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Impact of Underground Water Pollution from Municipal Waste on the Distribution of Pathogenic Bacteria at Different Depths in Otuoke Community

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Abstract: This study aimed to assess the levels of pathogenic bacteria in groundwater at different depths within Otuoke Community, focusing on the influence of underground pollution from municipal waste disposal on bacterial presence at various depths. Eighteen samples were collected from three locations which are: Beach Road, Highness Road, and Azikiel Road. Six samples were taken from boreholes at depths ranging from 11 ft to 66 ft. A sterile distilled water sample served as a control. The samples were analyzed using standard microbiological methods, including Total Heterotrophic Bacterial Count (THBC), Most Probable Number (MPN), Gram staining, and biochemical tests to identify bacterial species and measure bacterial loads. Results showed THBC values between 1.8×10^6 CFU/mL and 4.8×10^6 CFU/mL, with higher bacterial counts in shallower boreholes and significantly lower levels in deeper ones. Five bacterial species—*Pseudomonas spp., Micrococcus luteus, Bacillus spp., Staphylococcus aureus*, and *Klebsiella spp.*—were identified. The findings suggest that deeper boreholes (55-66 ft) tend to have reduced pathogenic bacteria, implying that municipal waste pollution impacts groundwater quality. Although deeper boreholes generally offer safer water, ensuring safety requires proper construction, routine microbiological testing, and good sanitation practices. It is recommended to drill boreholes to adequate depths and conduct regular monitoring to mitigate health risks associated with microbial contamination from municipal waste pollution.
Keywords: Underground Water, Pollution, Municipal Waste, Pathogenic Bacteria

Introduction: Water is an indispensable natural resource vital for human health, economic progress, and environmental sustainability. In rural communities like Otuoke in Nigeria, underground water accessed through boreholes serves as the primary source for drinking, cooking, and domestic use. While groundwater is often regarded as cleaner than surface water due to natural filtration through soil and rock layers (Li *et al.*, 2020), this perception does not always hold true, especially in areas affected by underground pollution from municipal waste. Factors such as shallow aquifers, high population density, inadequate sanitation, and poor waste management practices increase the risk of microbial contamination (World Health Organization [WHO], 2022). Pathogenic bacteria—including *Escherichia coli*, *Salmonella spp*., *Vibrio spp*., *Shigella spp*., and *Campylobacter spp*.—are commonly associated with contaminated groundwater. These microorganisms can cause waterborne illnesses such as cholera, typhoid fever, dysentery, and gastroenteritis. Contamination pathways include seepage from pit latrines, septic tanks, refuse dumps, agricultural runoff, and flooding events (Nwankwoala & Ngah, 2021). The depth of groundwater sources plays a crucial role in microbial contamination levels; shallow wells are more vulnerable due to their proximity to surface pollutants, whereas deeper aquifers tend to provide greater natural protection owing to longer travel times and enhanced filtration (Li *et al.*, 2020). Otuoke Community, situated in the Ogbia Local Government Area of Bayelsa State within the Niger Delta, experiences a tropical monsoon climate characterized by high rainfall and humidity. The low-lying terrain and shallow water table make the community heavily reliant on boreholes for groundwater. These environmental and anthropogenic factors heighten the community's vulnerability to pathogenic contamination, particularly from underground pollution stemming from municipal waste disposal practices. Understanding how groundwater depth influences bacterial contamination levels is essential for improving water safety and public health outcomes in Otuoke (Douye *et al.*, 2018;Okhuebor & Izevbuwa, 2020). Despite the community's dependence on underground water, the prevalence of waterborne diseases remains high, indicating ongoing contamination issues. Many boreholes and shallow wells are constructed without adequate technical guidance regarding optimal depth or positioning relative to contamination sources such as pit latrines, septic tanks, and refuse dumps (Anunonwu *et al.*, 2021). Heavy rainfall and flooding further facilitate pathogen infiltration into shallow aquifers. Residents often rely on untested underground water, using visual clarity and taste as indicators of safety, which poses significant health risks, especially to vulnerable groups like children and the elderly (Okhuebor *et al.*, 2026). This research focuses on bacteriological assessments of groundwater from boreholes at different depths in Otuoke. It aims to quantify the presence and concentration of pathogenic bacteria and determine the depth thresholds that offer the greatest microbial safety. Limiting the scope to microbiological analysis, the study will not assess physicochemical parameters. The results are intended to guide safe water sourcing practices and inform public health interventions to reduce waterborne disease transmission in the community.

Materials and Methods: Study Area: This research was conducted in Otuoke Community, situated within the Ogbia Local Government Area of Bayelsa State, Nigeria. Located in the Niger Delta region, Otuoke is characterized by abundant rainfall, high humidity, and a low-lying landscape. Geographically, it is positioned between latitudes 4°47′N and 4°49′N, and longitudes 6°19′E and 6°21′E. Presently, temperature range in Otuoke, Bayelsa State, Nigeria, generally varies between 22°C and 39°C throughout the year (Ogunlowo, 2024). The area experiences a tropical climate with relatively stable temperatures, with higher temperatures during the dry season and slightly cooler periods during the rainy season. The community is prone to seasonal flooding and has a shallow water table, which heightens the risk of groundwater contamination (Nwankwoala *et al.*, 2018). The predominant vegetation consists of freshwater swamp forest, while the soil is mainly sandy and clayey, facilitating water and contaminant infiltration into underground water sources. The main economic activities include fishing, agriculture, trading, and various white-collar occupations. Surface and borehole water are the primary sources of drinking water for residents (Abadom & Nwankwoala, 2024; Onisosomuya *et al.*, 2026)

Materials and Reagents: The materials used for this study include: Sterile sample bottles, Beakers, Conical flasks, Test tubes, Petri dishes, Inoculating loop, Bunsen burner, Incubator, Microscope, Measuring cylinder. While the reagents and culture media used include: Nutrient agar, MacConkey agar, Distilled water, Normal saline, Gram staining reagents, Hydrogen peroxide (for catalase test), Indole reagent

Sample Collection: A total of Eighteen (18) groundwater samples were collected from three newly drilled boreholes located close to municipal waste dumpsites within Otuoke Community, Ogbia Local Government Area of Bayelsa State. The sampling locations included Beach Road located at Latitude 4°47′32″N and Longitude 6°20′11″E, Highness Road located at Latitude 4°47′45″N and Longitude 6°20′24″E, and Azikiel Road located at Latitude 4°47′51″N and Longitude 6°20′37″E. The newly drilled boreholes varied in depth from 11 ft to 66 ft and were selected to evaluate the relationship between borehole depth and the presence of pathogenic bacteria in underground water. The water samples were collected as the drilling of the borehole is going on, using sterile sample bottles. Each sample bottle was rinsed three times with the water to be sampled before final collection to minimize contamination. The bottles were filled completely and properly sealed. Each sample was properly labeled for easy identification. The samples were immediately transported to the Laboratory where bacteriological analysis was carried out.

Sample Preparation: Serial dilution of the water samples was performed by transferring 1 ml of each sample into 9 ml of sterile normal saline, resulting in a 10^{-1} dilution. Subsequent serial dilutions were prepared up to 10^{-5} to facilitate precise bacterial enumeration.

Preparation of Culture Media: The culture media were prepared according to the manufacturer's instructions. An appropriate amount of media was weighed and dissolved in distilled water. The solution was then sterilized in an autoclave at 121°C for 15 minutes. After cooling, the media were aseptically poured into sterile petri dishes and allowed to solidify before use.

Inoculation and Incubation: A volume of 0.1 ml from each dilution was inoculated onto nutrient agar plates using the spread plate technique to ensure uniform distribution of bacteria. The inoculated plates were incubated at 37°C for 24 hours to promote bacterial growth.

Enumeration and Isolation of Bacteria: Following incubation, visible colonies were counted and recorded. The bacterial concentration was expressed as colony-forming units per milliliter (CFU/ml), using standard scientific notation (e.g., 2.5×10^3 CFU/ml). Distinct colonies were selected and subcultured onto fresh media to obtain pure isolates for further analysis.

Identification of Bacteria: Bacterial identification was performed through morphological and biochemical methods. Colony characteristics such as shape, size, and color were observed. Gram staining was conducted to distinguish between Gram-positive and Gram-negative bacteria. Additional biochemical tests, including the catalase and indole tests, were performed to further identify the bacterial isolates.

Data Presentation and Analysis: The data collected from the study were analyzed using descriptive statistical techniques, including calculations of means and percentages. The findings were organized and presented in tables and charts to illustrate variations in bacterial counts across the different sampling sites. This analysis also facilitated the assessment of the relationship between groundwater depth and the presence of pathogenic bacteria.

Results: Total Heterotrophic Bacterial Count (THBC): The Total Heterotrophic Bacterial Count (THBC) was measured to evaluate the overall bacterial population in the groundwater samples. Bacteria were cultivated and counted using Nutrient Agar, MacConkey Agar, and Eosin Methylene Blue (EMB) Agar. The results are shown in Table 1below. **Most Probable Number (MPN) of Total Coliforms and *Escherichia coli* in Groundwater Samples:** The Most Probable Number (MPN) technique was used to estimate the presence of total coliforms and *Escherichia coli* in the groundwater samples. The results obtained are presented in Table 2. Table 2 presents the MPN results for total coliforms and *Escherichia coli* in the groundwater samples from Otuoke Community. The shallow boreholes, ranging from 11 to 22 meters, showed the highest MPN values, suggesting higher levels of coliform contamination. As the borehole depth increased from 33 to 66 feet, the MPN values generally declined. Samples from

boreholes at 66 feet depth registered less than 3 MPN/100 mL, indicating the absence of detectable coliforms according to the MPN method

Gram Reaction and Morphological Characteristics of Bacterial Isolates: The bacterial isolates obtained from the groundwater samples were analyzed using Gram staining and microscopic examination to identify their Gram reaction and cellular morphology. The results of these analyses are shown in Table 3. Table 3 presents the Gram reaction and morphological characteristics of the bacterial isolates recovered from the groundwater samples. Five distinct bacterial groups were identified, including two Gram-negative rods—*Pseudomonas spp.* and *Klebsiella spp*.—and three Gram-positive bacteria—*Micrococcus luteus*, *Bacillus spp*., and *Staphylococcus aureus*. The presence of these microorganisms indicates that the groundwater contains both environmental bacteria and opportunistic pathogens. The detection of *Staphylococcus aureus* and *Klebsiella spp*. suggests potential contamination from human or environmental sources, while *Pseudomonas spp*. and *Bacillus spp*. are commonly found in soil and water environments. These findings underscore the importance of proper treatment of groundwater to ensure it is safe for domestic use.

Biochemical Characteristics of Bacterial Isolates: The bacterial isolates were further characterized using biochemical tests to confirm their identities. The biochemical tests performed included Indole, Catalase, Oxidase, Coagulase, Methyl Red (MR), Voges–Proskauer (VP), Citrate utilization and Triple Sugar Iron (TSI) tests. The results are presented in Table 4. The biochemical characteristics of the bacterial isolates obtained from the groundwater samples are detailed in Table 4. These results validate the identities previously determined through Gram staining and colony morphology. *Pseudomonas spp.* tested positive for catalase, oxidase, and citrate utilization. *Micrococcus luteus* was positive solely for catalase. *Bacillus spp.* demonstrated positive reactions for catalase, oxidase, and citrate. *Staphylococcus aureus* showed positive results for catalase, coagulase, methyl red, Voges–Proskauer, and citrate tests, confirming its identification. *Klebsiella spp.* exhibited positive reactions for catalase, Voges–Proskauer, and citrate tests, and produced acid with gas on Triple Sugar Iron agar. These biochemical profiles align with the characteristic features of the bacterial species isolated from the groundwater samples.

Relationship Between Borehole Depth and Pathogenic Bacterial Abundance in Groundwater Samples: The occurrence of pathogenic bacteria in relation to borehole depth was assessed to determine the approximate depth with the minimum bacterial contamination. The results are presented in Table 5. Table 5 illustrates the correlation between borehole depth and the presence of pathogenic bacteria in groundwater samples collected from Otuoke Community. The data reveal that shallower boreholes (11–22 ft) exhibited the highest bacterial loads and were more likely to harbour pathogenic bacterial isolates. As the depth increased from 33 ft to 66 ft, there was a general decline in bacterial load, and fewer pathogenic bacteria were detected. Samples from boreholes at 66 ft recorded the lowest heterotrophic bacterial counts. Overall, the results suggest that greater borehole depth enhances the potability of groundwater, with depths of approximately 55–66 ft offering relatively safer water sources in the study area.

Discussion of Findings: This study highlights the impact of underground pollution from municipal waste on the abundance of pathogenic bacteria at different depths in groundwater sources within Otuoke Community. The results demonstrated that Total Heterotrophic Bacterial Count (THBC) was higher in water samples from shallow boreholes compared to those from deeper ones. This suggests that groundwater closer to the surface is more susceptible to contamination from municipal waste, which often infiltrates the soil and leaches into the aquifer. This observation aligns with findings by Howard *et al.*, (2006), who noted that shallow groundwater sources are more vulnerable to surface-related contaminants due to their proximity to waste disposal sites and other human activities. Similarly, the World Health Organization (WHO, 2022) emphasizes that deep boreholes, when well-constructed, generally offer better protection against microbial contamination originating from surface pollutants. The Most Probable Number (MPN) analysis revealed a decrease in coliform bacteria as borehole depth increased, with samples from 55 ft to 66 ft showing significantly lower bacterial contamination. This supports the idea that deeper boreholes benefit from natural filtration processes provided by soil layers, which act as barriers to microbial infiltration. Bain *et al.*, (2014) also reported that deeper groundwater sources tend to contain fewer fecal indicator bacteria, further underscoring the protective role of increased depth against surface pollution. The laboratory analysis identified five bacterial isolates—*Pseudomonas spp*., *Micrococcus luteus*, *Bacillus spp*., *Staphylococcus aureus*, and *Klebsiella spp*.—indicating varying levels of contamination linked to municipal waste infiltration. The presence of P*seudomonas spp.* and *Bacillus spp*., common in soil and water, suggests natural environmental entry pathways. However, the detection of *Staphylococcus aureus* and *Klebsiella spp*. points to contamination from human activities, such as waste disposal or improper sanitation around boreholes. According to Cheesbrough (2010), these organisms serve as indicators of poor sanitary conditions and pose health risks if present in drinking water. Biochemical testing confirmed the identities of the bacterial isolates, with reaction patterns consistent with those reported by Cheesbrough (2010) and Whitman *et al.*, (2015). This validation affirms the reliability of the laboratory procedures used for bacterial identification.

Overall, the findings indicate that borehole depth significantly influences the abundance pathogenic bacteria in groundwater in Otuoke Community. Deeper boreholes tend to have lower bacterial loads and fewer pathogenic isolates, which is consistent with WHO (2022) recommendations that properly constructed and protected groundwater sources are generally safer for drinking. Nevertheless, the study emphasizes that depth alone cannot ensure safe drinking water; factors such as proper borehole construction, environmental sanitation, and ongoing water quality monitoring are essential. These measures align with the Nigerian Standard for Drinking Water Quality (NSDWQ, 2007), advocating regular pathogenic bacteria assessment to safeguard public health against contamination from municipal waste infiltrating groundwater sources.

Conclusion: This study investigated the influence of underground pollution from municipal waste on the abundance of pathogenic bacteria in groundwater at different depths in Otuoke Community, Ogbia Local Government Area, Bayelsa State. The microbiological quality of water from newly drilled boreholes was evaluated using Total Heterotrophic Bacterial Count (THBC), Most Probable Number (MPN), Gram staining, and biochemical characterization. The results revealed the presence of various

bacterial species, including *Pseudomonas spp.*, *Micrococcus luteus*, *Bacillus spp.*, *Staphylococcus aureus*, and *Klebsiella spp.*, in some of the groundwater samples. Microbial contamination in groundwater varies with proximity to surface waste and decreases with greater borehole depth, particularly between 55 and 66 feet within Otuoke community. However, depth alone does not guarantee water safety, as contamination can also result from poor sanitation and environmental factors. Therefore, regular microbiological testing and proper water quality management are essential to ensure that groundwater intended for domestic use remains safe for human consumption. Based on the findings of this study, the following recommendations are proposed: Boreholes designated for domestic water supply should be constructed to sufficient depths, ideally 66 ft and deeper, to minimize the risk of bacterial contamination from underground pollution. All newly drilled boreholes should undergo thorough microbiological testing before being commissioned for public or domestic use to ensure water safety. Groundwater quality should be regularly monitored to ensure compliance with WHO and Nigerian standards. Boreholes must be strategically placed away from pollution sources, and communities should be educated on waste management and hygiene to prevent contamination.

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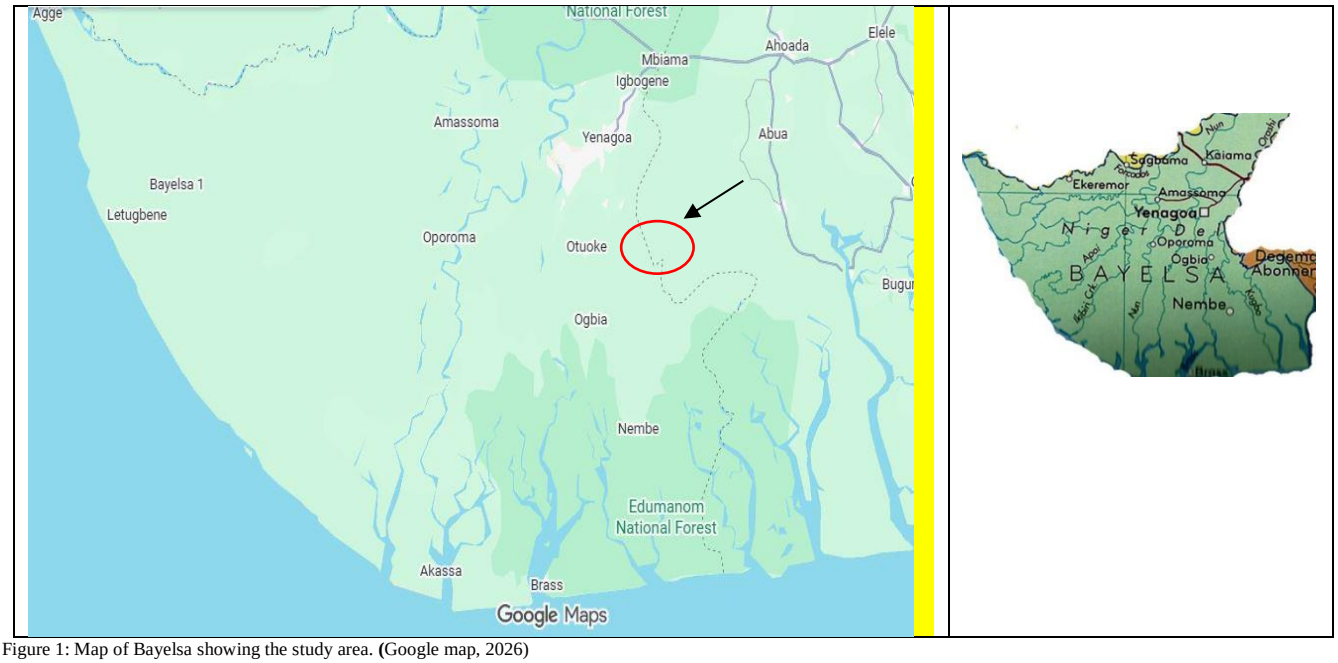

Figure 1: Map of Bayelsa showing the study area. **(**Google map, 2026)

Table 1: Total Heterotrophic Bacterial Count (THBC) of Groundwater Samples Collected from Otuoke Community

Sample	Sampling Location	Borehole Depth (ft)	Mean Colony Count	THBC (CFU/mL)	WHO Standard (CFU/100 mL)
Depth 1	Chief Oki's Compound	11	48	4.8×10^6	0
Depth 2	’’	22	44	4.4×10^6	0
Depth 3	’’	33	39	3.9×10^6	0
Depth 4	’’	44	33	3.3×10^6	0
Depth 5	’’	55	27	2.7×10^6	0
Depth 6	’’	66	21	2.1×10^6	0
Depth 1	Highness Road	11	46	4.6×10^6	0
Depth 2	’’	22	41	4.1×10^6	0
Depth 3	’’	33	36	3.6×10^6	0
Depth 4	’’	44	31	3.1×10^6	0
Depth 5	’’	55	25	2.5×10^6	0
Depth 6	’’	66	19	1.9×10^6	0
Depth 1	Azikiel Road	11	45	4.5×10^6	0
Depth 2	’’	22	40	4.0×10^6	0
Depth 3	’’	33	35	3.5×10^6	0
Depth 4	’’	44	29	2.9×10^6	0
Depth 5	’’	55	23	2.3×10^6	0
Depth 6	’’	66	18	1.8×10^6	0

Note: *THBC = Total Heterotrophic Bacterial Count; CFU/mL = Colony Forming Units per Millilitre; ft = Feet; WHO = World Health Organization; (–) = Not applicable.*

Table 2: Most Probable Number (MPN) of Total Coliforms and *Escherichia coli* in Groundwater Samples

Sample	Sampling Location	Borehole Depth (ft)	MPN Index (MPN/100 mL)
Depth 1	Chief Oki's Compound	11	17
Depth 2	’’	22	14
Depth 3	’’	33	11
Depth 4	’’	44	9
Depth 5	’’	55	5
Depth 6	’’	66	<3
Depth 1	Highness Road	11	16
Depth 2	’’	22	13
Depth 3	’’	33	10
Depth 4	’’	44	8
Depth 5	’’	55	4
Depth 6	’’	66	<3
Depth 1	Azikiel Road	11	15

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Depth 2	”	22	12
Depth 3	”	33	9
Depth 4	”	44	6
Depth 5	”	55	<3
Depth 6	”	66	<3

Notes: *MPN = Most Probable Number; mL = Millilitre; E. coli = Escherichia coli; (–) = Not applicable; Ft = Feet;*

Table 3: Gram Reaction and Morphological Characteristics of Bacterial Isolates Recovered from Groundwater Samples

Sample	**Sampling Location**	**Borehole Depth (ft)**	**Gram Reaction**	**Cell Morphology**	**Presumptive Identity**
Depth 1	Chief Oki's Compound	11	Negative	Rod	*Pseudomonas* spp.
Depth 2	”	22	Positive	Cocci	*Micrococcus luteus*
Depth 3	”	33	Negative	Rod	*Pseudomonas* spp.
Depth 4	”	44	Positive	Rod	*Bacillus* spp.
Depth 5	”	55	Positive	Cocci	*Staphylococcus aureus*
Depth 6	”	66	Negative	Rod	*Klebsiella* spp.
Depth 1	Highness Road	11	Negative	Rod	*Pseudomonas* spp.
Depth 2	”	22	Positive	Cocci	*Micrococcus luteus*
Depth 3	”	33	Positive	Rod	*Bacillus* spp.
Depth 4	”	44	Positive	Cocci	*Staphylococcus aureus*
Depth 5	”	55	Negative	Rod	*Klebsiella* spp.
Depth 6	”	66	Negative	Rod	No bacterial isolate recovered
Depth 1	Azikiel Road	11	Negative	Rod	*Pseudomonas* spp.
Depth 2	”	22	Positive	Cocci	*Micrococcus luteus*
Depth 3	”	33	Positive	Rod	*Bacillus* spp.
Depth 4	”	44	Positive	Cocci	*Staphylococcus aureus*
Depth 5	”	55	Negative	Rod	No bacterial isolate recovered
Depth 6	”	66	Negative	Rod	No bacterial isolate recovered

Table 4: Biochemical Characteristics of Bacterial Isolates Recovered from Groundwater Samples

Sample	Sampling Location	Borehole Depth (ft)	IND	CAT	OXI	COA	MR	VP	CIT	TSI	Confirmed Identity
Depth 1	Chief Oki's Compound	11	–	+	+	–	–	–	+	K/K	*Pseudomonas* spp.
Depth 2	”	22	–	+	–	–	–	–	–	K/K	*Micrococcus luteus*
Depth 3	”	33	–	+	+	–	–	–	+	K/K	*Pseudomonas* spp.
Depth 4	”	44	–	+	+	–	–	–	+	K/K	*Bacillus* spp.
Depth 5	”	55	–	+	–	+	+	+	+	A/A	*Staphylococcus aureus*
Depth 6	”	66	–	+	–	–	–	+	+	A/A, Gas	*Klebsiella* spp.
Depth 1	Highness Road	11	–	+	+	–	–	–	+	K/K	*Pseudomonas* spp.
Depth 2	”	22	–	+	–	–	–	–	–	K/K	*Micrococcus luteus*
Depth 3	”	33	–	+	+	–	–	–	+	K/K	*Bacillus* spp.
Depth 4	”	44	–	+	–	+	+	+	+	A/A	*Staphylococcus aureus*
Depth 5	”	55	–	+	–	–	–	+	+	A/A, Gas	*Klebsiella* spp.
Depth 6	”	66	–	–	–	–	–	–	–	–	No bacterial isolate recovered
Depth 1	Azikiel Road	11	–	+	+	–	–	–	+	K/K	*Pseudomonas* spp.
Depth 2	”	22	–	+	–	–	–	–	–	K/K	*Micrococcus luteus*
Depth 3	”	33	–	+	+	–	–	–	+	K/K	*Bacillus* spp.
Depth 4	”	44	–	+	–	+	+	+	+	A/A	*Staphylococcus aureus*
Depth 5	”	55	–	–	–	–	–	–	–	–	No bacterial isolate recovered
Depth 6	”	66	–	–	–	–	–	–	–	–	No bacterial isolate recovered

Notes: *IND = Indole; CAT = Catalase; OXI = Oxidase; COA = Coagulase; MR = Methyl Red; VP = Voges–Proskauer; CIT = Citrate Utilization Test; TSI = Triple Sugar Iron; (+) = Positive reaction; (–) = Negative reaction; K/K = Alkaline slant/Alkaline butt; A/A = Acid slant/Acid butt; ft = Feet.*

Table 5: Relationship Between Borehole Depth and Pathogenic Bacterial Abundance in Groundwater Samples in Otuoke

Sample	Sampling Location	Borehole Depth (m)	THBC (CFU/mL)	Bacterial Isolate Identified	WHO Standard (CFU/100 mL)	Interpretation
Depth 1	Chief Oki's Compound	11	4.8×10^6	*Pseudomonas* spp.	0	High contamination
Depth 2	”	22	4.4×10^6	*Micrococcus luteus*	0	High contamination
Depth 3	”	33	3.9×10^6	*Pseudomonas* spp.	0	Moderate contamination
Depth 4	”	44	3.3×10^6	*Bacillus* spp.	0	Moderate contamination
Depth 5	”	55	2.7×10^6	*Staphylococcus aureus*	0	Low contamination
Depth 6	”	66	2.1×10^6	*Klebsiella* spp.	0	Lowest contamination
Depth 1	Highness Road	11	4.6×10^6	*Pseudomonas* spp.	0	High contamination
Depth 2	”	22	4.1×10^6	*Micrococcus luteus*	0	High contamination
Depth 3	”	33	3.6×10^6	*Bacillus* spp.	0	Moderate contamination
Depth 4	”	44	3.1×10^6	*Staphylococcus aureus*	0	Moderate contamination
Depth 5	”	55	2.5×10^6	*Klebsiella* spp.	0	Low contamination
Depth 6	”	66	1.9×10^6	No pathogenic isolate recovered	0	Lowest contamination
Depth 1	Azikiel Road	11	4.5×10^6	*Pseudomonas* spp.	0	High contamination
Depth 2	”	22	4.0×10^6	*Micrococcus luteus*	0	High contamination
Depth 3	”	33	3.5×10^6	*Bacillus* spp.	0	Moderate contamination
Depth 4	”	44	2.9×10^6	*Staphylococcus aureus*	0	Moderate contamination
Depth 5	”	55	2.3×10^6	No pathogenic isolate recovered	0	Low contamination
Depth 6	”	66	1.8×10^6	No pathogenic isolate recovered	0	Lowest contamination

Notes: *THBC = Total Heterotrophic Bacterial Count; CFU/mL = Colony Forming Units per Millilitre; m = Metre; WHO = World Health Organization; (–) = Not applicable*