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Assessment of Radiation Dose Level in the Farm Soil of Federal University Wukari, Northeast Nigeria

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Abstract

The study has assessed the amount of radiation exposed to farm soils of federal university Wukari, Taraba State with the aim to determine radiation dose in soils and to provide necessary information of human health risks associated with high radioactivity in soil and its effects on plant materials. Ten different soil samples were collected from different location in the farming soil and the Geiger Muller counter was used to measure the level of radiation exposure in the samples. The analyzed results showed low amount of radiation dose level. The absorbed dose values ranging between 0.1607 Gy/hr - 0.1730Gy/hr while equivalent dose rate ranges between 0.2815mSv/yr - 0.2956mSv/yr. These results revealed that the dose rate does not exceed the recommended values by International Commission on Radiological Protection (ICRP) which is 1 mSv/yr for the general public and therefore do not pose a significant health hazard. The radiation dose level has no negative effect on both the plants and the dwellers. Therefore, the study area is safe for human activities.

Keywords: Dose level, Geiger Muller, Elements, Emission, Radiation

INTRODUCTION

Radiation is the emission or transmission of energy in the form of waves or particles through space or through a material medium (Etuk, 2015). Radiation harm or destruction to tissue and/or organs relies on the dose of radiation received or the absorbed dose (Senthilkumar and Narayan Swam, 2016). The radiation in soil and air are the ones that affect man greatly. Soil is the warehouse of radiation and radionuclides. Hence it is the main source where most materials are being contaminated. High radiation dose will impose danger to man and plants while low radiation dose will not impose danger to man nor plant. Nowadays, agricultural chemical fertilizers, including phosphate fertilizers, are an essential component of the agricultural activities that help to increase crop production and to improve the properties of the nutrient-deficient lands. Therefore, the agricultural usage of phosphate fertilizers could be a potential source of radiation exposure to the farmers and public. The interactions between the cycle of soil Nitrogen and Phosphate with the soil carbon cycle affect the distribution of Soil Organic Carbon and then affect the environmental effects of riparian zone (Jin et al., 2017). Soil supports food production, controls water storage and groundwater recharge, and shapes the biogeochemical cycles for essential nutrients in the environment (Laurel et al 2015). Elements in the soil are the source of plant nutrients (Onudibia,. et al, 2012). Soil has many purposes and applications. Structures are built on soil and crops are also cultivated on soil. Plants derived their nutrients from the soil, and man depends on plants for his survival. Plants grow and derived their nutrients from the soil, and man gets most of his nutrients of survival from the plants (Onudibia et al, 2012). Soils are the main reservoirs for artificial radionuclide emanating from precipitation and they act as media for transfer of elements to biological systems (Abeokuta et al,. 2017, Ademola J.A, 2008, Ahmed & El-Arabi, 2005 and IAEA, 1990). After chemical weathering, metals are released and either redistributed on soil constituents, or mobilized and leached out to soil depth. (Jibiri & Agomuo, 2007)

The study area lies within longitude; 9.840352^0E - 9.67958^o E and latitude: 7.849391^0N - 7.831738^oN

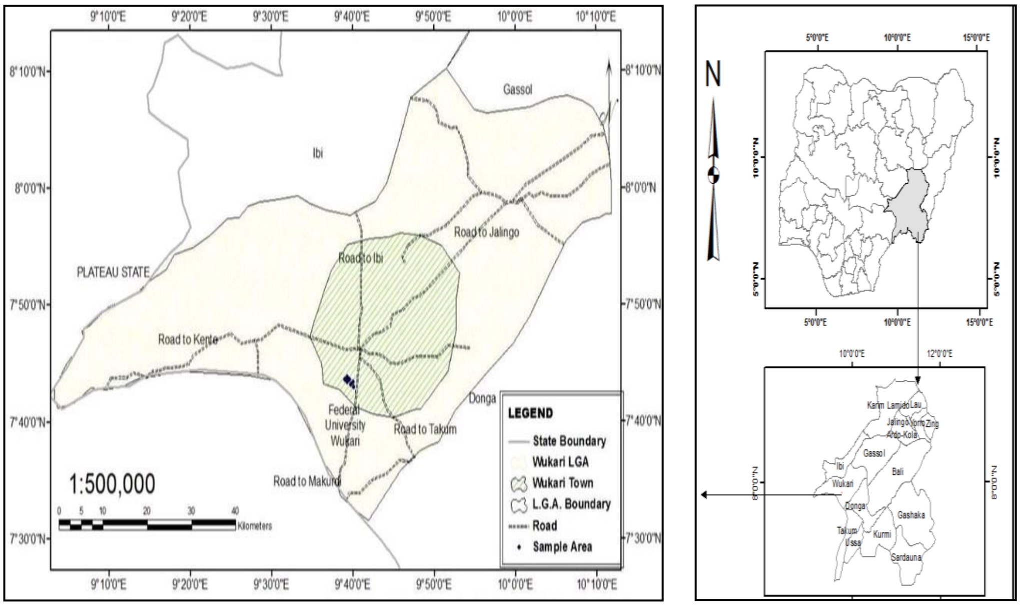

Fig 1: Map of the study area showing University Farm

The aim of this study is to determine the radiation dose level in the farm soil of Federal University Wukari with the objectives of determining the radiation absorbed dose and equivalent dose levels of radiation emitted from the farm soil in Gray per hour as well as comparing the result with the minimum safety limit by UNSCEAR.

METHODS

Ten (10) soil samples were collected from different location in federal university Wukari farm soil, using GPS coordinates. At each location, an area of about 1m^2 was marked out. The humus layer of soil, which contains decay organic matter, was removed using a flat blade shovel. Soil samples were then dug up to a depth of about 5cm at each corner of the identify 1m^2 area and at its center. Extraneous materials such as plants roots where remove from the soil and samples collected in labeled black polyethene bag applying the soil auger. The soil samples collected from the farm were kept in room with ambient temperature for few days and then taken to the laboratory for analysis.

The Geiger counter was held 1cm to 2 cm above each soil sample for one minute and the radiation level in the soil samples were registered on the inspector as counts. Measurement were taken two times, the average or mean radiation were then calculated and computed.

The measured values in CPM from the Radiation Alert Meter were converted to the absorbed dose in μSv/hr while the equivalent dose rate in μSv/hr were converted to equivalent dose rate in mSv/yr using the mathematical relationship (Marilyn Maguire 1995)

$$HTC = \frac{\delta x \mu x 24 x 365}{1000} \quad (1)$$

$$\delta = \frac{HT}{Q} \quad (2)$$

Where

HTC = Equivalent dose in mSvyr-1,

δ = Absorbed dose in Gyhr-1

HT = Equivalent dose in μSvhr-1

μ= Outdoor occupancy factor (0, 2)

Q = Quality factor = 1 (ICRU, 2011)

Table 1: Soil samples and absorbed dose in Gray per hour ($Gyhr^{-1}$)

Latitude N°	Longitude E°	Elevation (yd)	Soil Samples	Absorbed dose
7.845055	9.777221	198	SS1	0.1639
7.845743	9.765670	176	SS2	0.1607
7.847391	9.777054	189	SS3	0.1618
7.841638	9.768035	170	SS4	0.1573
7.8470439	9.773353	184	SS5	0.1618
7.84548	9.777464	186	SS6	0.1368

Table 2: Equivalent dose in mSv/yr according to the soil sample

Latitude N°	Longitude E°	Elevation (yd)	Soil Samples	Equivalent dose (msv/yr)
7.845055	9.777221	198	SS1	0.2832
7.845743	9.765670	176	SS2	0.2815
7.847391	9.777054	189	SS3	0.2834
7.841638	9.768035	170	SS4	0.2756
7.8470439	9.773353	184	SS5	0.2835

Latitude N°	Longitude E°	Elevation (yd)	Soil Samples	Equivalent dose (msv/yr)
7.84548	9.777464	186	SS6	0.2397
7.842798	9.765156	172	SS7	0.2178
7.840354	9.769582	165	SS8	0.2616
7.844001	9.774485	197	SS9	0.2956
7.844139	9.774069	178	SS10	0.2796

RESULTS AND DISCUSSION

The analysis of the data was carried out using microsoft excel by comparing various dose levels. The obtained results are presented as graphs and pie chart, showing the

absorbed dose verses soil samples (fig: 2) below.

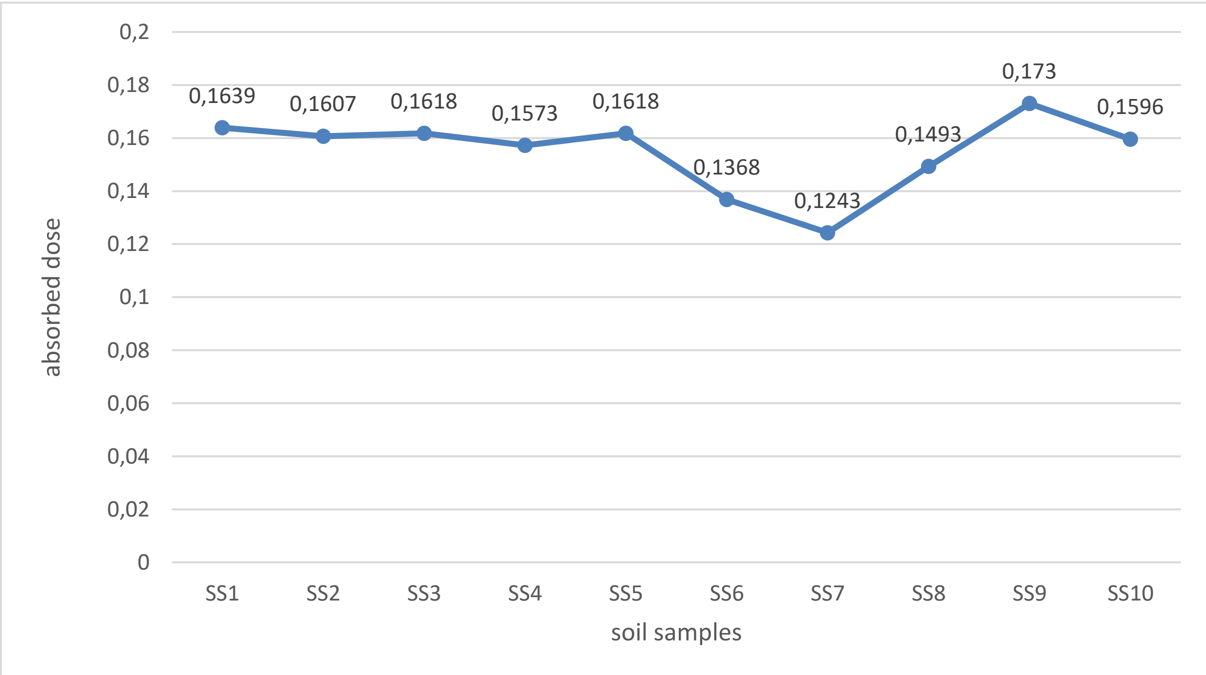

Fig 2: Absorbed dose in Gyhr-1 per soil sample

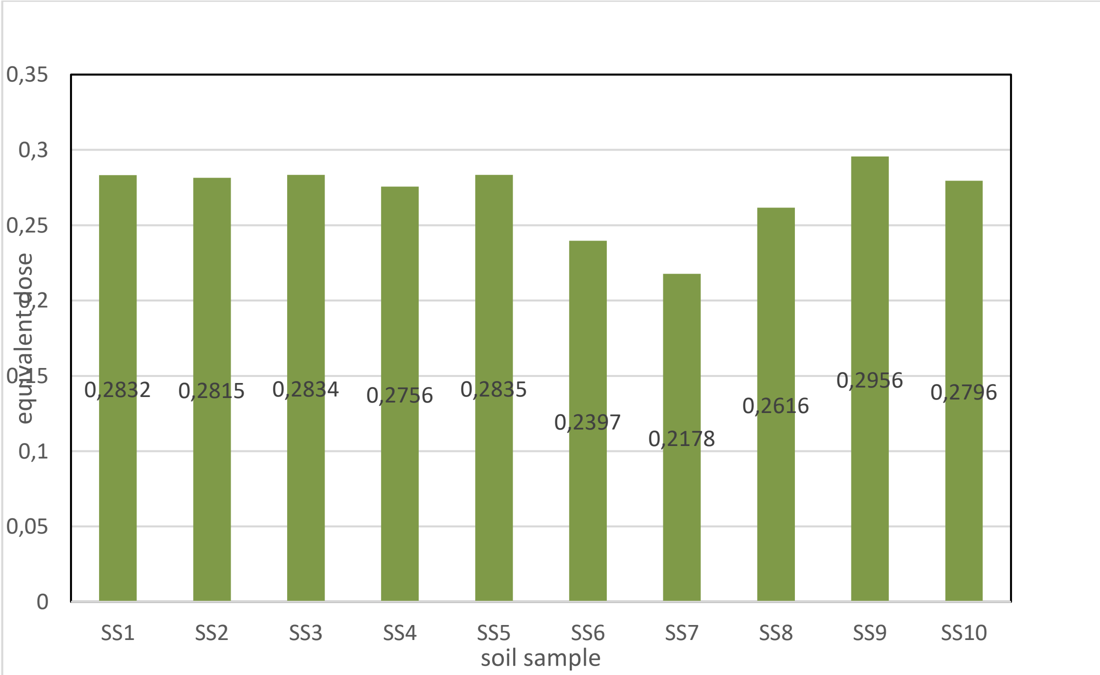

Fig 3: showing equivalent dose per soil sample

From fig 2 and 3 above the absorbed dose and equivalent dose in soil sample (7) is the lowest dose which is 0.1243µsv/hr and equivalent dose of 0.2178msv/yr. Soil sample (6) has the second least absorbed and equivalent dose of 0.1368µsv/hr /0.2397msv/yr, which is also below 1mSv/yr as recommended for the general public by ICRP. Soil sample (8) contains low radiation doses of 0.1493µsv/hr /0.2616msv/yr, the absorbed and equivalent dose is in the increasing order as from soil sample 4, which is 0.1573µsv/hr /0.2796msv/yr. Sample (1) has doses of 0.1639µsv/hr /0.2832msv/yr, while soil sample (5) has 0.1618µsv/hr /0.2835msv/yr and sample (10) has 0.1596µsv/hr /0.2796msv/yr respectively. Sample (9) contains the highest average absorbed dose of 0.1730µSv/hr and equivalent dose of 0.2956mSv/yr.

The maximum permissible exposed dose limit recommended by ICRP is 1mSv for the general public. Result from Table 4.1 and 4.2 soil radiation dose reveals the minimum equivalent dose of 0.1243µSv/hr and maximum equivalent dose of 0.2956mSv/yr. The absorbed dose and equivalent dose is below 1mSv/yr in all the soil samples and this shows that the radiation dose has no negative effect on both plants and humans dwelling within this vicinity.

CONCLUSION

In this study the radiation absorbed dose and equivalent dose was evaluated in ten samples of soil collected from different location in the farming soil of Federal University Wukari, the samples were collected in polythene bags, the Geiger muller counter was then used to record the radiation as count by each sample. The counts were converted into the absorbed dose and equivalent dose respectively using the equation 1 and 2 respectively. The micro soft excel application software was used for the analysis of the data.

The result shows high dose of absorbed dose of 0.1730μSv/hr, which is the highest, while low equivalent dose of 0.2956mSv/yr was observed indicating the highest in all the soil samples collected.

From this study, assessment of radiation dose level in farm soils of Federal University Wukari, shows that the absorbed dose rate values ranges between 0.1607μSv/hr to 0.1730μSv/hr, and the equivalent dose rate ranges between 0.2815mSv/yr to 0.2956mSv/yr. The obtained values of absorbed dose rate and equivalent dose rate were found to be below the recommended safety limits. Therefore, do not pose a significant health hazard. The radiation dose level has no negative effect on the plants and the inhabitants. Therefore, human being will not be exposed to radiation. Hence, there is no risk associated with any activity such as farming and building in soil farm land of Federal University Wukari. These are indications that the study area is safe for human activity

REFERENCES

Abeokuta I.C, Okeyode A.O, Mustapha N.N, Jibiri V, Makinde F.G, Akinboro F.S, Saka D, Al-azmi (2017). Comparion of activity concentrations of natural radionuclides in soils collected at different depths of selected handdug wells. Journal of Natural Science, Engineering and Technology, 2: 119-130

Ademola, J.A. (2008) 'Exposure to high background radiation level in the tin mining area of Jos Plateau Nigeria', Journal of Radiological Protection, Vol. 28, pp.93–99.

Ahmed, N.K. and El-Arabi, A.G.M. (2005) 'Natural radioactivity in farm soil and phosphate fertilizer and its environmental implications in Qena, governorate, Upper Egypt', Journal of Environmental Radioactivity, Vol. 84, pp.51–64.

Beretka, J. and Mathew, P.J. (1985) 'Natural radioactivity of Australian building materials, industrial wastes and by-products, Health Physics, Vol. 48, pp.87–95.

Etuk S.E, George N.J, Essien I.E, Nwokolo S.C (2015). Assessment of radiation exposure levels within IkotAkpaden Campus of AkwaIbom State University, Nigeria. Journal of Applied Physics, 3: 86-91

International Atomic Energy Agency (IAEA), 1990. Gamma-ray surveys in uranium exploration. Technical Report Series No. 186, International Atomic Energy Agency.

International Commission on Radiation Units and Measurements (ICRU), 2011. Fundamental quantities and units for I onizing radiation. Journal of the ICRU Volume 11 No 1, Published by Oxford University Press

Jin Qian, Jingjing Liu, Peifang Wang, Chao Wang, Kun Li, Mengmeng Shen.(2017): Riparian soil Physicochemical properties and correlation with soil organic carbon of an inflowing river of Taihu Lake. Conf. Series: Earth and Environmental Science. 2017. 59-012053.

Jibiri, N.N. and Agomuo, J.C. (2007) 'Trace elements and radioactivity measurements in some terrestrial food crops in Jos-Plateau, Northcentral, Nigeria', Radioprotection, Vol. 42, pp.29–42.

Laurel Woodruff, William F. Cannon, David B. Smith, Federico Solano(2015). The Distribution of selected elements and minerals in soil of the conterminous United States. Journal of Geochemical Exploration 154. 49–60. Vv

Marilyn E, Maguire J (1995). Radiation protection in health sciences. World Scientific Publishing, Singapore, 296316.

Onudibia M. E, Opara I.J, Iseh A.J, Ayuni N.K, Ocheje J.A. Distribution pattern of elements of soils from haji kogi farms in agwan jaba area of Zaria, Nigeria. Open Science Journal of Modern Physics, 1: 1-6.

Senthilkumar R.D, Narayanaswamy R (2016). Assessment of radiological hazards in the industrial effluent disposed soil with statistical analyses, Journal of Radiation Research and Applied Sciences, 9: 1-4.