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ORIGINAL RESEARCH ARTICLE

Quality and Health Risk Assessment of Harvested Rainwater Collected from Corrugated Iron Rooftops in Gashaka Lamorde, Mubi, Adamawa State, Nigeria

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ABSTRACT

This study assessed the quality of rainwater harvested from corrugated iron rooftops in Gashaka Lamorde, Mubi Metropolis, Adamawa State, Nigeria, to determine its suitability for domestic use and evaluate associated health risks. Rainwater samples were collected from selected locations during the rainy season between May and September. Standard analytical procedures were used to determine physicochemical parameters, heavy metal concentrations, and microbiological quality, while health risk assessment models were applied to evaluate carcinogenic and non-carcinogenic risks in adults and children. The results showed variations in water quality across sampling locations and periods. Most physicochemical parameters were within recommended drinking water standards, while heavy metals detected were generally below permissible limits. However, total coliform bacteria were detected in several samples, indicating microbial contamination likely associated with rooftop debris and environmental pollutants. Non-carcinogenic health risks were generally within acceptable safety limits, although children showed relatively higher exposure risks than adults. Carcinogenic risk values were mostly within internationally acceptable limits. Overall, harvested rainwater from corrugated iron rooftops in the study area can serve as an alternative domestic water source, but routine monitoring, proper rooftop maintenance, and appropriate treatment before consumption are recommended to ensure public health safety.

Introduction

Water is an essential natural resource required for human survival, environmental sustainability, and socioeconomic development. However, access to safe and reliable water remains a major challenge in many developing nations, particularly in rural and semi-urban communities where conventional municipal water supply systems are inadequate or non-existent. As a result, rainwater harvesting has become an important alternative source of domestic water supply in many regions to bridge the water demand gap (Terêncio et al., 2018).

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Rainwater harvesting involves the collection and storage of rainwater from rooftops or other catchment surfaces for domestic, agricultural, and environmental purposes. This practice has gained increasing attention globally because it can significantly reduce pressure on conventional groundwater and surface water resources while improving seasonal water availability in water-scarce communities (Eludoyin et al., 2021). In many parts of Nigeria, harvested rainwater is commonly used for drinking, cooking, washing, and other vital household activities due to inadequate access to treated pipe-borne water infrastructure (Musa et al., 2017).

Although rainwater is often considered relatively clean during atmospheric fall, its chemical and physical quality may be deeply influenced by several localized environmental factors. These include atmospheric deposition, rooftop material composition, windblown dust particles, and animal droppings deposited on roof catchment surfaces before rainfall events (De Buyck et al., 2021). Catchment materials are particularly important because they may introduce chemical contaminants into the harvested rainwater through continuous corrosion and leaching processes. Corrugated iron roofing sheets are widely used across Nigeria because of their affordability, durability, and commercial availability, but they can potentially introduce trace metals into harvested water systems during precipitation events (Mendez et al., 2011; Itodo et al., 2021).

The microbiological quality of harvested rainwater is also a critical public health concern. Previous studies have reported the presence of coliform bacteria in rooftop-harvested rainwater due to fecal and organic contamination from environmental debris and animal wastes deposited on rooftop surfaces by birds and rodents (Ezemonye et al., 2016). Ingestion of contaminated water can dramatically increase the risk of waterborne diseases and outbreaks, particularly in communities where harvested rainwater is consumed raw without prior treatment (Gundry et al., 2012).

In addition to microbiological hazards, the presence of heavy metals in drinking water poses significant chronic health risks when concentrations rise above recommended international limits. Long-term exposure to heavy metals such as chromium, cadmium, lead, and nickel can result in severe toxic effects, including chronic kidney damage, permanent neurological disorders, and increased lifetime cancer risks (Ali et al., 2019). Therefore, regular field monitoring of harvested rainwater quality is necessary to safeguard public health and ensure its safety for domestic use.

Despite the widespread use of corrugated iron rooftops for rainwater harvesting in Gashaka Lamorde, Mubi LGA, limited information exists regarding the local physicochemical characteristics, microbiological quality, heavy metal concentrations, and associated health risks of harvested rainwater in this community. This study was therefore conducted to assess the quality of rainwater harvested from corrugated iron rooftops in Gashaka Lamorde, Mubi LGA, Adamawa State, Nigeria, and to evaluate its chemical and biological suitability for domestic consumption.

Materials and Methods

Materials

All reagents and chemicals used in this study were of analytical grade. Nitric acid (HNO_3) and hydrogen peroxide (H_2O_2) were used for sample digestion, while ultrapure water was used for dilution and rinsing of laboratory apparatus. Clean acid-washed plastic containers were used for sample collection to prevent contamination. Instruments used in the analysis included a calibrated pH meter, dissolved oxygen (DO) meter, biochemical

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oxygen demand (BOD) incubator, membrane filtration unit, and Atomic Absorption Spectrophotometer (AAS).

Study Area

The study was conducted in Mubi Metropolis, the second largest commercial town in Adamawa State, Nigeria. The metropolis covers an estimated land area of approximately 600 km² and lies about 260 km north of Yola, the state capital. Geographically, the metropolis is located between latitudes 10°05′ and 10°30′ N of the equator and between longitudes 13°12′ and13°19′ E of the Greenwich meridian (Yohanna et al., 2014).

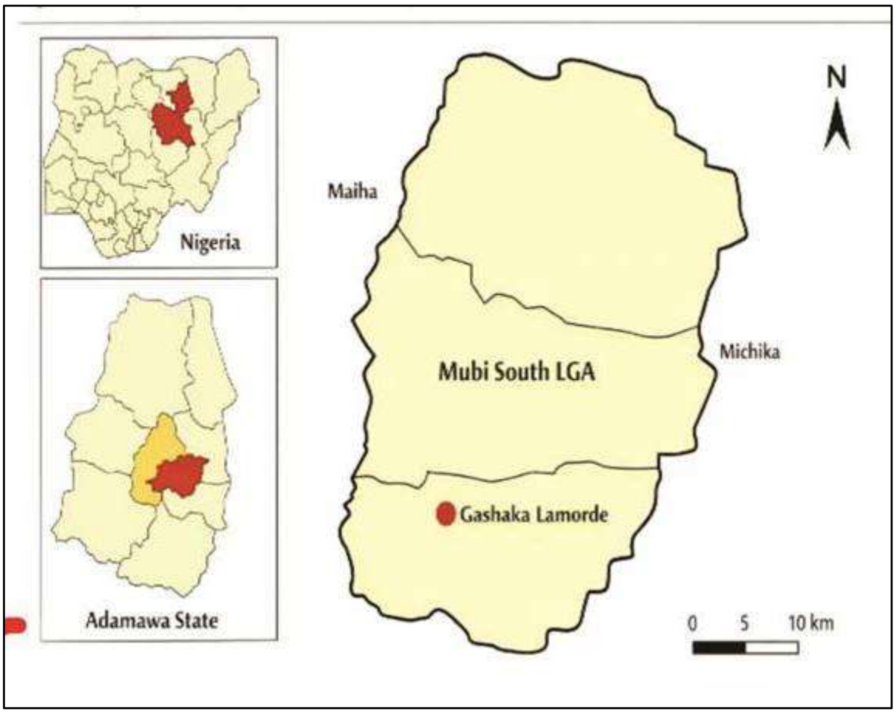

Figure 1: The Study Area

Sample Collection and Preparation

Rainwater samples were collected from corrugated iron rooftops in selected residential buildings within Mubi Metropolis during the rainy season in May, July, and September. Three replicate samples were collected during each sampling period, resulting in a total of nine harvested rainwater samples.

Control samples of rainwater were collected at ground level in open spaces to minimize rooftop interference. These control samples were used to evaluate the influence of rooftop surfaces on rainwater quality.

Samples were collected from Gashaka Lamorde using clean plastic containers previously rinsed with nitric acid. Immediately after collection, samples were filtered through 0.45 µm membrane filters to remove suspended particles. The filtered samples were transported to the laboratory in ice-cooled containers and stored below 4°C prior to analysis

Digestion Procedure

Sample digestion was carried out using a microwave digestion method to ensure complete dissolution of heavy metals. A volume of 100 mL of each filtered rainwater sample was transferred into a microwave

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digestion vessel. Subsequently, 5 mL of concentrated nitric acid (HNO_3) and 2 mL of hydrogen peroxide (H_2O_2) were added. The mixture was digested at 600 W for 10 minutes at 180°C. After digestion, the samples were allowed to cool to room temperature and diluted to a final volume of 50 mL using ultrapure water.

Heavy Metal Analysis

The concentrations of zinc (Zn), lead (Pb), cadmium (Cd), nickel (Ni), manganese (Mn), and chromium (Cr) were determined using Atomic Absorption Spectrophotometry (AAS) following the method described by Alexander et al. with slight modifications.

The digested samples were analyzed under the following operating conditions:

- Wavelengths (nm): Pb (217.0), Cd (228.8), Cr (357.9)
- Slit width: 0.5 nm
- Lamp current: 10 mA
- Flame type: Air–acetylene

An aliquot of each digested sample was aspirated into the AAS instrument and absorbance readings were recorded. Quality assurance procedures included reagent blanks, duplicate samples, certified reference materials, and spiked samples to ensure analytical accuracy and precision.

Determination of Physicochemical Parameters

Physicochemical parameters including pH, temperature, dissolved oxygen (DO), and biochemical oxygen demand (BOD) were determined using standard analytical procedures.

pH and Temperature

The pH and temperature of harvested rainwater samples were measured immediately after sample collection using a calibrated pH meter and temperature probe.

Dissolved Oxygen (DO)

The DO meter was calibrated using 0% and 100% saturation solutions before analysis. The probe was inserted into well-mixed rainwater samples and initial DO readings were recorded. Samples were subsequently incubated for five days at 20 ± 1°C before final DO measurements were taken.

Bacteriological Analysis (Total Coliform)

Total coliform counts were determined using the membrane filtration technique according to the American Public Health Association (APHA, 2017). Samples were filtered through membrane filters and placed on m-Endo agar. The plates were incubated at 35 ± 0.5°C for 24 hours, after which characteristic coliform colonies were counted and expressed as CFU/100 mL.

Health Risk Assessment

Chronic Daily Intake (CDI)

Health risk assessment for heavy metals was conducted using the chronic daily intake (CDI) model according to Ugwu et al. (2022):

$$CDI=C\times IR\times EF\times ED\times BW\times AT$$

Where:

- C = concentration of metal in water (mg/L)
- IR = ingestion rate
- EF = exposure frequency
- ED = exposure duration
- BW = body weight
- AT = averaging time

Non-Carcinogenic Risk Assessment

Non-carcinogenic risk was evaluated using the Hazard Quotient (HQ):

$$HQ=CDIRfD$$

Where:

- CDI = chronic daily intake
- RfD = reference dose

The Hazard Index (HI) was obtained by summing the HQ values for all metals. Values less than 1 indicate negligible health risk,

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while values greater than or equal to 1 indicate potential health risk.

Carcinogenic Risk Assessment

Carcinogenic risk was estimated using the Incremental Lifetime Cancer Risk (ILCR) equation:

$ILCR = CDI \times CSF$

Where:

- CDI = chronic daily intake
- CSF = cancer slope factor

The acceptable cancer risk range was considered to be 1×10^{-6} to 1×10^{-4}, as recommended by the United States Environmental Protection Agency.

Statistical Analysis

A one-way analysis of variance (ANOVA) was used to evaluate significant differences in physicochemical parameters, heavy metal concentrations, and microbiological characteristics across sampling locations and months. Statistical analysis was performed using SPSS, with significance set at $p \leq 0.05$. Post-hoc comparisons were conducted using Tukey's HSD test.

Results and Discussion

Physicochemical Properties, Heavy Metals, and Total Coliform Levels of Harvested *Rainwater from Corrugated Iron Rooftop (May–September) at Gashaka Lamorde, Mubi*

The results of Physicochemical Properties, Heavy Metals, and Total Coliform Levels of Harvested Rainwater from Corrugated Iron Rooftop (May–September) at *Gashaka Lamorde*, Mubi are presented on Table 1.

Temperature

The temperature of the harvested rainwater from the corrugated iron rooftops in Gashaka Lamorde ranged from 25.50 ± 0.12 °C to 27.20 ± 0.12 °C across the testing periods, while the corresponding atmospheric control samples ranged from 24.50 ± 0.15 °C to 26.20 ± 0.40 °C. All recorded temperatures were within the ambient limits recommended by international and national regulatory authorities, including the World Health Organization (WHO), United States Environmental Protection Agency (USEPA), and National Agency for Food and Drug Administration and Control (NAFDAC).

The relatively higher temperatures consistently observed in the rooftop runoff samples compared to the control points can be directly attributed to solar radiation and heat absorption by the metallic corrugated iron roofing sheets prior to and during precipitation events. Ambient factors and seasonal weather variations also regulated the overall baseline. Because temperature deeply influences several physicochemical and biological processes in water—such as microbial growth rates, chemical solubility, and dissolved oxygen concentrations—maintaining these stable baselines is vital. Overall, the values obtained indicate that the harvested rainwater in Gashaka Lamorde maintained acceptable thermal conditions suitable for domestic utilities.

pH

The pH values of the harvested rainwater ranged from 6.90 ± 0.06 to 7.70 ± 0.30, while the control samples ranged from 6.20 ± 0.06 to 7.60 ± 0.06. Most of the pH values fell within the permissible range of 6.5–8.5 recommended by WHO, USEPA, and NAFDAC, except the May control sample which was slightly acidic. The near-neutral pH values indicate that the harvested rainwater was chemically stable and suitable for domestic applications. Variations in pH may be associated with atmospheric deposition, seasonal changes, and interactions between rainwater and roofing materials.

Biological Oxygen Demand (BOD)

The Biological Oxygen Demand values ranged from 5.90 ± 0.25 mg/L to 7.82 ± 0.06 mg/L in the harvested rainwater samples and from 5.60 ± 0.10 mg/L to 6.50 ± 0.16 mg/L in the control

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samples. The values were within the USEPA recommended range of 5–10 mg/L but exceeded the NAFDAC permissible limit of 5 mg/L in most cases. Elevated BOD values indicate the presence of biodegradable organic matter in the harvested rainwater, likely originating from bird droppings, dust particles, leaves, and other organic debris accumulated on rooftop surfaces before rainfall. Increased BOD levels may encourage microbial growth and reduce water quality.

Dissolved Oxygen (DO)

The dissolved oxygen concentrations ranged from 5.20 ± 0.06 mg/L to 6.85 ± 0.80 mg/L in the harvested rainwater and from 5.96 ± 0.10 mg/L to 8.23 ± 0.06 mg/L in the control samples. These values were within the WHO and USEPA permissible limits of 5–8 mg/L. The relatively lower dissolved oxygen concentrations observed in some rooftop samples may be associated with elevated BOD levels, as microorganisms consume oxygen during the decomposition of organic matter. Nevertheless, the dissolved oxygen values suggest adequate aeration and acceptable water quality.

Lead (Pb)

Lead was not detected in either the harvested rainwater or control samples throughout the study period. This is a positive finding because lead is highly toxic and may cause neurological, kidney, and developmental disorders when present in drinking water. The absence of lead suggests that the roofing materials and surrounding environment did not contribute detectable lead contamination to the harvested rainwater.

Zinc (Zn)

Zinc concentrations ranged from 0.15 ± 0.01 mg/L to 0.30 ± 0.06 mg/L in the harvested rainwater samples, while the control samples ranged from 0.02 ± 0.06 mg/L to 0.04 ± 0.01 mg/L. Although zinc concentrations were higher in the rooftop samples, all values remained well below the permissible limit of 5.0 mg/L established by WHO, USEPA, and NAFDAC. The presence of zinc may be attributed to corrosion and leaching from the corrugated iron roofing sheets during rainfall. However, the concentrations recorded are considered safe and do not pose significant health risks.

Chromium (Cr)

Chromium was not detected in any of the harvested rainwater or control samples throughout the study period. This suggests that there was no chromium contamination from either environmental sources or the roofing materials. The absence of chromium indicates good chemical quality of the harvested rainwater with respect to this parameter.

Nickel (Ni)

Nickel was not detected in all samples analyzed. This finding indicates that the harvested rainwater was free from nickel contamination and suggests minimal industrial or metallic pollution within the study area

Cadmium (Cd)

Cadmium was not detected in any of the harvested rainwater or control samples. Since cadmium is a highly toxic heavy metal associated with kidney damage and other health complications, its absence indicates that the harvested rainwater was chemically safe regarding cadmium contamination.

Manganese (Mn)

Manganese concentrations ranged from 0.02 ± 0.00 mg/L to 0.03 ± 0.01 mg/L in both the harvested rainwater and control samples. These values were below the permissible limits recommended by WHO, USEPA, and NAFDAC. The low manganese concentrations suggest minimal leaching from the corrugated iron roofing materials and indicate that

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manganese contamination was not a significant concern in the harvested rainwater.

Total Coliform

The total coliform counts ranged from 5.00 ± 1.0 CFU/100 mL to 6.0 ± 1.0 CFU/100 mL in the harvested rainwater samples and from 2.00 ± 0.00 CFU/100 mL to 6.00 ± 0.00 CFU/100 mL in the control samples. All values exceeded the WHO, USEPA, and NAFDAC permissible limit of 0 CFU/100 mL for potable water. The presence of total coliform bacteria indicates microbial contamination, which may have originated from bird droppings, dust particles, animal waste, and decaying organic matter deposited on the rooftop surfaces before rainfall. This suggests that the harvested rainwater may not be suitable for direct human consumption without proper treatment such as boiling, filtration, or disinfection.

The harvested rainwater from corrugated iron rooftops in Gashaka Lamorde, Mubi LGA exhibited acceptable physicochemical characteristics and low concentrations of heavy metals, with most parameters falling within recommended permissible limits. However, the elevated BOD values and the presence of total coliform bacteria indicate organic and microbial contamination. Therefore, although the harvested rainwater may be suitable for some domestic purposes, adequate treatment is recommended before drinking to ensure compliance with safe water quality standards

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Table 1: Physicochemical properties, heavy metals, and coliform level of harvested rainwater on Corrugated Iron Roof Top (May-September) in Gashaka Lamorde Mubi LGA

Corrugated Iron Roof Top									
	May		**July**		**Sept**		**Permissible Limits**		
Parameters	**Test Sample**	**Control**	**Test Sample**	**Control**	**Test Sample**	**Control**	**WHO, 2015**	**USEPA, 2015**	**NAFDAC, 2015**
Temp (^oC)	27.20 ± 0.12^a	24.50 ± 0.15^b	$26.20 \pm .20^b$	26.20 ± 0.40^a	25.50 ± 0.12^a	25.10 ± 0.10^b	Ambient	Ambient	Ambient
Ph	7.10 ± 0.06^a	6.20 ± 0.06^b	6.90 ± 0.06^a	7.60 ± 0.06^b	7.70 ± 0.30^a	7.50 ± 0.50^a	6.5-8.5	6.5-8.5	6.5-8.5
BOD (mg/L)	7.82 ± 0.06^a	6.40 ± 0.06^b	6.00 ± 0.0^a	6.50 ± 0.16^b	5.90 ± 0.25^a	5.60 ± 0.10^a	-	5-10	5
DO (mg/L)	5.20 ± 0.06^b	8.23 ± 0.06^a	5.81 ± 0.20^b	5.96 ± 0.10^a	6.85 ± 0.80^a	6.60 ± 0.60^b	5-8	5	5
Pb (mg/L)	ND	ND	ND	ND	ND	ND	0.01	-	0.01
Zn (mg/L)	0.15 ± 0.01^a	0.03 ± 0.01^b	0.30 ± 0.06^b	0.04 ± 0.01^a	0.30 ± 0.01^a	0.02 ± 0.06^b	5.0	5.0	5.0
Cr (mg/L)	ND	ND	ND	ND	ND	ND	0.05	0.1	0.05
Ni (mg/L)	ND	ND	ND	ND	ND	ND	0.07	0.1	0.15
Cd (mg/L)	ND	ND	ND	ND	ND	ND	0.003	0.005	0.003
Mn (mg/L)	0.02 ± 0.00^a	0.02 ± 0.0^a	0.03 ± 0.01^a	0.03 ± 0.01^a	0.03 ± 0.00^b	0.02 ± 0.01	0.4	0.05	0.05
Total *coliform* (CFU/100mL)	6.0 ± 1.0^a	6.00 ± 0.00^b	5.00 ± 1.0^a	2.00 ± 0.00^b	5.50 ± 0.50^a	3.00 ± 1.0^b	0	0	0

Values are presented as Mean ± SEM for three determinations (n = 3).
Values with different superscript letters within the same row are significantly different at $p < 0.05$.
ND = Not Detected

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Table 2: Total Hazard Quotient (THQ) of Adults for Corrugated Iron Rooftops

Location	May Test	May Control	July Test	July Control	Sept Test	Sept Control
Gashaka Lamorde	0.055072	0.043642	0.089784	0.065024	0.089784	0.042689

The empirical results show that all calculated adult THQ values in Gashaka Lamorde remained significantly below the critical international regulatory safety threshold of 1.0. Toxicologically, a THQ value below unity signifies that the daily exposure dose does not exceed the pathologically acceptable daily intake limit. Consequently, the long-term consumption of harvested rainwater in this community is highly unlikely to cause adverse systemic or non-carcinogenic health complications for adult consumers.

The adult THQ indices demonstrated subtle variations across the sampling timeline. The lowest risk value for test samples was observed during the May test phase (0.055072), while the highest values peaked identically during the July and September testing intervals at 0.089784. This slight increase during the mid-to-late rainy season points to continuous, low-level atmospheric deposition or progressive physical weathering of the corrugated iron matrices. Conversely, the control samples fluctuated within a narrow range from 0.042689 to 0.065024. The marginal variance between the rooftop test samples and the direct atmospheric control values confirms that the localized roofing substrate introduces minimal heavy metal contaminants into the harvested supply.

The low THQ profile across all months suggests a pristine ambient environment and exceptional water purity regarding non-carcinogenic trace metals. However, to prevent any cumulative toxicological shifts over extended periods, routine water quality monitoring and the deployment of basic point-of-use filtration systems are recommended to preserve these safe baseline levels.

Non-Carcinogenic Health Risk Assessment for Children

The potential for non-carcinogenic health issues in children consuming harvested rainwater from corrugated iron setups was calculated using pediatric-specific THQ parameters. Children are a key high-risk group in environmental toxicological assessments. Their smaller physiological body volume, rapidly growing organs, undeveloped toxicological filtration mechanisms, and higher daily water ingestion rate per kilogram of body weight make them highly vulnerable to trace metal toxicity. The pediatric THQ findings for Gashaka Lamorde are displayed in Table 3.

Table 3: Total Hazard Quotient (THQ) of Children for Corrugated Iron Rooftops

Location	May Test	May Control	July Test	July Control	Sept Test	Sept Control
Gashaka Lamorde	0.128548	0.101881	0.209524	0.151747	0.209524	0.099658

The data shows that all pediatric THQ values in Gashaka Lamorde remained safely below the 1.0 toxicological limit throughout the entire study. The values ranged from a minimum control value of 0.099658 in September to a maximum test value of 0.209524 during both July and September. Because these values remain well below 1.0, the untreated rainwater poses no immediate

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non-carcinogenic health hazards to the local pediatric population.

A comparative cross-cohort analysis reveals that the children's THQ values were consistently higher than the adults' indices across all matching testing intervals. For example, during the July and September test periods, the adult THQ was 0.089784, whereas the child THQ increased to 0.209524. This trend confirms the heightened vulnerability of children to identical environmental exposure pathways due to their lower body mass index.

The low heavy metal footprint in the rainwater samples protects children from systemic issues like developmental delays, cognitive changes, or metabolic imbalances. However, because the child THQ values approach roughly 21% of the maximum safety threshold during peak months, public health measures remain important. Implementing first-flush diverters on local rainwater harvesting systems will help prevent any seasonal surges in trace contaminants and keep pediatric risks low.

The Incremental Lifetime Cancer Risk (ILCR) model assesses potential lifetime cancer risks from heavy metal exposure in harvested rainwater based on a 70-year lifespan. International frameworks define an ILCR between 1.0×10^{-6} and 1.0×10^{-4} as tolerable, with values exceeding 1.0×10^{-4} indicating serious public health risks requiring remediation.

Carcinogenic Risk Assessment

The carcinogenic risks associated with exposure to heavy metals through the consumption of harvested rainwater from corrugated iron rooftops were evaluated using the Incremental Lifetime Cancer Risk (ILCR) model. The ILCR estimates the probability of an individual developing cancer over a lifetime as a result of exposure to carcinogenic contaminants. According to international regulatory guidelines, an ILCR value within the range of 1.0×10^{-6} to 1.0×10^{-4} is generally considered acceptable, while values exceeding 1.0×10^{-4} may indicate potential carcinogenic health concerns.

The results showed that no carcinogenic risk was recorded in Gashaka Lamorde, as all ILCR values for the adult demographic were zero throughout the entire sampling period. This indicates that the long-term consumption of harvested rainwater from corrugated iron rooftops in this locality does not present a quantifiable lifetime cancer risk for adults.

The complete absence of carcinogenic risk in Gashaka Lamorde may be attributed to the non-detection or extremely low concentrations of carcinogenic heavy metals—such as lead, cadmium, chromium, and arsenic—in the harvested rainwater samples. This lower metal footprint suggests that the local corrugated iron roofing sheets and the ambient atmospheric conditions do not release or deposit dangerous levels of chemical mutagens into the runoff during the wet season.

Cancer Risk for Children

The carcinogenic risk associated with the consumption of harvested rainwater by children was also evaluated using the ILCR model. Children are generally more susceptible to carcinogenic contaminants because of their lower body weight, developing organs, and higher exposure rates relative to body mass.

Similar to the adult assessment, Gashaka Lamorde recorded zero carcinogenic risk for children throughout the study period, suggesting minimal exposure to carcinogenic contaminants. Despite the inherent physiological vulnerabilities of the pediatric cohort, the absolute lack of detectable carcinogenic heavy metals in the harvested rainwater completely eliminates the statistical probability of lifetime cancer development via this ingestion pathway.

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The findings confirm that the roofing material substrate and air quality conditions in this community provide an alternative water supply that is chemically safe from a carcinogenic standpoint across all evaluated seasonal months. However, continuous monitoring and appropriate treatment of harvested rainwater are recommended to maintain safe water quality standards over long periods.

Properties, Heavy Metals, and Total Coliform Levels of Harvested Rainwater from Corrugated Iron Rooftop in Gashaka Lamorde, Mubi LGA

The results of the physicochemical properties, heavy metals, and total coliform levels of harvested rainwater collected from corrugated iron rooftops in Gashaka Lamorde, Mubi LGA during May, July, and September revealed variations across the sampling periods. The observed values were compared with standards established by the World Health Organization (WHO), United States Environmental Protection Agency (USEPA), and National Agency for Food and Drug Administration and Control (NAFDAC).

Conclusion

This study assessed the physicochemical characteristics, heavy metal concentrations, microbiological quality, and potential health risks of rainwater harvested from corrugated iron rooftops in Gashaka Lamorde, Mubi, Adamawa State, Nigeria. The results showed that most physicochemical parameters were within the guideline limits recommended by WHO, USEPA, and NAFDAC. Heavy metals were either not detected or occurred at concentrations below the permissible limits, indicating that contamination from the roofing material was minimal.

Despite the acceptable chemical quality, total coliform bacteria were detected in all harvested rainwater samples, indicating microbial contamination and rendering the water unsuitable for direct consumption without treatment. The health risk assessment further showed that both non-carcinogenic and carcinogenic risks associated with heavy metal exposure were within acceptable limits for adults and children, suggesting that heavy metals do not currently pose a significant health concern in the study area.

On a general note, the harvested rainwater from corrugated iron rooftops can serve as an important supplementary source of domestic water in Gashaka Lamorde where conventional water supplies are limited. However, appropriate treatment measures, including first-flush diversion, filtration, disinfection, and regular cleaning of rooftop catchments and storage facilities, should be adopted before the water is used for drinking. Periodic monitoring of harvested rainwater quality is also recommended to ensure its continued safety for domestic use.

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