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The Background Radiation Dose of a Few Mining Ponds in Nasarawa LGA, Nasarawa State

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Abstract

Trace amounts of naturally occurring radioactive elements as well as minerals are collected from the crust of the earth (NORM). In the study, activity concentrations in a few mining ponds were examined; it was discovered that these values above the ICRP recommended standard for all Organs. The issues of Ribi Town are estimated to be about (Th-232-30.2180Bq) greater than those of the other four mining ponds, which could constitute a major health concern to anyone leaving the area. Little risk to health exists from modest amounts of NORM exposure. However, activities that involve the extraction, mining, processing, transmission, storage, disposal, and/or recycling of NORM-contaminated materials may raise the exposure levels of employees and other people to levels that are of concern.

Keywords: Mining, Concentration, Radioactivity, and Exposure

I. Introduction

Naturally occurring radioactive materials (NORM) are abundant and widely distributed in a variety of environmental samples, with varying concentrations depending on the geological and geographical definitions of any given region [1]. Coal, a naturally abundant fossil fuel, contains radioactive materials with varying levels of activity [2]. Human activities, such as coal mining, redistribute and transport coal radioactivity to the surface, raising radioactivity levels in the human environment above background [2-3]. Long-lived radionuclides, specifically 238U, 232Th and their radioactive progeny, and 40K, are primarily to blame for human radiation exposure [4].

Mining activities have had a significant impact on man and his environment [4]. Mining operations involve the removal of vast amounts of top soil as well as the generation of significant amounts of mining waste (tailings) with elevated radioactivity. These massive amounts of mine tailings are strewn about the mine, where they are transported by atmospheric processes and eventually concentrated in the soil environment. Tailings leaching can occur in wet climates, transferring radionuclides into surface and groundwater bodies. The use of mine tailings as aggregates for building materials and for agricultural purposes is another source of human contamination [2].

Numerous atoms are unstable and would spontaneously transform into atoms of another element while emitting ionizing radiation; this process is known as radioactivity, and the transformation is known as radioactive decay [5]. The term "radionuclide" refers to unstable atoms that undergo radioactive decay. Radon, for example, results from the decay of radium, which in turn results from the disintegration of uranium (238U). Thorium, produced by the decay of thorium, is another radionuclide (232Th) [6]. Terrestrial gamma radiation is the other major geological source of radiation, and it is caused by potassium nuclide (40K). They are simply referred to as naturally occurring radioactive materials and are widely distributed in terrestrial materials such as rocks, soils, and building materials that have been excavated from below the surface of the earth (NORM)[7].

In addition to being present in the biosphere's air, soil, water, and food, NORM can also emerge from human activities including the production of oil, gas, and fertilizer. Nearly 80% of the total radiation exposure of the world's population still comes from natural sources [8]. The amount of gamma radiation that is naturally present in the environment and the accompanying external exposure to it in different parts of the world depends mostly on the geological and geographical factors. In order to evaluate background radiation, 226Ra, and 232Th in several mining ponds in Nasarawa LGA, Nasarawa State, this research aims to measure some of the radiation.

II Material and Method

Material

The materials used for this research is the Survey meter for the collection of data.

i. Geo positioning system ii. Survey meter

ii. Camera iv. Writing material v. Mobile Topographer

Method

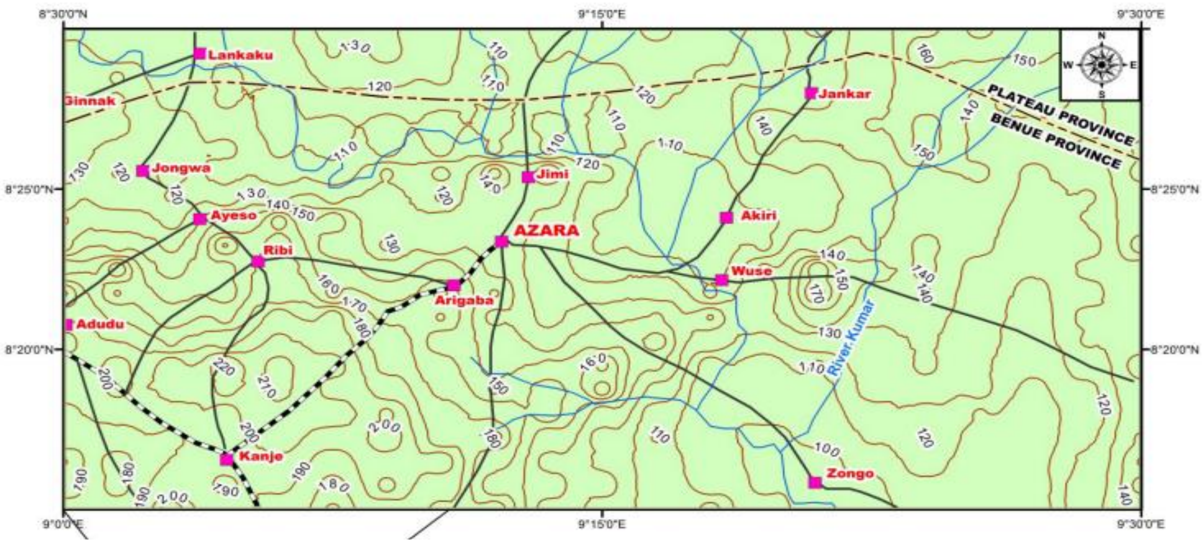
The various principles, methodologies, and procedures used to estimate environmental background radiation are numerous. This experiment used a survey meter for an external gamma survey to determine background radiation and NORM concentrations. The measurement points were determined by the local soil and geology. The geology map of the region was used to locate these locations.

Sample Collection

About fifty (50) samples were obtained from the mining ponds using Survey Meter, and each sample was analyzed in order to determine which analytical method will be used in this work.

Area of Study

Five villages in Nasarawa LGA, Nasarawa State, Nigeria, were sampled: Aribaga, Ribi, Azara, Wuse/Mauakin, Azara, and Akiri. Nasarawa's headquarters are in the town, which has a population of 30,949 and is located at 8°32'N 7°42'E. (as of 2016). The local government area is 5,704 km2 in size and has 189,835 residents in the 2006 census.The state of Nasarawa is noted for having a diversified geology and is situated in the center of Nigeria. Igneous, sedimentary, and metamorphic rocks make up the majority of the state's geology. Sandstone and shale make up the majority of sedimentary rocks, whereas schist and gneiss make up the majority of metamorphic rocks. The majority of the igneous rocks are granites and basalts. Gold, coal, limestone, clay, and other mineral resources are known to be present in the state.



IV Results

The NORM activity concentration results from Aribaga, Ribi, Azara, Wuse/Mauakin, Azara, and Akiri are presented in the tables below.

Table 1: Aribaga (AR) Activity Concentration

S/N	Sample Code	Ra-226 (Bq)	Th-232 (Bq)
1	AR_1	0.002049	0.007178
2	AR_2	0.002119	0.004213
3	AR_3	0.006244	0.002485
4	AR_4	0.007418	0.009323
5	AR_5	0.005091	0.008815
6	AR_6	0.004831	0.004741
7	AR_7	0.009013	0.008292
8	AR_8	0.006624	0.003218
9	AR_9	0.0073	0.006024
10	AR_{10}	0.006111	0.006105

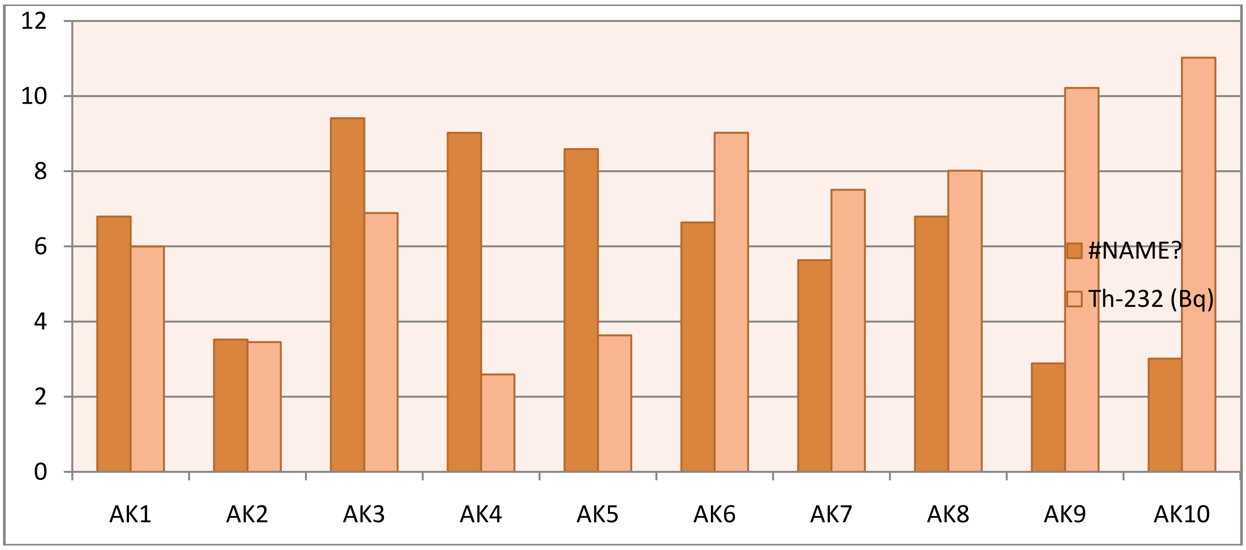


Table 2: Akiri (AK) Activity Concentration

S/N	Sample Code	Ra-226 (Bq)	Th-232 (Bq)
1	AK_1	0.006797	0.005999
2	AK_2	0.003521	0.003452
3	AK_3	0.009412	0.006891
4	AK_4	0.009025	0.002592
5	AK_5	0.008591	0.003632
6	AK_6	0.006638	0.009025
7	AK_7	0.005634	0.007509
8	AK_8	0.006794	0.008013
9	AK_9	0.002887	0.01022
10	AK_{10}	0.003014	0.011023

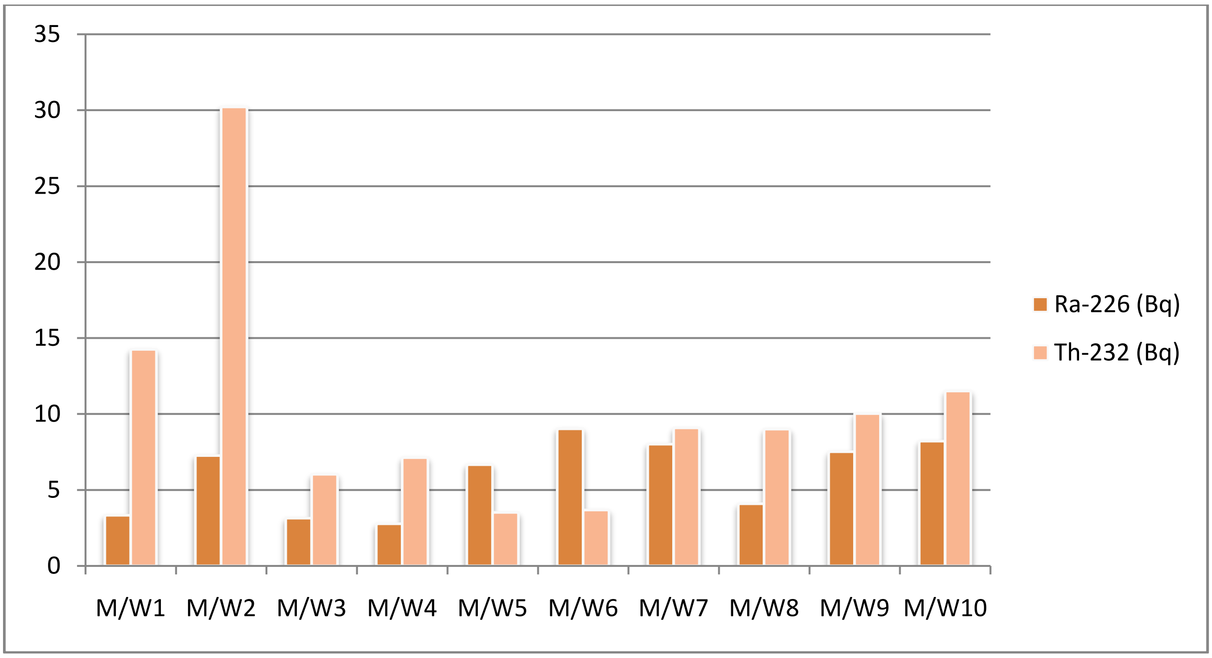


Table 3: Azara (AZ) Activity Concentration

S/N	Sample Code	Ra-226 (Bq)	Th-232 (Bq)
1	AZ_1	0.007785	0.006422
2	AZ_2	0.003192	0.007216
3	AZ_3	0.006798	0.004281
4	AZ_4	0.003145	0.009025
5	AZ_5	0.008213	0.005577
6	AZ_6	0.006512	0.006058
7	AZ_7	0.007125	0.005556
8	AZ_8	0.008232	0.020214
9	AZ_9	0.008022	0.023621
10	AZ_{10}	0.00246	0.030218

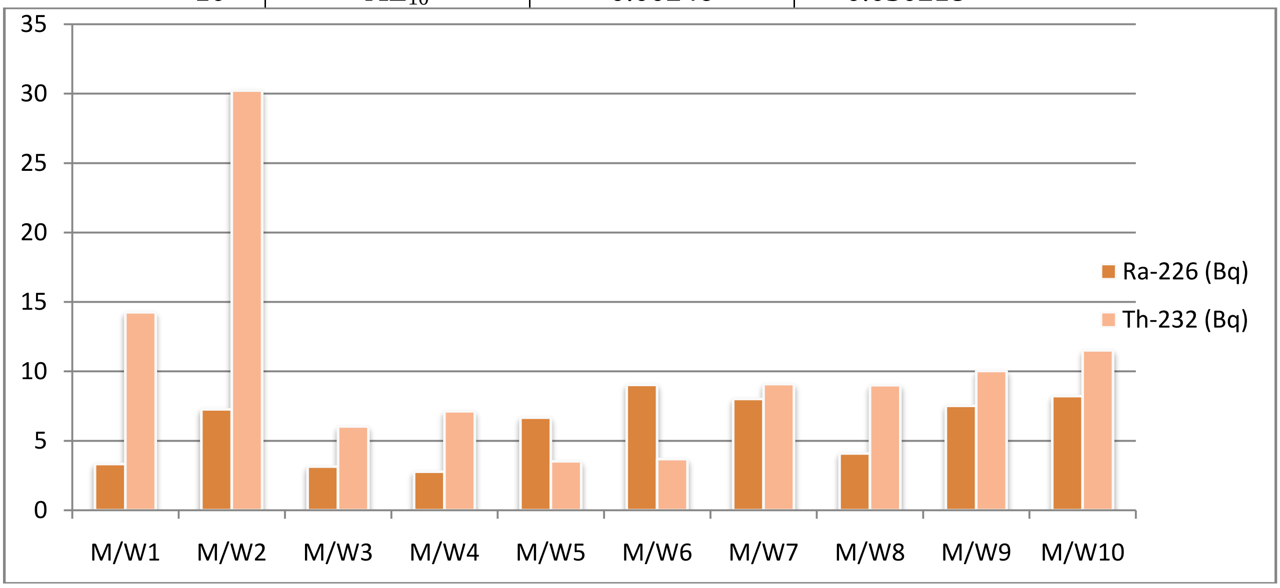


Table 4: Ribi (RB) Activity Concentration

S/N	Sample Code	Ra-226 (Bq)	Th-232 (Bq)
1	RB_1	0.002055	0.009323
2	RB_2	0.001387	0.00603
3	RB_3	0.004091	0.008711
4	RB_4	0.007822	0.004782
5	RB_5	0.008814	0.006437
6	RB_6	0.008627	0.006256
7	RB_7	0.010422	0.004641
8	RB_8	0.011221	0.004256
9	RB_9	0.011013	0.006329
10	RB_{10}	0.003257	0.008065

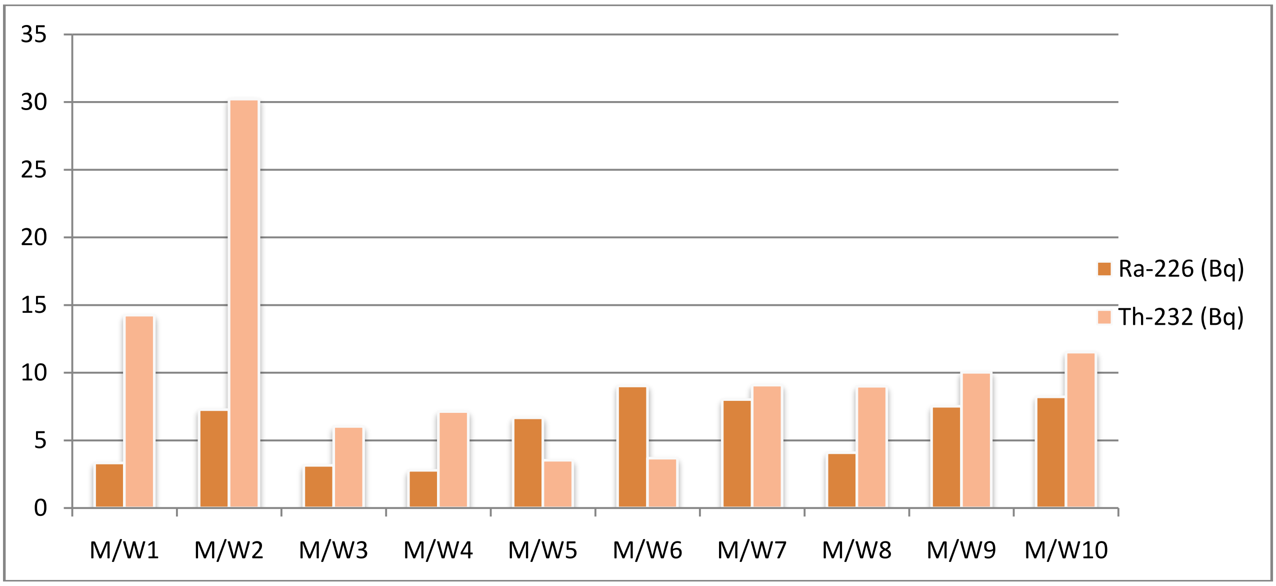
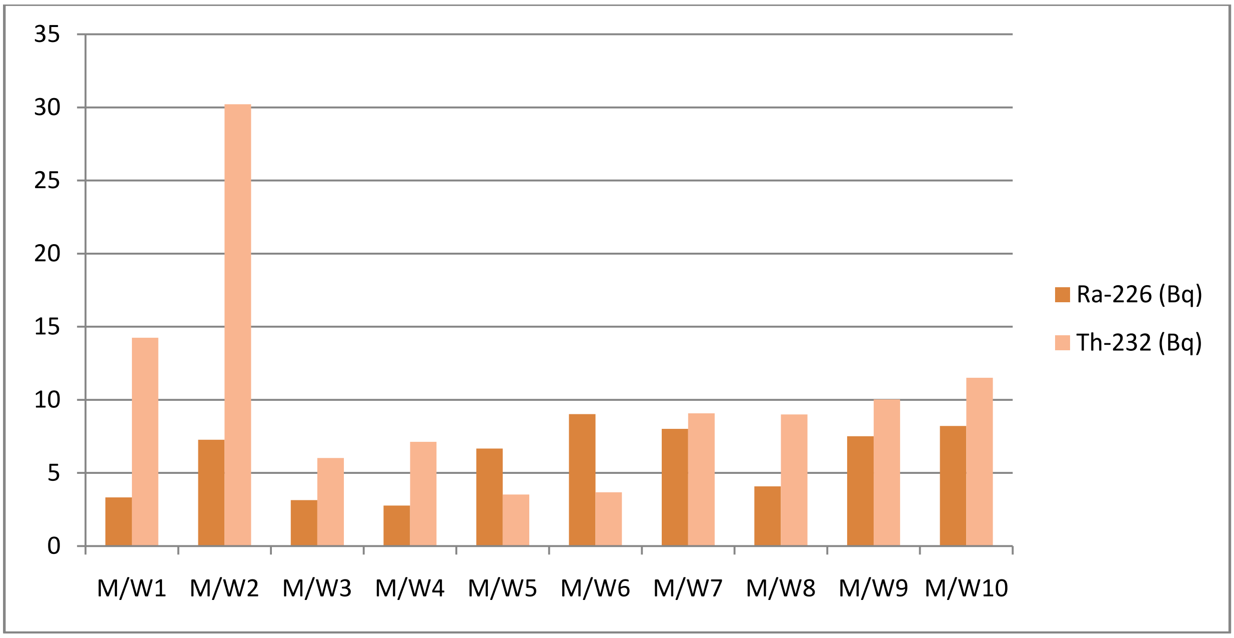


Table 5: Wuse/Mauakin(M/W) Activity Concentration

S/N	Sample Code	Ra-226 (Bq)	Th-232 (Bq)
1	M/W_1	0.00333	0.014248
2	M/W_2	0.007267	0.030218
3	M/W_3	0.003145	0.006028
4	M/W_4	0.002776	0.007129
5	M/W_5	0.006666	0.003522
6	M/W_6	0.009022	0.003681
7	M/W_7	0.008013	0.009082
8	M/W_8	0.004089	0.009
9	M/W_9	0.007513	0.010028
10	M/W_{10}	0.008214	0.011512



V. Discussion

The results presented above were derived directly from survey meters that were collected from mining ponds. The outcomes were acquired directly from various sources.

Table 1 of Aribaga shows their considerable rise of radioactive nuclide in comparison to ICRP Standard (Ra-226 - 9.0125Bq and Th-232 - 9.3229). (0.12Bq). This is a result of local farming and mining operations.

Table 2 of Akiri Town shows a significant increase in activity concentration when compared to the ICRP Standard (Ra-226 - 9.4122Bq and Th-232 - 11.023). (0.12Bq). this might be a result of local farming and mining operations. Additionally, Th-232 activity is very concentrated in this region.

Table 3 shows that it has a far greater activity concentration than any other place (Ra-226 – 8.2316Bq and Th-232- 30.2180). This outcome exceeds the ICRP Standard (0.12Bq). This can be the effect of excessive mining activity in the region. Additionally, Th-232 activity is very concentrated in this region.

Table 4 shows that Ribi Town has a considerable increase in activity concentration as compared to the ICRP Standard (Ra-226 - 11.221Bq and Th-232 - 9.3228). (0.12Bq). this might be a result of nearby mining operations. Additionally, Ra-226 activity is highly concentrated in this region.

Table 5: The largest concentration of Th-232 (Bq) is found in this town, although there are less mining operations here than in Azara. Farming operations may be responsible for the concentration of activity.

VI Conclusion

The assessment of the background radioactivity of some mining ponds was addressed in this study since naturally occurring radioactivity (NORM) is typically found beneath the earth. According to the research, the Th-232 activity concentration in the village of Azara is higher than what the International Commission on Radiological Protection (ICRP) recommends for both organs (0.12Bq). Staying here could pose a major radiation risk. As advised by ICRP, remaining in this mining region could generally result in radioactive hazards.

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