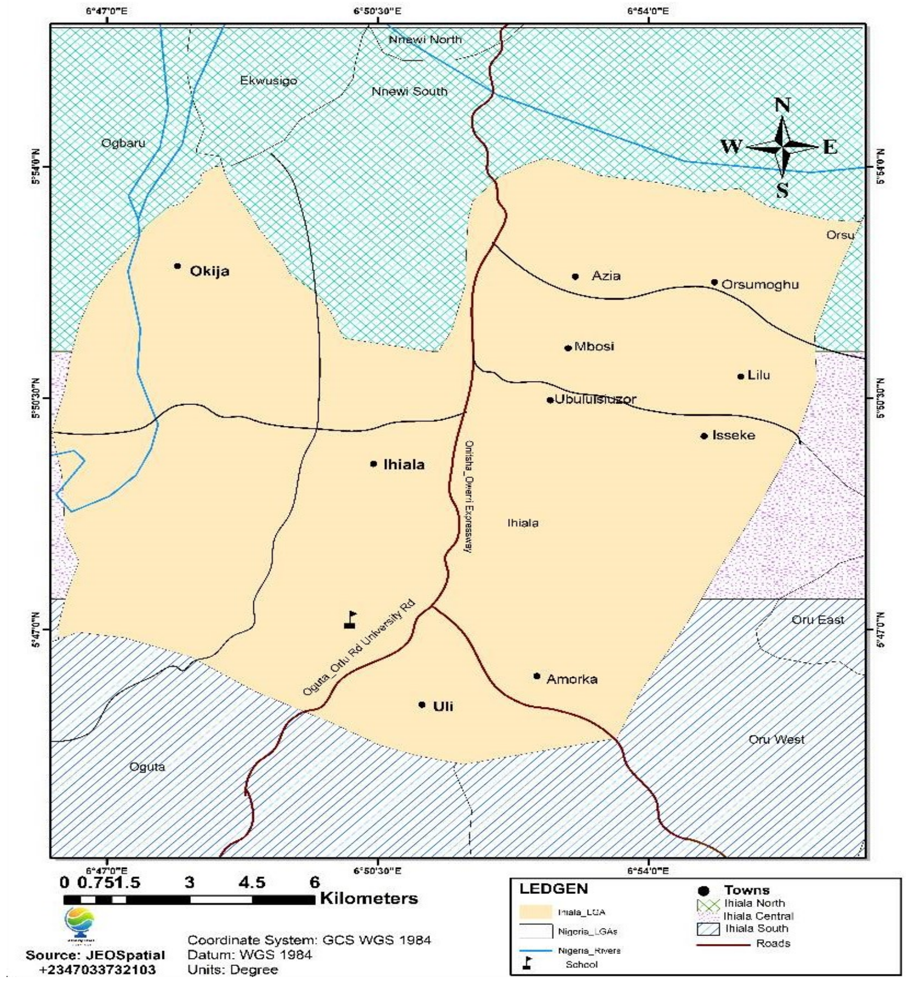


Figure 2: Location of Okija,Ihiala and Uli on the Map of Ihiala Local CouncilArea

Source: Jeospatial GIS Services, Awka, Anambra State (2023).

RESEARCH METHODS

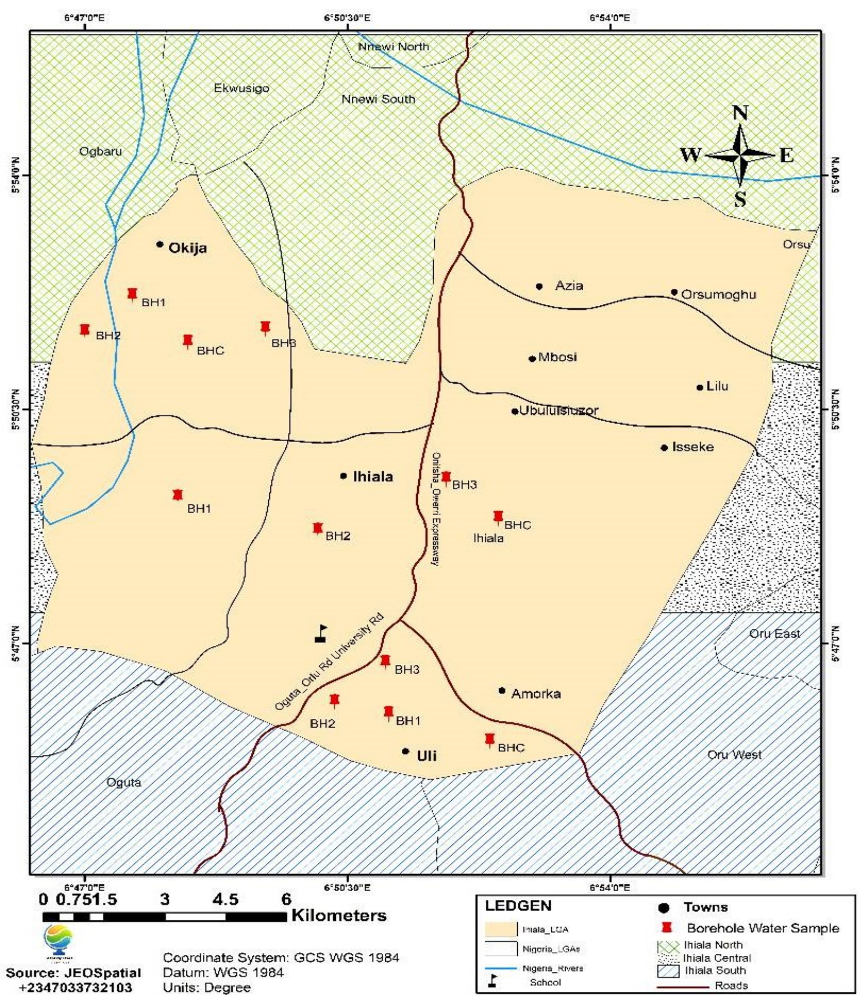
The study is an empirical research work with a composite sample technique adopted for a water sample collection from each of the three communities namely Okija, Ihiala and Uli, all in the Ihiala council area. Physicochemical, volatile organic compounds and inorganic materials were analysed on the water samples. Three boreholes were sampled from each community while for Uli a larger settlement, four boreholes were sampled. A total of eleven (11) water samples including a control sample were collected and analysed. Water samples were collected using sterilized 1-litre plastic cans between the hours of 6 am and 7 am. At each sample location, water samples were collected from three different wells each 10m apart in the direction outward from the automobile workshop. In sample collection, each sample was collected 3 times and a composite was made before storing it in a 1-litre plastic container, securely corked and stored in an ice-parked container before transport to a laboratory. For the oil and grease samples, a 1-litre silicate bottle was used to store the water samples. All collected samples were allowed to settle for about four hours before analysis (Uzoekwe & Oghosanine, 2011; Dewangan *et al.,* 2022). Heavy metals analysed include iron, cobalt, copper, lead, chromium, cadmium, manganese and zinc with the aid of an Atomic Absorption Spectrophotometer (AAS), (Umeoguaju, et al., 2022; USEPA, 2008). Physicochemical parameters analysed include pH, acidity, colour, odour, alkalinity, conductivity, turbidity, chloride, sulphate, salinity, nitrates, oil & grease according to American Public Health Association (APHA), 2005 methods of analyses and USEPA, 2008). The pH was determined immediately after collection using the portable digital pH meter (HI98108 pHep®, Hanna Instruments, Rhode Island).

Figure 3: Base Map of Ihiala Local Government Area showing borehole water Sampling Locations

Source: Splendour GIS Services, Awka, Anambra State (2023)

RESULTS AND DISCUSSION

The physicochemical analyses of the various samples collected from the three communities in Ihiala LGA are shown in Table 1. The table shows that the pH of the water samples ranged from a minimum of 5.6 for a borehole water sample at Ihiala to a maximum of 6.9 for a borehole water sample at Uli, The pH of water is very important in determining the quality of water since it affects solubility and the rate of reaction of the metal species that are involved in corrosion. Thus, excessively high or low pH can be detrimental to users of the water.



However, the pH values obtained in the present study are within the permissible limit for drinking water sources (NSDWQ, 2007). Acidity of the water samples ranged from a minimum of 3.30 for a borehole water sample at Okija to a maximum of 12.1 for a borehole water at Ihiala, Acidic water is a serious water quality problem as it leads to plumbing damage and aids heavy metal leaching from eroded pipes. However, the acidity level of the water samples is correlated with its high pH value (Adewuyi, Oputu, & Opasina, 2010). The total dissolved solid (TDS) of the water samples ranged from a minimum of 0.5 for a borehole water sample at Uli to a maximum of 32.80 for a borehole water sample at Okija, TDS is essentially a measure of anything dissolved in water that is not a water molecule, especially organic and inorganic substances. The low level of TDS is evident in the absence and minimal levels of most analysed heavy metals such as cadmium, lead chromium, copper and iron. The total alkalinity of the water samples ranged from a minimum of 8.0 for a borehole water sample at Uli to a maximum of 20.00 for a borehole water sample at Ihiala, The Highest saline water sample was recorded from a borehole water sample at Uli and the highest turbidity and water conductivity (Ec). Turbidity is an essential physical parameter of water that portrays the nature of water. The turbidity of water might be a consequence of a wide array of suspended materials, which extend in measure from colloidal to coarse scatterings and are contingent on the level of disturbance (Prakash & Somashekar, 2006). The high turbidity recorded in Uli water samples may be attributed to human activities including the dumping of wastes, and human excreta, within the studied area; also, the run-off from the refuse dumpsite (Udiba *et al.,* 2013). Conductivity value is an index used to estimate the amount of dissolved minerals in water samples (Wongsasuluk *et al.,* 2014). The highest conductivity value recorded for the Uli water sample also suggests that it contained the highest amount of dissolved material as also shown in Table 1. Chloride ions enter the groundwater aquifer from solid waste when they come in contact with rainwater and then gain entrance into the aquifer (YakubuInuwa *et al.,* 2014). Chloride does not react chemically with species in water and is harmless at relatively low concentrations as shown in Table 1. Therefore, the low levels of chloride ions in the study areas Okija, Ihiala and Uli when compared with the reference standards might be an indication of low mineral pollution arising from the wastes generated from the automobile workshop activities. The presence of hydrocarbon in all the water samples (Table 1) shows the presence of conventional contaminants such as biological oxygen demand, chemical oxygen demand, TSS, turbidity, and toxic metals such as Cd, Cr, Ni and Pb. However, analyses of most of the parameters showed minimal levels in all the borehole water samples, an indication of the safe water source.

The low concentrations of sulphate, nitrite and nitrate in the water samples when compared with the reference standards suggest that most of the wastes in the site do not contain nitrogen and sulphur. It may also be attributed to low agricultural wastes and sewage discharge since nitrogen mostly enters groundwater from agricultural activities and nitrogenous fertilizers (Groen et al., 1988). The findings in the present study concerning relatively low concentrations of sulphate and nitrate in the groundwater samples and leachate are similar to a previous report by Inuwa *et al.,* (2014). Metals could exert effects that are beneficial or harmful to the human body. Heavy metals are especially renowned for their toxic effects on human beings, aquatic life and the environment. The concentrations of the analysed heavy metals (Pb, Fe, Zn, Cu, Mn, Cr, Cd and Co) were within permissible limits in all the water samples analysed (NSDWQ, 2007). These are indications that they might not have been accumulated substantially to levels that could be detrimental to the environment, humans and aquatic animals. In contrast, the level of Mn which has exceeded the WHO permissible limit in both Ihiala and Uli borehole water samples may be of toxicological concern to man and the environment (WHO, 2001).

Table 1: Physicochemical analyses of water samples collected from the three communities assayed in Ihiala LGA

PARAMETERS	W_1, IHIALA	W_2 IHIALA	W_3 IHIALA	W_4 ULI	W_5 ULI	W_6 ULI	W_7 ULI	W_8 OKIJA	W_9 OKIJA	W_{10} OKIJA	$W1_{11}$ OKIJA (Control)
pH (at 27^{0c})	5.6	6.5	6.7	6.9	6.6	6.8	6.3	5.8	6.7	6.4	6.5
Acidity (as $CaCO_3$) (mg/L)	4.80	12.1	3.76	4.30	6.10	7.70	4.20	3.30	4.80	5.00	7.46
TDS mg/L	0.70	1.50	3.80	3.60	0.50	3.90	18.30	32.80	19.0	31.10	29.90
Alkalinity (mg/L)	20.0	17.20	17.60	20.00	20.00	20.00	8.0	10.00	8.0	16	8.0
Chloride (mg/L)	3.08	3.08	3.08	3.08	6.16	4.60	1.23	6.16	6.16	6.16	6.16
Sulphate (mg/L)	0.30	0.30	0.21	0.26	0.22	0.34	0.33	0.22	0.27	0.22	0.26
Salinity (%)	6.20	6.00	6.20	6.30	6.20	10.80	5.60	5.20	6.20	6.30	6.20
Nitrates ($N\text{-}N0_3^-$) mg/L	0.002	0.002	0.001	0.003	0.001	0.001	0.001	0.002	0.001	0.002	0.002
Turbidity (NTU)	0.0001	0.0003	0.000	0.000	0.003	0.002	0.000	0.000	0.000	0.000	0.000
Electrical Conductivity	0.16	0.14	0.18	0.19	1.26	0.91	0.64	0.62	0.66	0.60	0.58
Iron (Fe) (ppm)	1.6	0.06	0.06	0.06	0.06	0.07	0.15	0.06	0.25	0.25	0.06
Cobalt (ppm)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	1.5	Nil	Nil
Copper (ppm)	Nil	Nil	Nil	Nil	Nil	Nil	0.08	0.08	1.5	Nil	Nil
Zinc (ppm)	3.35	1.28	0.18	0.25	0.11	1.25	0.00	1.28	Nil	Nil	Nil
Lead (ppm)	00	00	00	00	00	00	00	00	00	00	00
Manganese (ppm)	0.11	0.07	0.07	0.08	0.07	0.07	0.08	Nil	Nil	Nil	Nil
Chromium (ppm)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cadmium (ppm)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Oil and Grease mg/L	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Hydrocarbon (mg/L)	0.0677	0.1428	0.7165	1.7136	0.038	2.1928	2.2371	5.7175	0.3256	2.1415	0.6063

The results of the physicochemical composition of the10 boreholes sampled water from the three communities in the council area were subjected to a one-sample T-test. The analysed results were compared with the values of the control borehole located more than 150m distant from any of the automobile workshops assayed and are summarized in Table 2

Table 2: Comparison of assayed borehole waters with control borehole: (Mean physicochemical parameters of borehole water from the three communities with control borehole water)

PARAMETERS (mg/l)	Mean ±SE (95% CL)	p-value	Control borehole	Remarks
pH (at 27^{0c})	6.43±0.14	0.000	6.5	No difference
Acidity (as $CaCO_3$)	5.61±0.82	0.000	7.46	Difference
TDS	11.52±4.02	0.019	29.90	Difference
Alkalinity	15.68±1.60	0.000	8	Difference
Chloride	4.27±0.57	0.000	6.16	Difference
Sulphate	0.27±0.02	0.000	0.26	No difference
Salinity	6.50±0.49	0.000	6.20	No difference
Nitrates ($N\text{-}N0_3^-$)	0.0016±0.0002	0.000	0.002	Difference
Turbidity	0.0008±0.0004	0.082	0.000	Difference
Conductivity	0.54±0.12	0.001	0.58	No difference

Iron	0.26±0.15	0.116	0.06	Difference
Cobalt	0.21±0.14	0.169	0	Difference
Copper	0.00±0.00	-	0	
Zinc	0.77±0.34	0.048	0	Difference
Lead	0.00±0.00	-	0	
Manganese	0.056±0.013	0.002	0	Difference
Chromium (as Cr)	0.00±0.00	-	0	
Cadmium (as Cd)	0.00±0.00	-	0	
Oil and Grease	0.00±0.00	-	0	
Hydrocarbon	1.53±0.55	0.021	0.6063	Difference

The findings showed that the physicochemical compositions of the control borehole water differ from the sampled boreholes situated within the proximity of the automobile workshops in parameters such as acidity, TDS, alkalinity, chloride, nitrates ($N\text{-}N0_3^-$), turbidity, iron, cobalt, zinc, manganese and hydrocarbon (Table 2). From the table, the value of the physical parameters such as acidity, TDS, alkalinity, and chloride, is higher than the control. This is an indication of groundwater contamination due to the deposition of pollutants from vehicular maintenance, repair, and cleaning activities and improper waste disposal onto the soil which eventually seep into the groundwater aquifer via infiltration. The difference in physicochemical compositions is evident that leaching of the generated automobile wastes into the groundwater is possible, and could lead to harmful effects on human health and the environment (Umbugadu et al, 2024; Yakubu & Omar 2019). Hence the a need to monitor the groundwater sources in these contaminants, especially in high spring-built areas with unregulated waste disposal methods.

In addition, the borehole water samples from the three communities were further assayed for volatile organic carbons to ascertain the levels of organic micro-pollutants in the water samples. The results are shown in Table 3.

Table 3: VOC in the assayed borehole water from the three Communities.

Borehole Samples	**VOCs**					
	Ethylbenzene	**Toluene**	**p-xylene**	**Benzene**	**m-xylene**	**o-xylene**
Sample 1: Ihiala	0.0312	0.0021	0.0050	0.0107	0.0288	0.0173
Sample 2: Uli	0.0275	0.0011	0.0049	0.0100	0.0267	0.0183
Sample 3: Okija	0.0127	0.0018	0.0038	0.0082	0.0226	0.0118

As shown in Table 3 above, ethylbenzene ranged from a minimum of 0.0127 in a water sample from Okija to a maximum of 0.0312 in a water sample from Ihiala, Toluene ranged from a minimum of 0.0011 in the Uli sample to a maximum of 0.0021 in Ihiala water sample. P-xylene ranged from a minimum of 0.0038 in a sample from Okija to a maximum of 0.0050 in a water sample at Ihiala, Benzene ranged from a minimum of 0.0100 in a Uli sample to a maximum of 0.0107 in a sample from Ihiala, m-xylene ranged from a minimum of 0.0226 in

Okija sample to a maximum of 0.0288 in a sample from Ihiala and o-xylene ranged from a minimum of 0.0118 in a sample from Okija to a maximum of 0.0183 in a sample from Uli community respectively.

The results of the volatile organic carbons from the three samples drawn from the three communities were subjected to a one-sample T-test. The values were compared with the NESERA Intervention Standard for micro-pollutants in groundwater pollution. The study found that all the analysed VOCs are within acceptable levels according to NESREA (2011) and, hence are not significantly different from the tolerance limit (Table 4).

Table 4: Comparing VOCs in borehole water samples with NESREA (2011) intervention standard for micro-pollutant.

Parameters (VOCs)	N	Mean ±SE (95% CL)	P-value	Target value (ug/l)/ppm	Intervention value NESREA (2011), ug/l /(ppm)	Remark
Ethylbenzene (ppm)	3	0.0238±0.0057	0.052	0.2 (0.002ppm)	150ug/l /(0.15ppm)	Acceptable
Toluene(ppm)	3	0.0017±0.0003	0.030	0.2(0.002ppm)	1000 ug/l/ (1ppm)	Acceptable
p-Xylene(ppm)	3	0.0046±0.0004	0.007	0.2(0.002ppm)	70 ug/l /(0.07ppm)	Acceptable
Benzene(ppm)	3	0.0096±0.0007	0.006	0.2(0.002ppm)	30 ug/l /(0.03ppm)	Acceptable
m-Xylene(ppm)	3	0.0260±0.0018	0.005	0.2(0.002ppm)	70 ug/l /(0.07ppm)	Acceptable
o-Xylene (ppm)	3	0.0160±0.0020	0.016	0.2 (0.002ppm)	70 ug/l /(0.07ppm)	Acceptable

Table 4 shows that the mean VOC values are within the acceptable limit of the NESERA Intervention Standard for micro-pollutants in groundwater (NESERA, 2011). However, there is growing concern about the increase of these pollutants in the environment (Srijata and Pranab, 2011). Volatile organic carbons contaminate the soil through spills by petroleum products such as gasoline, diesel fuel, lubricating oil and heating oil from leaking oil tanks, and paints (Srijata and Pranab, 2011) and at a comparatively high level, they are associated with human health risks. In addition, the entry of these compounds into water bodies leads to fatality in the short or long term. All BTEX chemicals are carcinogenic and are capable of inducing neurological impairment (USEPA, 2011) Hence, the a need to monitor water sources intermittently to ensure human and environmental safety.

CONCLUSION

This study has uncovered many chemical substances and processes used at automobile workshops which are potential dangers to the environment, humans and animals. Thus the improper disposal of spent oil lubricants has resulted in the accumulation of heavy metals into the aquifer when compared with the control water source. The concentrations of the analysed heavy metals (Pb, Fe, Zn, Cu, Mn, Cr, Cd and Co) were within permissible limits in all the water samples analysed (NSDWQ, 2007). These are indications of low heavy metal accumulation devoid of deleterious effects on the environment, humans and aquatic animals. In contrast, Mn level exceeding WHO permissible limits in both Ihiala and Uli borehole water samples poses toxicological concerns to man and the environment (WHO, 2006). The result of the hypothesis indicated that the calculated difference in water characteristics between borehole water within the automobile workshops and the control with a distance (150m) away from the automobile vicinity were statistically significant. Also, groundwater data generated from this study provides empirical data needed for sustainable water planning and management in the vicinities of the study areas for better livelihoods devoid of pollution and contamination. As a result of these findings, it is recommended that groundwater be routinely assayed to identify discrepancies in water quality parameters in tandem with approved standards. Automobile workshop operators should be exposed to an orientation on safe waste handling and disposal methods intermittently, while relocation to a particular formation called a mechanic village that accommodates large numbers rather than scattering along the road within the residential area is advocated.

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