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Research Article

Regulatory Mapping, Risk of Exposure to Electromagnetic Radiation, Case of Douala

Abdoul-Djamil Dodo[2]*, Séverin Mbog Mbog[1,2] and Dieudonné Bitondo[1,2]

[1]Quality, Health, Safety and Industrial Environment Engineering Department, Ecole Nationale Supérieure Polytechnique de Douala, Cameroon

[2]Energy, Materials, Modelling and Methods Laboratory, University of Douala, Cameroon

***Corresponding Author:** Abdoul-Djamil Dodo, Energy, Materials, Modelling and Methods Laboratory, University of Douala, Cameroon.

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Abstract

Telecommunications masts are a source of exposure to electromagnetic radiation. Chronic exposure to this radiation is reputed to have significant deleterious effects, which are often reversible; disabling effects from a functional point of view have also been validated by the WHO. In view of the increase in the number of mobile operators and infrastructure operators in Cameroon, compliance with the regulations governing the siting of masts is an issue. The aim of this field study was to show the health risks incurred in the city of Douala because of non-compliance with the regulations governing the siting of telecommunications masts. To do this, we used GPS applications, ARGIS 10.8 software, Google Form and Excel to collect, process and analyze data from field surveys and documentary research. We then used the "measure" tool in the ARCGIS 10.8 software to determine the distances between pylons and compare them with the regulatory value for distance between pylons. Our results show that almost 20% of the masts in our study do not comply with the minimum regulatory distance, and that 26% of the number of telecommunications masts in the city of Douala, according to data from 2022, are not compliant. Regarding the regulations on the distance between telecommunication masts, it appears that these are not really respected, which could substantially contribute to the exposure of populations to microwaves.

Keywords: Regulatory Mapping; Pylons; Electromagnetic Radiation; Environmental Exposure

Introduction

The Official Journal of the European Communities Electromagnetic fields are defined as static fields, extremely low frequency (ELF) fields and radio frequency (RF) fields, including microwaves, over the entire frequency range from 0 Hz to 300 GHz [1]. The World Health Organisation's (WHO) International Agency for Research on Cancer (IARC) group of experts classified the radiofrequency electromagnetic fields emitted by mobile base stations as category "2B "1 in its publication of 31 May 2011, i.e. "potentially carcinogenic". The radiation emitted by mobile phones thus joins asbestos and tobacco in this classification [2]. In the same vein, a study by Santini in France established a link between the distance and proximity of base stations and symptoms such as headaches, lack of concentration, etc. [3]. In Cameroon, the Directorate of Civil Protection (DPC) has identified electromagnetic fields from mobile telephony as a technological risk, and its use should therefore be regulated [2].

At the same time, several coalitions of doctors and scientists made a public appeal to denounce the biological inadequacy of the standards of the International Commission on Non-Ionizing

Radiation Protection (ICNIRP), on which Canada relies [4]. They are calling for them to be revised and for biocompatible exposure standards to be produced [4]. These calls, notably from Freiburg, Benevento and the Syndicate de Medicine Générale de France, are a call for precaution. Against this problematic backdrop, in 2010 the French Council of State and the European Commission both adopted resolutions applying the precautionary principle to the deployment of telecommunications antennas [4]. Since Europe has been exposed to radio frequencies for longer than we have, the erection of antennae is a major public health concern (and not a collection of individual problems referred to psychiatry) [4]. Several towns are ordering the removal of antennas and systematically lowering power levels to biocompatible thresholds throughout their territory. This is even though setting thresholds is still the subject of scientific dispute, even at sub-thermal levels of exposure [5].

Over the last few decades, the rapid development of wireless communications, particularly mobile telephony, has rightly raised questions in terms of health effects and regulation [6]. Following a very active period of international research in the 2000s, it is now possible to conclude that the body of scientifically established data does not indicate that there is a significant risk to human health under normal conditions of use [6].

In this context, with the development of the mobile network in Cameroon over the last few decades and the increase in the number of operators, the proliferation of base stations in the urban landscape, etc., has led to an increase in the number of mobile operators [2]. Bearing in mind that the regulations governing the conditions for installing towers and masts for telecommunications use in Cameroon, Decision No. 0000000/MINPOSTEL of 18 April 2013 [7] allowing a base, minimum distance between 02 telecommunication pylons and the percentage for obtaining the distance between telecommunication pylons and electricity pylons equal to 120% of the height of the telecom pylon. It is worth asking whether this combination of telecoms and electricity pylons complies with national standards and international distance recommendations.

From this question stems the subject of our research, which is entitled: "Regulatory mapping, risk of exposure to non-ionizing electromagnetic radiation, the case of Douala".

The main objective of this article is to show the health risk incurred in the city of Douala because of non-compliance with regulations on the distance between telecommunication masts when they are erected. Specifically, the aim was to:

- Identify and select electromagnetic radiation transmitting and receiving towers in the city of Douala.
- Carry out an analysis of the distances between pylons and compare them with the values set out in national regulations.

Materials and Methods

The hardware and software used to carry out this study, Global positioning system (GPS) application: my coordinates Version 5.11(260) Accuracy of +/- 4m; aeronautical reconnaissance coverage geographic information system (ARCGIS) software version 10.8, Excel and Google Form.

Data collection

Data collection methods are varied, and the choice of one depends essentially on the nature of the objectives and the hypotheses adopted. For each piece of research, a suitable instrument and technique must be designed and constructed [8]. More or less structured primary data collection, observation methods, the basic principle of which is to collect, classify, schematize and simplify the information gathered in the field [8]. These were the elements on which the research team was based, and the monitoring of the project was based on these elements. Figure 1 using a mix of the 03 main categories of data collection that can be recognized: observation in the field, survey data, administrative documents, and archives [9]. The field study was carried out.

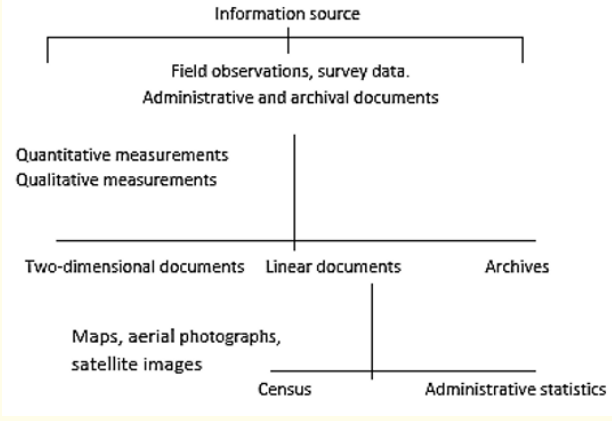

Figure 1: Data collection source [9].

Through observation in the field, administrative documents and archives, we were able to define the study area, the targets to be studied and the exclusion criteria. The survey documents enabled us to establish a database using Global Positioning System (GPS) coordinate sampling tools and information sharing, storage and processing tools for electromagnetic wave transmission and reception equipment, specifically telecommunication towers (guyed, self-supporting, triangular lattice, square lattice) [10]. and electricity (lattice; high voltage triangle (HTB), medium voltage (HTA)) [11].

Data processing and comparative analysis

The data representing the GPS coordinates of pylons in the city of Douala that can emit or receive electromagnetic radiation was processed using Excel and inserted into ARCGIS 10.8 software for representation on the map. This made it possible to calculate the distance between pylons to compare them with the regulatory distances using the ARCGIS "measure" tool. The aim is to produce and present geographically localized information, contributing to spatial management [12].

Steps in creating a map using ArcGIS [13]:

- Georeferencing the map: the WGS 1984 georeferencing system is used,
- Import of previously collected data into an Excel spreadsheet,
- Map layout,
- Export the map in pdf format,
- Print.

Results

Using the data obtained, we drew up a representative map of our sample based on the various Douala districts surveyed (Map 1).

The red dots represent electricity pylons and the green dots represent telecommunications pylons, 371 of which are located in the city of Douala [14]. We were able to cover 26% of the telecommunications masts, representing the number of masts geolocated during the survey divided by the total listed (371). We did not have data on the total number of electricity pylons installed in the city of Douala.

Data from the regulations gave us the minimum distance between 02 telecommunications masts, which is 750 m in urban areas, and 120% of the height of the telecommunications mast in the case of the distance between an electricity mast and a telecommunications mast [7]. After processing the data using ArcGIS 10.8 software, this information enabled us to obtain the distances between the telecommunications pylons and electricity pylons shown in the Table 1 and visualize the comparison in Figure 2.

Map 1: Representativeness of telecommunication and electricity pylons in the city of Douala.

Pylons (com)	Latitude	Longitude	Distance (m)	Neighbourhood	Comparison
Pylon 1	4.03206	9.79857	122.960	Japoma	C1
Tower 2	4.032093	9.79967			
Pylon 1	4.032067	9.79857	235.170	Japoma	C2
Tower 3	4.029998	9.79906			
Tower 2	4.032093	9.799677	241.584	Japoma	C3
Tower 3	4.029998	9.79906			
Tower 4	4.0611	9.7853	237.275	Pk11-pk12	C4
Tower 5	4.0624	9.787			
Tower 4	4.0611	9.7853	700.625	Pk12	C5
Tower 6	4.066	9.7893			
Tower 5	4.0624	9.787	472.969	Pk12	C6
Tower 6	4.066	9.7893			
Tower 5	4.0624	9.787	710.049	Pk12	C7
Pylon 7	4.0679	9.7903			
Tower 6	4.066	9.7893	237.640	Pk12-pk13	C8
Pylon 7	4.0679	9.7903			
Pylon 7	4.0679	9.7903	584.230	Pk13-pk14	C9
Tower 8	4.0729	9.792			
Pylon 7	4.0679	9.7903	609.03	Pk13	C10
Tower 9	4.0729	9.726			
Tower 9	4.0729	9.726	66.624	Pk13-pk14	C11
Tower 8	4.0729	9.792			
Pylon10	4.0901	9.8022	462.386	Pk18	C12
Pylon11	4.093	9.8052			
Pylon10	4.0901	9.8022	714.155	Pk17-pk18	C13
Pylon12	4.0914	9.8085			
Pylon11	4.093	9.8052	406.90	Pk17	C14
Pylon12	4.0914	9.8085			
Douala III - Douala V					
Pylons	Latitude	Longitude	Distance	Neighbourhood	Comparison
Pylon13	4.0927	9.8008	326.843	Pk17	C15
Pylon10	4.0901	9.8022			
Pylon13	4.0927	9.8008	489.681	Pk17	C16
Pylon11	4.093	9.8052			
Douala V					
Pylons	Latitude	Longitude	Distance	Neighbourhood	Comparison
Pylon14	4.0533	9.7507	410.499	Ndogbong	C17
Pylon15	4.057	9.7504			

Pylon16 Pylon17	4.0635 4.0663	9.7456 9.744	356.976	Makepe Missoke	C18
Pylon16 Pylon18	4.0635 4.0644	9.7456 9.7394	695.613	Makepe Missoke	C19
Pylon18 Pylon17	4.0644 4.0663	9.7394 9.744	552.312	Makepe Missoke	C20
Pylon19 Pylon20	4.0769 4.0774	9.7628 9.7632	70.920	Logpom	C21
Pylon19 Pylon21	4.0769 4.0799	9.7628 9.7631	333.408	Logpom-Makepe	C22
Pylon20 Pylon21	4.0774 4.0799	9.7632 9.7631	276.672	Logpom-Makepe	C23
Pylon22 Pylon23	4.0788 4.0832	9.775 9.7785	622.712	Logbessou	C24
Pylon24 Pylon25	4.0847 4.0859	9.7561 9.7605	659.049	Makepe	C25
Pylon26 Pylon27	4.0887 4.0864	9.7605 9.7663	692.423	Logpom	C26
Pylon26 Pylon28	4.0887 4.0916	9.7605 9.7621	366.606	Logbessou (Tankwa)	C27
Pylon24 Pylon34	4.0847 4.0859	9.7561 9.7526	410.664	Makepe	C28
Pylon24 Pylon26	4.0847 4.0887	9.7561 9.7605	659.049	Makepe	C29
Douala IV					
Pylons	Latitude	Longitude	Distance	Neighbourhood	
Pylon31 (com) Pylon1 (elec)	4.070175 4.070459	9.6867 9.686657	31.765	Bonassama	C30
Pylon32 (com) Pylon2 (elec)	4.088725 4.088168	9.663893 9.663587	70.343	Bonaberi	C31
Pylon33 Pylon32	4.091492 4.088725	9.662048 9.663893	368.225	Bonaberi	C32

Table 1: Comparative table of distances between telecommunications masts.

Figure 2: Comparison of distances between telecom masts and the regulatory value.

Figure 2 shows that none of the comparisons (C) of distances between telecoms masts reached the recommended minimum distance value, which is shown in red 750.

Discussion

Can an assessment of the distance between telecommunication towers that emit and receive electromagnetic radiation in the city of Douala, based on data from a field survey and several spatial and statistical analyses that make up our study and yield precise results showing non-compliance with the regulations, contribute to raising awareness and strict application of the regulations concerning the siting of telecommunication towers? From the point of view of decision-making in the context of managing the siting of masts in developed areas, can this result be sufficient to conclude that there is a significant risk to human health given that the conditions of use are not normal, as opposed to the fact that it is possible to conclude that all the scientifically established data do not indicate that there is a significant risk to human health under normal conditions of use? [6].

This work highlights the distances separating 02 telecommunications masts or the distance between the telecommunications mast and the electricity mast. The reference distance of 750 m was used to compare nearly 26% of the telecommunication towers in the city, where there were nearly 32 cases of non-compliant comparisons stipulating that the distance between towers was less than 750 m, i.e. 74 towers, about 20% of the telecommunication towers in the city [14]. This is worrying in the light of the work by Santini R on an epidemiological study carried out in France, which found that people living near mobile phone masts complained of exposure to microwaves [3]. In this study, two groups were formed. The first included residents living within a 300 m radius of the antenna. The second, the control group, was made up of people living beyond 300 m of the antenna or whose homes were located outside a relay station's right-of-way. Complaints relating to exposure to microwaves were noted in the group living within 300 m of the antenna. Some complaints were significantly more frequent only at certain distances from the antenna:

- From 0 to 10 m from the antenna: nausea, loss of appetite, visual disturbances, difficulty moving around.
- From 10 to 100 m from the antenna: irritability, depressive tendency, difficulty concentrating, memory loss, dizziness, reduced libido.
- From 100 to 200 m from the antenna: headaches, disturbed sleep, feelings of discomfort, skin problems.
- From 200 to 300 m from the antenna: fatigue.

This study concluded that the number of symptoms reported was higher close to the relay station than further away [2].

Can the results of this study be considered? Considering the sample of 96 telecommunications masts and a few electricity masts considered for the calculation of distances two by two (02) in addition to certain statistical data from the previous year and GPS data which can lead to an offset of almost 4 m due to precision.

It could be more significant with the consideration and location of base stations for cellular telephones and other cellular infrastructures, such as antenna installations on rooftops, especially in residential neighbourhoods, even though this is considered a contentious land use issue [4].

Conclusion

This work, which analyzed the problem of setting up telecommunications masts in compliance with national standards and international recommendations, had two (02) objectives, including: (1) Identifying and selecting the masts that emit and receive electromagnetic radiation in the city of Douala. To this end, 96 telecommunication masts were identified during the survey, representing 26% of the telecommunication masts in the city of Douala, spread over the 05 districts of Douala 1 to Douala 5, and (2) to carry out an analysis of the distances between masts and compare them with the value of the national regulations, which enabled us to determine that almost 20% of the national regulations had not been complied with, i.e. 32 cases of comparison between 02 masts that did not comply with the regulatory distance. We conclude that it is judicious to consider the siting criteria in terms of distance, which represents only one of the elements in terms of exposure to electromagnetic radiation for healthy development in society.

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Conflicts of Interest

The author declares no conflict of interest.

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