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Measurement of Magnetic Field Intensity within Captain Elechi Amadi Polytechnic Rumuola, Rivers State, Nigeria

S. A. Sokari[1*] and A. N. Orlunta[1]

[1]Department of Science laboratory Technology, Captain Elechi Amadi Polytechnic, Rumuola, River State, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author SAS designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author ANO managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The measurement of magnetic field intensity within Captain Elechi Amadi Polytechnic, Rumuola was carried out with the aid of a handheld Bentech (GM-3120) Model Electromagnetic Radiation Metre. A total of 6 sampled locations were recorded; randomly with six distinct measurement and their coordinates at each of the sampled location with the aid of the global system position satellite (GPS) device. The measurement took place between 2017 November to 2018 March. A minimum value of $0.3417 \pm 0.65\ \mu$T was recorded at the Administrative Block and a maximum value of $1.9767 \pm 1.43\ \mu$T at the Business Centre. The overall mean values of all the sampled locations all fall below the recommended limit for the outdoor magnetic field intensity exposure of 100μT of the International Commission of Non-Ionizing Radiation Protection (ICNIRP). The outcome of the measurement reveals that the exposure to magnetic field intensity to staffs, students and commercial workers within the campus of the Captain Elechi Amadi Polytechnic poses no health hazard.

Keywords: Electromagnetic radiation meter; magnetic field intensity; global positioning satellite.

**Corresponding author: E-mail: sylforlife@gmail.com;*

1. INTRODUCTION

Electromagnetic fields are present everywhere, the field transverse our environment at divers frequencies. The field composed of electric (E) and magnetic (H) waves simultaneously with one together. On one hand Electric field emanates from electric charges and the motion of other charges found in them and on the other hand magnetic field emanates from the motion of electric charges, from a current source. Research has shown that even the extremely low fields (ELF) may possibly hampered the secretion of melanin that is very vital for the protection of breast cancer [1]. Ahlbom et al. carried out a study of the effect of leukemia and residential buildings located near electricity transmission power lines and base on his findings concluded there is a relative risk of residential occupants living close to power lines within a range of 25 m [2]. A study carried out by Levallois et al. reveal that there is no relationship between the occurrence of childhood tumor growth and the exposure to the magnetic field of overhead power lines [3]. Although, the statistical computation was done to limited the number of children whose residential buildings are close to the power lines supply. A survey carried out by Verkasalo et al. [4] finds no link between the exposure to magnetic fields and residents living close to a high tension cables. However, according to Tynes et al. [1] provided some evidence that support the link between exposure to calculated residential magnetic fields and coetaneous malignant melanoma but still requested for further research to be carried out from their studies, efforts where put in place to reduce the impact of high intensity magnetic field exposure from the power lines were conducted and examined using industrial based electromagnetic fields software applications. The source of magnetic field intensity within the Captain Elechi Amadi Polytechnic includes; overhead power lines, public address system, generators, home and office electrical appliances. The recommended public exposure to non ionizing radiation is 100 μT from the International Commission of Non-Ionizing Radiation Protection (ICNIRP, 1998); the only way to ascertain this fact out is to carry out a detailed measurement of the magnetic field intensity within the Polytechnic Campus. Also, a research was done in 2005 by Drapper et al. [5] published by the British Medical Journal, shows that children living within 200 meters of a high-power line stand at a high probability to develop leukemia than those who lived within 600 meters away from such power lines.

2. MATERIALS AND METHODS

2.1 Study Area

The study area is within the perimeter of the Captain Elechi Amadi Polytechnic Rumuola, Rivers state, Nigeria. The tertiary institution is

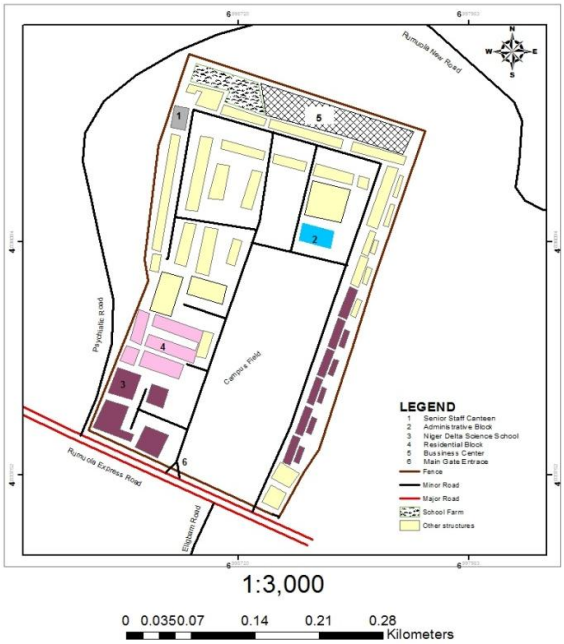

Fig. 1. Map of Captain Elechi Amadi Polytechnic showing the sampled locations

Fig. 2. A handheld electromagnetic radiation metre (*Bentech – GM 3120*)

located in the heart of Port Harcourt metropolis. The institution offers programmes in both Ordinary National Diploma (OND) and Higher National diploma (ND) course in addition; the institution is located between Lat. 4^0.50'02.81" - 4^0.50'13.90" and long. 6^0.59'42.56"-6^0.59 '45.88". The map of Captain Elechi Amadi Polytechnic indicating the sampled locations is shown in Fig. 1.

2.2 Methodology

The equipment used for the survey is a Handheld Electromagnetic Radiation Metre.GM 3120 Model. The metre is a passive detector and is powered by a 6F22 9V battery. The sensitivity of this device can detect electromagnetic field intensity from the0.01 -19.99 μT with a minimum sampling time range of 0.4 seconds. The Handheld Electromagnetic Radiation metre used in the survey is shown in Fig. 2. In addition a Global Positioning Satellite device was used to record the coordinates readings of the sampled points.

The measurement was carried out between 2017 November to 2018 March. Six sampled locations were measured within the polytechnic campus, while caring out the readings, emphasis was made on the possible sources generating electromagnetic fields; these include; power lines transmission cables, generators, and commercial electrical devices. In all 6 locations were measured within the perimeter of the Captain Elechi Amadi Polytechnic with an average of 6 sampled points and their coordinates where measured accordingly.

3. RESULTS AND DISCUSSION

The results of the measured magnetic field intensity of the sampled locations within Captain Elechi Amadi Polytechnic are presented in Table 1.

The results of the mean values of the magnetic field intensity of the sampled location are tabulated in Table 2.

The distributions of the magnetic field intensity both in 2-Dimension and 3-Dimension are shown in Fig. 1 and Fig. 2.

The Results presented were computed based on 36 sampled points within the perimeter of the Captain Elechi Amadi Polytechnic. The sampled points were randomly selected from the sampled location. Table 1 gives the measurement of magnetic field intensity at the various sampled location and the average levels are presented in Table 2. The average maximum value of the magnetic field intensity exists within the business area of the campus. This is as a result to the presences and frequent uses of commercial appliances such as; generators, computers, printers and other magnetic field generating devices. In addition, the minimum value of the magnetic field intensity lies within the unit of the Administrative block, where less activities are been carried out with electrical devices; most of the task is more of bookkeeping, recording of data and transfer of files from one office to another. This value is clearly shown in Table 2. The spatial distribution of the magnetic field intensity from region of higher to lower level or

vice-visa are illustrated in both 3-D and 2-D contour maps are shown in Fig. 3 and Fig. 4. Fig. 5. Clearly shows the Bar chart of the mean values of the magnetic field intensity of the various sampled locations indicating a maximum value of $1.9767 \pm 1.43\ \mu$T at the Business Centre and a minimum value of $0.3417 \pm 0.65\ \mu$T the Administrative Block within the sampled locations.

Table 1. *In-Situ* measurement of the magnetic field intensity around the sampled locations within the captain elechi amadi polytechnic

S/No	Location	S/Pts	Magnetic field intensity (μT)	Longitude (E)	Lattitude(N)
1.	Senior staff canteen canteen	1.1	0.24	6^0 59' 43.430000"	4^0 50' 5.650000"
2.		1.2	0.20	6^0 59' 43.790000"	4^0 50' 6.370000"
3.		1.3	0.27	6^0 59' 44.510000"	4^0 50' 4.930000"
4.		1.4	0.39	6^0 59' 56.041000"	4^0 50' 3.490000"
5.		1.5	3.21	6^0 59' 40.910000"	4^0 50' 3.130000"
6.		1.6	3.55	6^0 59' 40.210000"	4^0 50' 2.770000"
7.	Admin block	2.1	0.61	6^0 59' 39.830000"	4^0 50' 3.130000"
8.		2.2	0.22	6^0 59' 42.100000"	4^0 50' 3.120000"
9.		2.3	0.36	6^0 59' 43.450000"	4^0 50' 2.050000"
10.		2.4	0.24	6^0 59' 44.530000"	4^0 50' 1.690000"
11.		2.5	0.25	6^0 59' 45.970000"	4^0 50' 3.130000"
12.		2.6	0.36	6^0 59' 46.690000"	4^0 50' 4.210000"
13.	Niger delta science school (NDSS)	3.1	1.07	6^0 59' 47.500000"	4^0 50' 5.650000"
14.		3.2	1.22	6^0 59' 48.130000"	4^0 50' 6.370000"
15.		3.3	0.28	6^0 59' 47.041000"	4^0 50' 7.090000"
16.		3.4	0.54	6^0 59' 48.490000"	4^0 50' 9.970000"
17.		3.5	0.94	6^0 59' 48.850000"	4^0 50'10.690000"
18.		3.6	0.52	6^0 59' 48.860000"	4^0 50'11.410000"
19.	Residential buildings	4.1	2.22	6^0 59' 48.850000"	4^0 50' 11.410000"
20.		4.2	0.42	6^0 59' 48.490000"	4^0 50' 12.490000"
21.		4.3	0.62	6^0 59' 48.130000"	4^0 50' 13.930000"
22.		4.4	1.17	6^0 59' 45.970000"	4^0 50' 17.890000"
23.		4.5	0.41	6^0 59' 46.330000"	4^0 50' 14.290000"
24.		4.6	0.60	6^0 59' 45.610000"	4^0 50' 13.210000"
25.	Bussiness centre	5.1	0.72	6^0 59' 46.330000"	4^0 50' 14.650000"
26.		5.2	9.11	6^0 59' 45.250000"	4^0 50' 14.290000"
27.		5.3	0.28	6^0 59' 45.260000"	4^0 50' 13.930000"
28.		5.4	0.34	6^0 59' 43.450000"	4^0 50' 12.850000"
29.		5.5	0.27	6^0 59' 43.090000"	4^0 50' 12.840000"
30.		5.6	1.16	6^0 59' 43.080000"	4^0 50' 16.430000"
31.	Main gate entrance	6.1	0.27	6^0 59' 44.170000"	4^0 50' 7.450000"
32.		6.2	0.18	6^0 59' 44.890000"	$4^0$50' 7.470000"
33.		6.3	1.18	6^0 59' 42.730000"	4^0 50' 1.690000"
34.		6.4	0.18	6^0 59' 42.720000"	4^0 50' 2.030000"
35.		6.5	0.46	6^0 59' 42.740000"	4^0 50' 2.050000"
36.		6.6	0.23	6^0 59' 42.790000"	4^0 50' 2.770000"

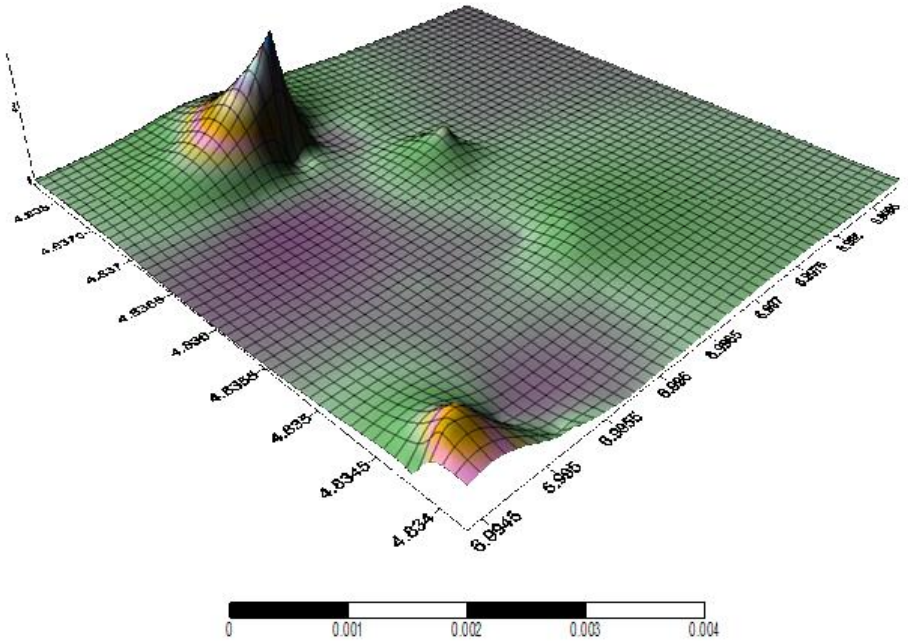

Fig. 3. Survey of the magnetic field intensity in 3-Dimension showing within captain elechi amadi polytechnic

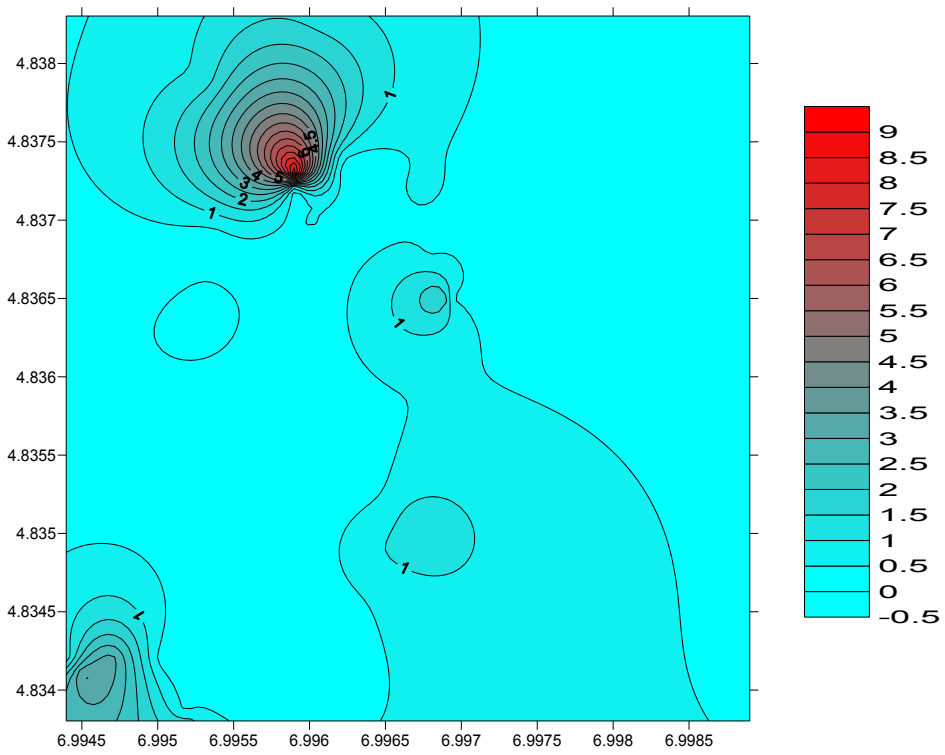

Fig. 4. Survey of the magnetic field intensity in 2-Dimension within captain elechi amadi polytechnic

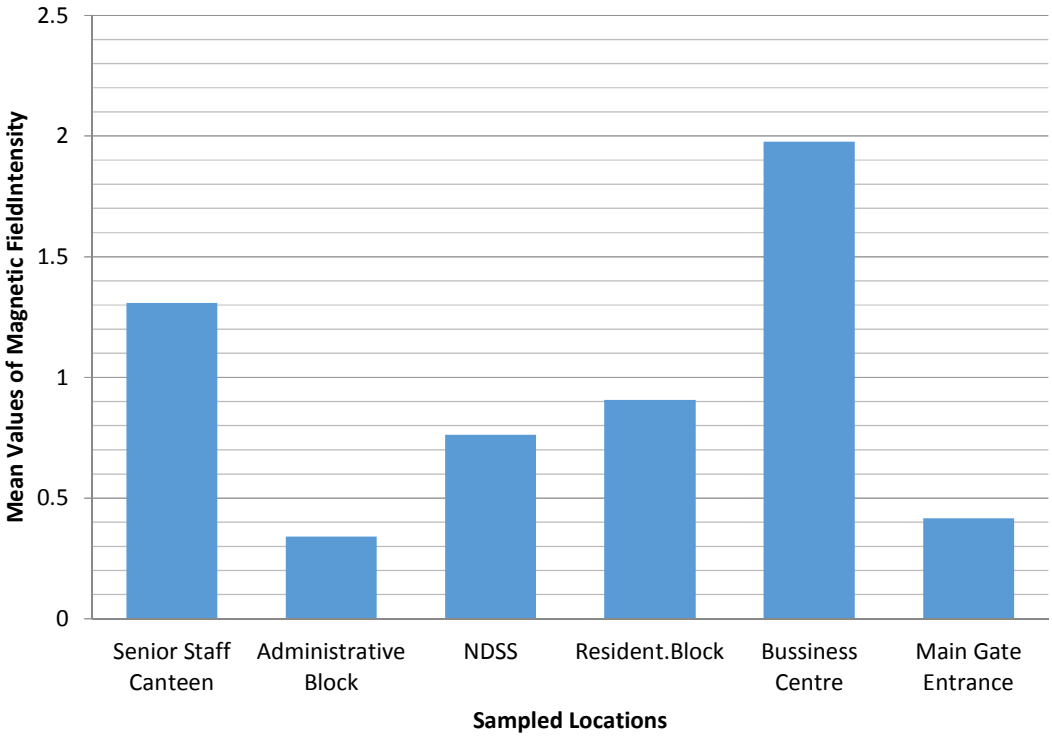

Fig. 5. The Bar chart of the magnetic field intensity of the sampled locations

Table 2. Mean values of the computed magnetic field intensity of the sampled Locations (μT) within captain elechi amadi polytechnic

S/Pts	Location	Mean value of magnetic field intensity (μT)
1.	Senior staff canteen	1.3083± 0.65
2.	Admin block	0.3417± 0.65
3.	Niger delta science school	0.7617± 0.15
4.	Residential buildings	0.9067± 0.29
5.	Bussiness centre	1.9767± 1.43
6.	Main entrance gate	0.4167± 0.15

4. CONCLUSION AND RECOMMENDATION

In conclusion, the measured valued of the magnetic field intensity within the polytechnic all fall below the permissible outdoor exposure limit of 100μT from the International Commission of Non-Ionizing Radiation Protection (ICNIRP, 1998). This implies that the exposure to magnetic field intensity poses no significant health hazards to staff, students and commercial workers within the Captain Elechi Amadi Polytechnic. In order to discourage the use of private own power plants for personal and commercial business to further reduce the level of the magnetic field intensity, the government needs to ensure constant delivery of service by the Power Holding Company of Nigeria (PHCN). In addition, the maximum value of the magnetic field intensity can be reduced within the Business Centre of the polytechnic campus by building a common generator house at a distance not accessible to the public.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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