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Assessment of Microbial Contaminants in Flooded and Drinking Water Post-Alau Dam Collapse in Maiduguri, Nigeria

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Abstract

On 10 September 2024, the collapse of Alau Dam caused a catastrophic flash flood in Borno State, Nigeria, severely affecting Maiduguri Municipal Council (MMC) and Jere Local Government Area (LGA). The flood resulted in loss of life, injuries, and mass displacement, and raised concerns about waterborne disease from contaminated water sources. This study assessed the microbial quality of water samples collected from five flood-affected locations: Monday Market, Post Office, College of Nursing, Shehuri, and Buduri. Samples were analysed using standard microbiological methods to determine total bacterial count (TBC) and to isolate and identify selected bacterial contaminants. TBC was elevated at all sampling sites, with the highest count recorded at Monday Market (9.3×10^6 CFU/mL). *Escherichia coli*, *Shigella* spp., *Salmonella* spp., *Vibrio cholerae*, and *Klebsiella* spp. were detected, and contamination levels varied among the five locations. The presence of these organisms, particularly the faecal indicator *E. coli*, suggests faecal contamination of the floodwater. These findings indicate a significant risk of waterborne diseases such as cholera, shigellosis, and salmonellosis in the affected communities. They highlight the need for systematic water-quality monitoring, confirmatory identification of priority pathogens, access to safe drinking water, improved sanitation and hygiene, and coordinated public health interventions following flooding.

Keywords: Alau Dam Collapse, Drinking Water Quality, *Escherichia Coli*, Flood-Related Public Health Risks, Floodwater Contamination, Microbial Contamination, Waterborne Pathogens

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INTRODUCTION

On September 10, 2024, a devastating flash flood swept through Borno State, Nigeria, significantly impacting the Maiduguri Municipal Council (MMC) and Jere Local Government Area (LGA). Approximately 40% of MMC and 11% of Jere LGA, the two hardest-hit areas, were submerged, resulting in the displacement of over 70% of Maiduguri's residents and 41% of those in Jere LGA (OCHA Nigeria, 2024a; OCHA Nigeria, 2024b). Overall, the flood affected 59% of Borno State's population, claiming 150 lives and leaving many injured. Within MMC, the most affected areas included Bama Road, Budum, Customs/Gamboru, Gwange, and Lagos Street (The Premium Times, 2024; Shibayan, 2024).

The disaster was triggered by the collapse of the Alau Dam, situated in Alau Community, Konduga LGA (coordinates: 11°13'27"N and 13°17'06"E) (Baffoe *et al*., 2024). Constructed by the Federal Government of Nigeria between 1984 and 1986 on the Ngadda River, a tributary of Lake Chad, the dam was integral to the region, supplying water for irrigation, domestic use, and fisheries (Babagana *et al*., 2015; Garba, 2019; Bdliya & Bloxom, 2010).

The dam, standing 9 meters (30 feet) high, had a reservoir covering approximately 50 square kilometers and a maximum storage capacity of 112 million cubic meters (Gutti *et al*., 2024). Its collapse triggered catastrophic flooding, devastating surrounding communities, causing loss of life, and killing over 80% of the animals at Sanda Kyarimi Park Zoo (The Premium Times, 2024). The disaster further exacerbated water scarcity in a region already facing increasing demand for clean water, potentially increasing communities' exposure to waterborne diseases. These risks are particularly concerning in Africa, where poor infrastructure, pollution, and limited resources contribute to water contamination and a high burden of waterborne diseases (Yahaya, 2025; Otorkpa *et al*., 2024).

Although flooding can compromise water quality, the extent and distribution of microbial contamination across different water sources in the areas affected by the Alau Dam collapse require investigation. This study therefore assesses microbial indicators and selected bacterial organisms in water samples collected from five locations in Maiduguri. The findings are intended to characterize the observed contamination and inform local water-safety and public-health interventions.

The study aimed to assess the microbiological quality of water samples collected from Monday Market, Post Office, College of Nursing, Shehuri and Buduri in Maiduguri, following the Alau Dam collapse, by determining total bacterial counts, total coliform levels and the occurrence of selected bacterial organisms.

METHODOLOGY

Water samples were collected from five different locations within Maiduguri: Monday Market, Post Office, College of Nursing, Shehuri, and Buduri. The selection of these sites included both flooded and drinking water sources to ensure a comprehensive assessment of water quality in the affected areas. Each sample was analyzed for microbiological parameters to assess bacterial contamination levels. The microbiological quality of the water samples was assessed by determining total coliform count (TCC), total bacterial count (TBC), and the presence of selected bacterial organisms. TCC was estimated using the multiple-tube fermentation method to assess coliform contamination, while TBC was determined using the pour plate method and expressed as colony-forming units per millilitre (CFU/mL). Bacterial

organisms investigated included *Enterobacter* spp., *Bacillus* spp., *Staphylococcus* spp., *Micrococcus* spp., *Proteus* spp., *Klebsiella* spp., *Pseudomonas* spp., *Vibrio cholerae*, *Escherichia coli*, and *Shigella* spp. The organisms were assessed using standard microbiological procedures appropriate for the analyses undertaken. The findings were used to characterize the microbial contamination of water samples collected from the flood-affected locations.

RESULTS

Table 1: Bacteria Isolate Of Budun Area, Maiduguri Water Sample.

S/N	Specie	Drinking Water	Method	FME STD
1	TOTAL COLIFORM (*MPN*/mL)	521	Multiple Tubes/ Fermentation	<2.2
2	TOTAL BACTERIA COUNT (*CFU*/mL)	1.3 X 10^6	Pour plate	1 x 10^2
3	Enterobacter *spp*.	+ve	Pour plate	0
4	*Bacillus spp*	+ve	Pour plate	0
5	Staphylococcus *spp*	+ve	Pour plate	0
6	Micrococcus *spp*	+ve	Pour plate	0
7	Proteus	+ve	Pour plate	0
8	*Klebsiella spp*	+ve	Pour plate	0
9	Pseudomonas *spp*	+ve	Pour plate	0
10	*Vibro cholerae*	+ve	Pour plate	0
11	*Escherichia coli.*	+ve	Pour plate	0

Table 2: Bacteria Isolate of College of Nursing, Maiduguri Water Sample

S/N	Specie	Drinking Water	Method	FME STD
1	TOTAL COLIFORM (*MPN*/mL)	920	Multiple Tubes/ Fermentation	<2.2
2	TOTAL BACTERIA COUNT (CFU/mL)	2.0 X 10^6	Pour plate	1 x 10^2
3	EnteroBacter *spp.*	+ve	Pour plate	0
4	*Bacillus spp*	+ve	Pour plate	0
5	*Staphylococcus* spp.	+ve	Pour plate	0
6	*Micrococcus spp*	+ve	Pour plate	0
7	Proteus	+ve	Pour plate	0
8	*Klebsiella spp*	+ve	Pour plate	0
9	Pseudomonas	+ve	Pour plate	0

10	*Vibro cholorae*	+ve	Pour plate	0
11	*Escherichia coli.*	+ve	Pour plate	0

Table 3: Bacteria Isolate of Post Office Area, Maiduguri Water Sample.

S/N	Specie	Flooded Area Sample	Method	FME STD
1	TOTAL COLIFORM (*MPN*/mL)	1600	Multiple Tubes/ Fermentation	<2.2
2	TOTAL BACTERIA COUMT (*CFU*/mL)	8.6 X 10^6	Pour plate	1 x 10^2
3	Enterobacter *spp*	+ve	Pour plate	0
4	*Bacillus Spp*	+ve	Pour plate	0
5	Staphilococcus *spp*	+ve	Pour plate	0
6	Micrococcus	+ve	Pour plate	0
7	Ptroteus	+ve	Pour plate	0
8	*Klebsiella spp*	+ve	Pour plate	0
9	Pseudomonas *spp*	+ve	Pour plate	0
10	*VibroCholorae*	+ve	Pour plate	0
11	*Escherichia Coli.*	+ve	Pour plate	0

Table 4: Bacteria Isolate of Monday Market, Maiduguri Water Sample.

S/N	Specie	Flooded Area Sample	Method	FME STD
1	TOTAL COLIFORM (*MPN*/mL)	1600	Multiple Tubes/ Fermentation	<2.2
2	TOTAL BACTERIA COUNT (*CFU*/mL)	9.3 X 10^6	Pour plate	1 x 10^2
3	EnteroBacter *spp*	+ve	Pour plate	0
4	*Bacillus spp*	+ve	Pour plate	0
5	Staphylococcus *spp*	+ve	Pour plate	0
6	Micrococcus spp	+ve	Pour plate	0
7	Proteus	+ve	Pour plate	0
8	*Klebsiella spp*	+ve	Pour plate	0
9	Pseudomonas	+ve	Pour plate	0
10	*Vibro cholorae*	+ve	Pour plate	0
11	*Escherichia coli.*	+ve	Pour plate	0

Table 5: Bacteria Isolate of Shehuri Area, Maiduguri Water Sample.

S/N	Specie	Drinking Water	Method	FME STD
1	TOTAL COLIFORM (*MPN*/100mL)	920	Multiple Tubes/ Fermentation	<2.2
2	TOTAL BACTERIA COUNT (*CFU*/mL)	1.4 X 10^6	Pour plate	1 x 10^2
3	*EnteroBacter spp*	+ve	Pour plate	0
4	*Bacillus spp*	+ve	Pour plate	0
5	Staphylococcus *spp*	+ve	Pour plate	0
6	Micrococcus *spp*	+ve	Pour plate	0
7	Proteus	+ve	Pour plate	0
8	*Klebsiella spp*	+ve	Pour plate	0
9	Pseudomonas	+ve	Pour plate	0
10	*Vibro cholorae*	+ve	Pour plate	0
11	*Escherichia coli.*	+ve	Pour plate	0

PRESENTATION AND DISCUSSION OF RESULTS

This section presents and discusses the results of the analysis conducted on five samples, each assessed for eleven parameters across four major as shown in Tables 1-5. Here the results are grouped and discussed under four major categories. Each parameter was evaluated to understand the microbiological quality of the samples, with a focus on the presence and concentration of pathogenic bacteria. The findings from the analysis of TBC offer insights into the overall microbial load, while the examination of specific pathogens such as *E. coli*, *Shigella* species, and *Salmonella* species, provides critical information on the potential public health risks posed by the samples

Total Bacteria Count (TBC)

TBC is crucial in flood-affected areas as it helps identify harmful microbes that pose risks to human, wildlife, and plant health. Floods can spread contaminants, making TBC an essential indicator for assessing water quality and safety for consumption, bathing, and recreation (Adejuwon & George, 2024). The TBC of water samples collected from Monday Market, Post Office, College of Nursing, Shehuri, and Buduri was determined using the Pour Plate Count method. The results are presented in Figures 1 and 5, and in Table 6.

The analysis revealed that the water sample from Monday Market exhibited the highest bacterial load, with a TBC of 9.3 × 10^6 CFU/mL, representing 41.2% of the total contamination, and a corresponding to 148.3^0. This was followed by the sample from the Post Office area, with a TBC of 8.6 × 10^6 CFU/mL, accounting for 38.1% of the total contamination, and 137.2^0 (Table 3). The College of Nursing sample had a significantly lower bacterial count of 2.0 × 10^6 CFU/mL, representing 8.9% of the total contamination, and 32^0. Samples from Shehuri and Buduri had TBC values of 1.4 × 10^6 CFU/mL (6.0%, and

22.3^0) and 1.3×10^6 CFU/mL (5.6%, and 20.2^0), respectively, as shown in Tables 6 and Figures 1 and 5. These findings align with previous studies on the bacteriological quality of water following floods, which reported TBC values ranging from 1.3×10^6 to over 9.3×10^6 CFU/mL (Dzodzomenyo et al., 2022; Chaturongkasumrit et al., 2013; Phan & Sherchan, 2020). However, a contrasting study on the impacts of flash floods on drinking water quality documented a much lower TBC range of 2.8×10^1 to 2.0×10^3 CFU/cm³, with an average of 1.1×10^3 CFU/cm³ (Baffoe et al., 2024). This significant difference may be attributed to the varying nature and intensity of flooding events and their associated impacts on water quality (Kistemann *et al*., 2002; Aborode, *et al*., 2025).

Table 6: Total Bacterial Count of Analyzed Water Samples.

S/N	Water Sample Location	Result (cfu/ml)	All water Sample Areas (%)	Degree (^{0})
1.	Monday Market	$9.3x10^6$	41	148.3^0
2.	Post Office	$8.6x10^6$	38.1	137.2^0
3.	College of Nursing	$2.0x10^6$	8.9	32^0
4.	Shehuri Area	$1.4x10^6$	6.2	22.3^0
5.	Buduri Area	$1.3x10^6$	5.6	20.2^0
	Total	**$22.6x10^{6cfu/m}$**	**100.0**	**360.0^0**

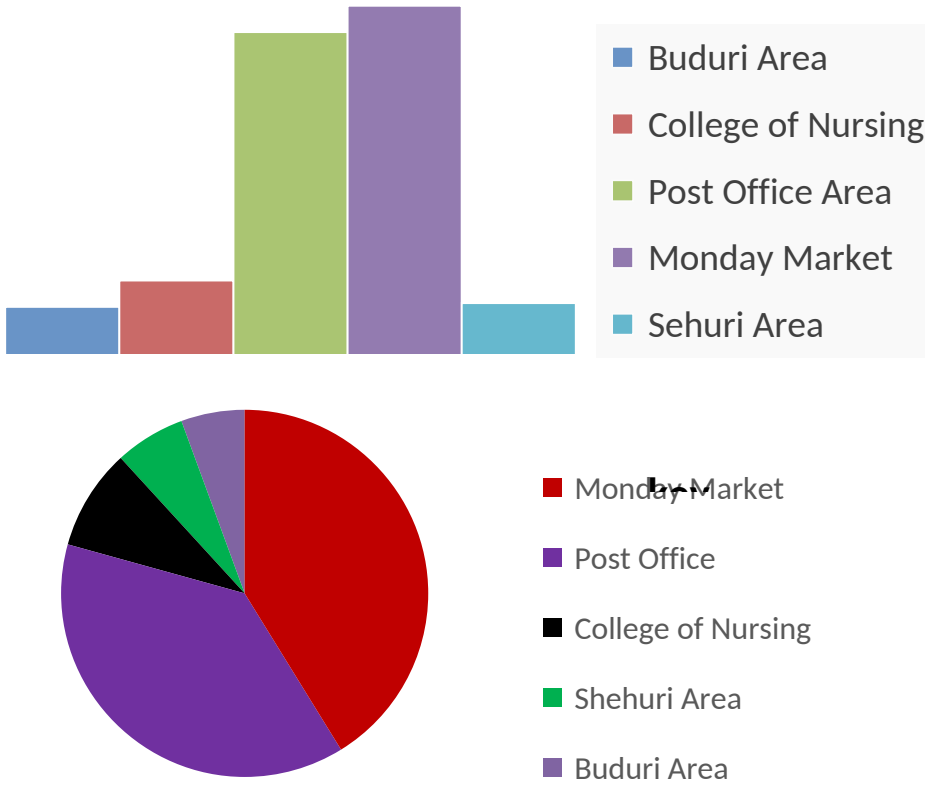


Figure 1: Result of the Measure of Number of Bacteria in Water Samples Analyzed.

Escherichia Coli

E. coli is a key indicator of fecal contamination in water, providing insight into potential health risks from harmful pathogens. It can survive in water for 4 to 12 weeks, making it a reliable marker for water quality. Simple, cost-effective detection methods have made *E. coli* the standard for assessing drinking water contamination (Khan & Gupta, 2020). Floodwater can contain pathogenic *E. coli*, which may cause diarrheal diseases if consumed and urinary tract infections (UTIs) if used for bathing or food preparation (Azhar *et al*., 2023). Water samples from five distinct areas were analyzed for the presence of *E. coli* using the Membrane Filter Analytical Method. As shown in Figures 2 and 6, and Table 7, the results revealed significant contamination across the samples. Notably, the highest levels of *E. coli* were observed in the Post Office area (5.4 × 10^3 CFU/mL), representing 40.0% of the total contamination, with a concentration of 144.00. The Monday Market sample exhibited similar contamination levels (4.8 × 10^3 CFU/mL, 35.6%, and128.0^0).

Other areas showed relatively lower levels of *E. coli* contamination. The Shehuri area recorded 1.2 × 10^3 CFU/mL (8.9% of the total contamination) and 32.0^0; Buduri showed 1.1 × 10^3 CFU/mL (8.1%) and 29.0^0; and the College of Nursing sample had 1.0 × 10^3 CFU/mL (7.4%) and 27.0^0.

The widespread presence of *E. coli* across all analyzed samples is consistent with previous studies. For example, research on the microbiological quality of drinking water in flood-prone regions of Ghana also reported the ubiquitous presence of *E. coli* in all tested samples. Similarly, studies examining the population dynamics of *E. coli* in metropolitan water systems found its presence in all samples analyzed, confirming its persistence in contaminated water sources (Otorkpa *et al*., 2019; Masters et al., 2017; Doering *et al*., 2021).

In contrast, a study on the impacts of heavy floods associated with seasonal rainfall indicated that only 33% of water samples were contaminated with *E. coli* pathotypes (Shah *et al*., 2016). This discrepancy may be attributed to differences in the intensity and characteristics of flooding events, variations in water management practices, or environmental factors that influence microbial survival and proliferation (Unger *et al*., 2009).

Table 7: Status of *Escherichia Coli* of Analyzed Water Samples.

S/N	Water Sample Location	Result (cfu/ml)	All water Sample Areas (%)	Degree (^{0})
1.	Monday Market	4.8x10^3	35%	128.0^0
2.	Post Office	5.4x10^3	40.0	144.0^0
3.	College of Nursing	1.0x10^6	7.4	27.0^0
4.	Shehuri Area	1.2x10^6	8.9	32.0^0
5.	Buduri Area	1.1x10^6	8.1	29.0^0
	Total	**13.5x$10^{6cfu/m}$**	**100.0**	**360.0^0**

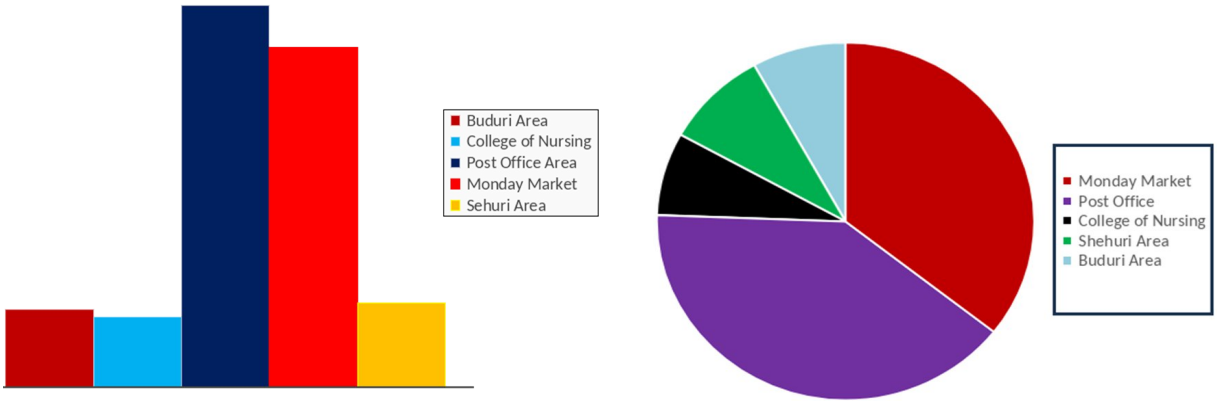


Figure 2: Status of Escherichia Coli of Analyzed Water Samples

Shigella Species

Shigellosis is primarily associated with water recreation, as individuals may accidentally ingest untreated water (Graciaa *et al*., 2018). While it can be caused by drinking contaminated water, wells are particularly vulnerable to Shigella contamination after flooding, especially if they are shallow or submerged for extended periods. Contamination can also occur due to sewage overflows, poorly maintained sewage systems, or polluted storm runoff (Knappett *et al*., 2012; Shafii *et al*., 2023). The presence of *Shigella* species in water samples from five sampling locations, Monday Market, Post Office, College of Nursing, Shehuri, and Buduri, was analyzed using the Pour Plate Count Analytical Method to determine colony-forming units (CFU) per milliliter (mL), as detailed in Table 8. The results showed significant contamination at Monday Market, with a concentration of 7.0 × 10^2 CFU/mL, representing 33.5% of the total contamination and 120.7^0. Post Office area followed closely with 5.4 × 10^2 CFU/mL (25.8% and 92.9^0), while Shehuri area had 4.9 × 10^2 CFU/mL (23.4% and 84.3^0). Lower contamination levels were found in Buduri area (2.0 × 10^2 CFU/mL, 9.7% and 34.6^0) and College of Nursing (1.6 × 10^2 CFU/mL, 7.6% and 27.5^0), as shown in Figure 3, Figure 7 and Table 8. This result aligns with the findings from several studies assessing the contamination of water sources with *Shigella* species after flooding, which consistently reported the widespread presence of the bacteria in water sources post flooding (Pandey *et al*., 2024; Yard *et al*., 2014). In contrast, a study on post-flood water quality found an average of 233 CFU/100mL of *Shigella* in water sources, which met the National Water Quality Standards for recreational use with body contact (Basri et al., 2015; Public Health Nigeria, 2022).

Table 8: Status of *Shigella* Species of Analyzed Water Samples.

S/N	Water Sample Location	Result (cfu/ml)	All water Sample Areas (%)	Degree (^{0})
1.	Monday Market	$7.0x10^2$	33.5	120.7
2.	Post Office	$5.4x10^2$	25.8	92.9
3.	College of Nursing	$1.6x10^2$	7.6	27.5
4.	Shehuri Area	$4.9x10^2$	23.4	84.3
5.	Buduri Area	$2.0x10^2$	9.7	34.6
	Total	**$20.9x10^2$**	**100.0**	**360.00**

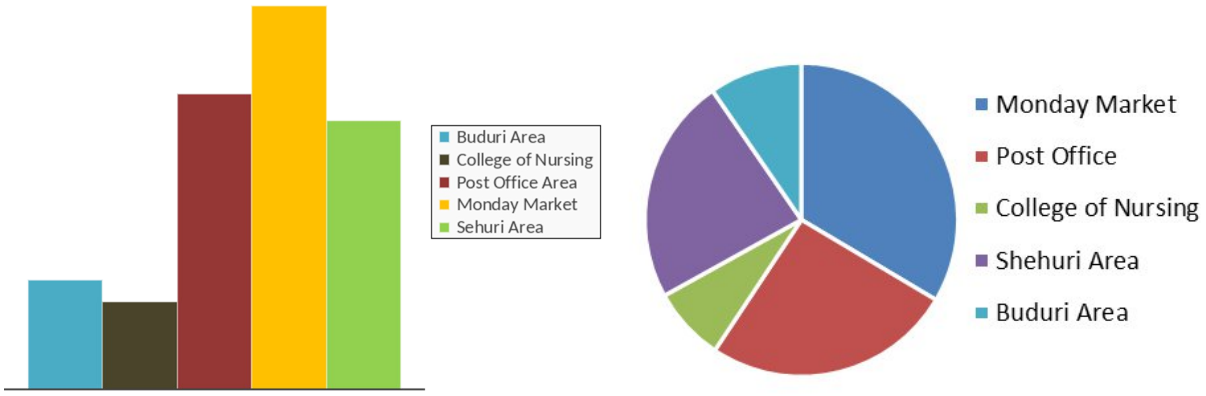


Figure 3: Status of *Shigella* Species of Analyzed Water Samples.

Salmonella Species

Salmonella spp. poses a substantial public health risk during and after flooding events (Levantesi et al., 2012; Song et al., 2018). Floods can facilitate the spread of *Salmonella* bacteria into various sources including public water supplies, drinking wells, and recreational bodies of water resulting in foodborne illness such as gastroenteritis, diarrhea, fever, and abdominal cramps (Andrade et al., 2018; Bett et al., 2021). Salmonella Species parameter was analysed using Pour Plate Laboratory Analytical Method in the measurement and determination of the value of the organisms in all the five water samples collected from Monday Market, Post Office, College of Nursing, Shehuri and Buduri areas. The results of the analysis were expressed in Colony Forming Units (CFU), per milliliter (ml). the sequence or ranking of contamination of the five (5) areas sampled and analysed included: Post Office area with $6.0x10^2$cfu/ml representing 38.5% and 139^0; Monday Market had $5.2x10^2$cfu/ml, representing 33.3% and 120^0; the College of Nursing had $1.8x10^2$ cfu/ml representing 11.5% and 41^0 Shehuri area had $1.4x10^2$cfu/ml representing 9.0% and 32^0 while Buduri area had $1.2x10^2$ cfu/ml 7.7% and 28^0 as shown in Figures 4 and 8 and Table 9. This result is consistent with the findings of studies (Nguyen et al., 2017; Blaskovich & Harris, 2023; Geldreich, 1996), which reported contamination of multiple water sources with *Salmonella* spp. during flooding events. However, a study on hurricane-induced flooding found that *Salmonella* was predominantly present in water samples from regions with swine farms, accompanied by a significant decrease in *Enterococcus* spp., suggesting pathogen removal by floodwaters. This could be due to the specific environmental conditions in areas affected by swine farming, as well as the distinct dynamics of pathogen transport and removal in floodwaters (Collender et al., 2016).

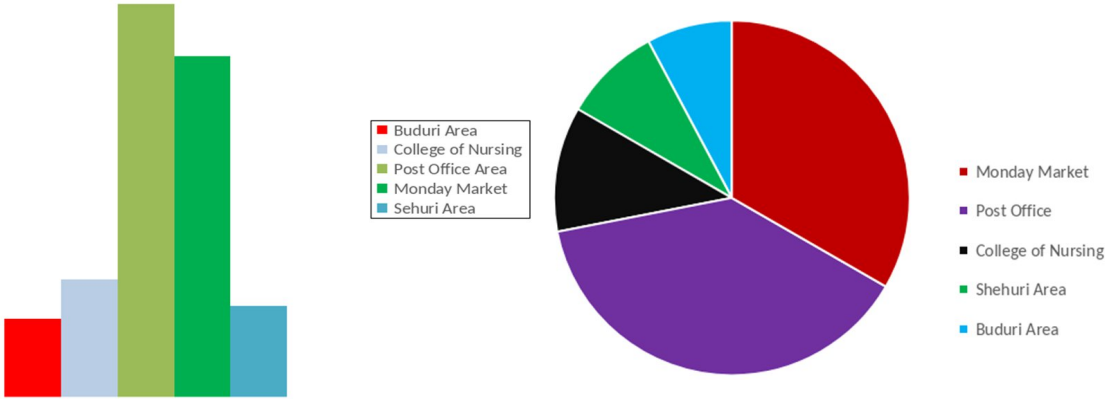


Figure 4: Status of Salmonella Species of Analyzed Water Samples.

Table 9: Status of Salmonella Species of Analyzed Water Samples.

S/N	Water Sample Location	Result (cfu/ml)	All water Sample Areas (%)	Degree (^{0})
1.	Monday Market	$5.2x10^2$	33.3	120^0
2.	Post Office	$6.0x10^2$	38.5 **Key**	139^0
3.	College of Nursing	$1.8x10^2$	11.5	41^0
4.	Shehuri Area	$1.4x10^2$	23.4	32^0
5.	Buduri Area	$1.2x10^2$	7.7	28^0
	Total	**$15.6x10^2$**	**100.0**	**360.00**

SUMMARY OF BACTERIOLOGICAL ANALYSIS

The bacteriological analysis of floodwater samples collected from five locations in Maiduguri Municipal Council Monday Market, Post Office, College of Nursing, Shehuri, and Buduri revealed significant contamination levels. Monday Market and Post Office were identified as the most affected areas. Among these, Monday Market exhibited the highest level of bacterial contamination, with an average Total Bacterial Count (TBC) of 41.2%, *Escherichia coli* at 35.6%, *Shigella* species at 33.5%, and *Salmonella* species at 33.3%, resulting in a combined average of 35.9%.

The Post Office area ranked second, with an overall average contamination level of 35.6%, comprising TBC at 38.1%, *Escherichia coli* at 40.0%, *Shigella* species at 25.8%, and *Salmonella* species at 38.5%. These high levels of contamination indicate that these two areas pose the greatest risk for bacterial exposure and waterborne diseases.

Moderate contamination levels were observed in Shehuri, with an average of 11.8%, while lower contamination was recorded in the College of Nursing and Buduri areas, with averages of 8.9% and 7.8%, respectively. The findings, summarized in Table 10 and visualized in Figure 9, highlight the heightened risk of waterborne bacterial infections in flood-impacted zones, particularly at Monday Market and Post Office. Studies have implicated these microorganisms as major contaminants of water sources in Nigeria.

Table 10: Summary of the Bacteria Isolation in Relation to Water Sample Areas

S/N	Water Sample Location	TBC	Escherichia Coli Spp	Shigella Spp	Salmonella Spp	Total
1.	Monday Market	41.2	35.6	33.5	33.3	35.9
2.	Post Office	38.1	40.0	25.8	38.5	35.6
3.	College of Nursing	8.9	7.4	7.6	11.5	8.9
4.	Shehuri Area	6.2	8.9	23.4	9.0	11.8
5.	Buduri Area	5.6	8.1	9.7	7.7	7.8
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

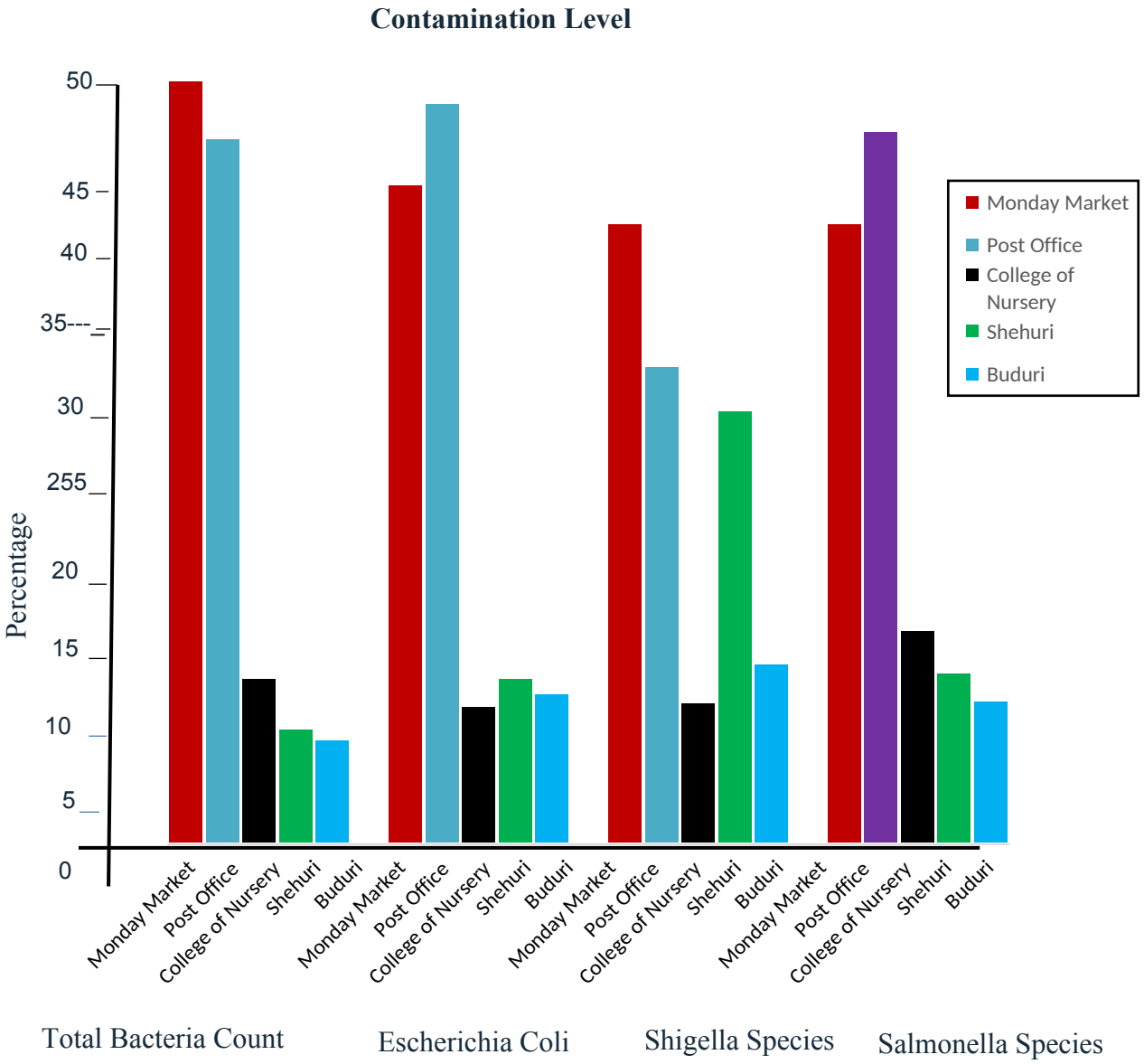


Figure 5: Result of Laboratory Analysis of Water Sample

CONCLUSION

The microbiological analysis of water samples collected from flood-affected areas and drinking water sources in Maiduguri, Borno State, following the collapse of Alau Dam, revealed substantial bacterial contamination with potential public health implications. Elevated total bacterial counts (TBC) were reported across the sampled locations, with Monday Market recording the highest count, followed by the Post Office area. The reported detection of *Escherichia coli*, *Shigella* spp., *Salmonella* spp., and *Vibrio cholerae* raises concerns about the microbiological safety of the sampled water and the potential for exposure to organisms associated with waterborne infections.

These findings highlight the importance of ensuring access to safe drinking water in communities affected by flooding. Relevant interventions include the provision of safe alternative water supplies, appropriate household water treatment, protection of water sources

from further contamination, improved sanitation and waste management, and public education on safe water handling and hygiene practices. Environmental health authorities should also strengthen routine water-quality monitoring and disease surveillance to identify potential hazards promptly and guide appropriate public health responses.

Furthermore, coordinated action among public health agencies, environmental health professionals, water and sanitation authorities, and affected communities is necessary to reduce exposure to contaminated water and support recovery following flood disasters. Future investigations should include more extensive sampling across affected locations, clear differentiation between floodwater and drinking water sources, and robust microbiological identification and reporting procedures. Such efforts would provide a stronger evidence base for assessing contamination patterns, prioritizing interventions, and evaluating the effectiveness of water-safety measures. Overall, the findings underscore the need for sustained water-quality surveillance, improved sanitation infrastructure, and timely public health interventions to protect communities from potential waterborne disease risks following flooding.

Declarations

Declaration of Ethical Responsibilities

All authors have read, understood, and have complied as applicable with the statement on "Ethical Responsibilities of Authors" as found in the Instructions for Authors.

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Contributions

A.A.U and B.M.Y conceptualized the current study. B.M.Y, A.A.U., O.J.O and A.A.N wrote the first draft manuscript. A.A.U B.M.Y., O.J.O., B.M.T., A.A.N, S.E., E.B.A., C.O., and S.M.S. edited and reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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Ethics Declarations

Ethics Approval and Consent to Participate

This article does not contain any studied with human participants or animals performed by any of the authors.

Informed Consent

Not applicable.

Competing Interests

The authors declare that they have no competing interests.

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