# Influence of Radiation Emitted by Communication Network Masks on Environmental Radiation Level at Ikot Ekpene, Nigeria

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**Abstract:** The experiment was carried out to determine the influence of communication network mask on environmental radiation levels at Ikot-Ekpene from a set radiometric classified data. A typical portable Inspector Alert TM Nuclear Radiation Monitor was employed to measure the level of radiation at a distance of 0.03m above the ground surface and 1.5m away from the mobile phone based masks. Since radioactivity measurement or process is statistical, 130 readings were taken on each mobile phone based mask, average and error of the readings were obtained. IBM SPSS version 21 was employed to evaluate the average, standard error, regression coefficients, coefficient of correlation and coefficient of determination. The result which is comparable to those reported for environs in Nigeria's revealed that the annual effective dose equivalent dose is minimal when compared to Nigeria's average and the world maximum permissible dose level. The correlation analysis result reveals that the ionization radiation emitted by the communication network mask influences the background radiation and total ecosystem and general environment negatively. From the result of this radiometric survey of communication network mask and its background radiation show that the level of equivalent dose are both below the stipulated maximum permissible dose level given by the regulatory and control agencies locally and internationally thus, does not pose serious threat of radiological and environmental health hazards on the inhabitants of the community, but no matter how low, all levels of radiation still constitutes a hazard.

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**Key words**: Background radiation; Ionization radiation; Equivalent dose; Effective dose; Environment

## 1. Introduction

All living species are each day, exposed to certain amount of natural radiation in the form of particles and rays either from cosmic sources or background radiation from materials on the earth. Such radiations vary largely, depending on elevation above sea level and most importantly the geology of the area (Abdel-Rassout and Aigbedion, 2007; Armstrong et al., 2000; Adiukwu-Brown and Ogezi, 2001).

Radiation absorbed dose rates vary from country to country and from place to place. It is a function of the local and regional geology, altitude above mean sea level, the level of mining and processing of radioactive mineral, as well as the disposal methods for mine wastes, communication network emitted radiation and medical operations.

Measurements of natural background and Ionizing radiation has been carried out in different places, regions and country around globe using different variety of techniques. These techniques includes laboratory analyses of the radioactive elements in soil, rock samples, airborne scintillation counters and ionization chambers have been used to estimate the effective equivalent dose in several parts of the world (Abdel-Rassout and Aigbedion, 2007; Armstrong et al., 2000; Adiukwu-Brown and Ogezi, 2001; Ajayi and Ajayi, 1999; Ajayi, 2002; Azu, 1995; Solomon, 2010; Esen et al., 2015; Etuk et al., 2015). In this study, inspector Alert handheld nuclear radiation monitor was used to measure the level of ionizing radiation in Ikot Ekpene. Therefore, the aim of this research paper is to Influence of radiation emitted by Communication Network Mask on Environmental Radiation Level at Ikot Ekpene, Nigeria.

## 2. Study Area and Method of Investigation

The study was carried out at Ikot Ekpene in Ikot Ekpene Local Government Area (LGA) of Akwa Ibom State, Nigeria. Ikot Ekpene is located between Latitude 5.18oN and Longitude 7.72oE with an altitude of 176 meters above sea level in mangrove swamp climatic zone of Southern Nigeria. It has an annual rainfall of 6.04 mm/day, 81.4% annual mean relative humidity and 24.9$^0$C annual mean temperature.

A typical portable Inspector Alert TM Nuclear Radiation Monitor was used to detect and measure the radiation equivalent dose. The survey meter, model GLR61-6AM6-9V, serial No. 33333. Quality1. The Nuclear Radiation Monitor is made in USA by

International Medcom. Easy to read digital display shows a wide variety of readings: mR/hr, CPM, CPS, or µSv/hr. But in this study, the measurement was expressed in micro Sievert per hour ($\mu Svhr^{-1}$). The survey meter is run by one 9V battery. At each laboratory, the survey meter was held about 0.03m away from each mobile communication network masks so as to record the ionization radiation and 1.5m away from the mobile communication network based masks in order to obtain the background radiation. The equivalent dose rates were measured at 15 mobile phone base mask sites in Ikot Ekpene. Since radioactivity measurement or process is statistical, 130 readings were taken on each mobile phone based mask, average and error of the readings were obtained. The equivalent dose in µSvhr-1 from the survey meter was converted to the annual dose rate in mSvyr-1 for each of the location using the relation:

$$\text{Effective dose rate (mSv/y)} = \text{Dose rate (mSv/yr)} \times 24\ \text{h} \times 365\ \text{d} \times 0.2 \times 10^{-3}$$

Regression analyses, coefficient of correlation and determination were carried out for radiation data obtained in Table 1 for each location of the mobile phone base station measured using IBM SPSS version 21.

**3. Result Analysis**

Owning to the differences in geological formation, regulatoy control employed by the communication network providers and natural radioactivity of the different locations under study, their radiation levels differ significantly from one network and location to another. The results of the radiometric assessment obtained from ionizing radiation of MTN, Glo, Airtel, Starcomms, Visafone and Etisalat, and background radiation were used to evaluate the mean, standard error, regression equations, coefficient of correlation (R) and coefficient of determination (R2) as presented in Table 1 – 3 and Figure 1 – 2.

**Table 1: Names of the locations, Type of Network and Mean Equivalent Dose in Ikot Ekpene**

| S/N | Locations | Network | Ionizing Radiation (mSv/yr) | Background Radiation (mSv/yr) |
|---|---|---|---|---|
| 1. | 1 Ibiakpan Akanawan, Waterboard Road, off Uyo Road | MTN | 0.174±0.00071 | 0.161±0.0012 |
| 2. | 28 Church Road | MTN | 0.161±0.00069 | 0.151±0.0090 |
| 3. | 3 Chubb Road, Opposite Insight Bible Church | MTN | 0.190±0.00073 | 0.136±0.0084 |
| 4. | 1 NEPA Iine, Road, Off Ibiakpan Primary School | Airtel | 0.173±0.0117 | 0.160±0.0097 |
| 5. | 41 Atan Road | Airtel | 0.201±0.0414 | 0.191±0.0989 |
| 6. | Ikot Ekpene Local Government Council | Airtel | 0.170±0.0216 | 0.116±0.0095 |
| 7. | 5 market Road | Glo | 0.187±0.0015 | 0.175±0.0074 |
| 8. | 41 Atan Road | Glo | 0.277±0.0018 | 0.267±0.0087 |
| 9. | 12 Church Road | Glo | 0.181±0.0215 | 0.127±0.0034 |
| 10. | 20 Church Road | Etisalat | 0.181±0.0215 | 0.169±0.0065 |
| 11. | 2 Tom Atia Lane, off Ibo Hall Road | Etisalat | 0.166±0.0001 | 0.147±0.0084 |
| 12. | 3 Queen Street | Etisalat | 0.142±0.0002 | 0.151±0.0063 |
| 13. | 8 Eto Road | Starcoms | 0.159±0.0113 | 0.147±0.0082 |
| 14. | 6 Queen Street | Starcoms | 0.187±0.0123 | 0.177±0.0098 |
| 15. | 18 Church Road | Starcoms | 0.198±0.0132 | 0.144±0.0035 |
| 16. | 14 Church Road | Visafone | 0.203±0.0232 | 0.191±0.0056 |
| 17. | 4 Ikono Road | Visafone | 0.201±0.0218 | 0.189±0.0019 |
| 18. | 18 Atan Road | Visafone | 0.198±0.0219 | 0.144±0.0067 |

## 4. Discussion

Similar variations of background and ionization radiation were observed from one communication network to another. This is could attribute to the controlled effect stipulated by the monitoring and regulatory agencies of maximum permissible dose level in any community across the country. The minimum mean ionizing and background equivalent dose level of 0.161±0.0116mSv/yr and 0.136±0.0071mSv/yr respectively were recorded for Etisalat while the maximum mean ionizing and background equivalent dose level of 0.277±0.0018mSv/yr and 0.267±0.0087mSv/yr respectively were registered for Glo. However, the effective equivalent dose of ionizing radiation of 0.1857±0.0287mSv/yr and background radiation of 0.1603±0.0083mSv/yr in Ikot Ekpene. The higher values obtained for the ionizing radiation from the communication network mask is could be attributed to the emission of radiation from the network mask in the location while background radiation attributed to natural radiation in the environment. However, the results recorded is safe for occupants of the community compared to the maximum permissible dose of 1mSv/yr recommended by (ICRP, 1990; NCRP, 1976) for non radiation occupational workers irrespective of the study area is situated within the oil-rich Niger Delta region, where oil exploration, spoillage and soil mineral mining is increasing. In general, this result is lower than the record for locations in the same Southern Nigeria (Solomon, 2010; Esen et al., 2015; Etuk et al., 2015).

The empirical constants of the proposed regression equations varied for R, R2 and standard error of estimation for different network as shown in Table 3. This could attributed to seasonal variation of geological materials, radioactive emissions from communication network mask, wind, temperature, soil type and other atmospheric and meteorological parameters within each location in the study locations. The correlation coefficient, R, of 0.164 – 0.959 and correlation of determination R2 of 0.027 – 0.919 exist between the dependent variable (ionization radiation) and independent variable (background radiation) for Glo and Starcoms. This indicates that Glo network mask contributed the lowest ionizing radiation to the total background radiation and Starcoms contributed the highest ionizing radiation total background radiation among the networks studied. This implies that the background radiation is optimally controlled by the ionizing radiation from the communication network masks depending on the network and other environmental factors. Although the values obtained were minimal and does not pose a threat of radiological health hazards on the dwellers of the community, efforts must been put in place to checkmate the level of radioactivity and protect the environment for adequate health and wellbeing of the occupants, as well as to conserve and use sustainably the environment and natural resources for the benefit of the present and future generation.

**Table 2: The Mean of Ionizing Radiation (MIR) where Communication Phone Based Masks is Avaliable and Mean of Ionizing Radiation where Communication Phone Based Masks is not Avaliable (MBR) in (mSv/yr) for Different Networks at Ikot Ekpene.**

| Radiation | MTN | Airtel | Glo | Etisalat | Starcoms | Visafone |
|---|---|---|---|---|---|---|
| MIR | 0.175±0.0213 | 0.181±0.0269 | 0.215±0.0083 | 0.161±0.0116 | 0.181±0.0123 | 0.201±0.0919 |
| MBR | 0.149±0.0062 | 0.156±0.0181 | 0.190±0.0065 | 0.136±0.0071 | 0.156±0.0072 | 0.175±0.0047 |

**Table 3: Equations with Regression and Statistical indicator for Mean of Ionizing Radiation (MIR) where Communication Phone Based Masks is Avaliable and Mean of Ionizing Radiation where Communication Phone Based Masks is not Avaliable (MBR) in (mSv/yr) for Different Networks at Ikot Ekpene.**

| Equations | Network | R | $R^2$ | Standard Error |
|---|---|---|---|---|
| MBR = 0.277-0.688(MIR) | MTN | 0.634 | 0.402 | 0.0159 |
| MBR = 0.121-0.390(MIR) | Airtel | 0.860 | 0.740 | 0.0123 |
| MBR = 0.078+0.725(MIR) | Glo | 0.959 | 0.919 | 0.0216 |
| MBR = 0.102+0.434(MIR) | Etisalat | 0.948 | 0.898 | 0.0088 |
| MBR = 0.153+ 0.180(MIR) | Starcoms | 0.164 | 0.027 | 0.0281 |
| MBR = 0.153+0.088(MIR) | Visafone | 0.932 | 0.869 | 0.0013 |

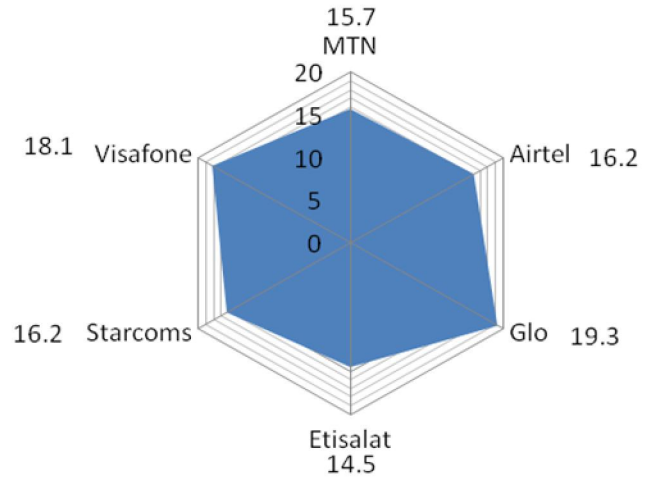


**Figure 1: Percentage Average of Ionizing Radiation for all Network Investigated in Ikot Ekpene**

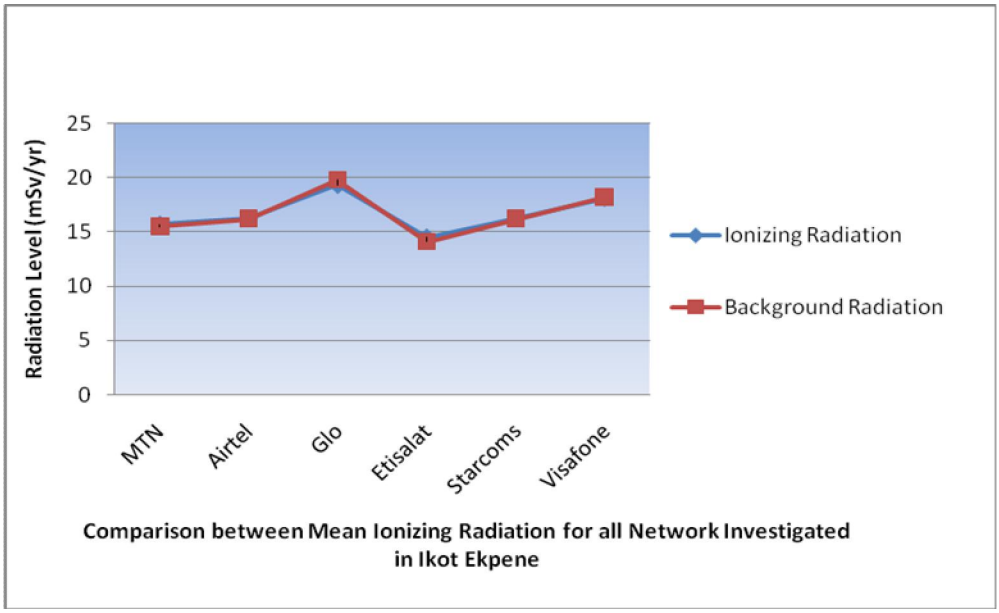


**Figure 2: Comparison between mean ionization radiation for all network invesigated in Ikot Ekpene**

## 5. Conclusion

The average annual effective dose equivalent in Ikot due of mobile phone based mask ionizing radiation was found to 0.175±0.0002 mSv/yr for MTN, 0.181±0.0147 mSv/y for Airtel, 0.215±0.0155 mSv/yr for Glo, 0.155±0.0008 mSv/yr for Etisalat, 0.174±0.0013 mSv/yr for Visafone, 0.181±0.0287 mSv/yr for Starcomms and 0.201±0.0232 mSv/yr for Visafone. These values are less than the world average of 1mSv/yr specified by (ICRP, 1990; NCRP, 1976) for non occupational radiation workers (general public). Hence the probability of occurrence of any of the health effects of ionizing radiation is low. The result in this research also reveals that the equivalent radiation dose is minimal when compared to those reported for the environs in Nigeria and the world average. Although no matter how low all levels of ionizing radiation are hazardous to health and environment. It is therefore not expected that there should be fear of any serious health hazard from ionizing radiation exposure or dose emanating from the communication network mask at Ikot Ekpene

community. However, routine assessment to monitor the radiation level of the communication network mask within the community which has been in operation for the fast sixteen years and its surrounding environment is recommended to check and maintain low radiation because of its hazardous influence on environment, plant and man.

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