Assessment of Heavy Metal Concentrations in Crude Oil Impacted Underground Water in Ogale, Eleme, Rivers State, Nigeria

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ABSTRACT

The study carried out assessment of heavy metal concentrations in crude oil impacted underground water in Ogale, Eleme, Rivers State, Nigeria.

The combination of quasi-experimental and descriptive (cross-sectional) research designs were taken on to address the different study objectives. Subsequently, Thus, in-situ measurement of some of the water parameters were carried out in the field. While other parameters were determined in the laboratory. Questionnaire was likewise used to decide the occupants' view of the impacts of the water utilized in the community.

It was tracked down that a portion of the boundaries in the separate tested boreholes were not within the W.H.O passable cutoff points. Four (4) out of the five (5) tested boreholes has hostile smell, total Hardness for the five examined boreholes were not within W.H.O passable point. Nonetheless, heavy metals, for example, copper and mercury were underneath as far as possible while arsenic content was within W.H.O limit.

As per the reactions from the respondents in the field, a portion of the impacts of the crude oil contaminated water in the space were body itching, rashes and coughing. In this manner, examination of the expressed speculation showed that the contamination impact was huge.

It was suggested that, remediation process be initiated to reestablish the wellspring of drinking water of the people, clinical evaluation ought to be carried out on the occupants to know the impacts of these poisons on individuals, government and private organisations ought to site a compact and a decent drinking water source and channel it to the local area as well as carrying out an awareness campaign to sensitize to individuals on the risk associated in the utilization of this polluted water.

Keywords: Crude Oil, Pollution, Underground Water, Ogale, Eleme.

INTRODUCTION

Water is the most valuable asset that people use from nature. It is a day-to-day existence emotionally supportive network for people as well as "is the living climate for an enormous extent of earth's creatures and plants" (Manson, 1991). Groundwater is only a piece of the bigger water framework. Both the quality and amount of the groundwater asset are significant at a worldwide, public and nearby scale. In the Word reference of Life Sciences, contamination is characterized as: "the presence in the climate of huge measures of unnatural substances or unusually high convergences of normal constituents at a level that causes unwanted impacts, like bronchial disturbances, consumption or natural change". Connell (1981) expressed that contamination happens when "substances are added to the climate making an impeding change its physical, synthetic, natural or tasteful trademark". Toxins in this setting are either unfamiliar substances or regular substances released in unnecessary sums. Contamination can thusly, be viewed as an outcome of human movement as well as a

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characteristic peculiarity. Groundwater contamination in this manner is when unfamiliar or normal substances are tracked down in the underground water at levels that poses danger on people's as well as plants' wellbeing.

Human exercises can adjust the normal arrangement of ground water through the removal or spread of synthetic compounds and microbial matter at the land surface and into soils, or through infusion of squanders straightforwardly into ground water. In this way, groundwater contamination or groundwater pollution is characterized as an unfortunate change in groundwater quality coming about because of human exercises. Groundwater is a significant wellspring of new water for the worldwide populace and is utilized for homegrown, farming, and modern purposes.

Around 33% of the worldwide populace relies upon groundwater for drinking water (Global Relationship of Hydrogeologists, 2020). Groundwater is an especially significant asset in bone-dry and semi-parched districts where surface water and precipitation are restricted (Li et al., 2017a). Getting a protected and inexhaustible stockpile of groundwater for drinking is one of the urgent drivers of economic improvement for a country. Nonetheless, urbanization, rural practices, modern exercises, and environmental change all posture critical dangers to groundwater quality. In Africa, including Nigeria, larger part of the populace depend on ground water supplies for drinking and other household uses. The force of human exercises has prompted expanding natural contamination, which influences adversely on ecological and human wellbeing. The pathways through which people and other biological substances are presented to natural poisons incorporate water, air, soil and plants. The method of openness is either by ingestion, inward breath, through the skin (dermal openness) or a blend of two or all. Human exercises which sully groundwater incorporate landfill, mining, coincidental spills of synthetic compounds or waste materials, situation of septic and different tanks in hydrological and topographical unsteady areas, underground pipeline spillage, ill-advised utilization of composts and pesticides, among others (Lehr, 2002). Since groundwater is important for the hydrologic cycle, toxins in different pieces of the cycle, like surface water, can be moved into groundwater supplies (Groundwater Establishment, 2012).

polluted groundwater is detrimental for human consumption. The impacts on any uncovered populaces can incorporate sub-persistent poisonousness, constant harmfulness and cancer-causing nature, contingent upon the sort of impurities, prompting higher public use on medical services. Also, surface water quality and the soundness of the oceanic organic entities can be adversely impacted when groundwater moves foreign substances to surface water through the hydrologic cycle. In this way, admittance to safe drinking water, specifically, is basic to one's wellbeing and, likewise, one's pay and prosperity. Underground wells are the primary supply of drinking water in the Niger Delta, and the groundwater is not always treated before consumption. As a result, water continues to be a vital environmental component that affects both humans and other life forms. In this way, individuals of Ogale People group in Eleme nearby Government Region have over the course of the years experienced oil spillage which could adversely affect their wellspring of drinking water through penetration into the spring. The hydrocarbon items in unrefined petroleum which maliciously affect the wellbeing of people and aquatic lives could track down their ways into the groundwater in this manner presenting difficulties to individual's life and well being. It is against this setting, the current review considered it fit to carried out assessment of heavy metal concentrations in crude oil impacted underground water in Ogale, Eleme, Rivers State, Nigeria.

Aim and Objectives of the study

The aim of this study was to assess heavy metal concentrations in crude oil impacted underground water in Ogale, Eleme, Rivers State, Nigeria. To achieve this aim, the following set of objectives were investigated. Which are to;

i. assess the physicochemical parameter of underground water in Ogale
ii. assess the heavy metal contents of underground water in Ogale
iii. investigate the possible effects of the use of this water by the people of Ogale

Empirical Review

Groundwater resources represent one of the most important treasures of our planet; this water is located below the ground surface and stored in underground geological formations. As water is the principal and important

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component of life, springs fundamentally influence the natural equilibrium of the planet and are straightforwardly connected with the situation with the biological systems and the human wellbeing. Groundwater contamination is today one of the dangers to the climate and explicitly to the human progress. Fast populace increment, environmental change and different human exercises put in peril the accessibility of new water assets and corrupt the nature of groundwater. Many wellsprings of groundwater contamination can be recognized, either anthropogenic (because of human exercises, for example, metropolitan spillover, modern effluents, wastewater releases or normal like seawater interruption, rock disintegration and radon pollution by radioactive rot of uranium and thorium series.

New water assets are significant for people as well as for each type of life on The planet. Water assets utilization involves underground water (95-96%), surface water, for example, lakes, streams and so on (3.5%) and soil dampness (1.5%) (Giordano, 2009). As water shortage issues happen in many regions of the planet, groundwater double-dealing shows up as the simplest method for covering the rising water requests (Oki and Kanae, 2006; Giordano, 2009) An assessment of the mean water assets utilization in industrialized nations is roughly 315 liters each day for homegrown use, individual cleanliness, planting, consumable water and cooking utilizes. Consumable water and cooking use address roughly 8 liters each day which is the most significant for endurance (Giordano, 2009). A great many individuals have passed on over the course of the past a long time because of absence of admittance to clean consumable water.

Including the utilization of water assets for metropolitan and rustic purposes, and modern creation, it tends to be assessed that the same accessible amount of water assets to every individual is roughly 7.5 m^3 each day.

Study by Peiyue et al. (2021) on Sources and Consequences of Groundwater Contamination. This reports on the latest research conducted in the eastern hemisphere on the sources and scale of groundwater contamination and the consequences for human health and the environment, as well as technologies for removing selected contaminants from groundwater. It affirmed that groundwater defilement is a worldwide issue that essentially affects human wellbeing and biological administrations, its temperament and impacting factors are different between nations, climatic districts, and land highlights. It may not be ideal to take on remediation moves toward that are fruitful in different nations or districts.

Groundwater Pollution: Human and Natural Sources and Risks investigated by Stefanakis et al. (2015), states that, "Metropolitan and country focuses are generally amassed in regions with satisfactory amounts of water sources. Underground water is the significant water hotspot for a large portion of these areas. The nature of underground water goes from great quality new water (consumable), to medium (homegrown, modern) or improper quality for any utilization. The water quality relies upon different anthropogenic and regular factors that cause contamination and defilement.

Anthropogenic variables that influence groundwater quality can be arranged into direct (e.g., over-siphoning, limitless utilization of composts, mining exercises, squander dumps, or even graveyards, among others), and circuitous ones (e.g., expanded metropolitan turn of events, neighborhood climatic circumstances, water bowls and stream network interference). Normal debasement of groundwater quality happens because of seawater interruption, geothermal saline solution penetration in geothermal fields, rock-water draining connections and radioactive rot of isotopes, for example, uranium and thorium, to create radon which is tracked down in rocks and soils. One more grouping of groundwater contamination sources additionally incorporates point and non-point sources. Groundwater contamination happens with the presence of a few toxins, for example, weighty metals, pathogenic microorganisms, pesticides, nitrate, drugs and others, which can likewise cause an adverse consequence on human wellbeing and environment safeguarding" (Stefanakis et al., 2015).

Study by Talabi and Kayode (2019) on Groundwater Pollution and Remediation. The study reviewed groundwater pollution and discussed possible remediation measures. This study uncovered two principal sources (point source and non-point wellspring) of contamination with non-point contamination more challenging to remediate because of degree of spread. Moreover, most contamination of groundwater is human-centric and can be forestalled through serious wellbeing schooling. In this way, groundwater contamination might cause environment unevenness separated from extreme affliction which might prompt

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passing. Anticipation of groundwater contamination is more fitting than remediation. Such preventive measures incorporate appropriate garbage removal, checking of unsafe materials, directing natural review occasionally and increasing wellbeing schooling while remediation incorporates stream stripping, oxygen sparging, bioremediation, substance oxidation and warm treatment (Talabi & Kayode, 2019).

Study in India on Groundwater Pollution and Contamination by Kumar and Tushaar (2018), certified that preventive and remedial measures against contamination and tainting of groundwater may keep on getting low need for quite a long time into the future, and mechanical measures to forestall the evil consequences for human wellbeing will get need in present moment. Demineralization utilizing RO framework can eliminate all perilous debasements from drinking water and would be practical much of the time where TDS, nitrate and fluoride in groundwater are above admissible levels. The cost of demineralization is falling rapidly. Groundwater Quality in Nigerian Metropolitan

Groundwater Quality in Nigerian Urban Areas: A Review by Ocheri et al. (2014), it was noticed that different examinations have shown that Nigeria metropolitan groundwater quality is impacted by the geography and geochemistry of the climate, pace of urbanization, industrialization, landfill/dumpsite leachates, weighty metals, bacteriological contamination, and impact of seasons. Along these lines, confirmed that medicinal measures recommended incorporate security of water sources, legitimate treatment of squanders and development of sterile landfills, control of all land use dirtying exercises, and treatment of water before is utilized for utilization. Nonstop observing of groundwater quality is important to hinder any disagreeable results (Ocheri et at., 2014).

Investigation by Kalu (2018) on Groundwater Management Protection Program for Nigeria, this article investigates groundwater contamination in Nigeria; groundwater utilizes and proposes how to go about security of Nigeria's underground water. They announced that Contamination can limit right to utilize protected and dependable supplies, checking of Nigeria's groundwater by NIHSA has revealed that exercises on the land have dirtied and uncovered, surficial springs debasements and poisons. In addition, that normally happening contaminations and pollutions are likewise found in Nigeria's groundwater in various international locales of the country. As indicated by him, a portion of the contaminations comprise of arsenic, manganese, fluoride and others (Kalu, 2018). He proposed that in regards to human wellbeing, the climate and legitimate strategies, the National Legislature of Nigeria, Administrative Services, State Government, State Services, nearby state run administrations, neighborhood specialists and all ecological assurance organizations should be severe with regulations on removal of sewage squander, civil waste and screen exercises at abattoirs in every international district.

Domestic Water Pollution among Local Communities in Nigeria ----Causes and Consequences by Galadima et al. (2011). The paper centers essentially around the causes, results and approaches to moderating the continuous new water contamination issues among Nigerian people group. That's what they attested "Sufficient inventory of protected and disinfected new water is an unavoidable variable for human and financial turn of events.

Albeit the new worldwide consideration centers around how the momentum and predictable water emergency and related results would be tended to, absence of schooling, low monetary subsidizing, wasteful government approaches, debasement, dry spell and other anthropogenic variables are progressively adding to the contamination of homegrown water in Nigeria. The homes, neighborhood markets, abattoirs, oil and horticultural exercises are reliably cutting off the restricted new water sources through removal of hurtful squanders. This prompted the rise of a few sicknesses and weighty metals harming the nation over. The main ways forward are the appropriate sterile, mindfulness and waste administration training, sufficient subsidizing of water assets and wellbeing areas, successful execution of legal measures and reception of examples from key created nations like Joined Realm. A "system" approach is expected for effective executions" (Galadima et al., 2011).

Study by Kola-Olusanya (2023) on impact of municipal solid wastes on underground water sources in Nigeria, the review presents the estimation and examination of the water tests gathered from two significant dumpsites

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in Lagos, the Olusosun and Solous dumpsites and bordering regions. Discoveries uncovered examples from Solous dumpsite didn't affirm contamination from leachates consequently proposing that the water from the close by wells is compact and can be drunk. Then again, investigation of water tests from Olusosun dumpsite and encompassing regions affirmed the presence of feacal coliforms during microbiological examinations, proposing that the water test gathered from Olusosun isn't appropriate for utilization. Perpetual examples gathered from Olusosun dumpsite and abutting regions ought to go through additional treatment before utilization because of the presence of different microorganisms (Kola-Olusanya, 2023).

Research by Oyiboka (2014) on effects of landfill sites on groundwater quality in Igando, Alimosho Local Government Area, Lagos State. The review explored the impacts of open landfill destinations on the underground water quality by analyzing the physical and synthetic properties of underground water close by dug wells around the Solous landfill destinations in Igando, Alimosho Nearby Government Area of Lagos State. Deliberate irregular testing was utilized for information gathering. Eighteen hand-dug wells were examined at expanding good ways from the landfill site. Physical, compound and microbiological boundaries were dissected at the Lagos State Natural Security Organization (LASEPA). Soil tests were likewise taken from both the A (0 - 30cm) and B (30 - 60cm) skylines of the water inspecting focuses to decide the dirt surface (sediment, earth and loamy creation) and to show the effect of soil surface on ground water quality inside the examined region. The degree of defilement of groundwater was likewise resolved utilizing the Pollution File technique. The outcomes showed serious level of conformance with W.H.O standard as for the microbiological properties of the examined groundwater. In any case, coliform tests demonstrated the expected presence of microorganisms. Of the seven (7) actual boundaries tried, conductivity was higher in one example. The investigation of substance properties from the eighteen wells showed five (5) boundaries (broke down oxygen, complete alkalinity, iron, lead, nitrates and copper) above W.H.O limits in certain examples. The water may consequently not be ok for human utilization and there is a serious need to screen the groundwater quality nearby (Ayiboka, 2014).

The degree of tainting of groundwater was likewise resolved utilizing the Defilement Record strategy. Areas of high and medium tainting were found. There was no region with low tainting level in the space examined. Discoveries likewise showed that the water around Solous 1 was of preferable quality for homegrown use over groundwater around Solous 2 and 3 because of transient decrease of pollutant focus.

It was proposed consequently, "there is in this manner a requirement for sufficient and legitimate preparation, plan and development, and vital administration removal of waste, as well as the execution of a superior maintainable natural disinfection practice"(Ayibola, 2014).

An assessment of underground water quality in Okobo local government area of Akwa Ibom State, Nigeria by Umana et al. (2022): according the report ground water quality of Okobo Local Government Area was investigated. Sixteen boreholes (BHs) water tests were gathered from four zones (Okopedi, Ekeya, Ukwong and Okiuso) in Okobo. Standard logical systems were utilized to examine the physicochemical, bacteriological and weighty metal boundaries in the water tests and the outcomes contrasted with Nigerian norm for drinking water quality (NSDWQ). A few physicochemical boundaries examined were inside as far as possible set by NSDWQ with the exception of pH (5.99 ± 0.37), DO (0.31 ± 0.06) mg/L, BOD5 (6.26 ± 0.4) mg/L and Nitrate (62.53 ± 5.96) mg/L. Bacteriological boundary like waste coliform (128.69 ± 31.40) MPN/100 mL and absolute coliform (287.63 ± 40.31) MPN/100 mL were additionally over the cutoff points set by NSDWQ suggesting natural contamination because of waste tainting. Weighty metals were additionally inside as far as possible with the exception of Lead (0.1 ± 0.1) mg/L, Chromium (0.4 ± 0.2) mg/L, and Manganese (0.16 ± 0.2) mg/L which were somewhat above adequate cutoff points in every one of the zones.

Investigation by Dungus et al. (2022) on the Assessment of Underground Water Quality from Wash Boreholes in Some Selected Wards of Jere L.G.A. Borno State, Nigeria, the goals of the review are: 1. to distinguish and analyze the qualities of wash boreholes in the review region, 2. To survey the nature of water from wash boreholes drank by inhabitants. The procedure included testing water from Wash Boreholes.

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Water tests were gathered from Wash Boreholes from the chose wards. The five (5) wards were purposively tested, taking into perception area of private thickness and other outskirts. Water tests were gathered from 10 different wash boreholes, six (6) from business and 4 from private for the examinations of the physicochemical and microbial.

Every one of the Wash Borehole water tests were broke down for the accompanying boundaries; pH, Electrical conductivity, Manganese, Iron, Calcium, Bicarbonate, Sodium, Chloride, Nitrite, Sulfate, magnesium, potassium, Absolute Disintegrated Solids, and Hardness. The Physiochemical and Bacteriological investigations were led at the Microbial science Lab of the Workforce Veterinary

Medication, College of Maiduguri. It is thusly suggested that Water quality examination ought to be completed on all the boreholes nearby somewhere around once in like clockwork to guarantee that rates of tainting are seen before for medicinal move to be made. The people group ought to be taught on the need to keep their environmental elements clean most particularly around the boreholes (Dungus et al., 2022).

Study by Abioye and Perera (2019) on Public health effects due to insufficient groundwater quality monitoring in Igando and Agbowo regions in Nigeria: A review; report has it that all examples utilized in the review had all the earmarks of being microbially polluted. As indicated by them, this is connected to excessively close distances [< 50 ft (15.24 m) the US Ecological Security Organization recommendation] between septic tanks and groundwater wells, as well as non-designed dumpsites utilized for garbage removal. This shows that groundwater inside the review region is hazardous for drinking. Indeed, even with the clayey soil stratigraphy of the review region which is accepted to impact the regular constriction of leachate into groundwater, high groupings of lead (Pb) and manganese (Mn) were found in certain areas around the dumpsite (Abioye & Perera, 2019).

Work by Raimi et al. (2021) “statistical and multivariate techniques to trace the sources of ground water contaminants and affecting factors of groundwater pollution in an oil and gas producing wetland in Rivers State, Nigeria”. The points of the examination is to follow the sources and influencing variables of groundwater contamination through measurable and multivariate factual procedures. As per them, the examination utilized standard scientific methods and that all testing, protection, transportation and investigation observed guideline methodology portrayed in APHA (2012).

The study reveals that the greater the number of principal components extracted, the greater the variation in geochemical composition of the ground waters. It showed that 34 boundaries were conveyed into six (6) and nine (9) head parts (laptops) separated for groundwater tests for both stormy and dry seasons, possibly proposing the contribution of various poisons from various sources.

Gas erupting, mineral disintegration/precipitation and anthropogenic information are the primary wellsprings of the physicochemical lists and minor components in the groundwater. Groundwater science is transcendently controlled by regular cycles like disintegration of carbonates, silicates, and dissipates and soil filtering, trailed by human exercises. Climatic factors and land use types are likewise significant in influencing groundwater science (Raimi et al.,2021).

Investigation by Ojukwu and Nwankwoala (2022) on the Assessment of Groundwater Quality in Parts of Port Harcourt Metropolis: subsequently, as per them, physicochemical boundaries were found out involving standard conventions for water testing. The outcome unveiled that the qualities for temperature, electrical conductivity, disintegrated oxygen, pH, CI, NO3 - ,Fe, Na, Ca, Mg, HCO3-, $SO4^{2-}$, all out broke down strong, Zn and turbidity fluctuated from 26.2 - 28.3°C, 200 - 1000 µS/cm, 3.9 - 6.3 mg/L, 4 - 7.15, 7.1 - 710 mg/L, 1.7 - 40.01 mg/L, 0.0001 - 9.6 mg/L, 4.6 - 404 mg/L, 34.5 - 620 mg/L, 22 - 880 mg/L, 12 - 365 mg/L, 5 - 16.16 mg/L, 210 - 684 mg/L, 0.01 - 0.17 mg/L and 0.01 - 0.97 NTU individually, with all values adjusting to WHO and NSDWQ principles, with the exception of pH, magnesium and iron. The water quality file (WQI) is as per the following: Rumuola primary Water station 28 (D), Bird Island Water Station 25 (D), Borokiri Sandfill Water Station 34 (D), Diobu Water Station 42 (D), Sincere Ikoli Water Station 46 (D), GRA, Omerelu Road Above Tank 42 (D), Moscow Street Water Station 45 (D), Elelenwo Water Station 41 (D), Rumuokwurushi

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Water Station 40 (D) and Trans Amadi Water Station 51 (C). Improvement in offices and water treatment should be actually focused on dire consideration, as the WQI for everything except one water station was awful (Ojukwu & Nwakwala, 2022).

Study by Woke and Bolaji (2015) on Assessment of Ground Water Quality in Emohua Lga, Rivers State, Nigeria, as per them, the physico-substance and microbial nature of ground water in Emohua, Streams State were analyzed between December - February, 2015. Five business borehole from 5 distinct networks were broke down for different physico-substance boundaries utilizing standard strategies. Electrical conductivity went from 10-97 µS/cm with mean worth of 32.8±3.2 µS/cm, pH went from 6.34 - 6.6 with a mean worth of 6.48±1.1, turbidity 0-34 with mean worth of 1.02±0.1, alkalinity 4-8 mg/L with mean worth of 5.6±0.5 mg/L, broke up oxygen found the middle value of 8.0±2.5 mg/L, natural oxygen request 3.36-13.28 mg/L with a mean worth of 6.912±0.6 mg/L, synthetic oxygen request 18.40-32.40 mg/L, with a mean worth of 28.96±3.8 mg/L and temperature 24.6-25.70C with a mean worth of 25.180C. Complete hardness seethed from 4-40 mg/L with mean worth of 18.8 mg/L, all out broke down solids went from 40-80 with mean worth of 32±2.5 mg/L and absolute suspended solids went from 20-140 with mean worth of 44±3.1 mg/L. Upsides of microbial examination went from 15-460 ml for waste coliform count while complete coliform count went from 7-43 ml. A few boundaries were inside Child/FEPA/WHO reasonable cutoff points. Just Borehole (B4) showed levels inside WHO standard for complete and waste coliform however had the least and most noteworthy DO and Body esteems separately (Woke & Bolaji, 2015).

Investigation by Sokpuwu (2017) on Groundwater Quality Assessment in Ebubu Community, Eleme, Rivers State, Nigeria, the review was done to survey the drinking water nature of Ebubu people group in Eleme between June 2015 and August 2015. Water tests were gathered from ten practical boreholes utilizing standard strategies.

Physicochemical boundaries (pH, electrical conductivity, TDS, Absolute hardness, Biochemical Oxygen Interest (Body), Synthetic Oxygen Interest (COD), Bicarbonate, Carbonate, Chloride, Nitrate, Phosphate, Sulfate, Magnesium, Potassium, Sodium and Calcium), harmful metals (Album, Pb, Ni and Co) and Polyaromatic Hydrocarbons (PAHs) levels were evaluated utilizing standard insightful conventions. It was uncovered further that Values recorded for physicochemical boundaries (aside from Magnesium and Calcium) were inside the World Wellbeing Association (WHO) limits. All components under study were distinguished at the ten areas. The mean worth of Cadmium (0.361 ± 0.381 mg/L) was seen to be the most elevated of all weighty metals examined. The levels of the weighty metals in the review region were viewed as in the request: Cadmium (0.361 ± 0.381 mg/L)>Lead (0.117 ± 0.056 mg/L)>Nickel (0.042 ± 0.0281 mg/L)>Cobalt (0.010 ± 0.009 mg/L) in the water tests. These qualities were over the WHO and NIS limits. PAHs were all <0.01 mg/L (Sokpuwu, 2017). In this manner, the water quality boundaries fluctuated across the examining periods (June and August); aside from Album whose mean worth was higher during the long stretch of June, however lower during the long stretch of August, any remaining harmful metals (Ni, Pb, and Co) and physicochemical properties were higher during the period of August. The groundwater from the local area is in this manner, perilous for drinking reason because of raised degrees of harmful metals.

Groundwater Quality Assessment in Selected Niger Delta Communities in Nigeria by Nwaichi and James (2012), in this review, groundwater tests were gathered from three utilitarian boreholes in Gokana, Ogale and Amadi people group in Streams Province of Nigeria to assess the appropriateness of the water tests for end-clients. The hydrochemistry, actual property and communicated microbial burden, utilizing regular field and research center methods were investigated. The outcomes gave huge varieties in most water qualities owing to Petrol creation, Distinctive refining, Unlawful tapping, and Modern exercises among others. In this manner, Physicochemical properties like TSS, DO, NH3, Causticity, Variety, and pH levels surpassed put down certain boundaries (Branch of Petrol Assets, DPR and Nigerian Norms for Drinking Water Quality, NSDWQ) for all areas and was equivalent to the UNEP's new report discoveries on Ogoniland and climate (Nwaichi & James, 2012).

Report by Ugbebor and Ntesat (2019) on “investigation of borehole water contaminant profile at igwuruta solid waste dumpsite, rivers state, Nigeria” The review researched the boreholes tainting profile at Igwuruta

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strong waste dumpsite. Physicochemical boundaries of the water nature of chosen boreholes at different distances were inspected, and the outcomes showed that borehole A, B and C had All out Coliform Microbes (TCB) of 140.0 cfu/100ml, 120.0 cfu/100ml and 0 cfu/100ml separately. All out Heterotrophic Microbes (THB) limit of A, B and C demonstrated 6.0x103cfu/ml, 4.8x103cfu/ml and 42cfu/ml individually. The water quality file (WQI) of boreholes A, B and C likewise demonstrated 560.82, 475 and 2.6, individually. The aftereffect of borehole C water quality showed it was superb and consumable for drinking. The WQI realistic at An and B showed contaminated boreholes because of conceivable leachate invasion into the groundwater and vicinity of these boreholes to the dumpsite. The review suggested the reception of strong waste re-use, reusing, and sterile landfill squander the board approach as best practice (Ugbebor & Ntesat, 2019).

MATERIALS AND METHOD

Research Design

The design for this study was the mix of quasi-experimental and Descriptive (Cross-Sectional) research designs. This was so in light of the fact that, a portion of the information that were procured in the field were broke down in-situ and others taken to the lab for a controlled examination. Likewise, the occupants' view of the utilization of the water and its belongings were evaluated using questionnaire.

This information was oppressed into graphic and inferential factual analyes in view of the expressed goals and examination questions. A portion of these devices were recurrence conveyance, tables, diagrams, charts. SPSS programming was utilized for the investigation (Examination of difference) of expressed speculation.

Study Location

The study area for this investigation was Ogale in Eleme Local Government Area of River State. Eleme local government area is situated in Rivers State, located at East of Port Harcourt local government area, South-south geopolitical zone of Nigeria with the central command of the nearby government in Ogale. The towns and towns that make up Eleme nearby government region incorporate Agbonchia, Akpajo, Alode, Ebubu, Onne, Ekporo, Ogale, Eteo, Alesa, and Aleto. Ogele is arranged near the towns Alode, Agbonchia, Ebubu, and Oyigbo. It is situated at Scope 40 47' 15" North and Longitude 70 7; 34" East. The nearby government region covers an all out area of 138 square kilometers with the LGA comprising of such countless waterways and feeders. The complete yearly precipitation of the LGA is 3,250 mm of precipitation while the typical temperature of the area is put at 25 degrees centigrade. the topography of this locale is described by sedimentary arrangements, as the area is important for the Niger Delta Bowl, Ogale in Eleme LGA is no exemption. The geography has been impact by the statement of natural rich residue, adding to the locale's significance in the Nigerian oil industry. The vegetation of the area is normally described by tropical rainforest and mangrove swamp biological systems. This locale, being essential for the Niger Delta, highlight lavish and various vegetation. The vegetation incorporates different trees, bushes, and other plant species adjusted to the muggy and heat and humidity of the area. Mangrove swamps are normal in the beach front areas of Eleme LGA, giving significant environmental capabilities and filling in as a territory for different sea-going and bird species. In land, the rainforest vegetation comprises of a blend of hard wood trees, palms, and understory vegetation. The biodiversity in the locale upholds a scope of untamed life, including different bird species, warm blooded creatures, and reptiles. Eleme LGA has gigantic stores of raw petroleum and flammable gas and the region is home to two of Nigeria's four significant processing plants. The region likewise has the Onne seaport which is a center point for the development of an assortment of cargoes. Fishing is additionally a significant monetary movement in Ogale, Eleme LGA as the area's numerous waterways are in fish. Other key monetary exercises embraced by the occupant of Ogale in Eleme LGA incorporate the cultivating and exchange. Eleme neighborhood government region covers an area of 138 km2 and as indicated by the 2006 registration, it has a populace of 190,884.

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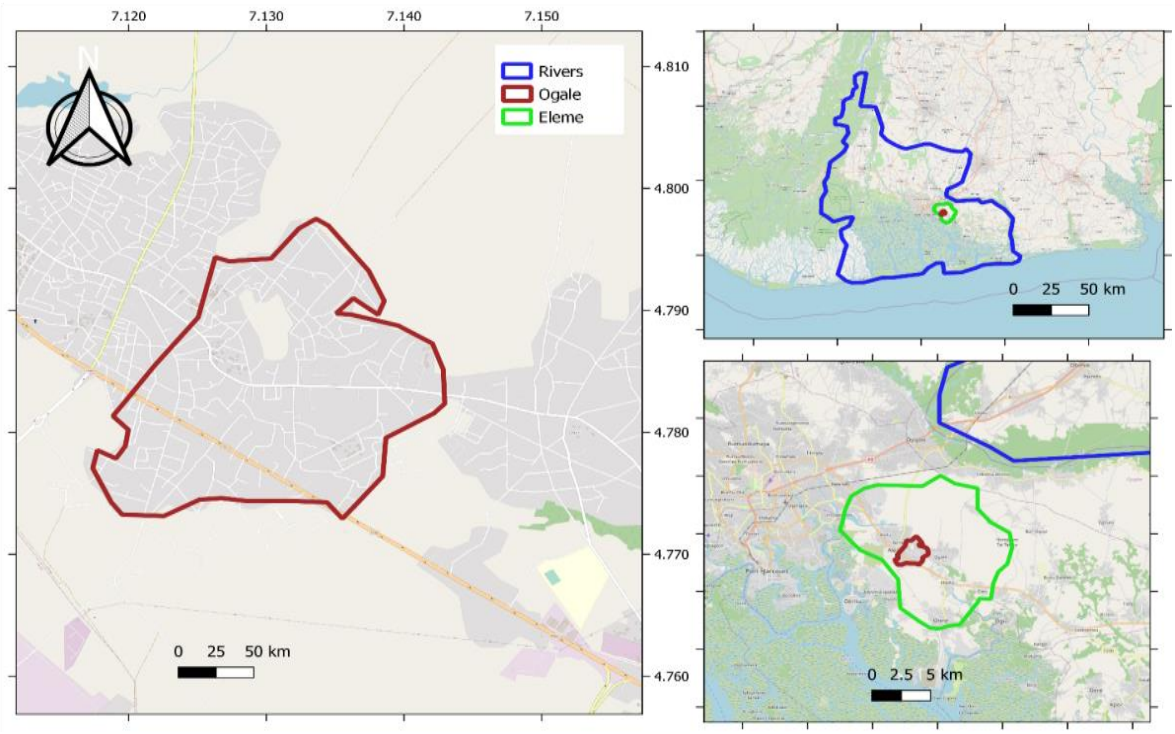

Figure 1: Study Location

Population for the Study

The populace for this study contained all the boreholes in Ogale people group. Consequently, in light of the pilot study completed by the scientist in the field, there are 310 boreholes sited locally (Analyst's Hands on work, 2023). In this manner, as per the 1991 Public Populace Figure by territory, Ogale has an extended populace of 12781 individuals (NPC, 1991).

Sample and Sampling Techniques

The testing procedures that were taken on in this exploration was separated irregular examining. The region was separated into layers. Here, a portion of the mixtures where boreholes are sited were placed into a layer in light of vicinity. In these layers, lies the objective populace which through basic irregular testing, 5 boreholes focuses were chosen for the review. Each of these boreholes was examined for the investigation of water contamination status (physicochemical, weighty metals, natural as well as bacteriology boundaries). Nonetheless, every one of the occupants were arbitrarily regulated the poll to evaluate the potential impacts of the water throughout the long term.

Utilizing Taro Yamane Equation to decide the example size for questionnaire distribution as accordingly;

$n = N/1 + N (e)^2$

where;

n is the sample size

N is the population of interest

1 is constant

e is the level of confidence.

$n = 12781/ 1 + 12781 (0.05)^2$

$= 12781/31.9525 = 400$

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Method of Data Collection

Physicochemical parameter analysis

Actual boundaries like Temperature, pH, conductivity, saltiness, turbidity and broke up oxygen were estimated in-situ in light of the fact that they are quick changing parameters and have an extremely short timeframe of realistic usability.

Temperature was estimated involving mercury in glass thermometer, pH utilizing HACH SESSION+ advanced pH meter, turbidity utilizing HACH 20100N turbidity meter, conductivity, saltiness, disintegrated oxygen and all out broke up strong will be estimated utilizing HACH 20100N conductivity meter. Variety was estimated utilizing LOVIBORD comparator.

Heavy Metals

Water tests for the investigations of weighty metals was gathered utilizing plastic holders after intensive flushing. Consequently, nitric corrosive was added into the compartments to stay away from precipitation of the weighty metals. With the examples all around marked and put away in a refrigerator prior to moving to the research center for examination.

Questionnaire Administration

400 hundred copies of the questionnaires were randomly administered to the residents of Ogale and retrieved at the spot.

Method of Data Analysis

Descriptive analysis was applied on water parameter data. This employed the use of charts, graphs, tables, frequency distribution.

RESULTS AND DISCUSSIONS

Table I Physicochemical Parameters in Crude Oil Impacted Underground Water

Parameters	W.H.O Limit	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5
PH	6.5 - 8.5	5.13	4.82	4.69	4.94	4.84
Electrical Conductivity (us/cm^3)	NS	44.50	32.10	43.10	52.70	16.98
Temperature (^{o}C)	30.00	27.40	29.20	29.80	28.90	28.90
Odour	Unobjectionable	Objectionable	Objectionable	Objectionable	Objectionable	Unobjectionable
Chemical Oxygen Demand (COD) (mg/l)	NS	2.00	1.00	3.99	3.00	5.99
Total Dissolved Solid (TDS) (mg/l)	600.00	22.20	16.00	21.50	26.30	8.52
Biological Oxygen Demand (BOD) (mg/l)	NS	3.20	1.95	2.10	2.40	1.59
Dissolved Oxygen (DO) (mg/l)	NS	4.30	3.00	3.10	3.50	2.20
Total Hardness (mg/l)	10-500	2.22	1.33	0.11	0.09	0.05

Source: Researcher's Fieldwork, 2024.

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Table I shows the physicochemical parameters of underground water in Ogale. In this manner, the PH of the separate boreholes as examined in Ogale are 5.13, 4.82, 4.69, 4.94 and 4.84 separately. Be that as it may, these doesn't fall inside the WHO admissible restriction of 6.5 - 8.5. what this mean is that the water is surprisingly acidic.

The electrical conductivity of the different boreholes in the review region despite the fact that its admissible breaking point not determined by WHO are, 44.50us/cm^3, 32.10us/cm3, 43.10us/cm^3, 52.70us/cm^3 and 16.98us/cm^3 separately. The temperature in degree Celsius of the tested underground water in Ogale are inside the WHO allowable restriction of 30^oC as displayed on the table above.

Four out of the five tested underground water in Ogale has hostile smell (borehole 1, borehole 2, borehole 3 and borehole 4). Just borehole 5 was in accordance with WHO admissible constraint of unobjectionable.

The COD of the separate examples are; borehole 1 (2.00mg/l), borehole 2 (1.00mg/l), borehole 3 (3.99mg/l), borehole 4 (3.00mg/l) and borehole 5 (5.99mg/l) individually. Be that as it may, WHO didn't determine the cutoff for this boundary.

All out broke up strong in the separate tested boreholes are inside the WHO passable restriction of 600mg/l as uncovered in the table above. While as far as possible isn't indicated by WHO yet the different inspected borehole has its fixations as consequently, 3.20mg/l, 1.95mg/l, 2.10mg/l, 2.40mg/l and 1.59mg/l separately.

With the WHO passable cutoff not determined, the centralizations of broken down oxygen in the different borehole tests were 4.30mg/l, 3.00mg/l, 3.10mg/l, 3.50mg/l and 2.20mg/l separately.

All out hardness of the underground water as tested in Ogale didn't fall inside the WHO furthest reaches of 10-500mg/l (table I).

Table II: Heavy Metal Contents in Crude Oil Impacted Underground Water

Parameters	W.H.O Limits	Borehole 1	Borehole 2	Borehole 3	Borehole 4	Borehole 5
Iron Fe (mg/l)	NS	4.268	5.162	8.057	6.179	4.850
Copper Cu (mg/l)	2.00	0.059	0.033	<0.001	0.057	<0.001
Mercury Hg (ng/l)	0.006	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic As (mg/l)	0.01	<0.001	<0.001	<0.001	<0.001	<0.001

Source: Researcher’s Fieldwork, 2024.

Table II shows the heavy metal items in the underground water tests in Ogale. The heavy metals of interest were iron, copper, mercury and arsenic. The convergence of Iron in the examples are 4.268mg/l, 5.162mg/l, 8.057mg/l, 6.179mg/l and 4.850mg/l separately. However, the WHO allowable cutoff for this boundary isn't indicated. The fixations for Copper are; 0.059mg/l, 0.033mg/l, <0.001mg/l, 0.057mg/l and <0.001mg/l separately. Subsequently, the fixations are beneath WHO reasonable restriction of 2.00mg/l. for Mercury, the focuses are <0.001mg/l, <0.001mg/l, <0.001mg/l, <0.001mg/l and <0.001mg/l individually. The mercury focuses in the underground water tested were beneath the WHO admissible restriction of 0.006mg/l.

Arsenic focuses in the underground water of the tested boreholes are; <0.001mg/l, <0.001mg/l, <0.001mg/l, <0.001mg/l and <0.001mg/l separately. In any case, the breaking point set by WHO is 0.01. This implies that the boundary (As) in the underground water test was inside as far as possible.

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Questionnaire Administration and Response Rate

Table III Questionnaire Distribution and Retrieval

Questionnaire	Frequency	Percent
Administered	400	100%
Un – Retrieved	29	7.3%
Retrieved	371	92.8%
Correctly filled	320	80%

Source: Researcher's Fieldwork, 2024.

The table above shows the circulation of poll to respondents, recovery as well as accurately filled. A sum of 400 polls were managed, out of which 371 duplicates of the surveys were effectively recovered addressing 92.8%, 29 duplicates of the polls couldn't be recovered, addressing 7.3% and 320 duplicates (80%) were accurately filled, which was utilized for the examination of the exploration question.

Table IV Demographic Profile of Respondents

S/NO	Demographic variables	Frequency	Percent (%)
1	**Gender**		
	Male	181	56.6
	Female	139	43.4
	Total	320	100
2	**Age**		
	Less than 35 years	109	34.1
	36-50 years	121	37.8
	51 year and above	90	28.1
	Total	320	100
3	**Marital Status**		
	Single	88	27.5
	Married	198	61.9
	Widowed	29	9.1
	Divorced	5	1.5
	Total	320	100
4	**Educational Level**		
	Primary Education	18	5.6
	Secondary Education	201	62.8
	Tertiary Education	101	31.6
	Total	320	100
5	**Occupation**		
	Farming	74	23.1
	Fishing	26	8.1
	Civil Servant	56	17.5
	Trading	127	39.7
	Others	37	11.6
	Total	320	100

N=320

Researcher's Fieldwork, 2024.

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Table IV above shows the data on segment profile of respondents. The table uncovered that 181 respondents (56.6%) were male while 139 respondents (43.4%) were female. This infers that male respondents were of the larger part.

The data on age section of the respondents in segment 2 of Table IV above shows that 109 respondents (34.1%) were inside under 35years, 121 respondents (37.8%) were inside 36 - 50 years, while 90 respondents (28.1%) were in no less than 51 years or more. This data shows that greater part of the respondents was inside the ages of 36 - 50 years.

Segment 3 of Table IV. shows the conjugal status of respondents. 88 respondents (27.5%) were Single, 198 respondents (61.9%) were hitched, 29 respondents (9.1%) are bereaved, and there were 5 (1.5%) respondents that were separated. This data shows that wedded respondents are greater part.

Area 4 of Table IV above shows data on the respondents' degree of training. They were addressed as follows: essential training (18) (5.6 %), optional schooling (201) (62.8%), tertiary instruction (101) (31.6%). From the data it shows that respondents with Tertiary training are of the larger part.

Segment 5 of Table IV records the control of respondents. 74 respondents (23.1%) are cultivating, 26 respondents (8.1%) are fishing, 56 respondents (17.5%) government workers, 127 respondents (39.7%) exchanging, 37 respondents (11.6%) were arranged as Others. This data shows that respondents who are exchanging are of the greater part.

Table V Responses of Residents on the Effects of the Water Usage

S/No		Responses					Total
		SA	A	D	SD	U	
1	After bathing, one’s body itches which makes one uncomfortable.	151 47.2	83 25.9	26 8.1	11 3.4	49 15.3	320 100
2	There is usually rashes on the body mostly on visitors who use the water for the first time.	128 40	113 35.3	24 7.5	19 5.9	36 11.3	320 100
3	One always experiences frequent coughing which is common amongst families in the area.	198 61.8	57 17.8	29 9.1	13 4.1	23 7.2	320 100

SA-Strongly Agree; A-Agree; D-Disagree; SD-Strong Disagree; U-undecided

Source: Researcher’s Fieldwork, 2024.

Table V above introduced the reactions of the occupants of Ogale on the impacts of the underground water utilized nearby.

47.2% of the respondents firmly concurred that after washing with the water, their body tingles and makes them self-conscious, 25.9% consented to the assertion, 8.1% and 3.4% of the respondents differ and unequivocally differ separately while 15.3% of the respondents are uncertain to the assertion. From these, more noteworthy level of the respondents maintained the explanation.

On the explanation "there is generally rashes on the body for the most part on guests who utilize the water interestingly", the reactions of the respondents have is as in this way; 40% concurred emphatically, 35.3% concurred, 7.5% dissented, 5.9% differ while 11.3% are uncertain. This means larger part of the respondents are insisting the assertion.

Reactions on the articulation "One generally encounters regular hacking which is normal among families nearby", uncovered in this manner, 61.8% of the respondents firmly concurred, 17.8% concurred, 9.1% differ while 4.1% emphatically differ and the excess 7.2% of the respondents are uncertain to the assertion. Accordingly, on the general, a lot number of people are confirmed to the assertion.

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DISCUSSION

Ogale Community in Eleme local Government Region have over the years experienced oil spillage which could perniciously affect their wellspring of drinking water through penetration into the spring. The hydrocarbon items in unrefined petroleum which meaningfully affect the wellbeing of people and different life forms in the event that they could find their ways into the underground water subsequently presenting wellbeing difficulties to individuals.

The current review sanctuary examined weighty metal fixations in unrefined petroleum affected underground water in Ogale, Eleme Nearby Government Region, Streams State, which was accomplished through testing of the different drinking water sources nearby. For this situation, five (5) borehole focuses which were investigated for physicochemical and weighty metal boundaries as well as the view of the inhabitants of Ogale on the chaperon impact of the wellspring of water for their homegrown use. the physicochemical boundaries of underground water in Ogale for the five borehole focuses are; for PH-5.13, 4.82, 4.69, 4.94 and 4.84 separately. Be that as it may, these doesn't fall inside the World Wellbeing Oganisation (WHO) reasonable constraint of 6.5 - 8.5. what this mean is that the water is more acidic than it should be.

The electrical conductivity of the different boreholes in the review region despite the fact that its allowable breaking point not determined by WHO are, 44.50us/cm^3, 32.10us/cm^3, 43.10us/cm^3, 52.70us/cm^3 and 16.98us/cm3 separately. The temperature of underground water in Ogale are inside the WHO allowable constraint of 30^{o}C as displayed on the table over (1).

Four out of the five tested underground water in Ogale has hostile smell (borehole 1, borehole 2, borehole 3 and borehole 4). Just borehole 5 was in accordance with WHO admissible constraint of unobjectionable.

The substance oxygen interest of the separate examples are; borehole 1 (2.00mg/l), borehole 2 (1.00mg/l), borehole 3 (3.99mg/l), borehole 4 (3.00mg/l) and borehole 5 (5.99mg/l) individually. Be that as it may, World Wellbeing Association (WHO) didn't determine the breaking point for this boundary.

The heavy metal items in the underground water tests in Ogale is introduced in table 2. The weighty metals that explored were iron, copper, mercury and arsenic. After the research facility examination, Iron substance in the examples were 4.268mg/l, 5.162mg/l, 8.057mg/l, 6.179mg/l and 4.850mg/l separately. However, the WHO allowable cutoff for this boundary isn't determined. Copper content are; 0.059mg/l, 0.033mg/l, <0.001mg/l, 0.057mg/l and <0.001mg/l separately. Hence, the focuses are beneath WHO allowable constraint of 2.00mg/l. Mercury content-<0.001mg/l, <0.001mg/l, <0.001mg/l, <0.001mg/l and <0.001mg/l individually. The mercury focuses in the underground water tested were underneath the WHO passable constraint of 0.006mg/l.

Arsenic content in the underground water were; <0.001mg/l, <0.001mg/l, <0.001mg/l, <0.001mg/l and <0.001mg/l separately. Be that as it may, the breaking point set by WHO is 0.01. This implies that the boundary (As) in the underground water test was inside as far as possible.

Table V presents the reactions as attested by the occupants of Ogale on the impacts of underground water for homegrown purposes nearby. In this manner, one of the purposes of the water is for washing, which 47.2% of the respondents emphatically concurred that after washing with the water, their body tingles and makes them self-conscious, 25.9% consented to the assertion, 8.1% and 3.4% of the respondents differ and firmly differ separately while 15.3% of the respondents are uncertain to the assertion. From these, more prominent level of the respondents maintained the articulation made in table 5.

As examined from the field and existing writing, one of the impacts of hydrocarbon contaminated water when utilized generally for beginner for washing, it could give one rashes. In this way, as per the reactions of the respondents (table 5), 40% concurred firmly, 35.3% concurred, 7.5% deviated, 5.9% differ while 11.3% are uncertain. This means larger part of the respondents are asserting that the water causes rashes on the people who involves the water interestingly perhaps for washing (Reseacher's Field Report, 2024).

One more factor that was set out for examination as one of the impacts of hydrocarbon contaminated water when ingested was 'hacking' as caught in the proclamation "One generally encounters continuous hacking which is normal among families nearby" (table V), the attestation has it subsequently; 61.8% of the

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respondents emphatically concurred, 17.8% concurred, 9.1% differ while 4.1% firmly differ and the leftover 7.2% of the respondents are unsure to the assertion. In this manner, on the general, a lot number of people are positive to the explanation which implies the dirtied water when ingested either through drinking of cooking, could result to hacking (Researcher's Field Report, 2024).

CONCLUSION

Having been a known fact that Ogale community in Eleme suffered hydrocarbon pollution which has devastated the living standard of the people. This was seen and maintained in their wellspring of drinking water which the current review surveyed and determined the convergences of heavy metals in this contamination in the area.

The greater part of the boundaries going from physicochemical and weighty metal items in the underground water in Ogale were not in accordance with WHO passable breaking point.

This resistance of a portion of the boundaries of the underground water nearby with the suggested norm, resultantly affects the wellbeing of the inhabitants as seen by the reactions of the respondents. These impacts that may almost certainly radiate from the utilization of the water as per the occupants were body tingling, rashes and hacking which could be liable to additional examination as suggested currently in this review.

In end from the review, the level of the contamination in the review region is extremely huge as these poisons are equally disseminated across the local area.

RECOMMENDATIONS

i. Initiation of remediation process to clean up the pollutants in order to restore the source of drinking water of the people of Ogale.
ii. Medical appraisal ought to be done on the inhabitants to know the impact of this poison on individuals.
iii. Medical assessment should be carried out on the residents to know the effect of this pollutant on the people.

Government and private organisations ought to site a convenient and a decent drinking water source and channel it to the local area.

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