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INVESTIGATION OF ENVIRONMENTAL BACKGROUND RADIATION IN THE SURROUNDINGS OF THE ARTS AND SCIENCE FACULTIES, AHMADU BELLO UNIVERSITY, ZARIA

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Abstract

This study evaluates natural radioactivity levels around the Faculties of Arts and Science at Ahmadu Bello University, Zaria, with the aim of assessing potential radiological hazards and ensuring environmental safety. A portable gamma-ray spectrometer was used to measure the activity concentrations of Potassium (K), Uranium (U), and Thorium (Th) at 50 selected locations within the study area. GPS coordinates were recorded at each site to enable the spatial mapping of radiation distribution. From the measured activity concentrations, the absorbed dose rates were calculated and used to estimate the annual

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effective dose (AED) as well as radiological hazard indices, including the external hazard index (Hex) and internal hazard index (Hin). The results showed notable variations in radioactivity levels across the study area, with Uranium and Thorium contributing significantly to elevated dose rates. Spatial distribution analysis revealed that the northern and central regions exhibited relatively higher radiation levels compared to other parts of the faculty. The estimated annual effective doses for most of the sampled locations were found to be within the recommended safety limits provided by the International Commission on Radiological Protection (ICRP). However, a few locations exceeded the global average background radiation levels, indicating the necessity for regular monitoring. This research provides critical baseline data on background radiation in a key academic environment and underscores the importance of environmental radiation surveillance. The findings highlight areas that may require future attention to mitigate long-term exposure risks and maintain a safe learning and working environment.

Introduction

Exposure to natural background radiation is inevitable and generally considered harmless at low levels. However, prolonged exposure to elevated radiation doses has been linked to increased risks of adverse health effects, including cancer and genetic mutations (ICRP, 2007). To ensure safety, various international organizations (such ICRP, 2007; UNSCEAR, 2000; WHO, 2016) have established guidelines for permissible radiation levels. As such, understanding the spatial distribution and intensity of natural radioactivity is crucial for evaluating potential health risks and implementing effective safety measures. Several studies across Nigeria have investigated natural radioactivity levels, revealing notable spatial variations influenced by geological and anthropogenic factors (Ahmad et al., 2017; Suleiman & Yakubu, 2019; Bello & Ibrahim, 2020; Onuh et al., 2021). These investigations commonly utilize techniques such as soil sampling, in-situ gamma spectrometry, and indoor radon measurements to quantify radionuclide concentrations and estimate radiation doses (Gilmore, 2008; Mahur et al., 2008; Knoll, 2010; Oke et al., 2020; Akpan &

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Adamu 2021). Obed et al. (2005) analyzed the distribution of population radiation doses based on soil radioactivity concentrations in 18 cities across Nigeria. Their findings indicated considerable variability in the concentrations of ^{238}U, ^{232}Th, and ^{40}K, largely shaped by local geology and land use practices. Similarly, Ademola (2008) conducted a study on natural radioactivity in soils and water around a cement factory in Ewekoro, Southwestern Nigeria. The results revealed elevated radionuclide levels, attributed to both the area's geological composition and ongoing industrial activities. Environmental background radiation is a critical component of the natural radiation environment to which all living organisms are continuously exposed. This radiation originates from naturally occurring radioactive materials such as Potassium-40 (^{40}K), Uranium-238 (^{238}U), and Thorium-232 (^{232}Th), which are found in soil, rocks, and building materials (Cothern & Rebers, 1990; Gupta & Sinha, 2007; Ademola, 2008).

Although background radiation is often regarded as harmless at low levels, prolonged exposure to elevated radiation levels can pose significant health risks, including increased chances of cancer and genetic mutations. Therefore, periodic assessment of background radiation in inhabited areas, especially academic institutions, is essential to ensure the safety and well-being of staff, students, and the public. The presence of natural radionuclides in the environment, while common, can pose health risks through prolonged exposure. Elevated levels of background radiation can increase the likelihood of cancer and other radiation-induced diseases (WHO, 2016).

Ahmadu Bello University (ABU), Zaria, is one of the largest and most prestigious institutions in Nigeria, with diverse faculties and high daily human traffic. Among these are the Faculties of Arts and Science, which accommodate numerous buildings, laboratories, and lecture halls that may contribute to environmental radiation due to their construction materials or proximity to naturally radioactive sources. However, there is a paucity of data on the radiological conditions within this part of the university campus. This study aims to investigate the environmental background radiation in the vicinity of the Arts and Science Faculties of ABU, Zaria. By employing portable gamma-ray spectrometry and geospatial analysis, this research seeks to evaluate the spatial distribution of radiation levels and assess any potential radiological hazards. The findings will

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serve as a valuable reference for environmental safety planning and radiological protection on campus.

Study Area

The study area covers the Faculty of Arts and Science at Ahmadu Bello University (ABU), Zaria—a renowned academic institution situated in Zaria, Kaduna State, Nigeria. This section outlines the geographical, geological, and environmental characteristics of the study site. Located within the Samaru campus of ABU, the Faculty of Arts and Science lies approximately 12 kilometers north of Zaria's city center. The campus is geographically positioned between latitudes 11.153 °N and 11.168 °N, and longitudes 7.622 °E and 7.639 °E. It spans a considerable area, offering a varied landscape that is well-suited for investigating natural background radiation. Geologically, the Zaria region is underlain by diverse rock types, including granites, schists, and gneisses. These rocks are known to contain naturally occurring radionuclides such as uranium (^{238}U), thorium (^{232}Th), and potassium (^{40}K), which contribute to background radiation levels. The campus environment features a combination of natural vegetation and landscaped zones, resulting in spatial variability in soil and rock composition that may influence the distribution of radioactivity across the area.

MATERIALS AND METHODS

Materials

In this study, a portable gamma spectrometer (Figure 1) was employed to measure ambient radiation levels, while a GPS device (Figure 2) was used to record the geographical coordinates of each measurement point. The gamma spectrometer is designed to detect gamma radiation emitted by naturally occurring radionuclides in the environment. It identifies and quantifies specific radionuclides such as uranium-238 (^{238}U), thorium-232 (^{232}Th), and potassium-40 (^{40}K) by measuring the energy and intensity of emitted gamma rays. This allows for the accurate determination of radionuclide concentrations and the assessment of radiation levels at each site. The GPS device was used to capture the precise coordinates of all sampling locations. These geospatial data points are essential for mapping the spatial distribution of radioactivity and for linking radiation measurements to specific geological features of the study area.

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Figure 1: A Portable Gamma Ray Spectrometer (Radcomm, 2020)



Figure 2: A GPS Device (Generated by Imagen3, 2024)

Data Collection

Data collection involved the systematic measurement of gamma radiation at multiple locations within the Faculties of Arts and Science. The procedures were carefully designed to ensure the accuracy, consistency, and reliability of the data obtained. Measurement points were strategically selected to represent diverse locations across the study area, including open spaces, building surroundings, and zones with notable geological features. At each selected point, the gamma spectrometer was positioned directly on the ground to measure ambient radiation levels. Prior to each measurement session, the spectrometer was calibrated to maintain the accuracy of the readings. Simultaneously, a GPS device was used to record the precise geographical coordinates of each measurement location, enabling spatial analysis and mapping of radiation levels. To account for potential temporal variations in background radiation, measurements were conducted at different times of the day. This approach enhanced the robustness of the dataset and ensured a more comprehensive understanding of the radiation profile within the study area.

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Data Processing

All recorded measurements, including gamma radiation readings and corresponding GPS coordinates, were systematically organized in a structured format for ease of analysis. These data were compiled into a tabular form, as illustrated in Tables 1 and 2, to facilitate clear interpretation and ensure consistency. The structured dataset enabled efficient correlation of radiation levels with specific geographic locations within the study area. This organization also supported subsequent spatial analysis, including the generation of distribution maps and statistical evaluation of radiological parameters.

Table 1: Measured Background Radiation at Faculty of Arts, Ahmadu Bello University, Zaria

S/N	Potassium (%)	Uranium (ppm)	Thorium (ppm)	Dose Rate (nGy/h)	Latitude (Degrees)	Longitude (Degrees)
0	1.78	11.70	12.0	119.8	11.1486	7.6531
1	1.39	8.10	13.80	99.1	11.1483	7.6533
2	3.66	8.90	31.20	176.3	11.1486	7.6536
3	4.29	12.30	19.60	175.2	11.1492	7.6542
4	2.89	11.10	28.40	171.9	11.1494	7.6544
5	2.63	8.30	22.30	137.3	11.1500	7.6542
6	4.17	8.70	22.90	161.5	11.1503	7.6544
7	4.32	9.20	24.40	170.1	11.1506	7.6536
8	3.20	3.90	26.20	129.7	11.1508	7.6533
9	1.24	9.30	17.10	111.8	11.1514	7.6528
10	3.30	5.80	25.10	139.2	11.1514	7.6525
11	3.75	4.80	20.30	127.2	11.1508	7.6525
12	2.08	9.20	21.10	132.5	11.1506	7.6522
13	4.27	7.10	28.00	166.4	11.1506	7.6525
14	2.34	10.30	30.40	164.9	11.1494	7.6528
15	3.41	6.30	39.30	178.8	11.1494	7.6533
16	3.49	9.50	24.70	161.7	11.1497	7.6533
17	3.57	12.10	25.90	180.4	11.1500	7.6533
18	2.76	10.70	26.00	161.8	11.1500	7.6531
19	3.11	6.10	24.00	135.9	11.1506	7.6533
20	3.41	8.19	16.05	162.7	11.1514	7.6539
21	2.82	10.74	28.80	176.6	11.1508	7.6536
22	2.24	10.35	29.35	172.0	11.1567	7.6544
23	1.60	7.46	29.53	145.6	11.1508	7.6536
24	1.24	5.27	28.44	177.4	11.1503	7.6522

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Table 2: Measured Background Radiation at Faculty of Science, Ahmadu Bello University, Zaria.

S/N	Potassium (%)	Uranium (ppm)	Thorium (ppm)	Dose Rate (nGy/h)	Latitude (Degrees)	Longitude (Degrees)
25	2.65	9.37	23.17	180.4	11.1542	7.6544
26	4.19	6.79	29.22	112.0	11.1608	7.6533
27	4.32	9.35	20.87	180.4	11.1539	7.6531
28	2.55	4.90	20.66	180.4	11.1547	7.6533
29	3.17	8.16	29.46	166.8	11.1486	7.6525
30	4.03	3.90	16.14	177.1	11.1594	7.6522
31	1.24	8.07	27.80	123.5	11.1542	7.6539
32	3.59	9.11	17.40	168.9	11.1514	7.6536
33	3.71	7.20	19.72	138.5	11.1489	7.6528
34	2.95	9.54	28.01	164.8	11.1503	7.6531
35	4.29	5.14	19.52	155.6	11.1536	7.6544
36	2.75	12.30	24.44	151.6	11.1503	7.6525
37	2.00	7.12	18.79	140.0	11.1492	7.6542
38	1.97	9.60	26.47	158.6	11.1544	7.6539
39	4.32	12.30	12.00	150.6	11.1594	7.6525
40	4.29	12.30	24.61	155.8	11.1483	7.6525
41	4.10	9.05	13.40	152.3	11.1508	7.6522
42	3.63	7.94	21.81	162.5	11.1542	7.6522
43	3.90	12.30	25.63	159.0	11.1503	7.6539
44	1.41	8.60	26.20	160.9	11.1564	7.6542
45	3.50	11.02	14.19	107.9	11.1597	7.6539
46	4.32	8.15	19.23	180.4	11.1528	7.6539
47	3.03	4.44	27.17	144.1	11.1503	7.6528
48	1.89	12.04	23.94	142.2	11.1508	7.6522
49	2.09	12.30	21.76	133.8	11.1556	7.6531

Data Analysis

The collected data were analyzed to determine the natural radioactivity levels and their spatial distribution across the Faculties of Arts and Science. This section outlines the analytical techniques employed to process and interpret the data.

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Calculation of Radiological Hazard Indices

Standard formulas were used to compute key radiological hazard indices, including the absorbed dose rate and the annual effective dose, which provide quantitative assessments of potential health risks from natural background radiation.

Absorbed Dose Rate (D)

The absorbed dose rate in air at 1 meter above ground level due to the presence of natural radionuclides is calculated using the following UNSCEAR (2000) formula:

$$D(nGyh^{-1}) = 0.462C_U + 0.604C_{Th} + 0.0417C_K \quad (1)$$

where C_U , C_{Th} , and C_K are the activity concentrations of ^{238}U, ^{232}Th, and ^{40}K, respectively.

Annual Effective Dose (AED)

The AED is calculated using:

$$AED(mSv/year) = D(nGy/h) \times 8760 \times 0.7 \times 10^{-6} \quad (2)$$

where 8760 is the number of hours in a year and 0.7×10^{-6} is the dose conversion factor.

External Hazard Index (Hex)

The External Hazard Index (Hex) is calculated to evaluate the potential external exposure to gamma radiation due to natural radionuclides present in the environment. To ensure radiation hazard is within acceptable limits, the value of Hex must be less than 1.

The index is calculated using the following formula:

$$H_{ex} = \frac{C_U}{370} + \frac{C_{Th}}{259} + \frac{C_K}{4810} \quad (3)$$

C_U is the concentration of Uranium (U-238) in parts per million (ppm).

C_{Th} is the concentration of Thorium (Th-232) in parts per million (ppm).

C_K is the percentage of Potassium (K-40), and it's converted from percentage to ppm by multiplying by 10,000.

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Internal Hazard Index (Hin)

The Internal Hazard Index (Hin) is used to assess the potential internal exposure to radiation, particularly through inhalation or ingestion of radioactive elements like radon and its short-lived progeny. To ensure safety, the value of Hin should also be less than 1.

The index is calculated using the following formula:

$$H_{in} = \frac{C_U}{185} + \frac{C_{Th}}{259} + \frac{C_K}{4810} \qquad (4)$$

Statistical Analysis

Statistical analysis was conducted to identify trends, patterns, and correlations within the collected radiation data. Descriptive statistics such as mean, median, and standard deviation were calculated using Microsoft Excel to summarize the distribution of radiation levels across the study area. These metrics provided insight into the central tendency and variability of the measured values. In addition, spatial analysis techniques were employed using the Python programming language, incorporating libraries such as Pandas, NumPy, Matplotlib, and GeoPandas. These tools were used to visualize and interpret the spatial distribution of radioactivity, allowing for the identification of potential hotspots and areas with elevated radiation levels. The integration of statistical and spatial analysis enhanced the overall interpretation of the data, contributing to a better understanding of the environmental radiation landscape within the Faculties of Arts and Science at Ahmadu Bello University, Zaria.

RESULTS AND DISCUSSIONS

The background radiation levels varied across the different locations sampled within the faculty. Table 3 presents the descriptive statistics of the measured concentrations of Potassium (^{40}K), Uranium (^{238}U), and Thorium (^{232}Th), along with the corresponding absorbed dose rates. The results reveal considerable variability in radionuclide concentrations and associated dose rates throughout the Faculty of Arts and Science. This spatial variation suggests the possible influence of geological differences and anthropogenic activities, such as construction and infrastructure development, on the natural background radiation levels in the study area.

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Table 3: Descriptive statistics of the measured concentrations of Potassium, Uranium, and Thorium, as well as the absorbed dose rates.

	Potassium (%)	Uranium (ppm)	Thorium (ppm)	Dose Rate (nGy/h)
count	50	50	50	50
mean	3.059712081	8.731806747	23.33203019	153.7079422
std	0.982687208	2.443405068	5.624301343	21.79655954
min	1.24	3.9	12	99.1
25%	2.269030362	7.14432535	19.63002699	138.7159679
50%	3.186439442	8.979493704	24.2	160.016331
75%	3.868549881	10.61342903	27.64367393	171.45
max	4.32	12.3	39.3	180.4

Figure 3 illustrates the spatial distribution of Potassium (%), Uranium (ppm), Thorium (ppm), and the absorbed dose rate (nGy/h) across the study area. The distribution of Potassium concentrations reveals a broad spatial spread, with notably higher values in the northern and western parts of the faculty. This variation is likely influenced by the natural composition of the soil and underlying rock formations in these areas. Uranium concentrations also show distinct spatial variability, with elevated levels primarily clustered in the northern and central zones. These patterns may reflect the presence of localized geological features rich in Uranium-bearing minerals. Similarly, Thorium concentrations exhibit a gradient, with higher values predominantly found in the northern part of the faculty. The spatial distribution of Thorium closely resembles that of Uranium, suggesting a potential co-occurrence of these radionuclides within the same lithological units. The absorbed dose rate map provides insight into the spatial variation in radiation exposure across the study area. Elevated dose rates were observed in regions with high concentrations of Uranium and Thorium, confirming that these radionuclides are the primary contributors to the background radiation levels. The correlation between radionuclide concentration and dose rate underscores the importance of geological factors in shaping the radiological characteristics of the environment.

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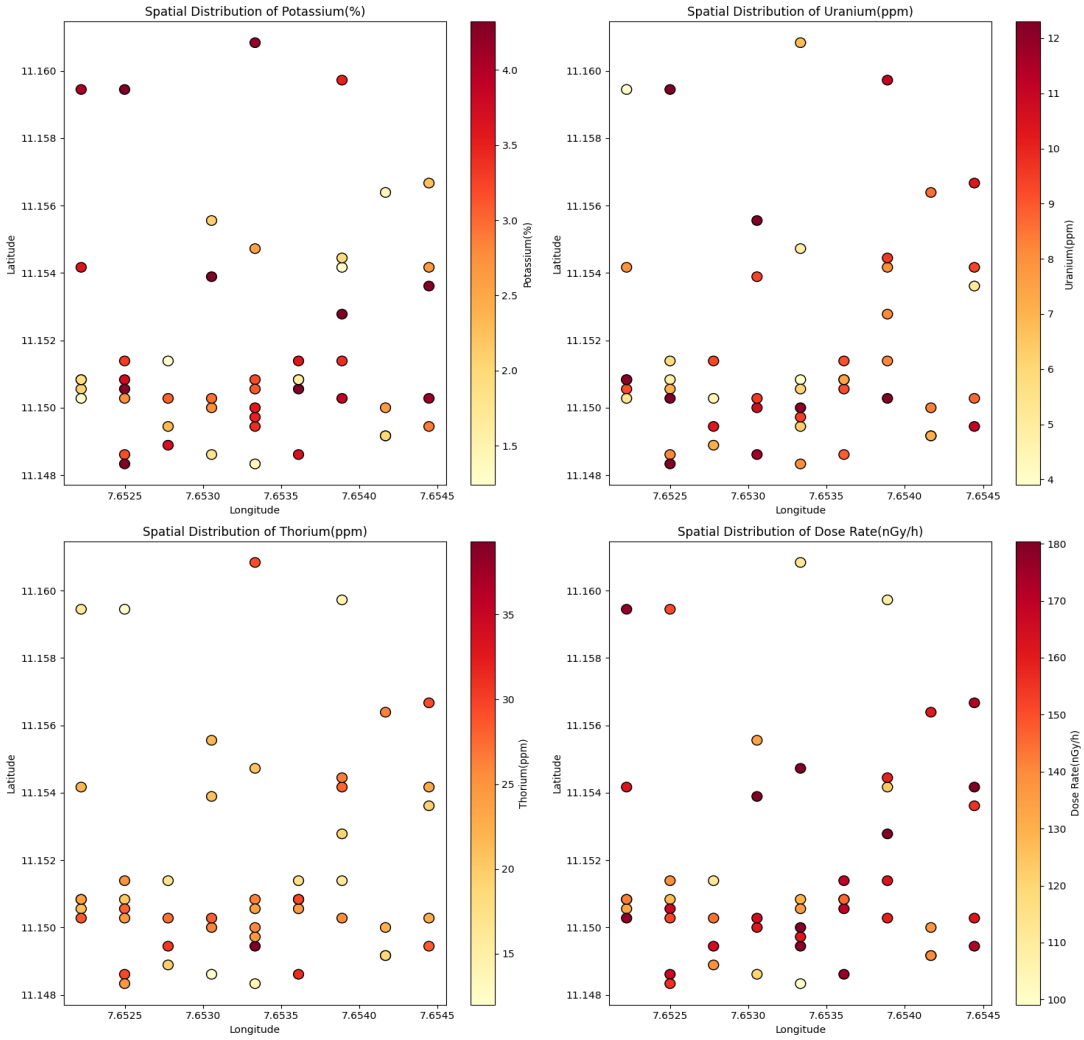

Figure 4.1 Spatial Distribution of Potassium, Uranium, Thorium and Dose rate

The calculated Annual Effective Dose (AED), External Hazard Index (Hex), and Internal Hazard Index (Hin) are summarized in Table 4. Based on the measured concentrations of radionuclides, the absorbed dose rate and corresponding annual effective dose were computed for each sampling location. The average absorbed dose rate across the Faculty of Arts and Science was 153.71 nGy/h, yielding an average annual effective dose of 0.943 mSv/year. The Hex values, which assess potential external exposure to gamma radiation, range from 0.072 to 0.168. According to international radiological safety guidelines, a value of Hex less than 1 indicates safe levels of external radiation. As all calculated Hex values fall below this threshold, it can be concluded that external radiological hazards are

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within acceptable safety limits across all sampled locations. Similarly, the Hin values, used to evaluate internal exposure risks—particularly from radon and its short-lived progeny—range from 0.083 to 0.185. A Hin value below 1 also signifies no significant internal radiological risk, and all values in this study comply with that criterion.

As expected, higher absorbed dose rates generally correspond with increased values of both Hex and Hin, reflecting the direct relationship between gamma radiation intensity and radiological hazard indices. Likewise, the annual effective dose increases proportionally with dose rate. Despite some spatial variability in hazard values, all computed indices remain below the recommended safety limit, indicating no immediate radiological threat to individuals in the study area.

Table 4: Calculated Annual Effective Dose, Hex and Hin

S/N	Longitude (Degrees)	Latitude (Degrees)	Dose Rate (nGy/h)	Annual Effective Dose (mSv/year)	Hex	Hin
0	7.6531	11.1486	119.8	0.7346136	0.077957369	0.10957899
1	7.6533	11.1483	99.1	0.6076812	0.075176635	0.097068527
2	7.6536	11.1486	176.3	1.0810716	0.144524984	0.168579038
3	7.6542	11.1492	175.2	1.0743264	0.108927838	0.142171081
4	7.6544	11.1494	171.9	1.0540908	0.139658518	0.169658518
5	7.6542	11.1500	137.3	0.8419236	0.108538286	0.130970719
6	7.6544	11.1503	161.5	0.990318	0.111939171	0.135452685
7	7.6536	11.1506	170.1	1.0430532	0.11908234	0.143947205
8	7.6533	11.1508	129.7	0.7953204	0.111705495	0.122246035
9	7.6528	11.1514	111.8	0.6855576	0.091160879	0.116296014
10	7.6525	11.1514	139.2	0.8535744	0.112593733	0.128269409
11	7.6525	11.1508	127.2	0.7799904	0.091359148	0.104332121
12	7.6522	11.1506	132.5	0.8124900	0.106336371	0.131201236
13	7.6525	11.1506	166.4	1.0203648	0.127306175	0.146495364
14	7.6528	11.1494	164.9	1.0111668	0.14521722	0.173055058
15	7.6533	11.1494	178.8	1.0964016	0.168771568	0.185798595
16	7.6533	11.1497	161.7	0.9915444	0.121049727	0.146725402
17	7.6533	11.1500	180.4	1.1062128	0.132710125	0.165412827
18	7.6531	11.1500	161.8	0.9921576	0.129310757	0.158229676
19	7.6533	11.1506	135.9	0.8333388	0.109157045	0.125643531
20	7.6539	11.1514	162.7	0.997853258	0.084127642	0.106271182
21	7.6536	11.1508	176.6	1.08343412	0.140255861	0.169286005
22	7.6544	11.1567	172.0	1.055071638	0.141321067	0.169304084
23	7.6536	11.1508	145.6	0.893008707	0.13422738	0.15441623

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S/N	Longitude (Degrees)	Latitude (Degrees)	Dose Rate (nGy/h)	Annual Effective Dose (mSv/year)	Hex	Hin
24	7.6522	11.1503	177.4	1.088344479	0.124108208	0.138370605
25	7.6544	11.1542	180.4	1.1062128	0.11484668	0.140189968
26	7.6533	11.1608	112.0	0.687286703	0.131220187	0.149595016
27	7.6531	11.1539	180.4	1.1062128	0.105901764	0.131189823
28	7.6533	11.1547	180.4	1.1062128	0.093029319	0.106274108
29	7.6525	11.1486	166.8	1.022893969	0.135844852	0.157917876
30	7.6522	11.1594	177.1	1.086320267	0.072889946	0.083430487
31	7.6539	11.1542	123.5	0.757647409	0.129177434	0.15101091
32	7.6536	11.1514	168.9	1.036015024	0.091815508	0.116438065
33	7.6528	11.1489	138.5	0.849616953	0.09561801	0.115088886
34	7.6531	11.1503	164.8	1.010748411	0.133981952	0.159785614
35	7.6544	11.1536	155.6	0.95429325	0.08928194	0.103182619
36	7.6525	11.1503	151.6	0.929653832	0.12762779	0.160871033
37	7.6542	11.1492	140.0	0.858772756	0.091839957	0.111094981
38	7.6539	11.1544	158.6	0.973011992	0.128184942	0.154138773
39	7.6525	11.1594	150.6	0.924014036	0.079584271	0.112827514
40	7.6525	11.1483	155.8	0.955801285	0.128271814	0.161515057
41	7.6522	11.1508	152.3	0.93424645	0.076238065	0.100721815
42	7.6522	11.1542	162.5	0.996758443	0.105707453	0.12719267
43	7.6539	11.1503	159.0	0.975427574	0.132213772	0.165457015
44	7.6542	11.1564	160.9	0.987012709	0.124436894	0.147701694
45	7.6539	11.1597	107.9	0.662234314	0.084783087	0.114762885
46	7.6539	11.1528	180.4	1.1062128	0.09632679	0.118360127
47	7.6528	11.1503	144.1	0.884209722	0.116913013	0.128914537
48	7.6522	11.1508	142.2	0.872204873	0.124992396	0.157540408
49	7.6531	11.1556	133.8	0.820923708	0.117293498	0.150536741

Discussions

The results of this study revealed significant spatial variations in the concentrations of natural radionuclides—Potassium (K), Uranium (U), and Thorium (Th)—and their corresponding radiation dose rates across different locations within the Faculties of Arts and Science. These variations suggest that underlying geological formations and possible anthropogenic influences significantly affect natural radioactivity levels in the area. The average absorbed dose rate was found to be 153.71 nGy/h, with mean concentrations of Potassium at 3.06%, Uranium at 8.73 ppm, and Thorium at 23.33 ppm, reflecting considerable heterogeneity in radionuclide distribution. Higher Potassium concentrations were

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observed predominantly in the northern and western regions of the study area, while Uranium and Thorium levels were more elevated in the northern and central regions. The spatial distribution of absorbed dose rates mirrored the radionuclide concentration patterns, indicating that these natural sources substantially contribute to environmental radiation exposure.

The calculated annual effective dose (AED) ranged from 0.61 to 1.08 mSv/year. Although most sampled locations fell within the International Commission on Radiological Protection (ICRP) recommended public exposure limit of 1 mSv/year, some areas slightly exceeded this threshold—particularly where Uranium and Thorium levels were elevated. The external hazard index (Hex) and internal hazard index (Hin) remained below the critical value of 1 across all locations, suggesting no immediate radiological threat. Nevertheless, periodic monitoring is advised, especially in areas approaching the dose limit, to ensure continued radiological safety.

CONCLUSION AND RECOMMENDATIONS

This study concludes that natural radioactivity levels in the vicinity of the Faculty of Arts and Science, Ahmadu Bello University (ABU), Zaria, are generally within internationally accepted safety limits. However, certain locations exhibit elevated dose rates that may pose potential long-term risks if not properly monitored. The observed spatial variability in radionuclide concentrations—particularly Potassium (^40K), Uranium (^238U), and Thorium (^232Th)—suggests a strong influence of local geological formations on background radiation levels. While radiological hazard indices such as the absorbed dose rate and annual effective dose mostly fall below the recommended thresholds, specific areas, particularly in the northern and central parts of the faculty, approach or slightly exceed the 1 mSv/year public exposure limit set by the International Commission on Radiological Protection (ICRP).

To ensure long-term radiological safety and protect the health of students, staff, and visitors, the following recommendations are proposed:

Regular Monitoring: Implement a continuous radiation monitoring program across the faculty to detect fluctuations in background radiation and quickly identify potential risks.

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Further Investigation: Conduct detailed geological and environmental assessments to trace the specific sources of elevated Uranium and Thorium concentrations, especially in identified high-dose regions.

Public Awareness: Organize sensitization campaigns to educate the university community on natural radioactivity, associated health risks, and appropriate radiation safety practices.

Radiation Safety Protocols: Establish institutional safety guidelines, including restricted access to high-radiation areas and protective measures for individuals working near such zones.

Future Research: Encourage long-term epidemiological studies to assess the effects of low-dose radiation exposure and expand similar investigations to other parts of the university and surrounding communities for a broader understanding of environmental radioactivity

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