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ASSESSMENT OF RADIATION DOSE LEVEL AT KABBA COLLEGE OF AGRICULTURE, DIVISION OF AGRICULTURAL COLLEGES, AHMADU BELLO UNIVERSITY, ZARIA

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ABSTRACT

Background radiation involves the measure of the level of ionizing radiation present in the environment at a particular location. This research seek to generate data of the natural background radiation level of some selected Sections at Kabba College of Agriculture, using RadEye G20 survey meter. A total of 15 sections of the College were randomly selected and the background radiation dose rate of the sections were measured. The indoor dose rate ranged from (0.09 – 0.13) μ Sv/yr, while the outdoor dose rate ranged from (0.07 - 0.10) μ Sv/yr. The indoor annual effective dose were observed to be greater than the outdoor annual effective dose in all the College Sections measured. The lowest total annual effective dose 0.75 mSv/yr was found at the Academic staff block. The highest total annual effective dose of 1.09 mSv/yr was found at the livestock building, this might be due to the high-altitude nature of the area and the rocky materials used in the construction of the building. The highest total annual effective dose of the study area was slightly above the recommended limit of 1.0 mSv/yr. The result obtained from this research may not constitute immediate health risk to the staff and student of the college

Keywords: Background radiation, Environment, Annual Effective Dose and Health Risk

INTRODUCTION

Background radiation involves the measurement of ionizing radiation present in the environment at a particular location. The radiation around us, has been in existence since the creation of earth. It varies from different location and times. The Cosmic radiation from sun to the earth contributes to natural background. Background radiation can also be influenced by altitude and latitude at any site (Amanjeet et al., 2017).

Radon and its progenies are the major contributor in atmosphere, which is responsible for most of radiation dose received by general population (UNSEAR, 1994). Radon is the second major cause of lung cancer (Hensaw et.el. 1990, Amanjeet et al., 2017). Indoor dose rate depends upon the existence of natural radioactivity in the underlying soil or rock used for building. It is important to assess the radiation hazards arising due to use of soil samples in construction of dwellings. Many researches have been done to estimate the background radiation in Nigeria (Ademola et. el., 2014, Bello et al., 2019 and Jibiri et al., 2016) and other countries (Amanjeet et al. 2017, Ahmed and Farrag, 2016, Bala et. al. 2014, and Rani et al., 2015).

In this paper, the natural background radiation level at Kabba College of Agriculture was carried out using radiation survey meter. This is the first time of conducting this type of research and it will be of benefit to the staff and student of the college, for reference purpose.

The Study Area

Kabba College of Agriculture was established in 1964, situated in kabba, Kogi State, Nigeria. The College is located between longitude 6.0732^{0}E and latitude 7.8231^{0}N, covered a total area of 348 hectares. The soil around the area consist of enriched dark soil, suitable for tree crops, arable cultivation and other development. The College was basically designed to accommodate about hundred students but over the years, there has been substantial development and introduction of new programmes to the college, the population density of the school has increased to about 600. Due to high farm practice, settlement and increase in population of the college, there is need to determine the radiation dose level of the college.

MATERIAL AND METHOD

The background radiation measurement of the study area was conducted randomly, using a high sensitive survey meter (RedEye G20). The selected areas were measured by placing the detector 1 m above ground level for 30 seconds. Three readings were taken for each measured location for accuracy purpose and the average was used for final computation. The result obtained was compared with recommended limit of International Commission for Radiological Protection (ICRP), in order to determine, the exposure level of the study area have significant health risk to the inhabitant of the college. The sampling locations were recorded with a global positioning system (GPS).

Annual Effective Dose

The total annual effective dose rate is to be calculated using

Equations 1, 2 and 3. (Bello, 2018)

$T = 365 \text{ days} \times 24\text{hrs} = 8760 \text{ hr/yr}$ (1)

$IAE = D_{in}\,(\mu Sv/h) \times T \times OF \times Q$ (2)

$OAE = D_{out}\,(\mu Sv/h) \times T \times OF \times$ (3)

where D_{in} and D_{out} are the mean absorbed dose in air indoor and outdoor, T is the time converter from hours to year, OF, the occupancy factor, that is the fraction of time spent indoor and outdoor which are 0.8 and 0.2 respectively, Q is the conversion factor of 0.7 SvGy, which converts the absorbed dose rate in air to human effective dose received (UNSCEAR, 2000). Then the summation of indoor and outdoor dose rate was taken which gives the total annual effective dose.

$TAE\ (mSv\ y^{-1}) = OAE + IAE$ (4)

Where: OAE = outdoor annual effective dose, IAE = indoor annual effective dose, TAE = total annual effective dose and D = Dose rate (µSv/h).

RESULT AND DISCUSSION

Table 1: Dose Rate and Effective Dose Rate in the College.

S/N	Location	Dose Rate (μ Sv/yr) Indoor	Dose Rate (μ Sv/yr) Outdoor	Effective Dose Rate (mSv/yr) Indoor	Effective Dose Rate (mSv/yr) Outdoor	Total Effective Dose Rate (mSv/yr)
1	Admin. Office	0.10	0.08	0.70	0.14	0.84
2	Lab. A	0.11	0.07	0.77	0.12	0.89
3	Exam Office	0.10	0.09	0.70	0.16	0.86
4	Academic Staff Block	0.09	0.07	0.63	0.12	0.75
5	Account Office	0.09	0.09	0.63	0.16	0.79
6	IJMB Office	0.10	0.08	0.70	0.14	0.84
7	Lab. B	0.12	0.09	0.84	0.16	0.99
8	ND Class	0.10	0.07	0.70	0.12	0.82
9	HND Class	0.09	0.08	0.63	0.14	0.77
10	Lives Stock Section	0.13	0.10	0.91	0.18	1.09
11	Maintenance Unit	0.11	0.09	0.77	0.16	0.93
12	Staff Quarters	0.10	0.07	0.70	0.12	0.82
13	Horticulture Section	0.11	0.07	0.77	0.12	0.89
14	School Gate	0.10	0.09	0.70	0.16	0.86
15	Security Office	0.09	0.08	0.63	0.14	0.77

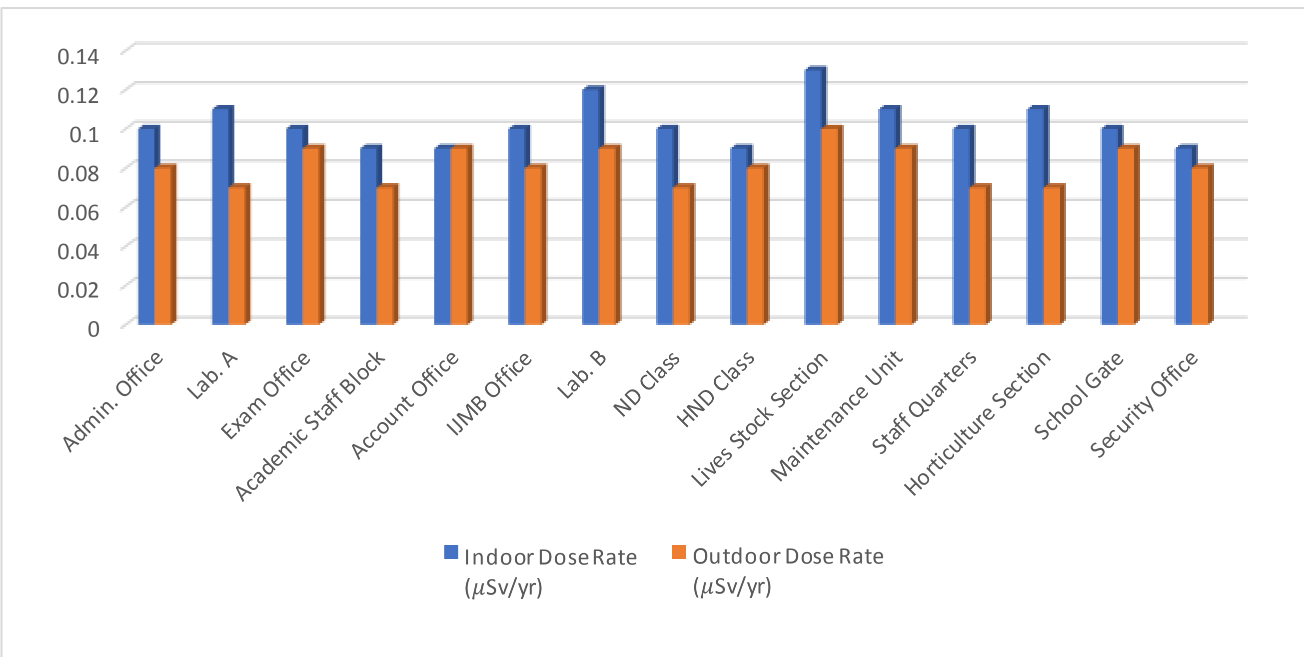

Figure 1: The Indoor and Outdoor dose rate in the School

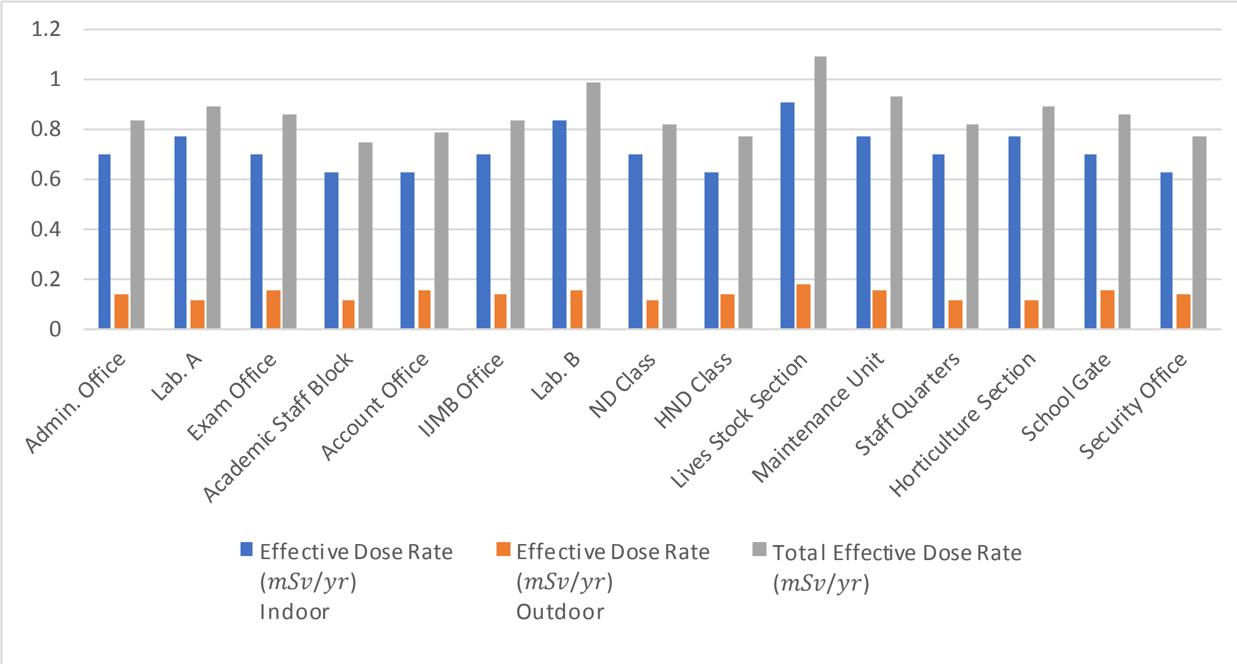

Figure 2: The Indoor, Outdoor and Total Effective dose rate in the School

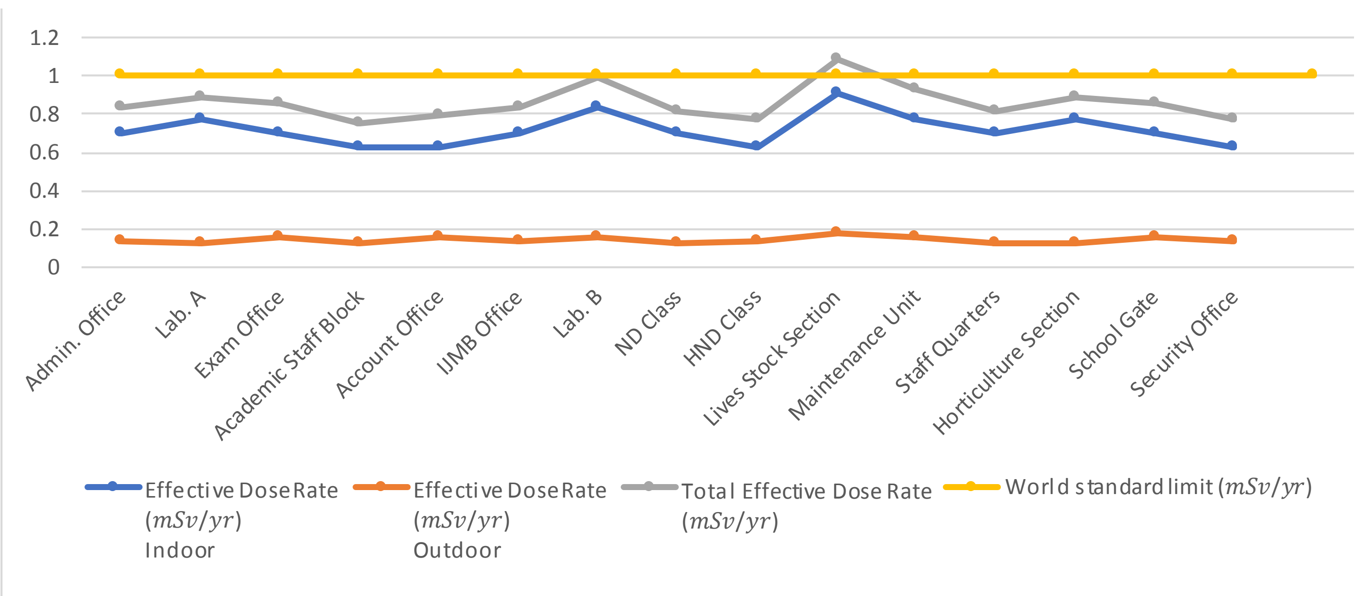

Figure 3: The Indoor, Outdoor and Total Effective dose rate in the School compared with the World Standard (ICRP).

A total of 15 sections of the College were randomly selected and the background radiation dose rate of the sections were measured. Table 1 represented the radiation dose rate and effective dose rate in the College. The average values of the radiation dose rate for the indoor ranged from 0.09 to 0.13 μ Sv/hr and for outdoor ranged from 0.07 to 0.10 μ Sv/hr. The indoor annual effective dose ranged from 0.63 to 0.91 mSv/y and the outdoor annual effective dose ranged from 0.14 to 0.18 mSv/y. The total annual effective dose ranged from 0.75 to 1.09 mSv/y.

From figure 1, lives stock section has the highest indoor and outdoor dose rate of 0.13 and 0.10 μ Sv/hr respectively, while the lowest effective indoor and outdoor dose of 0.09 and 0.07 μ Sv/hr was recorded in academic staff block.

Figure 2, indicate that the lives stock section has the highest total effective dose of 1.09 mSv/y, while the academic staff block has the lowest total effective dose of 0.75 mSv/y. Figure 3, shows all the measured values of the total effective dose were below, except the Livestock section which was slightly above the recommended limit of 1 mSv/y (ICRP, 1990). This might be due to the high-altitude nature of the area and the rocky materials used in the construction of the building in the section.

Table 2: The mean annual effective dose with other related studies

S/No.	Location	Region	Mean Annual Effective Dose (mSv/yr)	References
1	Kabba (Kogi State)	North Central	0.75 – 1.09	Present Study
2	Enugu	South-East	0.155 ± 0.006	Ugbede and Benson (2018_
3	Calabar	South-South	A: 0.21 – 0.31 B: 0.23 – 0.35 C: 0.33 – 0.40	Samuel *et al.* (2017)
4	Oraifite (Anambra State)	South-East	0.07	Uzo 2020
5	Nasarawa State	North Central	0.22	Kerinja *et al.* (2020)
6	Ondo State	South-West	1.17	Oladele and Arogunjo (2018)
7	World Standard		1	ICRP (1990)

From Table 2, the annual effect dose observed in the present study was compared with related published studies in different part of Nigeria and world standard. It was found the annual effective dose of the study area is slightly high compared to others but lower than that of Ondo State. This might be due to the high-altitude nature and geological formation of the area

CONCLUSION

The terrestrial background radiation level of some selected Sections at Kabba College of Agriculture, using RadEye G20 survey meter. A total of 15 sections of the College were randomly selected and the background radiation dose rate of the sections were measured. The indoor dose rate ranged from (0.09 – 0.13) μ Sv/yr, while the outdoor dose rate ranged from (0.07 - 0.10) μ Sv/yr. The indoor annual effect dose were observed to be greater than the outdoor annual effective dose in all the College Sections measured. The lowest total annual effective dose 0.75 mSv/yr was found at the Academic staff block. The highest total annual effective dose 1.09 mSv/yr was found at the livestock building, this might be due to the high-altitude nature of the area and the rocky materials used in the construction of the building. The highest total annual effective dose of the study area was slightly above the recommended limit of 1 mSv/yr. It was found the annual effective dose of the study area is slightly high, but compared favorably with other related published studies. This might be due to the high-altitude nature and geological formation of the area. Further research should be carried out on this study area, in other to assess the radiation dose level of the other section of the college, in order to have a full baseline for the study area. The result obtained from this research may not constitute immediate health risk to the staff and student of the college but long-term exposure in the area should be observed regularly.

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