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Table of Contents

		Page
1	Evaluation of the Cellular and Wi-Fi radiofrequency pollution levels in the Western Province of Sri Lanka *S A T UW K Suraweera1* and K P S C Jayaratne*	01
2	Pharmacological effects of Sesamum indicum; Systematic review *S H K Deepthika1*, K P K R Karunagoda, P K Perera*	15
3	Evaluation of the Perceived Palatability Levels of Grazing Forages of Wild Asian Elephants in Sri Lanka *U D Tharangi*, R U Halwathura and S Somaratne*	26
4	Impact of Electronic Media on Physical Development in Preschoolers in Sri Lanka: Parents' Perception in Kalutara District *P Seneviratne* and W. Hang*	41
5	Wi-Fi Fingerprint and Pedestrian Dead Reckoning-based Indoor Localization with Supervised Learning *D Y Algama, W K R N D Weerasekara, Y L L Thilakaratne and C S Silva**	51

Evaluation of the Cellular and Wi-Fi radiofrequency pollution levels in the Western Province of Sri Lanka

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ABSTRACT

Cellular communication networks and Wi-Fi sources are becoming abundant in the present day. There are some discussions about the adverse effects of the radiation emitted by these sources on people living in environments with higher radiation levels. In this study, background RF radiation levels due to common cellular network bands and Wi-Fi hotspots were monitored using a high-frequency spectrum analyser (SPECTRAN HF6065) within the Western Province of Sri Lanka to understand the current RF pollution levels in the environment. Results of the study reveal that the Colombo City area has the highest RF pollution levels of all the selected network bands. However, measured maximum radiation levels were approximately 0.9 % compared with the international guidelines published by International Commission on Non-Ionizing Radiation Protection (ICNIRP). Spatial distribution patterns were generated based on the measured Radio Frequency (RF) exposure levels which could be useful for the Central Environmental Authority (CEA) and Telecommunication Regulatory Commission of Sri Lanka (TRCSL) and for other concerned institutions.

Keywords: Health Impacts, RF Pollution, Spatial Distribution, Western Province.

INTRODUCTION

Wireless technologies become a necessary part of human lives especially due to the pandemic, and most people used to live with these devices than ever before. These wireless devices use Radiofrequency (RF) waves to carry their signals, which are categorised in the non-ionising radiation zone of the electromagnetic spectrum. Recently, there has been a debate in society about the health effects of these non-ionising radiations due to the exponential increase in cancers and other non-spreading diseases. The most abundant RF emitting sources in the environment are cell phones, cellular transmitting towers, Wi-Fi hotspots, and TV and Radio Transmission towers.

Radio Frequency Region and Frequency Bands

Radio Frequency (RF) is a region of the electromagnetic spectrum that falls between 3 kHz and 300 GHz. It is used to transmit radio waves, which are used in communication systems such as radio and television broadcasting, wireless networks, and cell phones. RF waves are produced by oscillators, which generate a continuous oscillating signal and these can be powered by different sources, such as electrical circuits, batteries, or transistors. The frequency of the oscillator determines the frequency of the RF wave that is produced.RF frequency bands are portions of the RF spectrum used for various wireless communication applications. They are divided into different frequency ranges to accommodate different types of transmissions. The frequency bands are usually divided into three main categories: low frequency (LF), medium frequency (MF), and high frequency (HF). LF bands are typically used for long distance

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communications, such as AM and FM radio broadcasts, while MF and HF bands are used for short distance communications, such as cell phones and Wi-Fi networks. Cellular and Wi-Fi frequency bands are also portions of the RF spectrum, but they are specifically used for cellular and Wi-Fi communication applications. Cellular frequency bands are used by cell phone networks and mobile broadband services, while Wi-Fi frequency bands are used by wireless local area networks (WLANs)(ICNIRP, 2020). The frequency bands are regulated by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) in Sri Lanka, and other organisations in some other countries.

Table 1 shows the selected frequency bands and their corresponding frequency ranges in this study.

Table 1. Different cellular network bands and Wi-Fi frequency band with the corresponding frequency ranges

Network Band	Frequency Range (MHz)
GSM900	890-915 (up link) /935-960 (down link)
GSM1800	1710-1785(up link) /1805-1880 (down link)
UMTS	1885-2025(up link) /2110-2200 (down link)
LTE2.6	2500-2570(up link) /2620-2690 (down link)
(Wi-Fi) WLan 2.4	2401-2484

RF Safety and Exposure Guidelines

RF (Radio Frequency) safety refers to measures taken to prevent potential harm to individuals and the environment from exposure to RF electromagnetic fields. These fields are generated by radio frequency equipment such as cell phones, wireless networks, and broadcast towers. To ensure RF safety, guidelines and standards are established by organisations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP) and the Federal Communications Commission (FCC). These guidelines specify the maximum permissible exposure levels for various frequencies and duration of exposure. It's important to follow these guidelines and best practices when operating or working near RF equipment, including using proper shielding and antenna placement, maintaining a safe distance from RF sources, and avoiding prolonged exposure to high levels of RF fields. Some countries in the world use different guidelines for RF exposure. However, in Sri Lanka Telecommunications Regulatory Commission follows the guidelines published by International Commission on Non-Ionizing Radiation Protection (ICNIRP). Table 2 shows the exposure guidelines published by ICNIRP in 2020(ICNIRP, 2020).

Table 2. Guidelines for non-ionising RF exposure published by ICNIRP

Exposure	Freq. Range	Incident Electric Field (V/m)	Incident Magnetic field (A/m)	Incident Plane Wave Power Density (S) (W/m^2)
Occupational	0.1-30 MHz	$660/f_m^{0.7}$	$4.9/f_m$	NA
	>30-400 MHz	61	0.16	10
	>400-2000 MHz	$3f_m^{0.5}$	$0.008f_m^{0.5}$	$f_m/40$
	>2-300 GHz	NA	NA	50
General Public	0.1-30 MHz	$300/f_m^{0.7}$	$2.2/f_m$	NA
	>30-400 MHz	27.7	0.073	2
	>400-2000 MHz	$1.375f_m^{0.5}$	$0.0037f_m^{0.5}$	$f_m/200$
	>2-300 GHz	NA	NA	10

To ensure the above guidelines, continuous monitoring is recommended by the respective authorities to make sure the safety of the people.

Exposure Level Measurements

There are many ways for humans to be exposed to RF radiation. Nearly all people are exposed to some degree of RF radiation daily. It is better to understand the elements influencing human exposure. These include RF radiation strength, volume and duration of RF exposure, Distance from the RF emitter, Tissue types that are exposed to RF radiation, frequency of the exposed RF radiation, and body resonance are the primary elements influencing human exposure.

The electric field intensity (E), magnetic field strength (B), and equivalent plane wave power density (EPPD) are the basic measurements of radio frequency electromagnetic waves at a particular point of space, and these could be measured by using high-frequency spectrum analysers or any other suitable EMR measuring instrument.

When considering exposure compliance, a Specific Absorption Rate can be used, and it measures the rate of energy absorbed by a unit mass of a particular type of tissue of a human or animal. More generally, the SAR value could evaluate thermal losses in human or animal tissues. This value depends on various properties, such as water content, the geometry of the particular type of tissue, and the incident wave frequency(Lak & Oraizi, 2013).

Health Effects of RF Waves

In 2011 World Health Organization (WHO) published a report on the research agenda for radiofrequency fields. High-priority research areas in health effects such as behavioural and neurological disorders and cancer on children and adolescents, monitoring of brain tumour incident trends through population-based cancer registries combined with population exposure data, effects on brain function due to RF exposure, RF-EMF provocation studies on children of different ages, effects of RF exposure on ageing, development, behaviour, neurodegenerative disorders and reproductive organs of animals and social science research such as determinants and dynamics of RF EMF-related health concern and perceived health risks and effects of RF exposure on wellbeing(van Deventer et al., 2011).

The International Agency for Research on Cancer (IARC) assessed the carcinogenicity of radiofrequency electromagnetic fields (RF-EMF) in 2011. RF EMF was deemed carcinogenic (Group 2B) to humans based on scant evidence of its carcinogenicity in humans and animals (IARC, 2011). In nine case-control studies undertaken in Sweden, France, and other nations, RF radiation was found to relate to glioma, an essential human malignancy, according to a study published in 2018 based on epidemiology studies published since 2011. Rising glioma incidence patterns have been noted in the UK and other nations. Meningioma and auditory neuroma are two non-malignant endpoints that are connected. Case-control studies can be more effective in assessing possible hazards for brain cancer than cohort studies or other approaches because they enable more in-depth consideration of exposure. Current epidemiological research enhances and supports the conclusion that RFR should be classified as human carcinogenic when taking into account recent animal experimental evidence (IARC Group 1) (Miller et al., 2018). The National Toxicology Program (NTP) reported a higher incidence of malignant glial tumours of the brain and heart Schwannoma in rats exposed to GSM and CDMA-modulated cell phone RF radiation in the first results of its long-term bioassays on near-field RF radiation released in 2016. The tumours found in the NTP study resemble those found in certain epidemiological studies of cell phone users (NTP (National Toxicology Program), 2016).

A large study carried out by Ramazzini Institute (RI) through the life-span of Sprague-Dawley rats in a carcinogenic investigation to assess the effects of RF radiation in a far-field scenario, simulating the ambient exposure to RF radiation produced by 1.8 GHz GSM antenna of mobile phone radio base stations shows a statistically significant increase in the incidence of heart Schwannomas in treated male rats when they exposed to a maximum r.m.s electric field intensity of 50 V/m and the particular study request to re-evaluate the IARC conclusions regarding the carcinogenic potential of RF radiation in humans (Falcioni et al., 2018) A systematic review and meta-analysis designed to investigate the association between exposure to radiofrequency radiation and the risk of breast cancer based on selected studies that were published in PubMed, Embase, Cochrane Library, Ovid MEDLINE, CINAHL Plus, Web of Science, Airiti Library, Networked Digital Library of Theses and Dissertations and ProQuest until May 2020 show a significant association between RF exposure and breast cancer risk. Furthermore, the study shows an increased risk of breast cancer, especially in women aged 50 or above years and in people who use RF sources such as mobile phones and computers (Shih et al., 2020). Another study was developed to evaluate the effect of continuous low-intensity exposure to electromagnetic fields from radio base stations (RBS) on cancer mortality, especially for breast, cervix, lung, and esophagus cancers in Brazilian people based on the number of deaths by cancer, gender, age group, gross domestic product per capita, death year, and the amount of exposure over a lifetime. The adjusted study demonstrated that cancer mortality increased directly to RBS radiofrequency exposure. For cervical cancer, the highest adjusted risk was seen. The regional study revealed that the city in southern Brazil with the highest RBS radiofrequency exposure was also the city with the highest overall cancer death rate, particularly for lung and breast cancer. The study's overall finding suggests that exposure to radiofrequency electromagnetic fields from RBS raises the mortality rate for all cancer types (Rodrigues et al., 2021).

Above are a few studies conducted by many researchers around the world, and there are more studies to confirm the adverse effects of these RF waves. Monitoring background radiation levels due to these waves is essential to minimise these effects and regulate RF exposure. The main objective of this study is to obtain an idea about the current background RF exposure levels in the most populated province in Sri Lanka, mainly due to cellular and Wi-Fi networks.

INSTRUMENTATION AND METHODOLOGY

Measurements were taken at places with at least one visible cellular tower structure and fewer radiation barriers, such as large buildings and metal structures. The peak value of the RMS electric field intensity was measured at the selected locations for the downlink of the cellular frequency bands GSM900, GSM1800, UMTS, and LTE2.6 and the peak electric field intensity due to Wi-Fi (WLan2.4) hotspots. SPECTRAN HF6065 selective spectrum analyser was used to collect all the data. This high-frequency electromagnetic wave meter can measure RF EMR within 10 MHz to 6 GHz. A compatible broadband directional antenna (Hyperlog7060) was used with the device, and the selected antenna is more accurate within the frequency range of 700 MHz to 6 GHz. Figure 01 shows the instrumentational setup used for the study.

Figure 1. Instrumental Setup

Since the setup contains a directional antenna, it was rotated 360° while holding the antenna on the horizontal plane to find the peak electric field intensity at a selected location for all the frequency bands. The data were collected in the daytime between 8 am and 4 pm within the first quarter of 2022.

RESULTS AND DISCUSSION

In this survey, 681 data points were collected within the Western Province of Sri Lanka. Figure 2 shows the collected data point in the map of the western province.

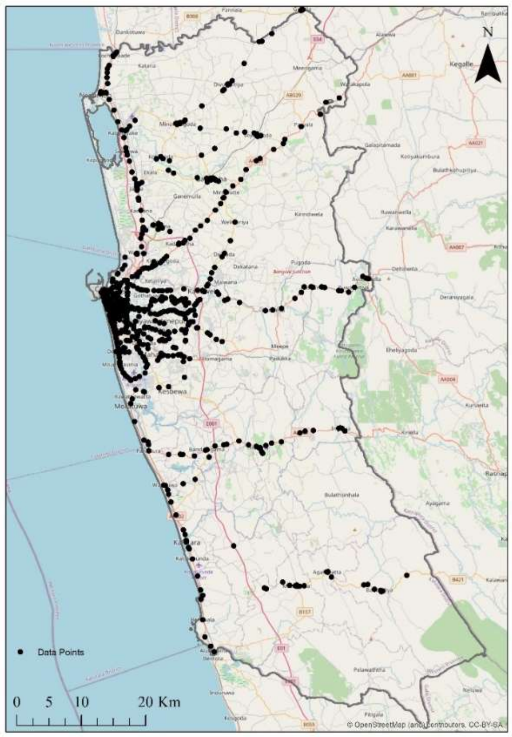

Figure 2. Survey points in the Western Province of Sri Lanka map.

Table 3 shows the calculated statistics for all the collected data in this survey.

Table 3. Calculated statistics for all the data collected in the survey within the Western Province of Sri Lanka.

Statistic	Electric field (V/m)				
	GSM900	GSM1800	UMTS	Wi-Fi (WLan2.4)	LTE2.6
Min	0.012	0.008	0.004	0.002	0.013
Max	1.031	2.325	1.487	0.155	0.978
Average	0.149	0.233	0.191	0.015	0.142
SD	0.132	0.247	0.184	0.014	0.126

Table 4 shows the location coordinates of the recorded maximum electric field intensity levels within the western province of Sri Lanka.

Table 4. Location details of the measured maximum E-field values in the survey

Frequency Band	Location Coordinates	
	Lat.	Long.
GSM900	6.884096	79.876028
GSM1800	6.927869	79.858558
UMTS	6.846181	79.866188
Wi-Fi (WLan2.4)	6.966308	79.870995
LTE2.6	7.014641	79.898051

Figure 3. shows the variation of the average of peak E-Field levels for each frequency band.

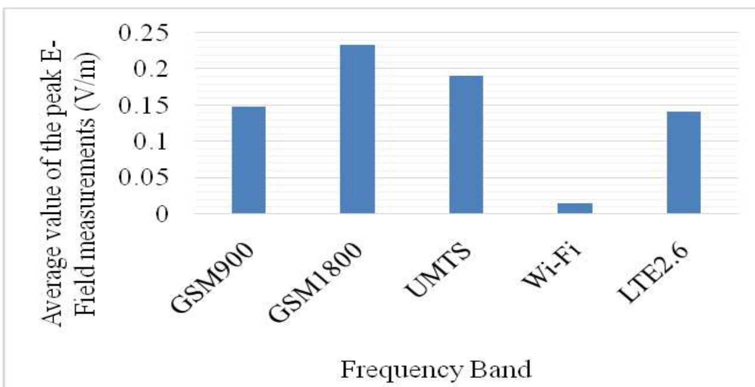

Figure 3. Variation of the calculated average values of the E field data for each frequency band.

Based on the data in the Table 3 and Figure 3,GSM1800 frequency band is more responsible for the background RF pollution levels and Wi-Fi frequency band contributes the least. However, it should be noted that most of the Wi-Fi devices are fixed inside the house, which could lead to higher exposure for the occupants due to Wi-Fi frequency bands.

Histogram for a particular data set is very important to get a visual idea about how much the data are distributed. Figure 4 shows the histogram for the collected data in the GSM900 frequency band.

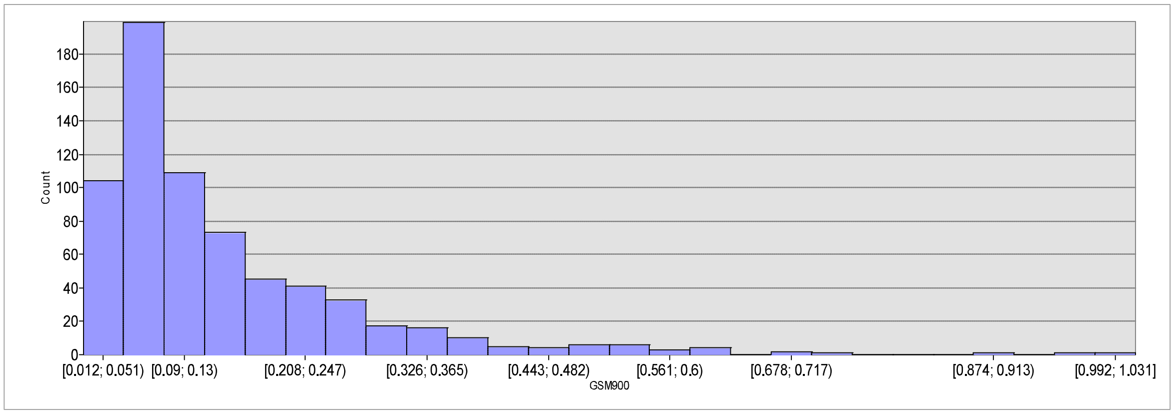

Figure 4. Histogram for the collected E field data in the GSM900 frequency band

According to Figure 4 most of the collected data for the GSM900 band are gathered between 0.051 V/m and 0.090 V/m range.

Figure 5 shows the histogram for the collected data in the GSM1800 frequency band.

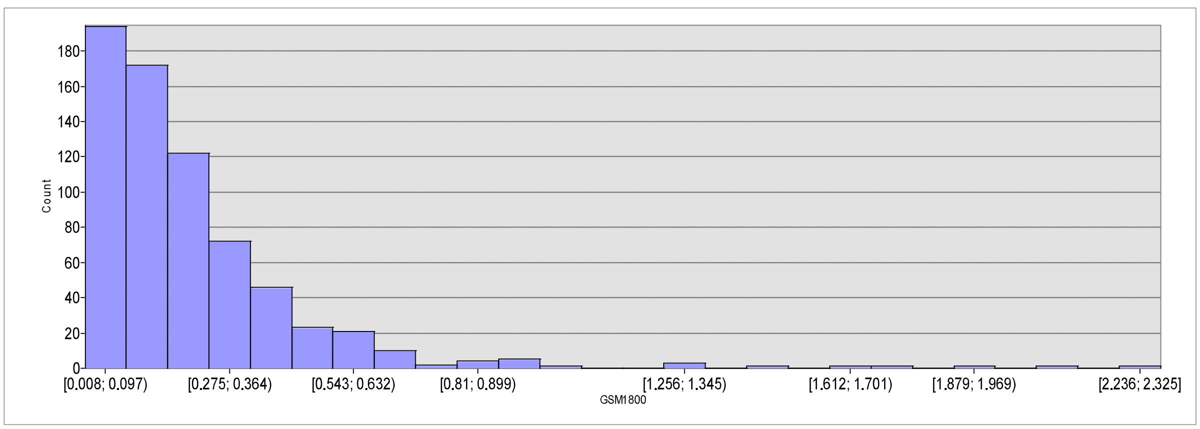

Figure 5. Histogram for the collected E field data in the GSM1800 frequency band

Based on Figure 5, most of the collected data for the GSM1800 band are gathered between the range 0.008 V/m and 0.097 V/m.

Figure 6 shows the histogram for the collected data in the UMTS frequency band.

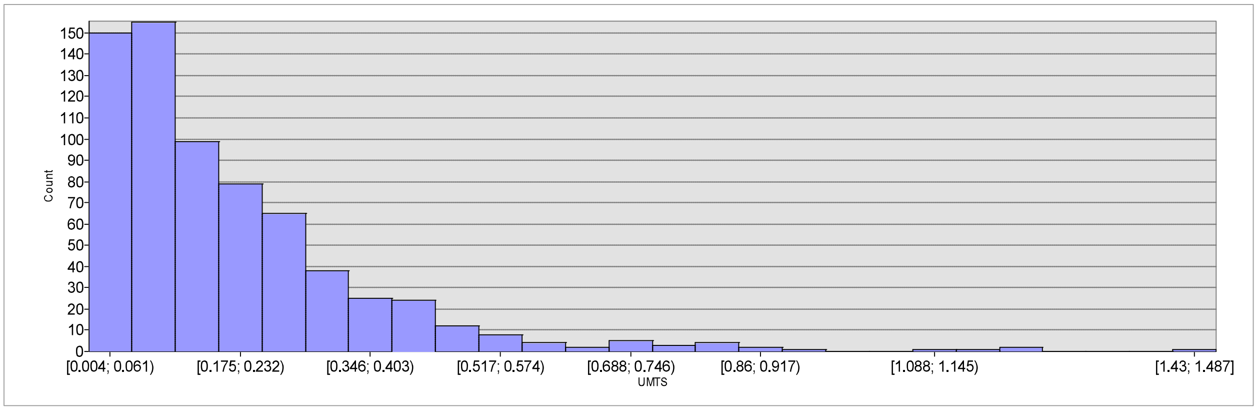

Figure 6. Histogram for the collected E field data in the UMTS frequency band

Based on Figure 6,most of the collected data for the UMTS band are below 0.175 V/m.

Figure 7 shows the histogram for the collected data in the Wi-Fi (WLan2.4) frequency band.

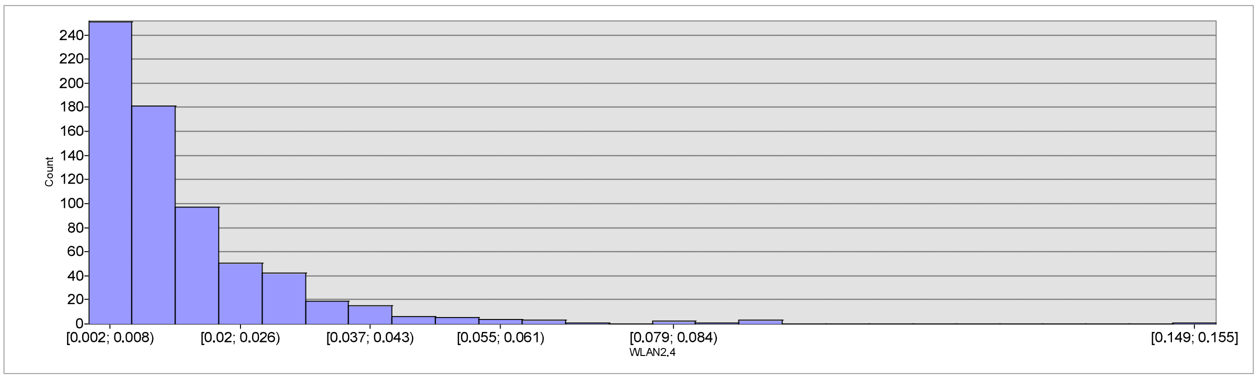

Figure 7. Histogram for the collected E field data in the Wi-Fi (WLan2.4) frequency band

Figure 7 reveals that the selected Wi-Fi frequency band's contribution to the everyday background RF radiation exposure is meagre, and most of the collected data are below the 0.02 V/m level.

Figure 8 shows the histogram for the collected data in the LTE2.6frequency band.

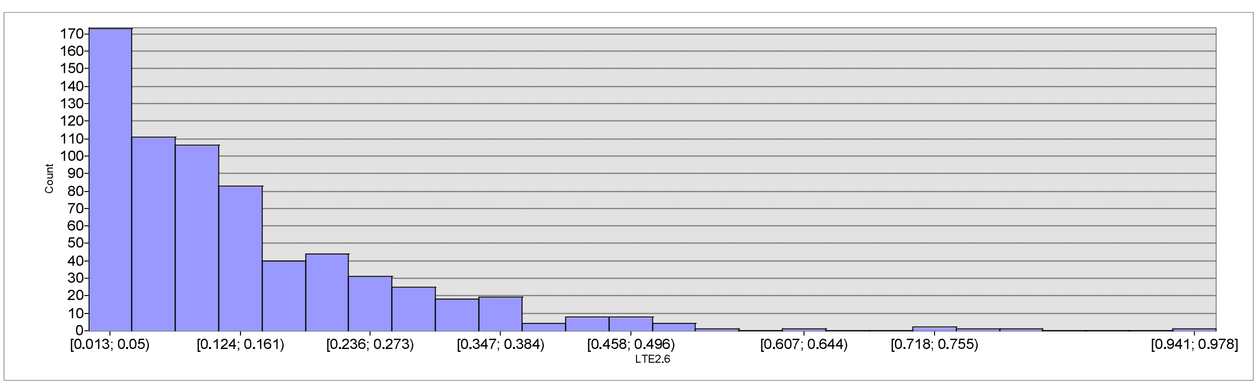

Figure 8. Histogram for the collected E field data in the LTE2.6 frequency band

Figure 8 indicates that most LTE2.6 frequency band E field levels are gathered within the range of 0.013 V/m to 0.124 V/m. This indicates that nearly the entire region of the western province is covered by the LTE2.6 band.

Based on all the histograms, it is clear that all the RF field measurements show a positively skewed distribution, which indicates lower RF exposure levels throughout the Western Province. This is generally good news for the residents, as it suggests that most locations have relatively lower RF radiation levels. However, it is crucial to pay close attention to areas with higher measurements, especially where cellular towers are situated near sensitive locations like hospitals, schools, and kindergartens. While the overall RF exposure levels seem to be within acceptable limits based on the histograms, these specific areas may warrant further investigation and monitoring.

To observe the spatial distribution of RF pollution levels within the Western Province of Sri Lanka, a spatial distribution pattern was generated using the IDW interpolation technique in ArcMap software. Figure 9 shows the corresponding spatial distribution of the E-Field for the selected frequency bands.

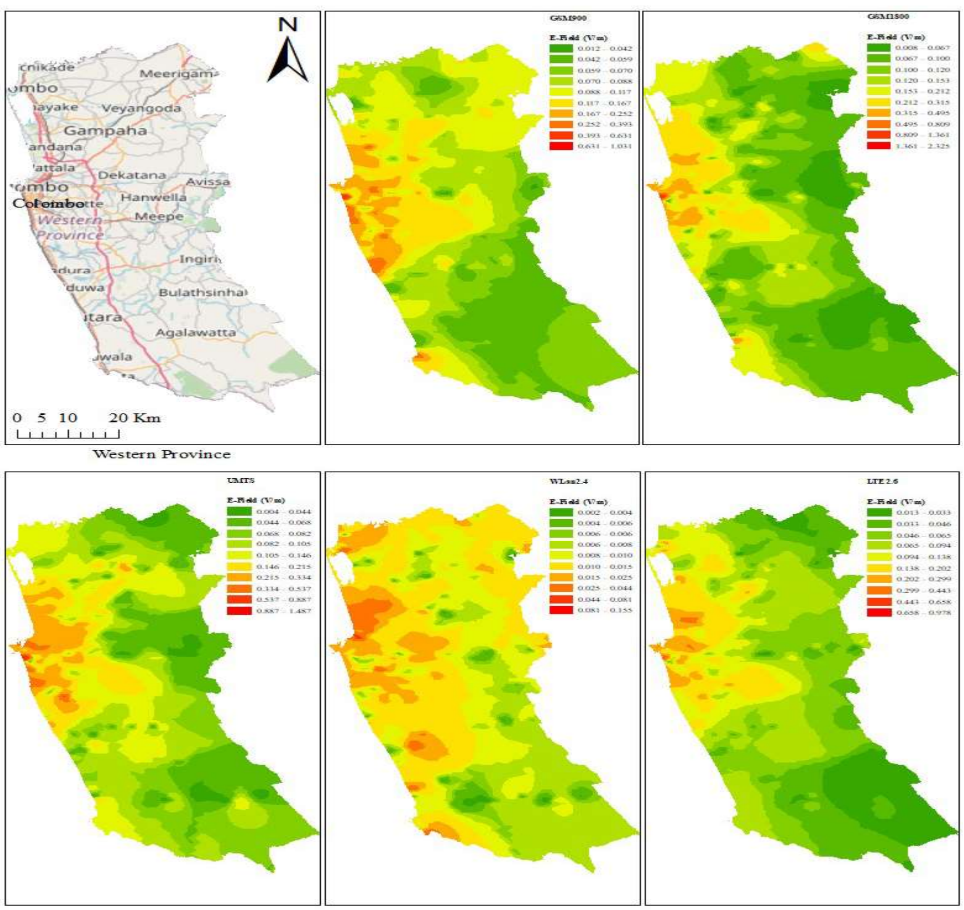

Figure 9. Predicted spatial distribution maps for E field variation based on the measured data for each frequency band.

Equivalent Plane-Wave Power Density (EPPD) levels can be calculated, to evaluate the overall exposure due to all the selected frequency bands at a particular point. Table 5 shows the calculated statistics for the equivalent plane wave values calculated based on the peak electric field intensity levels collected in this study.

Table 5. Calculated statistics for the equivalent plane wave power density (EPPD) levels calculated based on the collected data

Statistic	Equivalent plane wave power density (mW/m^{-2})
Min	0.004
Max	17.903
Average	0.695
SD	1.516

The location coordinates corresponding to the maximum EPPD is 6.927869, 79.858558. Based on the ICNIRP guidelines, the maximum permissible exposure levels depend on the frequency. However, when compared with 2 W/m^{-2}, above maximum EPPD value is approximately 0.9 %. Therefore, this reveals that as of the first quarter of 2022, the RF pollution levels do not exceed international guidelines.

Based on the calculated EPPD values, a spatial distribution pattern can be generated for the cumulative EPPD levels. Figure 10 shows the spatial distribution map of cumulative EPPD levels calculated and predicted using the IDW interpolation technique in ArcMap software based on the measured peak E-Field Values in the Western Province of Sri Lanka.

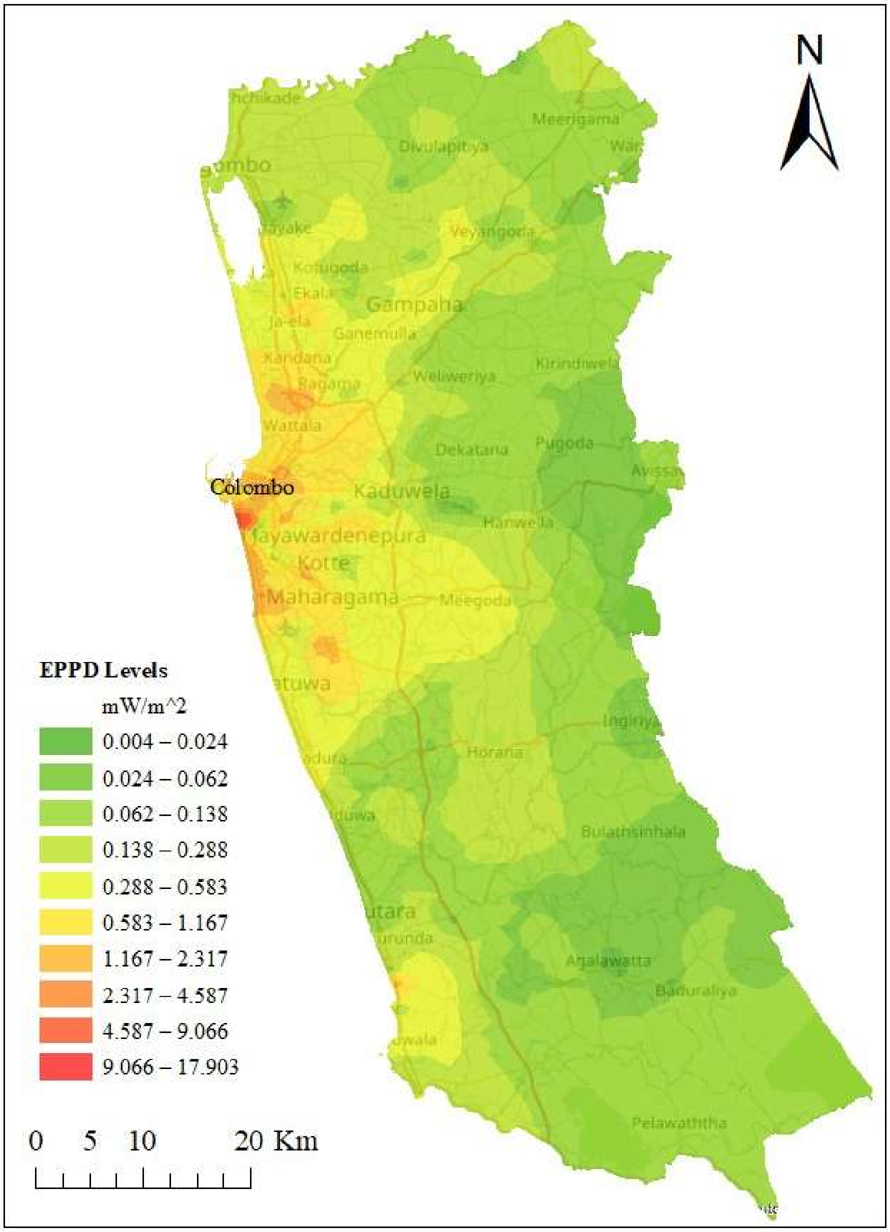

Figure 10. Spatial distribution of cumulative EPPD levels by all the selected frequency bands within the Western Province of Sri Lanka

Based on Figure 10, we can observe higher RF pollution levels in specific areas, particularly in proximity to Colombo City and along the coastal region from Moratuwa to Ja-Ela. These elevated RF pollution levels are attributed to the higher concentration of cellular towers and Wi-Fi hotspots in urban centres and densely populated coastal areas.

CONCLUSIONS

During this study, the authors identified many cellular tower structures situated very close to hospitals, schools, and kindergartens, especially within the Colombo city and in the coastal region from Moratuwa to Ja-Ela. Therefore, the authors would like to recommend a high-resolution RF survey in these areas under the supervision of the Central Environmental Authority of Sri Lanka and the Telecommunication Regulatory Commission of Sri Lanka.

Based on the collected data and calculated equivalent planewave power densities, it can be concluded that as of the first quarter of 2022, the western province is safe from RF pollution levels emitted by major cellular bands and WLan2.4 network band, based on the thermal effects published by ICNIRP. However, nowadays, the scientific community is concerned about adverse effects due to non-thermal effects of RF radiation. Since no exact guidelines are published to evaluate the threshold exposure, people must take safety precautions when living in places with considerably higher RF radiation levels. Especially pregnant women and children must limit their daily exposure to these non-ionising radiations.

REFERENCES

1. Falcioni, L., Bua, L., Tibaldi, E., Lauriola, M., de Angelis, L., Gnudi, F., Mandrioli, D., Manservigi, M., Manservisi, F., Manzoli, I., Menghetti, I., Montella, R., Panzacchi, S., Sgargi, D., Strollo, V., Vornoli, A., &Belpoggi, F. (2018). Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission. *Environmental Research*, *165*. https://doi.org/10.1016/j.envres.2018.01.037

2. IARC. (2011). *IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans*. World Health Organization.

3. ICNIRP. (2020). Guidelines for limiting exposure to electromagnetic fields (100 kHz to 300 GHz). International Commission on Non-Ionizing Radiation Protection. *Health Physics*, *118*(5).

4. Lak, A., &Oraizi, H. (2013). Evaluation of SAR distribution in six-layer human head model. *International Journal of Antennas and Propagation*, *2013*. https://doi.org/10.1155/2013/580872

5. Miller, A. B., Morgan, L. L., Udasin, I., & Davis, D. L. (2018). Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). *Environmental Research*, *167*. https://doi.org/10.1016/j.envres.2018.06.043

6. NTP (National Toxicology Program). (2016). Cancer Studies in Experimental Animals. *Report on Carcinogens*,*1046*(1–2), 194. http://www.academia.edu/download/32420714/roc12.pdf#page=202

7. Rodrigues, N. C. P., Dode, A. C., Andrade, M. K. de N., O'dwyer, G., Monteiro, D. L. M., Reis, I. N. C., Rodrigues, R. P., Frossard, V. C., & Lino, V. T. S. (2021). The effect of continuous low-intensity exposure to electromagnetic fields from radio base stations to cancer mortality in Brazil. *International Journal of Environmental Research and Public Health*, *18*(3). https://doi.org/10.3390/ijerph18031229

8. Shih, Y.-W., O'brien, A., Hung, C.-S., Chen, K.-H., Hou, W.-H., & Tsai, H.-T. (2020). Exposure to radiofrequency radiation increases the risk of breast cancer: A systematic review and meta-analysis. *Experimental and Therapeutic Medicine*, *21*(1). https://doi.org/10.3892/etm.2020.9455

9. Van Deventer, E., van Rongen, E., & Saunders, R. (2011). WHO research agenda for radiofrequency fields. *Bioelectromagnetics*, *32*(5). https://doi.org/10.1002/bem.20660

I. GENERAL INSTRUCTIONS

1) Research presented in the manuscript could be in any field of science. 2) The research work should not have been published or submitted for publication elsewhere. 3) A corresponding author who will be responsible for all communications with the SLAAS Office should be identified. 4) Submission of manuscripts: Manuscripts can be submitted online https://journal.slaas.lk/. 5) Certificate of authenticity: Declaration form should be duly filled, signed by all authors and attach separately. 6) Submissions that involve human or animal trials should provide evidence of approval obtained by an ethics review committee.

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1. Document to be submitted: Manuscript in MS Word format.

2. Format for typesetting
   - Paper size: A4 (210 x 297) typed single sided only.
   - Margins: Top, bottom and right margins of 25 mm and a left margin of 30 mm. 2
   - Line spacing: 1.5 (18 points) throughout the text.
   - Length: Length of the manuscript including text, tables, figures and references should not exceed 15 typed pages.
   - Page and line numbering: All pages should be sequentially numbered using Arabic Numbers. All lines should also be numbered sequentially starting from the top to the bottom of each page.
   - Font: Arial font, size 12. ! Language/spelling: UK English only.
   - Software: Authors may use either MS Word for Windows or the Macintosh equivalent.

3. Title Page: Title page should include the following Information;
   - Title and running title (less than 25 Characters). They should be in bold faced letters
   - Name/s and affiliation/s of author/s
   - Email address, mailing address and contact numbers of the corresponding author. Note: Identified the corresponding author by placing an asterisk after the name.

4. Abstract
   - Should be limited to a maximum of 250 words.
   - Up to a maximum of the five (05) key word should be identified, arranged in alphabetical order, included immediately after the abstract.
   - Abstract should be typed in italics. Scientific names in the abstract should be underlined.
   - No reference, tables, or figures should be included in the abstract.

5. Body
   - Introduction: Justification of the research work, objectives and hypotheses should be included in the introduction.
   - Methods and Materials/ Methodology: All materials, chemicals, clinical, subjects and samples used should be identified. Analytical, survey and statistical method should be explained concisely. Common analytical methods need not be elaborated.
   - Results and Discussion: Can be combined.
   - Conclusions: Should be concise.
   - Headings: All headings should be in bold capital and centered, e.g., INTRODUCTION
   - Subheadings: All subheadings should be in bold and in title case, e.g., Preparation of Land.
   - Non-English terms: All non-English terms should be italicized, e.g., et al., i.e., viz., except "etc."
   - References: Use APA style 3

6. Table and Figures
   - Should be included in the exact place within the text
   - Tables should be numbered sequentially using Arabic numerals. The titles should be self explanatory and placed above the tables.
   - Tabled should not contain any vertical lines
   - Illustration, Line drawing and photographs, if any, should be clear, properly numbered and captioned and ready for reproduction. They should be of high and resolution such as minimum of 300 dpi and saved in .tif or .bmp formats. Please do not use .jpeg or similar formats that do not reproduce well.
   - All lettering, graph lines and points on graphs should be sufficiently large and bold faced to permit reproduction for inclusion in the Journal.
   - Artworks and illustrations should be of appropriate thickness. Please note that thin lines do not reproduce well. Please note that the illustrations, line drawings and photographs should be placed in the appropriate location of the electronic file and numbered sequence with other figures.

7. Units
   - SI units should be used.
   - A single space should be left between the numerical value and the unit.

8. Acronyms and Abbreviations
   - All acronyms should be written in full at the first time of appearance. Abbreviations can be used subsequently.

- The full stop should not be included in abbreviations. Where abbreviations are likely to cause ambiguity or may not be readily understood by readers, the units should be mentioned in full.

9. On being informed of the acceptance, the manuscripts should be revised as per the reviewers' suggestions and re-submitted to the Editor – SLAAS. The accepted manuscripts will be published in the inaugural Journal of the SLAAS. Manuscripts that do not confirm to the above guidelines will not be accepted.
10. Acknowledgements Only the essential individuals and/or organizations/institutes should be include
11. Need to attach the manuscripts both as 1. with names and affiliations of the author and 2. Without with names and affiliations of the author

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Volume 5 Issue 1

Contents

Research Article

1 Evaluation of the Cellular and Wi-Fi radiofrequency pollution levels in the Western Province of Sri Lanka
S A T UW K Suraweera1 and K P S C Jayaratne*

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4 Impact of Electronic Media on Physical Development in Preschoolers in Sri Lanka: Parents' Perception in Kalutara District
P Seneviratne and W. Hang*

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*D Y Algama, W K R N D Weerasekara, Y L L Thilakaratne and C S Silva**

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