# Background radiation dose of dumpsites in Ota and Environs



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# Background radiation dose of dumpsites in Ota and Environs

**M R Usikalu, O O Ola, J A Achuka, I O Babarimisa and W A Ayara**

Department of Physics, Covenant University, PMB 1024, Ota, Ogun State, Nigeria

Email: moji.usikalu@covenantuniversity.edu.ng

**Abstract**. In-situ measurement of background radiation dose from selected dumpsites in Ota and its environs was done using Radialert Nuclear Radiation Monitor (Digilert 200). Ten measurements were taken from each dumpsite. The measured background radiation range between 0.015 $mRhr^{-1}$ for AOD and 0.028 $mRhr^{-1}$ for SUS dumpsites. The calculated annual equivalent doses vary between 1.31 $mSvyr^{-1}$ for AOD and 2.28 mSv/yr for SUS dumpsites. The air absorbed dose calculated ranged from 150 $nGyhr^{-1}$ to 280 nGy/hr for AOD and SUS dumpsites respectively with an average value of 217 $nGyhr^{-1}$ for all the locations. All the estimated parameters were higher than permissible limit set for background radiation for the general public. Conclusively, the associated challenge and radiation burden posed by the wastes on the studied locations and scavengers is high. Therefore, there is need by the regulatory authorities to look into the way and how waste can be properly managed so as to alleviate the effects on the populace leaving and working in the dumpsites vicinity.

## 1. Introduction

General environmental radiation and the outward vulnerability from gamma radiation, depend mainly on the earthly and geographical condition, and appear at various levels in the soils of each region in the world [1]. In the biosphere, the propagation of radionuclides depends on the transportation of the geological materials from which they are made from and the processes which establish them at a given location in specific area. The major way to understand these distributions, therefore, is to study the transportation of the source materials and the physical and geochemical processes that lead to increased concentrations of radionuclides under given conditions [2].

Man is continually exposed to different levels of ionizing radiation dose, due to the nature of his environment [3, 4]. This is mainly due to the radionuclides found in different rock types propagated around our environment, with little addition from cosmic rays (cosmogenics). Radionuclides enclosed in rocks form a key part of the Naturally Occurring Radioactive Material (NORM) in the environment, which when not properly audited and controlled, are capable of causing harm to man and the environment.

In the last few decades, the natural index of radionuclides has been elevated due to human activities. Waste generation and disposals have also added in no small quantity to the increased levels of human radiation exposures. Human radiation exposure could be from either external sourses from $^{40}K$, $^{226}Ra$ and $^{232}Th$ in soil or internal sources from inhalation of radon and its daughter particles in dust and fumes from waste disposal sites. The measurement of radiation exposure levels from waste dump-sites will provide information on any possible radiological risk that can arise from waste generation and disposal to human health and environment.

Radioactive dose obtained from various waste dumpsites have been studied by many researchers in Nigeria [5 – 11]. They reported that dumpsites show no significant radiological health hazards to the people living or working around the dumpsites. But in most studies, dumpsites doses were higher when compared with sites that are free from waste disposal. This is the first study on radiation dose from dumpsites in Ota and Environs. The background radiation dose measurement was carried out in some dump-sites so as to estimate the radiological challenges the dumpsite pose on the population around them. Therefore, this study will be useful in providing baseline data on radiation dose incurred in Ota and its environment from dumpsites.

## 2. Materials and Method

The assessment was carried out between March and May 2016 in 13 locations within and around Ota, a commercial town in Ogun state (Figure 1). Ota is located in 6° 41'N and 3° 41'E. It is the local government headquarter of Ado-odo and has an estimated 163,783 population as adopted by the last headcount in Nigeria.

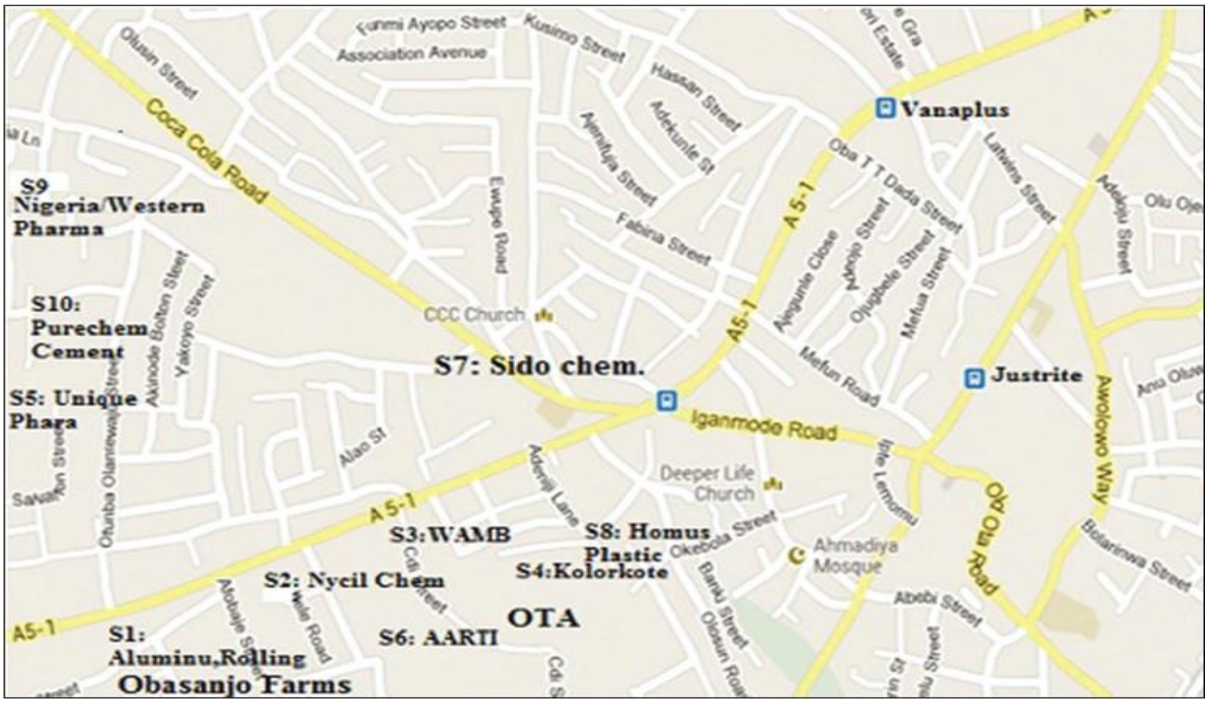


**Figure 1.** Location Map of the study area

In–situ method of measurement of radiation dose was employed in some selected dumpsites in Ota, Iju and Atan area of Ogun state. Table 1 showed different dumpsites used for this study and their associated waste. The measurement was done using a portable Geiger Muller Digilert 200 (S.E. Inspector) handheld digital radiation detector. The detector is a portable, survey meter based on microprocessor working principle and it has high sensitivity to measure low levels of alpha, beta, x-rays, gamma, for common isotopes to measure the dose rate or exposure in mixed field. It detects Alpha down to 2 MeV, Beta down to 0.16 MeV; typical detection efficiency at 1 MeV is approximately 25% and detects Gamma low to 10 KeV through the end window. Measurement was made randomly at 10 points from each thirteen dumpsites and average calculated for each location. For effective detection, the survey meter was positioned at gonad level i.e. at about one meter above ground level. It was switched on to absorb radiation for some seconds and stable value was recorded. The procedure was repeated at each location and readings were taken in micro sievert per hour.

**Table 1.** Dumpsites and the associated wastes.

| S/N | NAME | ASSOCIATED WASTE |
|---|---|---|
| 1 | KNL | Construction and iron steel wastes: irons, steels, alluminium etc |
| 2 | KN | Industrial waste and commercial wastes:mostly paper and wood |
| 3 | AOD | Market, residential and commercial wastes: rotten food, glass, plastics, ashes, paper, nylon, tin cans and an abattior site etc. |
| 4 | LPH | Mixture of medical and pharmaceuticals with industrial wastes: tin cans, nylons, paper, bottles, damaged electronics. |
| 5 | SNL | Wastes from industrial action: production of paper |
| 6 | TSM | Industrial wastes: Aluminium wastes, papers and nylons etc. |
| 7 | CUD | Different wastes including market, household, commercial and agricultural wastes dumped: vegetables, fruits, nylons, packaging materials and ashes etc. |
| 8 | VGP | Industrial and office wastes: plastics, nylons, paper |
| 9 | KD | Commercial, market and household waste: vegetables, fruits, nylons and unfinished foods |
| 10 | ARM | Waste from construction activities and industrial waste: building construction, welding metal scraps, and other commercial wastes around the area. |
| 11 | SUS | Construction and iron steel wastes: irons, steels, aluminium etc |
| 12 | IDA | Market, residential and commercial wastes: spoilt food, glass, clothes, smoke and ashes |
| 13 | ID | Different wastes including market, household, commercial and agricultural wastes dumped there includes vegetables, fruits, nylons, paper, packaging materials, ashes etc. |

## 3. Results and Discussion

The average dose rate and standard deviation measured from all the locations are shown in Table 2. The background radiation measured from the dumpsites range from 0.015 $mRhr^{-1}$ to 0.026 $mRhr^{-1}$. SUS, a steel producing company has the highest radiation, while the lowest dose rate was observed in AOD (Atan Oja dumpsite). Highest radiation observed in SUS may be attributed to the different types of construction waste such as steels and iron waste dumped in this site. It has been noted that steel and metals generally emits a high radiation dose than all other household waste and agricultural waste. In AOD it could be as a result of the composition of residential, market and commercial wastes that do not emit much radiation other sites. The background radiation exposure rates obtained in this study are slightly higher than the global background radiation standard of 0.013 $mRhr^{-1}$. The annual equivalent dose was estimated and conversion to absorbed dose was done using equation [1]

$$1\ radh^{-1} = 1.0 * 10^{-2}\ Gyh^{-1} \quad (1)$$

The calculated absorbed dose and annual effective dose equivalent is presented in Table 3. This was done in order to estimate the quantity of energy (radionuclides) delivered by ionization radiation to the human body in a given period. This was done to prevent any somatic, epidemiological, and radiological health implication recommended so as to set the maximum permissible limit for non–radionuclide industrial worker and the public [12]. The estimated annual equivalent dose rate (mSv/yr) ranged between 1.31 $mSvyr^{-1}$ and 2.28 $mSvyr^{-1}$ for AOD and SUS dumpsites respectively. Figure 2 shows the calculated annual equivalent dose rate for each location compared with [1] threshold. The estimated equivalent dose rates for all the thirteen locations studied were higher than the permissible limit of 1.3 $mSvyr^{-1}$ recommended [1].

The calculated absorbed dose rate ($nGyhr^{-1}$) ranged between 150 $nGyhr^{-1}$ to 280 $nGyhr^{-1}$ for AOD and SUS dumpsites respectively with an average of 217 $nGyhr^{-1}$. Figure 3 shows that the average air absorbed dose rates ($nGyhr^{-1}$) for the locations were higher than the world's average value of 60 $nGyhr^{-1}$ [1]. The higher values recorded in this work may be attributed to chemical, medical and other hazardous materials dumped together on the dumpsites. This will probably affect the surface water, soil and underground water sources of the environment. It may serve as source of contamination due to accumulation of radionuclide in the atmosphere, seepage and precipitation from the dumpsites Leachate. Therefore, people living and working around the dumpsites areas are exposed to different doses of radiation; these may result in health problems such as cancer, radiation poisoning and cell mutation. This calls for a serious concern and detailed studies of all the dumpsites in the state to ascertain the level of radiological impact of the sites workers, communities and the environment.

**Table 2.** Average radiation dose for all locations.

| S/N | SAMPLE | Average Radition ($mRhr^{-1}$) |
|---|---|---|
| 1 | KNL | 0.021 ± 0.0033 |
| 2 | KN | 0.019 ± 0.0022 |
| 3 | AOD | 0.015 ± 0.0027 |
| 4 | LPH | 0.021 ± 0.0030 |
| 5 | SNL | 0.022 ± 0.0039 |
| 6 | TSM | 0.022 ± 0.0039 |
| 7 | CUD | 0.023 ± 0.0037 |
| 8 | VGP | 0.022 ± 0.0039 |
| 9 | KD | 0.026 ± 0.0057 |
| 10 | ARM | 0.017 ± 0.0027 |
| 11 | SUS | 0.028 ± 0.0084 |
| 12 | IDA | 0.024 ± 0.0069 |
| **13** | **ID** | **0.025 ± 0.0069** |

**Table 3.** Air absorbed dose rate and equivalent dose rates.

| S/N | Location | Average Dose Rate ($mRhr^{-1}$) | Annual Equivalent Dose Rate, E($mSvyr^{-1}$) | Average Air Absorbed Dose Rate ($nGyhr^{-1}$) |
|---|---|---|---|---|
| 1 | KNL | 0.021 ± 0.0033 | 1.84 | 210 |
| 2 | KN | 0.019 ± 0.0022 | 1.67 | 190 |
| 3 | OD | 0.015 ± 0.0027 | 1.31 | 150 |
| 4 | LPH | 0.021 ± 0.0030 | 1.84 | 210 |
| 5 | SNL | 0.022 ± 0.0039 | 1.93 | 220 |
| 6 | TSM | 0.022 ± 0.0039 | 1.93 | 220 |
| 7 | UD | 0.023 ± 0.0037 | 2.02 | 230 |
| 8 | VGP | 0.022 ± 0.0039 | 1.93 | 220 |
| 9 | KD | 0.026 ± 0.0027 | 2.28 | 260 |
| 10 | ARM | 0.017 ± 0.0027 | 1.49 | 170 |
| 11 | SUS | 0.026 ± 0.0084 | 2.28 | 260 |
| 12 | IDA | 0.024 ± 0.0069 | 2.10 | 240 |
| 13 | ID | 0.025 ± 0.0069 | 2.19 | 250 |

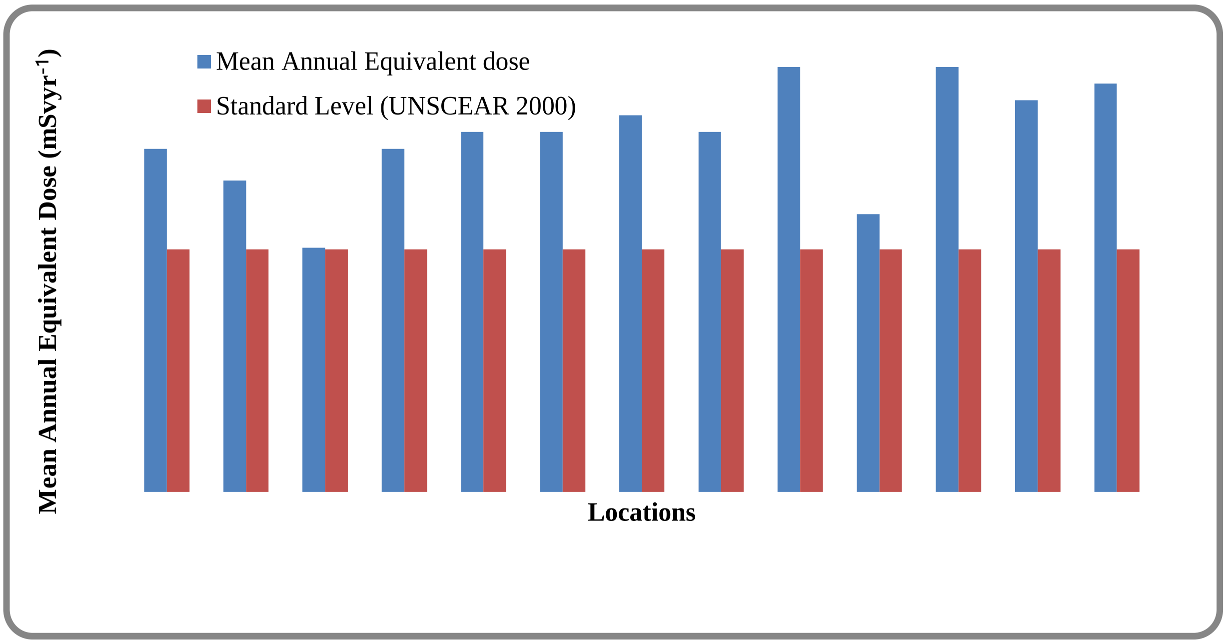


**Figure 2**. Comparison of average equivalent dose (mSvyr$^{-1}$) measured with the UNSCEAR (2000) Threshold.

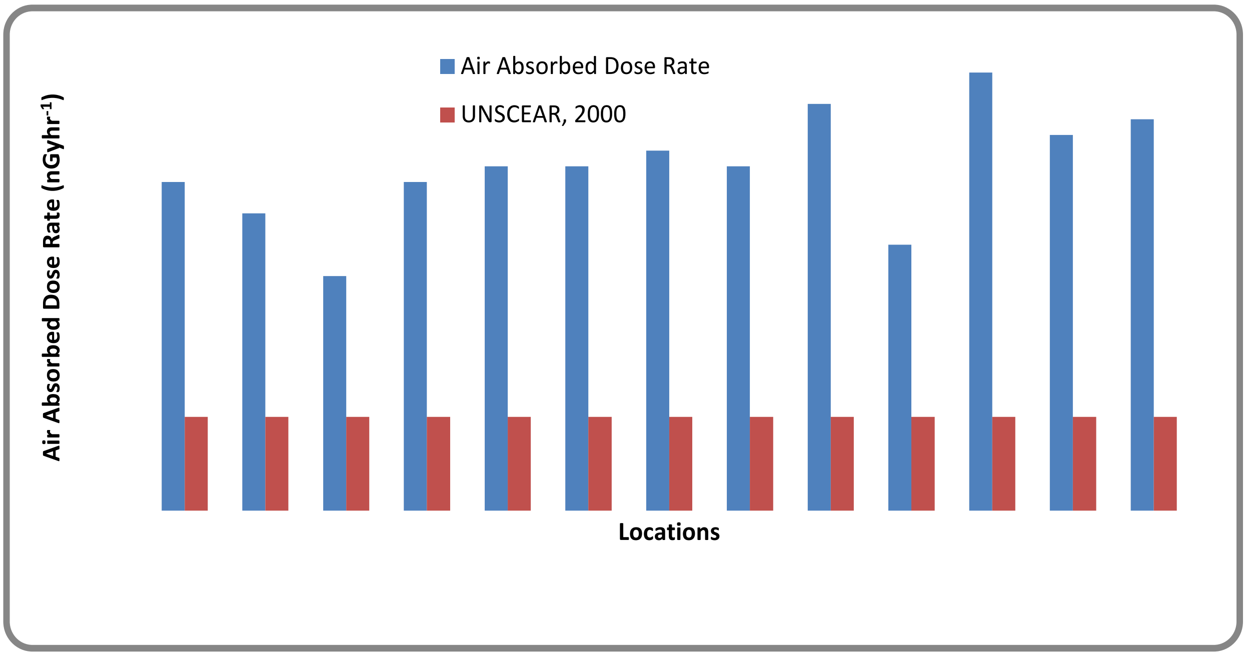


**Figure 3.** Comparison of average air absorbed dose (nGyhr$^{-1}$) measured with the UNSCEAR (2000) Threshold.

## 4. Conclusion

Radiaton dose from thirteen dumpsites in Ota and environs have been measured using the Digital alert meter. The estimated mean equivalent dose for all the dumpsites in all the locations was all higher than the permissible limits for background radiation for general public but lower than the 20 mSvyr$^{-1}$ for radiation workers. Based on these findings, the potential risk posed by wastes in most of the study locations to the environment (human, plants and animals) is minimal for now but may be a great concern with time. From the result of the study, we suggest that a perimeter fence at 10 m limits to dumpsite be constructed to serve as demarcation from building and other human activities in order to provide protection for the public. Therefore it is recommended for the local relevant authorities to provide perimeter fencing in order to restrict people from getting close to the dumpsites within the Metropolis while carrying out their daily activities.

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