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Impact of Electric Field Doses from High-Voltage Power Lines on Biodiversity

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Abstract
Death of Fulani herdsmen and their Cows as a result of High-Tension Wire Line wires electrocution, conductor, vandalization and associated impact on health and wellbeing of the Fulani herdsmen families informed this study. The study investigated the level of exposure of Fulani herdsmen and their livestock population to electric magnetic fields doses along the high-tension wire lines. Data were collected through field survey, questionnaire and focus group discussion. Electromagnetic radiation was measured using voltage meter. Data obtained was analyzed using statistical software (SPSS version 27) to determine the relationship between the level of electromagnetic field exposure and Fulani/livestock health. The result obtained revealed that Fulani hamlets in the study area were located 3-5 meters away from 123 and 330 KV high tension wire lines. The mean voltage doses recorded for one-month ranges from 165.77 to 292.83 microtesla (µT) per day/per hour/per month are generally above the minimum threshold level of 100 µT for human and Animals. Result on the comparison between WHO EMF threshold (100 µT) and the mean of EMF radiation 0.046 emitted at the Fulani hamlets using regression analysis revealed strong relationship at P>0.05.

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Keywords: Electromagnetic Fields (EMF), High-Tension Power Lines, Radiation Exposure, Fulani Hamlets, Health Impacts

Introduction

Recent studies have shown that having the ability to access electricity can increase output and have an impact on the economy as a whole (Peters & Sievert, 2016) [3]. According to Mori (2017) [6], electrification has several advantages, such as improving human existence overall, having an instantaneous effect on workforce, well-being, and learning, and increasing revenue. The dependence on appliances that run on electricity such as computers, phones, radios, televisions, and heaters, among others, has made having accessibility to electricity essential to human existence. For example, a kerosene stove or simple gas burner can now be replaced with an electrical hot plate; a kerosene lamp can now be replaced with solar lamps and rechargeable light bulbs, among many more alternatives. Consequently, there is less exposure to harmful gasses in the home, which improves general health (Olaniyan *et al*., 2024) [8].

Nevertheless, the impact of electromagnetic radiation (EMR) on human well-being extends transcend being exposed directly to devices such as cell phones and considers broader environmental variables. Since environmental stressors like EMR have been connected to fertility problems, research indicates that they might affect reproductive health (Aly & Crum, 2016) [2]. When talking about the environmental impact of disease, EMR is mentioned as a potential cause of several ailments, including psychological conditions and allergic/asthmatic ailments (Akhabir *et al*., 2019) [1]. Electricity is a daily general servant for people in many different professions. Few of these experts are actually aware of the exact energy levels that could result in harm or electrocution. Despite the fact that some people are aware of the dangers of exposed electrical contact. Small currents of electricity that travel from the brain to the many muscles throughout the body regulate and stimulate the human body, which can result in injuries or electrocution (Obi *et al*., 2020) [7].

High voltage transmission lines' negative health effects are a big concern for people nowadays. According to reports, there may be issues with leukemia, cancers of the breast, cognitive decline, and reproductive results (Dib & Mordjaoui, 2014) [5]. Power cables' constant energy loss makes them dangerous. Since we cannot see it and lack a detector, we are unable to detect electrical leaks. High-voltage power lines are now often used to carry electricity in the modern world. These power lines generate electromagnetic fields (EMFs) that could affect the terrestrial biota. The exposure of humans and animals to electromagnetic fields (EMFs) from high-voltage power lines has been a topic of study for a number of years. The effects of electromagnetic fields (EMFs) on human health have been extensively studied, but their effects on terrestrial biota are less well understood (Dib & Mordjaoui, 2014) [5].

To improve living standards and spur economic development, Nigeria's rural and periurban areas need to be electrified. The potential harm that this method could cause to the environment and human health, particularly in regions where nomadic tribes reside, is not well understood. Given the particular challenges faced by the Fulani, such as their nomadic lifestyle and reliance on cattle, a targeted investigation into the exposure levels of electric magnetic fields along high-tension lines is required.

Furthermore, people routinely lose their lives because they are unaware of the risks involved in climbing or leaving near high tension (high voltage) lines, and towns and villages continue to expand unchecked under these lines.

This study examined and evaluated the impacts of electricity radiation dosages on biodiversity, with a focus on Fulani hamlets situated next to high-tension wire lines. Estimating the distance between the high-tension wire and the Fulani hamlets, measuring the voltage doses released by the wire hourly or daily, and comparing the voltage doses to WHO-established norms were the objectives of the study. Environmental exposures to RF-EMFs have increased in the last two decades, and this trend may continue. The effects of this exposure at plant community level are unknown and difficult to assess in a scientifically appropriate manner. An observational study (Waldmann-Selsam *et al*. 2016) [10] described damage of tree canopy on the side facing mobile phone base stations. However, due to the selective approach (i.e., not all trees were selected randomly), no scientific conclusion can be drawn on the basis of these observations alone. Proposed recently new indicators and methods (e.g., altered species composition, altered biomass production, and changed plant canopy structure) to study the effects of EMF exposures on plant communities through a comparison between control and exposed pre-defined areas, for which the plant community, the climatic conditions, and the levels of exposure to EMF are well known.

Methodology

Study Area

The study was carried out in Bauchi Local Government area of Bauchi state with Latitudes 10° 18' 50.9724" N and 9° 50' 46.6152" E, northeast of the equator, and longitudes 100.31' 4159" and 90.84' 6282" east of the Greenwich meridian are the coordinates of Bauchi State. The HT line's 330KV tower and 132KV tower, which stretch 24km, were used to conduct a field survey between Jos and Gombe and Fulani Hamlets from Wuntin-dada to Kangere Village.

Source of Data

Data for this study were drawn from three principal sources, namely; Field Survey, Questionnaire and Focus Group Discussion.

Field Survey

Electromagnetic Radiation Dictator and Voltage meter were used to measured and analyzed the level of EMF generated by the high voltage power lines and the amount of voltage that is being generated along the two HT lines (330KV and 132KV) in the study area.

Focus Group Interview

Quantitative information regarding the possible effects of EMF exposure on livestock health was produced through interviews with Fulanis (livestock owners) and their herders (cattle rearers). The possible mitigation techniques to lower the dangers related to EMF exposure from high voltage power lines were further examined in the interview.

Data Analysis

To ascertain the connection between the degree of electromagnetic field exposure and the health of humans and livestock, the data was examined using statistical software (SPSS, version 27). The efficiency of potential mitigation techniques was further examined in the analysis.

Results

Fulani Hamlets Distance and Electromagnetic Field (EMF) Exposure

Each Fulani hamlet's EMF exposure and the distance between it and the High Tension (HT) power line are displayed in Table 4.1a. With a seven-day average RMF radiation exposure rate of 418 µT, Kangere is the closest hamlet to the power line, less than two meters away. Whereas Rugan Baushe Sati had an average RMF radiation exposure rate of 420 µT and was situated 10 meters from the power line. Nonetheless, Rugan Walbe A and B had mean radiation exposures of 1620.4 µT and 1275.8 µT, respectively, and were situated 6 to 5 meters from the power lines (132 and 330 KVA). While Hamlet located at Inkil Village was located in less than 3 meters from the power lines with mean radiation exposure 1276.8 µT.

Table 1: Fulani Hamlets Distance and Electromagnetic Field (EMF) Exposure

Fulani Hamlet	D(m)	7 Days EMF Exposure							Mean R µT
		1	2	3	4	5	6	7	
Rugan Bauche	5	200	435	685	805	210	735	300	418
Rugan Bauche Sati	10	935	395	345	270	205	795	485	420
Rugan Walbei (A)	6	4465	1255.5	1244	1302.5	1533	1543	1480	1620.4
Rugan Walbei(B)	5	1390.5	1529	1567.5	1567.5	1367	1509.5	1481.5	1275.8
Inkil	3	1559.5	1390.5	1533	1570	1367.5	1515	1488.5	1276.5
New makabarta	3	1405	1477.5	1531.5	1578.5	1494	1528	1478.5	1287.8
Kangere	2	1161.5	1202.5	1175	1145	1159	1167.5	1199.5	850.4

Cattle ranch distance and EMF exposure

The distance between cattle ranches and the high-tension wires (HT) (25 and 33KVA) is shown in Table 4.1b. The distances of Rugan Bauche Sati and Rugan Baushe were 3 and 5 meters from the HT, respectively, and were exposed to mean radiation levels of 1646 µT and 1670 µT; Rugan Walbee A and B were 5 meters from the HT, with mean radiation levels of 1584 µT; Inkil and New Makabarta Cattle ranched 10 meters from the HT, with weekly radiation exposures of 1689.5 µT and 1755 µT, while Kangere Cattle ranch was less than 2 meters from HT lines, with weekly mean radiation exposures of 1848.5 µT.

Table 2: Cattle Ranch Distance and EMF exposure

	D(m)	7 Days EMF Exposure						
		1	2	3	4	5	6	7
Rugan Bauche	3	1566.5	1555	1576.5	1600.5	1638	1679.5	1646
Rugan Bauche Sati	2	1612.5	1644	1604	1657.5	1627.5	1678.5	1670
Rugan Walbei (A)	5	1173.5	1448	1436	1462.5	1589.5	1591.5	1584
Rugan Walbei(B)	5	1512	1531.5	1568	1544	1501	1561	1585
Inkil	10	1712.5	1748	1766	1727	1670.5	1561	1689.5
New makabarta	10	1800.5	1758	1788	1810	1747.5	1790	1755
Kangere	2	1790.5	1729	1815	1821.5	1838.5	1854	1848.5

Relationship between distance and hamlets/cattle range to high tension wire

Regression analysis is used in Table 3 to determine the mean distance between the Cattle Ranch and Fulani Hamlets to the HT wire. The findings revealed a significant correlation between the HT and the Hamlets and Cattle Ranch, with a variance of 32.481 and a standard deviation of 5.73068. This suggests that the Hamlets and Cattle Ranch are too close to the HT wire.

Table 3: Mean Distance between Fulani Hamlets/Cattle Ranch to High Tension Wire

Descriptive Statistics							
	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Distance in m	14	18.00	2.00	20.00	7.9286	5.73068	32.841
Valid N (list wise)	14						

EMF doses of voltage emitted by high tension wire per hour/per day Jos-Gombe Sub-Station

Table 4 displays the daily voltage that the HT wire between the Jos and Gombe sub-stations emits each hour. The general entry per day/per hour had a mean value of 165.771 to 292.833 µT for the period under study (one month), which is generally above the minimum thrash hole of 100 µT for Human and Animal EMF emission under HT wire (ICNIRP 2020), with the exception of a few ovations where radiation emission was only minimal per week and the minimum emission doses were zero.

Table 4: EMF Doses of Voltage Emitted by High Tension Wire per hour/per day. Jos-Gombe Sub-Station

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
voltage doses	48	241.0	327.0	284.500	19.5263
voltage doses	48	232.0	335.0	292.833	22.0506
voltage doses	48	230.0	335.0	289.292	20.7897
voltage doses	48	215.0	318.0	270.479	21.6932
voltage doses	48	209.0	307.0	260.792	24.9774
voltage doses	48	165.0	285.0	231.104	23.8686
voltage doses	48	183.0	262.0	216.396	17.8370
voltage doses	48	185.0	295.0	232.438	25.8678
voltage doses	48	175.0	272.0	241.292	20.5912
voltage doses	48	152.0	307.0	243.958	26.4309
voltage doses	48	.0	289.0	165.771	102.8823
voltage doses	48	156.0	266.0	219.854	27.0114
voltage doses	48	200.0	309.0	246.500	22.3645
voltage doses	48	209.0	288.0	240.771	18.5544
voltage doses	48	208.0	306.0	252.063	26.6805
voltage doses	48	124.0	253.0	216.396	21.1657
voltage doses	48	.0	277.0	218.417	61.1102
voltage doses	48	162.0	337.0	231.708	40.6155
voltage doses	48	197.0	300.0	241.167	26.6780
voltage doses	48	184.0	300.0	244.792	24.0283
voltage doses	48	205.0	347.0	282.437	33.1835
voltage doses	48	196.0	284.0	243.063	22.6222
voltage doses	48	195.0	326.0	254.563	35.9349
voltage doses	48	217.0	355.0	268.146	29.6267

voltage doses	48	183.0	345.0	278.875	48.4446
voltage doses	48	183.0	326.0	253.854	41.0987
voltage doses	48	189.0	311.0	256.146	31.6698
voltage doses	48	208.0	334.0	268.604	32.6554
voltage doses	48	205.0	300.0	240.396	23.0557
voltage doses	48	191.0	335.0	257.042	32.3202
Valid N (listwise)	48				

Table 4 Contd.

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
@1st	48	86.0	241.0	327.0	284.500	19.5263	381.277
@2nd	48	103.0	232.0	335.0	292.833	22.0506	486.227
@3rd	48	105.0	230.0	335.0	289.292	20.7897	432.211
@4th	48	103.0	215.0	318.0	270.479	21.6932	470.595
@5th	48	98.0	209.0	307.0	260.792	24.9774	623.871
@6th	48	120.0	165.0	285.0	231.104	23.8686	569.712
@7th	48	79.0	183.0	262.0	216.396	17.8370	318.159
@8th	48	110.0	185.0	295.0	232.438	25.8678	669.145
@9th	48	97.0	175.0	272.0	241.292	20.5912	423.998
@10th	48	155.0	152.0	307.0	243.958	26.4309	698.594
@11th	48	289.0	.0	289.0	165.771	102.8823	10584.776
@12th	48	110.0	156.0	266.0	219.854	27.0114	729.617
@13th	48	109.0	200.0	309.0	246.500	22.3645	500.170
@14th	48	79.0	209.0	288.0	240.771	18.5544	344.266
@15th	48	98.0	208.0	306.0	252.063	26.6805	711.847
@16th	48	129.0	124.0	253.0	216.396	21.1657	447.989
@17th	48	277.0	.0	277.0	218.417	61.1102	3734.461
@18th	48	175.0	162.0	337.0	231.708	40.6155	1649.615
@19th	48	103.0	197.0	300.0	241.167	26.6780	711.716
@20th	48	116.0	184.0	300.0	244.792	24.0283	577.360
@21st	48	142.0	205.0	347.0	282.437	33.1835	1101.145
@22nd	48	88.0	196.0	284.0	243.063	22.6222	511.762
@23rd	48	131.0	195.0	326.0	254.563	35.9349	1291.315
@24th	48	138.0	217.0	355.0	268.146	29.6267	877.744
@25th	48	162.0	183.0	345.0	278.875	48.4446	2346.878
@26th	48	143.0	183.0	326.0	253.854	41.0987	1689.106
@27th	48	122.0	189.0	311.0	256.146	31.6698	1002.978
@28th	48	126.0	208.0	334.0	268.604	32.6554	1066.372
@29th	48	95.0	205.0	300.0	240.396	23.0557	531.563
@30th	48	144.0	191.0	335.0	257.042	32.3202	1044.594
Valid N (listwise)	48						

Table 4 Contd.

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
voltage doses	48	241.0	327.0	284.500	19.5263
voltage doses	48	232.0	335.0	292.833	22.0506
voltage doses	48	230.0	335.0	289.292	20.7897
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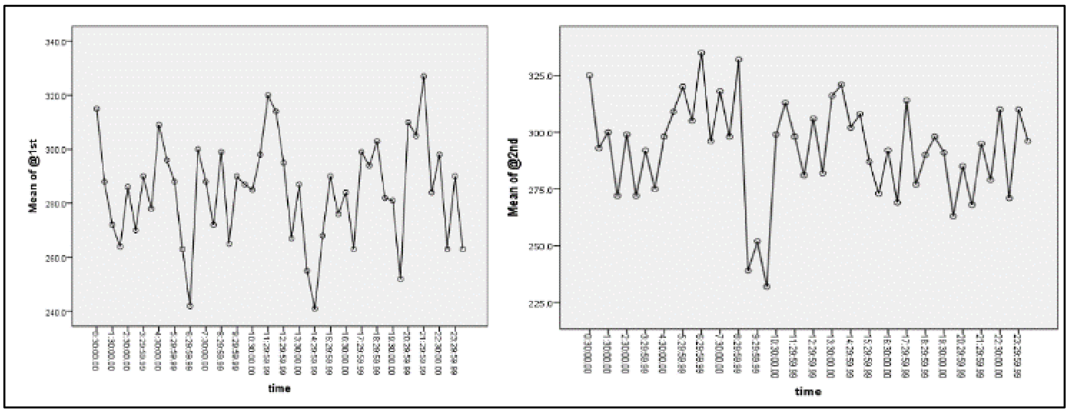
voltage doses	48	205.0	300.0	240.396	23.0557
voltage doses	48	191.0	335.0	257.042	32.3202
Valid N (listwise)	48				

Flow chat of daily voltage emitted from Jos-Gombe HT line per Hour (March, 2023)

The voltage emission tread along the HT line (both 132 and 330 KVA) in March 2023 is depicted in Figure 1. With the exception of the second, eighth, and seventeenth days, when the voltage was low, the pattern displays a similar steady tread throughout the month. However, depending on the temperature of the immediate environment, the stability of the voltage flow correlates with the quantity of electromagnetic field (EMF) radiating to the surrounding environment. The electromagnet value constantly rises as the temperature rises, but this increase is much smaller than that of the power loss.

However, the voltage cannot be used to estimate the magnetic field's size. This is due to the fact that the magnetic field is produced by the current in the line, not the voltage. The current is proportional to the size of the magnetic field surrounding a line. This indicates that as the line's current increases, so does the magnetic field level. High current can be carried by very high voltage lines (345 kV), which results in a comparatively strong magnetic field.



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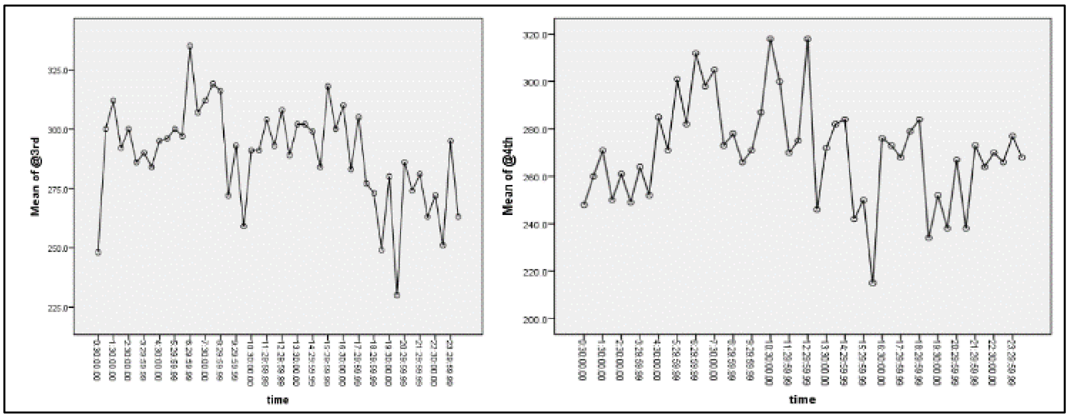

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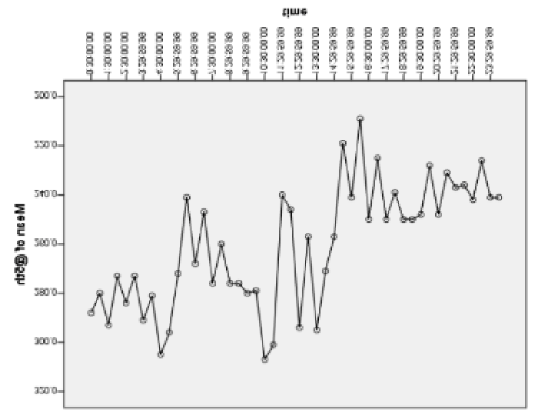

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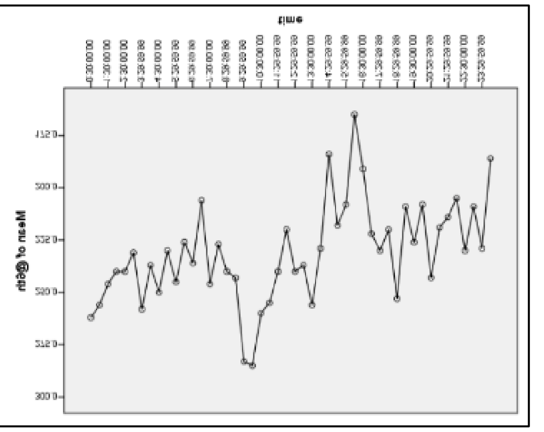

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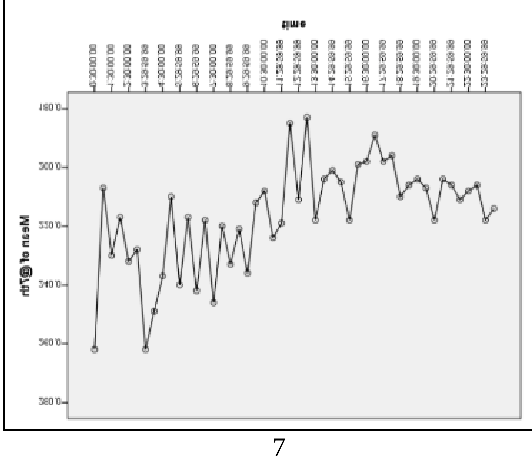

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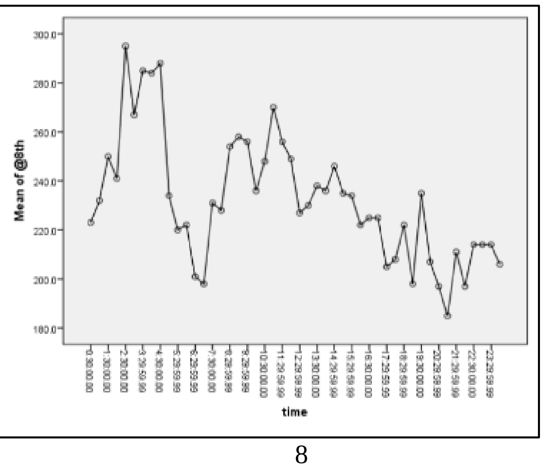

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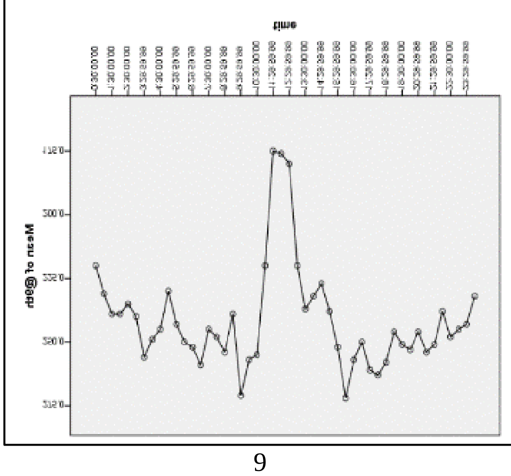

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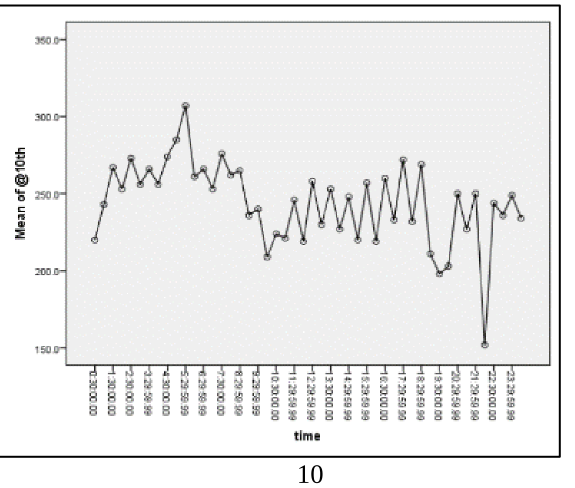

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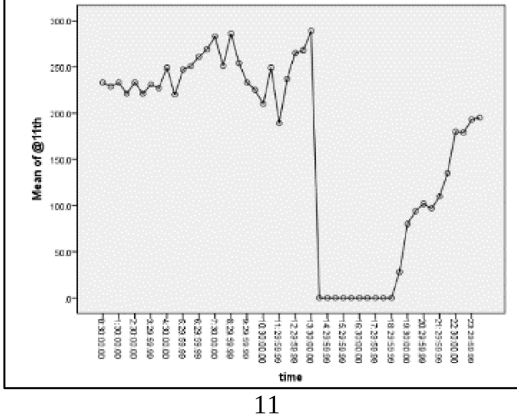

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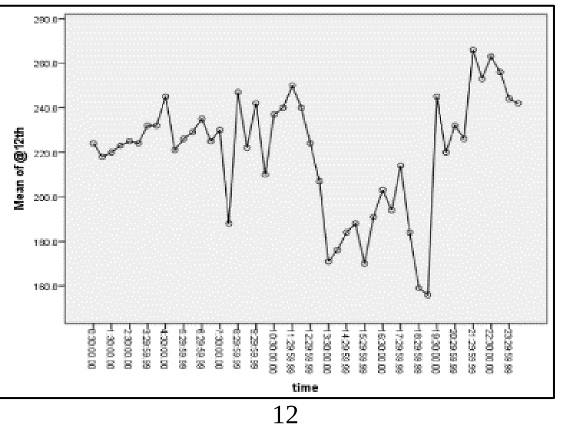

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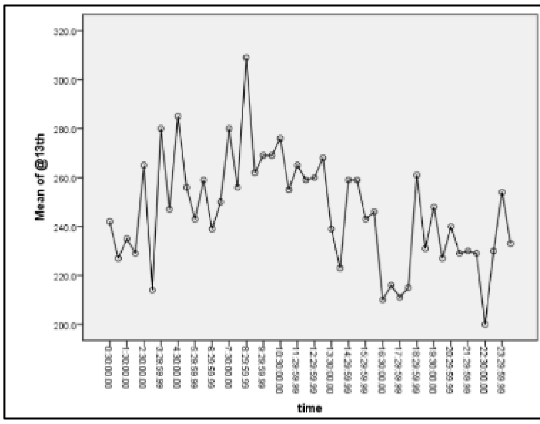

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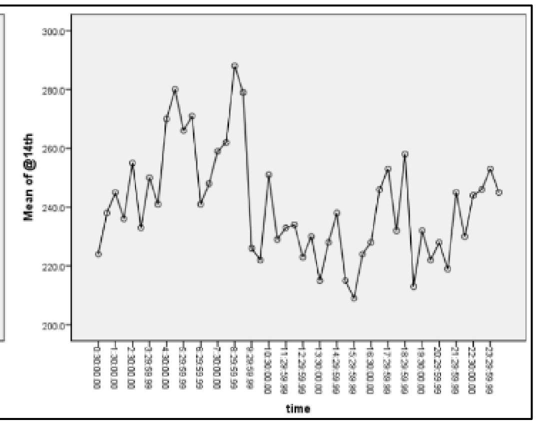

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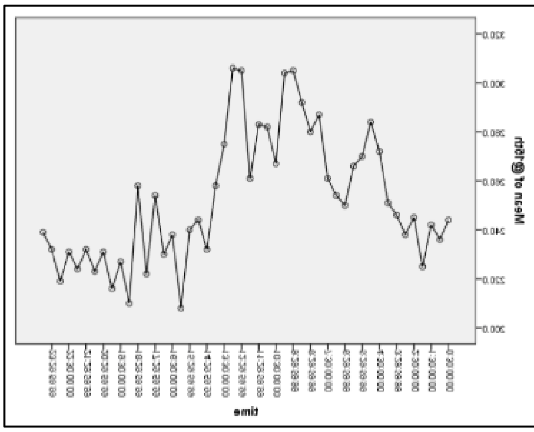

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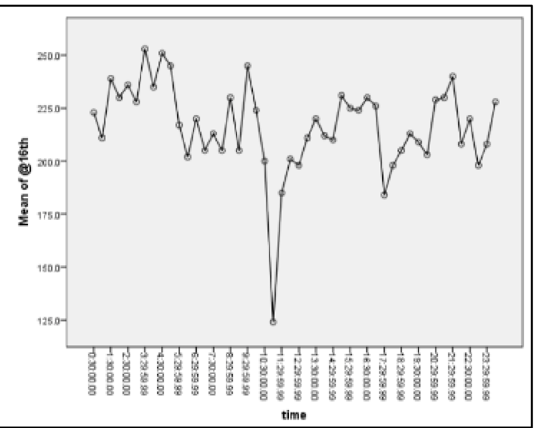

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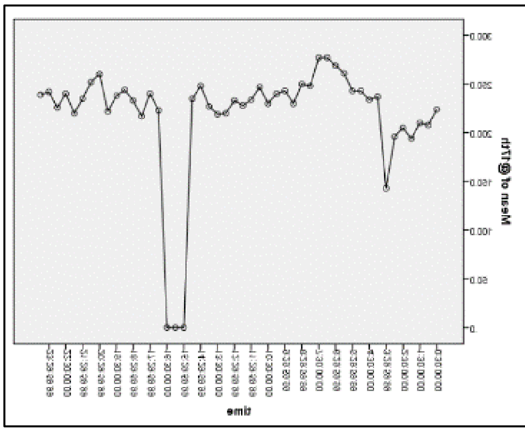

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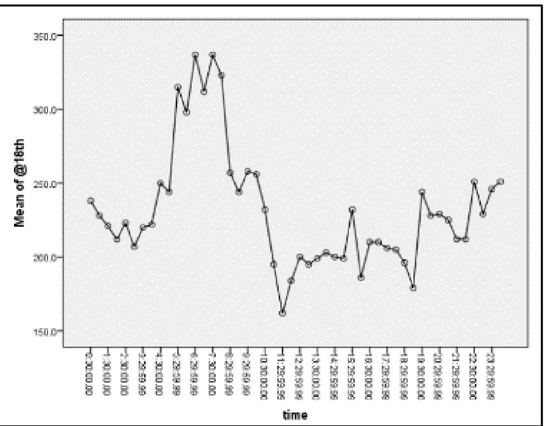

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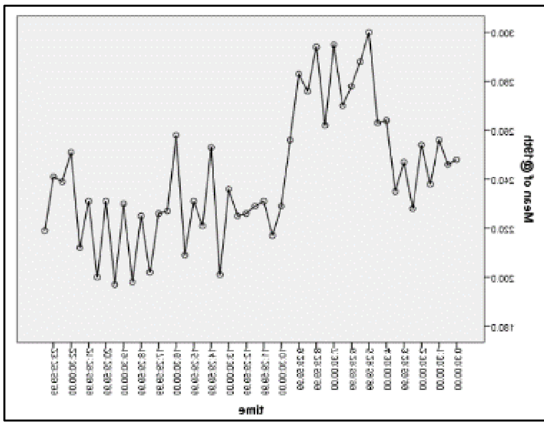

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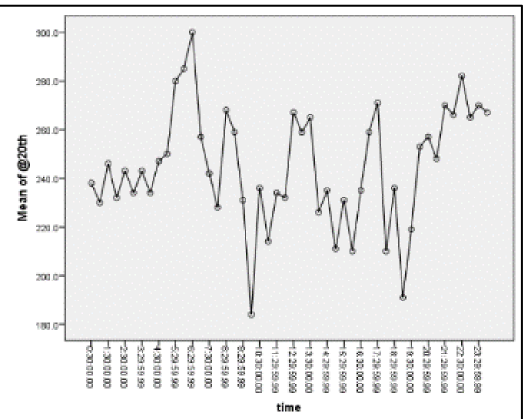

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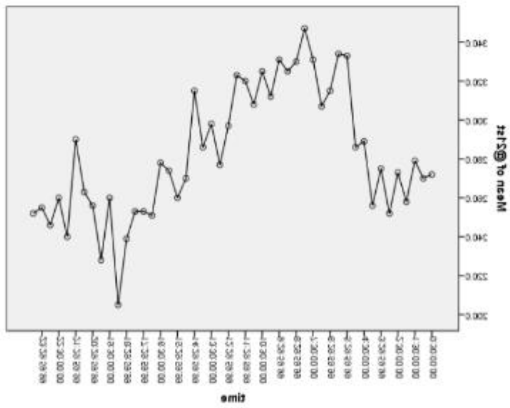

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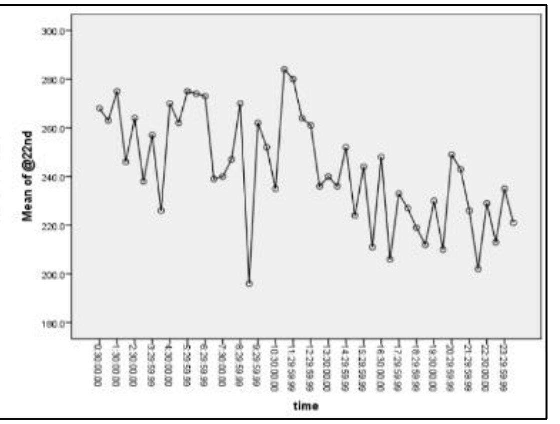

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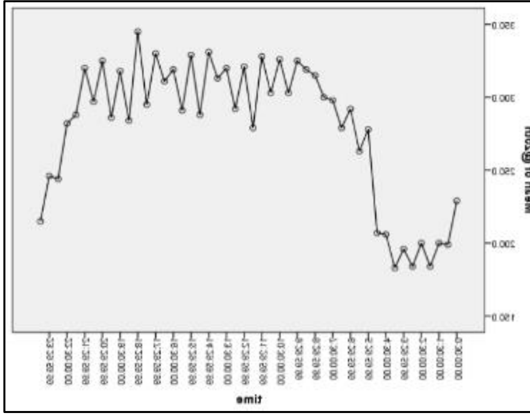

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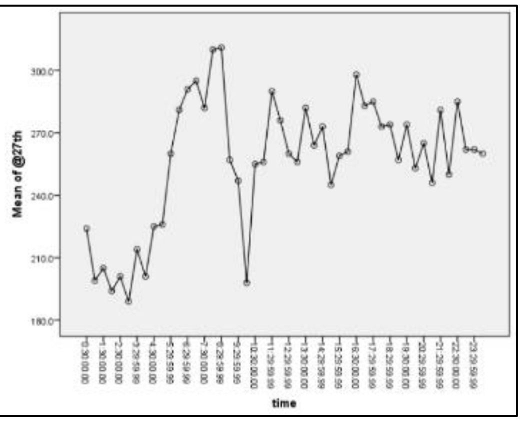
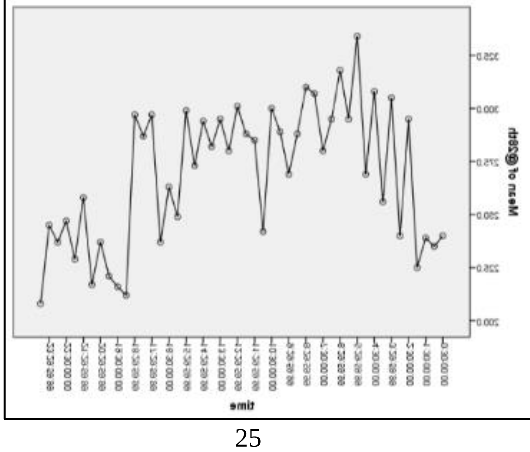


24



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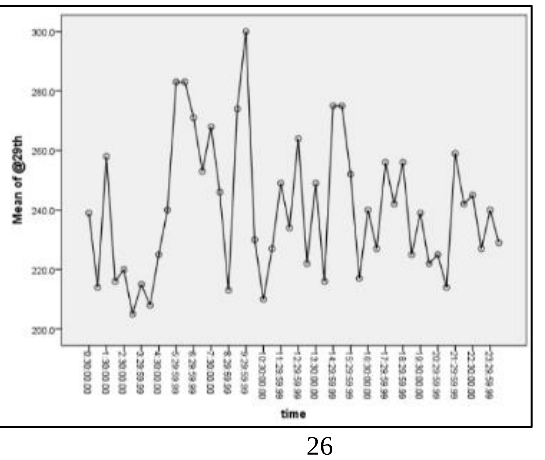

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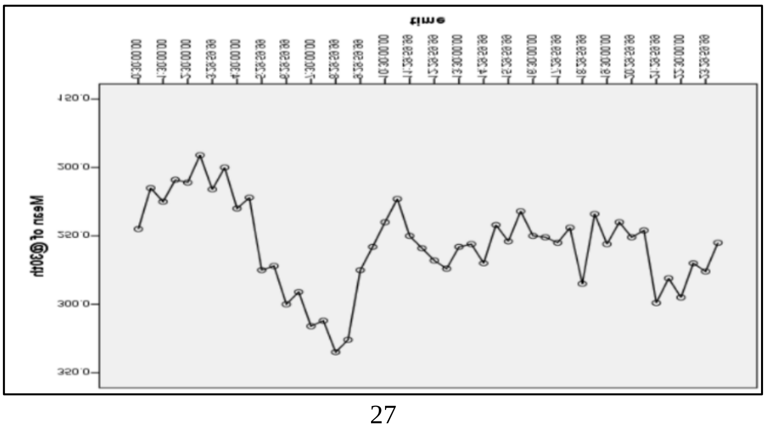

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Comparison between WHO EMF Thrash Hole and Mean EMF Radiation on Fulani Hamlet

The results of the comparative analysis between the mean EMF radiation emitted at the Fulani Hamlets and the WHO EMF thrash hole are displayed in Table 5. The findings showed that the EMF radiation levels in each of the seven hamlets above the 100µT WHO thrash hole guideline. The mean EMF radiation levels of 481.4286 µT and 504.2857 µT in the Rugan Baushe and Baushe Sati cases were close to the WHO threshold of 100 µT. But the results of the regression analysis also showed that the WHO EMF and the EMF radiation at Fulani Hamlets have a substantial correlation (0.046) at P>0.05.

Table 5: Comparison between WHO EMF Thrash Hole and Mean EMF Radiation on Fulani Hamlet

Sample Points (Fulani Hamlets)		WHO EMF Thrash hole (µT)	No of Days	Mean EMF Microtesla (µT)	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
							Lower Bound	Upper Bound			
Rugan Baushe (1)		100	7	481.4286	257.67735	97.39289	243.1168	719.7404	200.00	805.00	
Rugan Baushe Sati (2)		100	7	504.2857	263.09739	99.44147	260.9612	747.6102	205.00	935.00	
Rugan Walbe (3)		100	7	3446.1429	4175.54151	1578.20635	-415.5890	7307.8747	1244.00	12555.50	
Rugan Welbe 3 (4)		100	7	1487.5000	80.59311	30.46133	1412.9638	1562.0362	1367.00	1567.50	
Inkil (5)		100	7	1477.4167	81.03420	33.08207	1392.3765	1562.4568	1367.50	1570.00	
New Makabarta (6)		100	7	1499.0000	54.71289	20.67953	1448.3990	1549.6010	1405.00	1578.50	
Kangere (7)		100	7	1172.8571	21.28715	8.04579	1153.1698	1192.5445	1145.00	1202.50	
55			1	1559.5000	.	.	.	.	1559.50	1559.50	
Total			49	1440.0510	1748.88463	249.84066	937.7127	1942.3893	200.00	12555.50	
Model	Fixed Effects				1604.24036	229.17719	977.2183	1902.8838			
	Random Effects					358.46091	592.4257	2287.6764			551084.18369

Table 6: ANOVA Comparing the Relationship between WHO EMF thresholds with Fulani hamlets EMF radiation

Radiation					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	41295605.057	7	5899372.151	2.292	.046
Within Groups	105517072.565	41	2573587.136		
Total	146812677.622	48			

Comparison between WHO EMF Thrash Hole and Mean EMF Radiation on Fulani Cattle Ranch

The results of the comparative analysis between the mean EMF radiation output at the Fulani cattle ranch and the WHO EMF thrash hole are displayed in Table 5. The results showed that the EMF radiation emissions from all seven ranches above the 100µT WHO thrash hole limit. However, the results of the regression analysis also showed that the WHO EMF and the EMF radiation at Fulani cattle ranch have a strong and significant association (0.000), with P>0.05. the discovery of all ranches beneath the 132 and 330 KVA high-tension lines.

Table 7: Comparison between WHO EMF Thrash Hole and Mean EMF Radiation on Fulani Cattle Ranch

Radian											
Sample Points (Fulani Cattle Ranch)		WHO EMF Thrash hole (µT)	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Component Variance
							Lower Bound	Upper Bound			
Rugan Baushe (1)		100	7	1607.7143	45.86107	17.33386	1565.2999	1650.1287	1555.00	1679.50	
Rugan Baushe Sati (2)		100	7	1642.0000	28.53361	10.78469	1615.6108	1668.3892	1604.00	1678.50	
Rugan Walbe (3)		100	7	1469.2857	148.12350	55.98542	1332.2943	1606.2771	1173.50	1591.50	
Rugan Welbe 3 (4)		100	7	1557.5000	48.81854	18.45167	1512.3504	1602.6496	1501.00	1644.00	
Inkil (5)		100	7	1696.3571	68.01208	25.70615	1633.4565	1759.2578	1561.00	1766.00	
New Makabarta (6)		100	7	1778.4286	24.60425	9.29953	1755.6734	1801.1837	1747.50	1810.00	
Kangere (7)		100	7	1813.8571	43.25286	16.34804	1773.8549	1853.8594	1729.00	1854.00	
Total			49	1652.1633	131.15951	18.73707	1614.4899	1689.8367	1173.50	1854.00	
Model	Fixed Effects				70.04391	10.00627	1631.9698	1672.3567			
	Random Effects					45.91018	1539.8251	1764.5014			14053.33358

Table 8: ANOVA Comparing the Relationship between WHO EMF Thresh hole with Fulani Cattle Ranch EMF Radiation

Radian					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	619676.908	6	103279.485	21.051	.000
Within Groups	206058.286	42	4906.150		
Total	825735.194	48			

Discussion

Fulani herdsmen and livestock ranches are situated directly beneath the two transmission lines (132KVA and 330KVA) that radiate variable microteslas (µT) of electric magnetic field from Bauchi to Kangere. Therefore, the meaning of such brief exposure to human and animal life is essentially electrocution due to reactions in the neurological system. Nevertheless, there is currently insufficient scientific evidence to determine if more (harmful) impacts could occur in the future.

Living under a high tension line puts cows and ranchers at risk of electrocution since the stronger the electric magnetic field, the more likely it is to have a significant impact on nervous system reactions. The tower lines next to the Fulani village and the ranch beneath the tower may have a significant effect on the overall behavior of the animals (Cows), such as how they react to unfamiliar obstacles like vehicles, bicycles, motorcycles, etc. Over time, this could put the cattle at risk of accidents or being knocked off by passing cars. This claim was consistent with a research by Raab *et al*. (2011) [9] on the flight patterns of birds that came close to a power line.

The cattle ranch's position and the transmission line's close proximity to the Fulani hamlets created a clear barrier for the cows, an environmental annoyance for the hamlets, and even a physical barrier for certain organisms. Because of the noise and magnetic field flows, Fulani herdsmen and their families will experience sleep disorders if they live (sleep) beneath or too close to the high-tension line. Families of herders who live below the high-tension line may benefit from a favorable comparative advantage due to frightening organisms (pests) that could frighten the cattle, such as snakes and other animals related to reptiles. This might potentially lower the number of flies biting their cattle. However, this might encourage them to remain underneath and close to the high-tension wire.

Additionally, even while it might seem like it would harm the cows, high tension towers provided swarming bees with a suitable place to nest on the transit patch, which could cause the calves to become disturbed. The monthly, daily, and hourly variations in the electric voltage dosages that are transmitted by the high-tension line from Jos to Gombe or Gombe to Jos and that have a significant impact on the cattle's and Fulani herdsmen's survival are typically higher than the WHO threshold level. During the rainy season, the detrimental effects of this change on the livestock and herdsmen can be more noticeable.

There is a large chance of electrocution from the high-tension line's powerful electromagnetic field, which mostly doesn't influence the cows and herdsmen through noise, which could kill an animal or a human. More significantly, according to the data gathered from the comparative analysis of WHO and the mean EMF radiation, the livestock and herdsmen hamlets will be increasingly exposed to the risk of electrocution from conductor cuts as a result of the voltage flow variation. Since the radiation levels found in every research are higher than the WHO threshold limit (100µT), it is clear that these hamlets and the livestock ranches are in danger. Due to the cattle' and hamlets' close distance to the high-tension lines, they run the risk of becoming electrocuted during either the wet or dry season.

Conclusion

The study concluded that the preponderance of Fulani herdsmen hamlets and the cattle ranches under high tension lines is influenced by the comparative advantages of the high-tension line providing adequate space for the cattle to forage freely without fear of encroachment to the farmland and the bearing free from infestation. On the negative side, the prevalence of the high-tension lines and the tower affect the cattle and the Fulani (herdsmen and their families) through electrocution, change in animal behavior, reduction in population, calf mortality, noise as well as habitat landscape destruction. During construction and maintenance work which indirectly affect the Fulanis.

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