Assessment Of Electromagnetic Radiation Exposure Around Telecommunication Antenna Masts and Its Potential Health Implications

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***Abstract*—The rapid expansion of telecommunication infrastructure has increased public concern regarding exposure to electromagnetic radiation (EMR) emitted from antenna masts and its possible health implications. This study presents a comparative analysis of electromagnetic exposure levels measured near selected antenna masts and evaluates their potential health risks. Measurements were conducted at nine different locations using electromagnetic radiation detection devices to assess radiofrequency (RF) radiation, electric field intensity, magnetic field intensity, and cumulative radiation dose at distances of 0 m and 10 m from antenna installations. The findings revealed variations in electromagnetic field intensity among the investigated locations. Commercial antenna masts generally recorded higher radiation levels than Wi-Fi-based installations. However, cumulative radiation dose measurements ranged from 0.09 µSv to 0.22 µSv, remaining significantly below internationally recognized safety limits. The study further demonstrated that distance plays an important role in reducing exposure, as radiation levels generally decreased with increasing separation from antenna structures. Although some locations exhibited elevated RF, electric field, and magnetic field readings, the overall exposure levels did not indicate immediate health hazards according to established regulatory standards. The results support existing scientific evidence suggesting that electromagnetic emissions from properly regulated antenna masts are generally within safe exposure thresholds. Nevertheless, continuous environmental monitoring, adherence to international safety guidelines, strategic mast placement, and increased public awareness are recommended to minimize potential long-term risks. This study contributes to the growing body of knowledge on electromagnetic exposure assessment and provides valuable information for policymakers, telecommunication operators, researchers, and public health stakeholders.**

***Index Terms*—Electromagnetic Radiation, Antenna Masts, Radiofrequency Exposure, Electromagnetic Fields, Radiation Monitoring, Health Risk Assessment, Specific Absorption Rate (SAR), Telecommunication Infrastructure.**

I. INTRODUCTION

1.1. Background of the Study

The rapid growth of cellular communication has led to the widespread installation of base station transmitters, raising concerns about potential health effects for nearby residents and workers. Wireless communication technologies contribute over 65% of radiofrequency radiation exposure, with mobile phones as the main source. Studies have reviewed possible health and genetic effects of exposure to base stations. To regulate safety, ICNIRP provides exposure limits based on specific absorption rate (SAR) and field strength or power density. Research shows that these limits can be exceeded close to transmitting antennas, highlighting the need to establish minimum safe distances around base stations.

Electromagnetic radiation (EMR) consists of electric and magnetic fields from both natural and artificial sources and is part of everyday life. Common sources include household electricity, mobile phones, Wi-Fi, and telecommunications antennas, while higher levels are used in medical technologies such as MRI and CT scans. EMR also has beneficial medical applications. The electromagnetic spectrum includes ionizing and non-ionizing radiation: ionizing radiation (e.g., X-rays and gamma rays) has high energy and can damage biological tissues and DNA, whereas non-ionizing

radiation (e.g., microwaves, infrared, visible light, and low-frequency fields) is lower in energy and widely used in communication and daily technologies.

The rapid growth of mobile communication services has led to a proliferation of telecommunication base stations and antenna masts in urban and rural areas. This growth has raised concerns among the public about potential health risks associated with electromagnetic radiation exposure. The widespread adoption of mobile communication technologies has transformed the way people live, work, and interact with each other. The demand for reliable and high-quality mobile services has led to a significant increase in the number of telecommunication base stations and antenna masts in urban and rural areas.

1.2. Aim of the Study

The project aims to conduct a comparative analysis of electromagnetic exposure near antenna masts, assessing radiation levels, Specific Absorption Rate (SAR) values, and potential health risks associated with different types of antenna masts, locations, and exposure scenarios. It aims to provide insights into the potential health risks associated with electromagnetic exposure near antenna masts, informing policymakers, industry stakeholders, and the general public.

1.3. Objective of the Study

- To measure and compare the radiation exposure at 0 meters and 10 meters from various antenna masts, including Wi-Fi and broadcast masts.
- To identify which type of mast emits higher or lower radiation levels.
- To evaluate whether the recorded radiation levels pose any significant health concerns based on standard safety limits.
- To assess the influence of distance on the intensity of electromagnetic radiation near antenna masts.

1.4. Statement of the problem

Assessing and comparing the levels of electromagnetic exposure near different types of antenna masts and evaluating the potential health risks associated with long-term exposure.

1.5. Scope of the study

- Inform policy decisions: Provide evidence-based insights for policymakers and regulatory bodies to develop guidelines and policies that protect public health.
- Protect public health: Identify potential health risks associated with electromagnetic exposure near antenna masts and contribute to the development of strategies to mitigate them.
- Advance scientific knowledge: Contribute to the ongoing research and debate on the health effects of electromagnetic radiation exposure, helping to clarify the relationship between exposure levels and potential health risks.
- Promote transparency and awareness: Educate the public about electromagnetic radiation exposure and potential health risk, enabling informed decision-making and risk management.
- Support industry best practices: Provides insights for the telecommunication industry to develop and implement best practices for the installation and operation of antenna masts, minimizing potential health risks.

II. LITERATURE REVIEW

2.1. Introduction

Research on radiation exposure from base transceiver stations (BTS) and mobile phones shows that measured power density levels around BTS including those near schools and in Nigeria are generally within ICNIRP safety limits. Exposure varies with distance, antenna number, and mast collocation. Studies on mobile phones indicate that specific absorption rate (SAR) is an important parameter in assessing potential health risks, with users reporting symptoms for both high- and low-SAR devices.

2.2. Electromagnetic Radiation

Electromagnetic radiation (EMR) is a fundamental part of the physical universe and modern technology but is often poorly understood by the public and even educators. Misconceptions about EMR contribute to public anxiety, resistance to new technologies, and gaps in scientific literacy, underscoring the need for effective education and awareness.

2.2.1 Electromagnetic Spectrum

The electromagnetic spectrum ranges from low-frequency radio waves to high-frequency gamma rays, with each region having distinct properties and

applications. Visible light is the only portion detectable by the human eye, while other regions support critical technological and medical uses. Understanding the spectrum is essential for grasping how EMR interacts with matter and affects biological systems.

2.3. Health Risks

Studies have examined potential health effects of EMR exposure, including cancer risk and non-cancer symptoms such as headaches, fatigue, sleep disturbances, and concentration difficulties. Although some research suggests possible associations with long-term exposure, most measured exposure levels near BTS are below international safety limits, and conclusive causal links remain unestablished.

2.4. Benefits and Hazards of Electromagnetic Radiation in Physical Health and Telecommunication

Telecommunication devices have revolutionized communication and information access but also raise concerns about EMR exposure. While EMR has important medical and technological benefits, excessive or prolonged exposure has been associated in some studies with various health conditions, prompting ongoing research and precautionary recommendations.

2.4.1.Mobile Phones

Mobile phones are essential in modern life for communication, business, education, and emergencies. However, their use has been associated with reported symptoms such as headaches, fatigue, dizziness, sleep disturbances, and memory issues. Recommended precautions include limiting call duration, avoiding use in poor signal areas, and reducing close body contact.

2.5. Chronic Health Effects Associated with RF Exposure

Epidemiological research on long-term radiofrequency (RF) exposure faces challenges in establishing causality. Studied outcomes include carcinogenic, neurological, reproductive, cardiac, ocular, and developmental effects, with the strongest body of literature focusing on cancer and electromagnetic hypersensitivity.

2.5.1.Carcinogenicity

Evidence linking RF exposure to cancer remains inconclusive. RF radiation is classified by IARC as possibly carcinogenic (Group 2B), but large reviews, occupational studies, and recent systematic reviews generally find no consistent or significant association between RF exposure and cancer. Animal studies showing rare tumor increases involved exposure levels far above safety limits, limiting their relevance to human exposure.

2.6. Misinformation and Health Concerns

Misinformation about EMR health risks, including unfounded links between 5G and COVID-19, has spread widely online. Major health organizations such as WHO and ICNIRP have dismissed these claims. Scientific consensus emphasizes that no single study is decisive; conclusions must be based on reproducible, consistent evidence evaluated across multiple high-quality studies.

III. MATERIALS AND METHODOLOGY

3.1. Introduction

This chapter outlines the materials and procedures used to assess electromagnetic radiation exposure near antenna masts, including measurement of radiation levels, frequency ranges, exposure limits, and potential health risks.

3.2. Materials

The materials used for data collection included an electromagnetic radiation detector, a Bosean FS-1000 household nuclear radiation detector, measuring tape, a tripod stand, and a stop clock.

3.3. Description of Apparatus Used

The electromagnetic radiation detector was used to measure radiofrequency strength, electric field intensity, and magnetic field intensity. The Bosean FS-1000 detector measured cumulative radiation dose in real time. Measuring tape was used to determine device height and distance from the mast, the tripod stand supported the measuring instruments, and the stop clock controlled the sampling intervals.

3.3.1.Description of Hand-Held Tools Used

The hand-held electromagnetic radiation detector simultaneously measured RF intensity, electric field

intensity, and magnetic field intensity, displaying all values on a single interface with visual and audible alarms when limits were exceeded. It operated across relevant frequency ranges with high accuracy.

The FS-1000 household nuclear radiation detector measured real-time dose rates and accumulated doses, stored data internally, provided adjustable sound and light alarms, and allowed data transfer to a computer for further analysis.

PLATE 1: ELECTROMAGNETIC RADIATION DETECTOR DEVICE

PLATE 2: BOSEAN FS -1000 (RADIATION DETECTOR DEVICE)

PLATE 3: TRIPOD STAND

PLATE 4: TAPE

IV. RESULT AND DISCUSSION

1. Mast Within Love Park Garden

AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	8.18 Good	580.83 Warning	592.07 Warning
E-F (V/m)	1.70 Good	0.10 Good	0.00 Good
B-F (μT)	0.30 Good	0.23 Good	0.21 Good
Summary	Avoid	Avoid	Avoid

AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	65.16 Warning	298.83 Warning	200.14 Warning
E-F (V/m)	2.90 Good	0.00 Good	0.00 Good
B-F (µT)	0.29 Good	0.31 Good	0.17 Good
Summary	Avoid	Avoid	Avoid

2. Mast Behind Pure Water Factory

AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	418.89 Warning	318.29 Warning	451.70 Warning
E-F (V/m)	0.00 Good	0.03 Good	0.00 Good
B-F (µT)	0.27 Good	0.26 Good	0.31 Good
Summary	Avoid	Avoid	Avoid

Mast behind Pure Water Factory

AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	2.00 Good	555.75 Warning	576.15 Warning
E-F (V/m)	2.20 Good	1.00 Good	0.00 Good
B-F (µT)	0.23 Good	0.41 Warning	0.16 Good
Summary	Avoid	Avoid	Avoid

3. Mast Behind Blueroof Building

AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	10.19 Good	29.58 Good	28.72 Good
E-F (V/m)	0.00 Good	0.00 Good	0.00 Good
B-F (µT)	0.22 Good	0.21 Good	0.07 Good
Summary	Safe	Safe	Safe

Mast Behind Blueroof Building

AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	49.30 Warning	90.51 Warning	25.05 Good
E-F (V/m)	0.80 Good	0.30 Good	0.00 Good
B-F (µT)	0.29 Good	0.32 Good	0.27 Good
Summary	Alert	Alert	Safe

4. Mast Along Gbokoto's Road, A. (Along Rector's Lodge)

AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	105.36 Warning	322.09 Warning	444.53 Warning
E-F (V/m)	188.00 Warning	2944.30 Warning	2874.40 Warning
B-F (µT)	0.63 Warning	1.98 Warning	2.08 Warning
Summary	Avoid	Avoid	Avoid

Mast Along Gbokoto's Road, A. (Along Rector's Lodge)

AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	25.49 Good	168.52 Warning	139.79 Warning
E-F (V/m)	150.50 Warning	2765.70 Warning	2704.70 Warning
B-F (µT)	0.66 Warning	1.74 Warning	1.96 Warning
Summary	Avoid	Avoid	Avoid

5. Mast Along Gbokoto's Road, B. (Along Rector's Lodge)

AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	66.65 Warning	238.86 Warning	254.03 Warning
E-F (V/m)	399.00 Warning	2783.90 Warning	2683.00 Warning
B-F (µT)	0.50 Warning	1.83 Warning	1.77 Warning
Summary	Avoid	Avoid	Avoid

Mast Along Gbokoto's Road, B. (Along Rector's Lodge)
AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	47.29 Warning	337.69 Warning	431.66 Warning
E-F (V/m)	638.20 Warning	2943.60 Warning	2742.00 Warning
B-F (µT)	0.42 Warning	1.78 Warning	1.47 Warning
Summary	Avoid	Avoid	Avoid

6. Mast Within C.I.C.T. Centre
AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	0.44 Warning	25.98 Good	28.70 Good
E-F (V/m)	628.70 Warning	2388.00 Warning	2235.40 Warning
B-F (µT)	0.23 Good	1.55 Warning	1.54 Warning
Summary	Avoid	Avoid	Avoid

Mast Within C.I.C.T. Centre
AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	49.13 Warning	48.12 Warning	79.21 Warning
E-F (V/m)	392.20 Warning	2552.50 Warning	2731.50 Warning
B-F (µT)	0.47 Warning	1.53 Warning	1.76 Warning
Summary	Avoid	Avoid	Avoid

7. Mast Behind E-Library
AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	7.12 Warning	16.72 Good	22.10 Good
E-F (V/m)	1.50 Good	2268.00 Warning	1972.30 Warning
B-F (µT)	0.16 Good	1.26 Warning	1.75 Warning
Summary	Avoid	Avoid	Avoid

Mast Behind E-Library
AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	50.10 Warning	10.22 Good	12.22 Good
E-F (V/m)	391.10 Warning	258.20 Warning	529.20 Warning
B-F (µT)	0.22 Good	1.92 Warning	1.99 Warning
Summary	Avoid	Avoid	Avoid

8. Mast Behind Mass Com. Studio
AT 0m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	1.30 Good	7.84 Good	9.60 Good
E-F (V/m)	442.90 Warning	2470.90 Warning	2052.40 Warning
B-F (µT)	0.38 Good	1.80 Warning	1.22 Warning
Summary	Avoid	Avoid	Avoid

Mast Behind Mass Com. Studio
AT 10m to the wall housing the mast

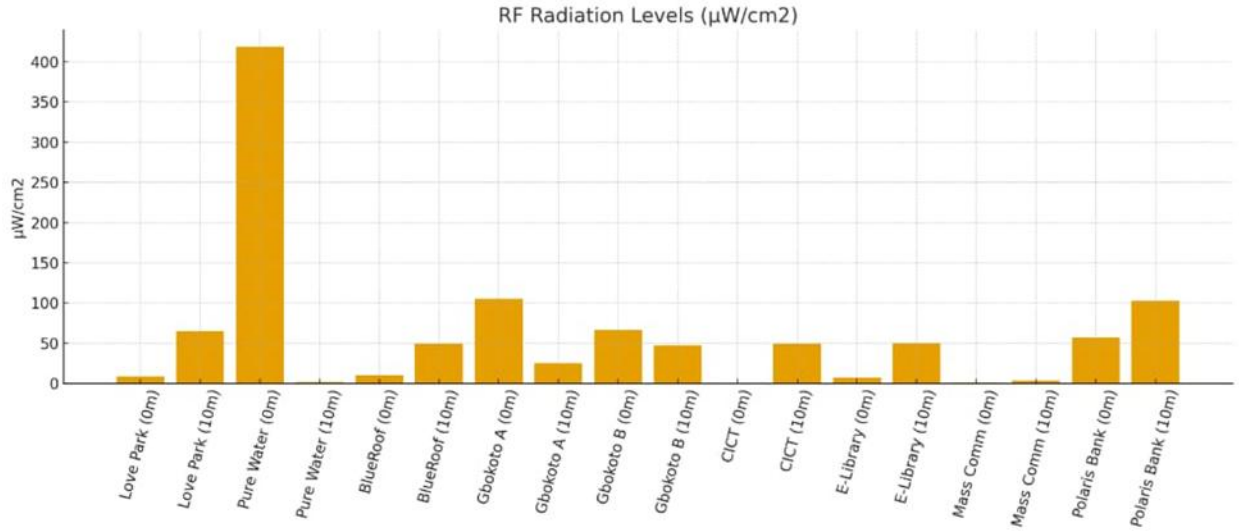
E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	3.55 Good	19.56 Good	24.32 Good
E-F (V/m)	5254.40 Warning	2467.90 Warning	2318.10 Warning
B-F (µT)	0.35 Good	1.39 Warning	1.73 Warning
SUMMARY	Avoid	Avoid	Avoid

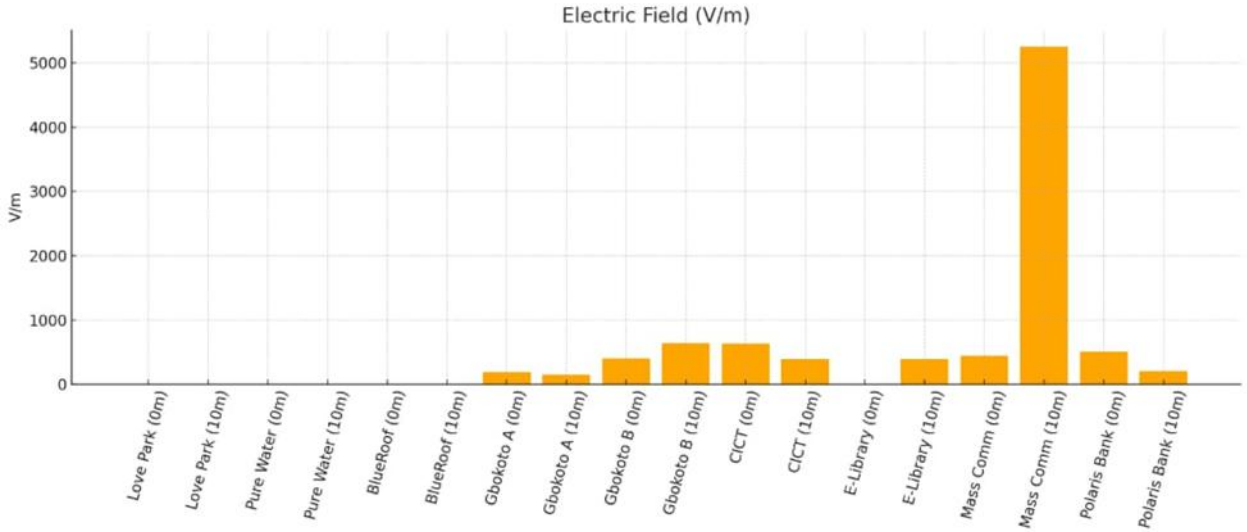
9. Mast Within Polaris Bank
AT 0m to the wall housing the mast

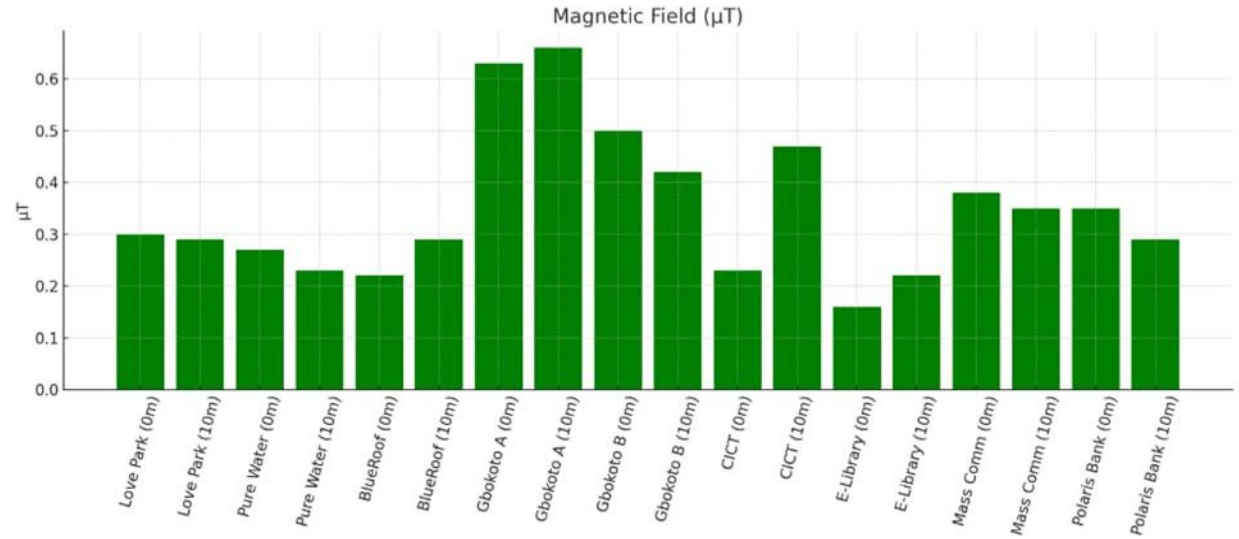
E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	57.02 Warning	289.84 Warning	318.50 Warning
E-F (V/m)	505.90 Warning	2895.70 Warning	1.00 Warning
B-F (µT)	0.35 Good	1.79 Warning	1.60 Warning
Summary	Avoid	Avoid	Avoid

Mast Within Polaris Bank
AT 10m to the wall housing the mast

E-M R	VPP	AVG	ACTUAL
RF ($\mu W/cm^2$)	102.86 Warning	303.60 Warning	159.55 Warning
E-F (V/m)	206.50 Warning	2860.8 Warning	1207.70 Warning
B-F (µT)	0.29 Good	1.06 Warning	0.67 Warning
Summary	Avoid	Avoid	Avoid

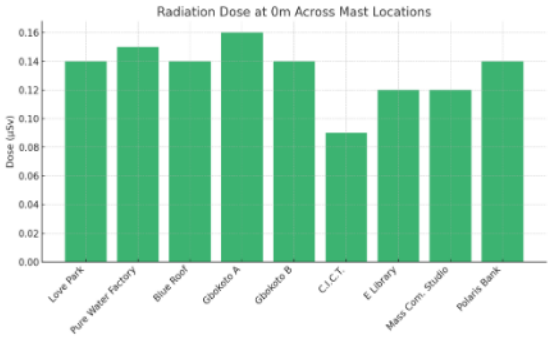

RF Radiation Levels (µW/cm2)
µW/cm2
0
50
100
150
200
250
300
350
400
Love Park (0m)
Love Park (10m)
Pure Water (0m)
Pure Water (10m)
BlueRoof (0m)
BlueRoof (10m)
Gbokoto A (0m)
Gbokoto A (10m)
Gbokoto B (0m)
Gbokoto B (10m)
CICT (0m)
CICT (10m)
E-Library (0m)
E-Library (10m)
Mass Comm (0m)
Mass Comm (10m)
Polaris Bank (0m)
Polaris Bank (10m)

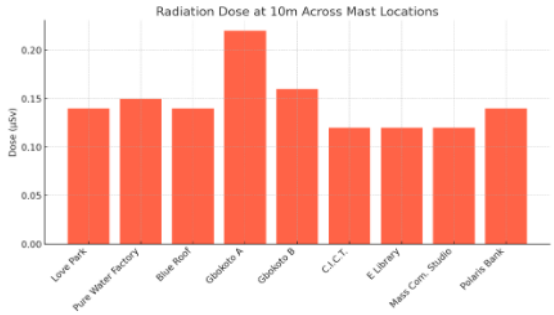

Electric Field (V/m)
V/m
0
1000
2000
3000
4000
5000
Love Park (0m)
Love Park (10m)
Pure Water (0m)
Pure Water (10m)
BlueRoof (0m)
BlueRoof (10m)
Gbokoto A (0m)
Gbokoto A (10m)
Gbokoto B (0m)
Gbokoto B (10m)
CICT (0m)
CICT (10m)
E-Library (0m)
E-Library (10m)
Mass Comm (0m)
Mass Comm (10m)
Polaris Bank (0m)
Polaris Bank (10m)


Magnetic Field (µT)
µT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
Love Park (0m)
Love Park (10m)
Pure Water (0m)
Pure Water (10m)
BlueRoof (0m)
BlueRoof (10m)
Gbokoto A (0m)
Gbokoto A (10m)
Gbokoto B (0m)
Gbokoto B (10m)
CICT (0m)
CICT (10m)
E-Library (0m)
E-Library (10m)
Mass Comm (0m)
Mass Comm (10m)
Polaris Bank (0m)
Polaris Bank (10m)

READINGS FROM BOSEAN FS-1OOO RADIATION DETECTOR DEVICE

S/N	LOCATION	DISTANCE	
		0m	10m
1	Love Park	0.14µSv	0.14µSv
2	Pure Water Factory	0.15µSv	0.15µSv
3	Blue Roof	0.14µSv	0.14µSv
4	Gbokoto A	0.16µSv	0.22µSv
5	Gbokoto B	0.14µSv	0.16µSv
6	C.I.C.T.	0.09µSv	0.12µSv
7	E library	0.12µSv	0.12µSv
8	Mass Com. Studio	0.12µSv	0.12µSv
9	Polaris Bank	0.14µSv	0.14µSv





V. RESULTS AND DISCUSSION

5.1. Summary of the Figures from the Table

Radiation measurements were conducted at nine different locations near antenna masts using a radiation detector device. Readings were taken at 0 meters and 10 meters from each mast over a one-hour period. Overall radiation levels were very low, ranging from 0.09 µSv to 0.22 µSv, indicating minimal exposure.

Radiation Levels at Wi-Fi Antenna Locations

Locations with Wi-Fi antenna masks, including Love Park Garden, Blue Roof Building, Central ICT Building, E-Library, Mass Communication Studio, and Polaris Bank, recorded consistently low radiation levels. Most readings showed little or no variation between 0 meters and 10 meters, with values typically between 0.09 µSv and 0.14 µSv.

Radiation Levels at Commercial Antenna Mast Locations

Commercial antenna masts, particularly at Gbokoto Road A and B, showed slightly higher radiation levels compared to Wi-Fi masts. The highest recorded value was 0.22 µSv at Gbokoto Road A, measured 10 meters from the mast. Despite these higher readings, the locations were far from buildings and human activity, reducing potential exposure risk.

Effect of Distance on Radiation Exposure

Across most locations, radiation levels were marginally lower at 10 meters compared to measurements taken at 0 meters. This confirms that distance plays an important role in reducing radiation exposure, although the overall differences were small.

Health and Safety Implications

All recorded radiation values were well below internationally accepted safety limits, including ICNIRP guidelines for non-ionizing radiation and SAR exposure. The study found no immediate evidence of hazardous radiation exposure, supporting global findings that emissions from antenna masts are generally low.

Conclusion from the Measurements

Although public concern persists about possible health effects of electromagnetic radiation, particularly from modern telecommunication systems, the results of this study indicate that radiation exposure within the study area remains within safe limits. Nevertheless, regular monitoring, proper mast placement, and increased public awareness are recommended to minimize long-term exposure risks.

VI. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

Electromagnetic fields (EMFs) are widespread and widely used, making thorough assessment of their potential health risks essential. Although current evidence does not allow for firm conclusions, possible

adverse health effects cannot be ruled out. Several studies suggest that EMFs may negatively affect health, even though the exact biological mechanisms are not fully understood; alternative explanations such as oxidative stress may account for observed effects.

The literature emphasizes the need for well-designed, long-term, and standardized studies with accurate exposure assessment to address limitations in previous research and clarify dose–response relationships. Evidence indicates that RF exposure below 30.0 μW/cm² generally has weak effects, but prolonged exposure, even at low energy levels, may still be significant. Findings from laboratory studies also suggest that some Wi-Fi masts emit radiation levels above acceptable limits, highlighting the importance of limiting the duration of direct exposure to radiation sources.

6.2. Recommendation

Based on the project objectives, methods, and results, the study is strongly recommended for Science Laboratory Technology students as it provides practical experience in measuring and analyzing electromagnetic radiation near antenna masts. The findings highlight that electromagnetic radiation including RF strength, electric fields, and magnetic fields can potentially affect the nervous, cardiovascular, immune, and reproductive systems, especially with prolonged exposure.

The study emphasizes the importance of minimizing EMF exposure by strictly adhering to safety guidelines set by regulatory bodies such as IEEE, WHO, and ICNIRP. Failure to follow these standards may increase long-term public health risks. Consequently, proper planning of antenna installations, adequate shielding of high-voltage transmission lines, underground cabling in urban areas, and the use of radiation-mitigating equipment are recommended to reduce harmful exposure and protect public health.

REFERENCES

[1] E. O. Alagbada, “Examining the EMF Exposure Effect of GSM Mast Antennas and the High-Tension Electric Cables on the Environment of Delta Park of University of Port Harcourt, Rivers State,” *Journal of Multidisciplinary Engineering Science and Technology (JMEST)*, vol. 11, pp. 3159–3160, 2015. [Online]. Available: http://www.jmest.org

[2] A. M. Mohammed, K. S. Olajide, and A. Zubairu, “Comparative Analysis of Radiation Exposure from Single Service and Collocate Services Masts: A Study of Damaturu in Yobe State of Nigeria,” Journal of Electronics and Communication Engineering Research, vol. 7, no. 9, pp. 24–29, 2021. [Online]. Available: https://www.researchgate.net/publication/357636425_Comparative_Analysis_of_Radiation_Exposure_from_Single_Service_and_Collocate_Services_MastsAStudy_of_Damaturu_in_Yobe_State_of_Nigeria

[3] A. Patel and H. M., “A Review on Radiation Detectors of Various Radiation Detection Application,” Journal of Radiation and Nuclear Applications, vol. 8, no. 2, pp. 93–111, 2023. [Online]. Available: http://www.naturalspublishing.com/Journals.asp95

[4] A. Batool, F. Bibi, F. Frezza, and F. Mangini, “Benefits and Hazards of Electromagnetic Waves, Telecommunication, Physical and Biomedical,” European Review for Medical and Pharmacological Sciences, vol. 23, pp. 3121–3128, 2019.

[5] Public Health Ontario, “Health Effects of Radiofrequency Electromagnetic Fields, Including 5G,” 2023.

[6] E. Hamiti, M. Ibrani, L. Ahma, V. Shala, and R. Halili, “Comparative Analysis of Electromagnetic Field Exposure Levels and Determination of the Minimum Safe Distances from Mobile-Phone Base Stations in Urban Areas,” Progress In Electromagnetics Research M, vol. 50, pp. 117–128, 2016.

[7] H. N. Hannu and G. James, “Potential Health Effects of Exposure of Electromagnetic Field (EMF),” Scientific Committee on Emerging and Newly Identified Health Risks, 2015.

[8] L. G. and K. T. Kotsis, “Electromagnetic Radiation: A Comprehensive Review of Misconceptions,” Eurasian Journal of Science and Environmental Education, vol. 4, no. 2, pp. 19–38, 2024, doi: 10.30935/ejsee/15719.

[9] M. Umoh J., “Assessment of Electromagnetic Fields (EMF) on Human Health in Uyo Metropolis,” Journal of Innovations in

Engineering Research and Technology, vol. 9, no. 2, pp. 8–10, 2022. [Online]. Available: https://www.researchgate.net/publication/380978980

[10] U. Sorgucu, "A Comparative Analysis of the Development of Electromagnetic Pollution Maps with Artificial Intelligence and Interpolation," Scientific Research and Essays, vol. 18, no. 2, pp. 15–24, 2023. [Online]. Available: https://academicjournals.org/journal/SRE/article-full-text/F289FFA70547