International Journal of Advanced Research, Volume 6, Issue 1, 2023
Article DOI: https://doi.org/10.37284/ijar.6.1.1337

International Journal of Advanced Research
ijar.eanso.org
Volume 6, Issue 1, 2023
Print ISSN: 2707-7802 | Online ISSN: 2707-7810
Title DOI: https://doi.org/10.37284/2707-7810

Original Article

Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria

Lumi Zamani Haruna[1], Julius O. Fasakin[2] & Adebayo Adewunmi Emmanuel[2]*

[1] Abubakar Tafawa Balewa University, PMB 0248, Bauchi Nigeria.
[2] Federal University of Technology, PMB 704, Akure, Nigeria.
* Author for Correspondence ORCID ID: https://orcid.org/0000-0001-5324-7590; Email: lharunazamani@gmail.com.

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Publication Date:

27 July 2023

Keywords:

Jos Metropolis, Noise Level, Land Use, Traffic.

ABSTRACT

Traffic noise in urban areas has always been a global issue. This study focuses on the land use analysis of traffic noise levels in the Jos Metropolis. The study was conducted in Jos Metropolis, Plateau State, Nigeria. Twenty-five (25) road corridors were sampled for the study. Measurement points were randomly selected along the road corridors. Traffic noise levels were collected using Sound Level Meter. The sound level meter was positioned at a distance of 6.5 m from the centreline of the nearest travel lane of the road and was held at about 1.5 m high from the ground level. The traffic noise levels data were collected three times a day during peak hour periods from Monday to Saturday. Noise data were measured for 15 minutes at an interval of 6 seconds in each measurement point for six days, making a total of 18 measurements per location. Data sourced from the field were analysed using Mean, Standard Deviation and Analysis of Variance (ANOVA). The study revealed that traffic noise levels in Jos Metropolis in the various land uses exceeded the maximum permissible noise levels recommended by WHO and FEPA. The study recommended the dispersal of land uses through land use allocation.

APA CITATION

Haruna, L. Z., Fasakin, J. O. & Emmanuel, A. A. (2023). Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria *International Journal of Advanced Research*, *6*(1), 88-101. https://doi.org/10.37284/ijar.6.1.1337

CHICAGO CITATION

Haruna, Lumi Zamani, Julius O. Fasakin and Adebayo Adewunmi Emmanuel. 2023. "Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria". *International Journal of Advanced Research* 6 (1), 88-101. https://doi.org/10.37284/ijar.6.1.1337.

HARVARD CITATION

Haruna, L. Z., Fasakin, J. O. & Emmanuel, A. A. (2023) "Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria". *International Journal of Advanced Research*, 6(1), pp. 88-101. doi: 10.37284/ijar.6.1.1337.

IEEE CITATION

L. Z., Haruna, J. O., Fasakin & A. A., Emmanuel, "Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria", *IJAR*, vol. 6, no. 1, pp. 88-101, Jul. 2023.

MLA CITATION

Haruna, Lumi Zamani, Julius O. Fasakin & Adebayo Adewunmi Emmanuel. "Analysis of Traffic Noise Levels on Land Use in Jos Metropolis, Nigeria". *International Journal of Advanced Research*, Vol. 6, no. 1, Jul. 2023, pp. 88-101, doi:10.37284/ijar.6.1.1337.

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

INTRODUCTION

The use of land refers to the various ways in which people can use and manage it (Qi, Wang & Lu, 2011). There are many different types of activities that land can accommodate, such as residential, commercial, agricultural, industrial, and educational. Land-use planning is also important when it comes to controlling noise pollution in a given area (Zubala & Sadurska, 2016). The movement of people, vessels, planes, trains, and other goods along certain routes within or outside of an urban area is referred to as traffic (Halim *et al.,* 2017). Road traffic is the movement of individuals and vehicles along paths, roads, and streets within an area (Uzondu, Jamson & Lai, 2019). These moving objects generate speed, noise and air pollution and cause accidents.

The location of certain activities and the accessibility of these areas create the demand for moving goods and services (Hawkins & Nurul Habib, 2019). The use of land determines the types of activities that can be accommodated in an area. According to a study conducted by Ayo-Odifiri, Fasakin and Okoko (2018), the factors that influence the quality and viability of an area's attractions and activities are the transport system's efficiency and accessibility. This suggests that the failure of one sector of the transportation system could affect other sectors (Ayo-Odifiri *et al.*, 2018). The relationship between the use of land and traffic has been compared to that of an egg and chicken. Oduwaye, Alade and Adekunle (2011) noted that the contents of land affect the character and generation of traffic on roads and streets.

The origin of the word "noise" can be traced back to the word "nausea," which literally means "unwanted sound" (Basner, 2019). Sound can become unwanted when it affects people's quality of life and prevents them from sleeping or talking (Zerihun *et al.,* 2017). Noise can have a negative impact on people's quality of life, including their ability to talk and sleep. It can also reduce their work efficiency and cause stress (Paiva, Cardoso & Zannin, 2019). Ho and Tang (2017) explained that urban noise consists of various sounds that come from trains, planes, and automobiles.

The noise generated by traffic is considered to be an undesirable effect or sound of the railway, aircraft, and roadway. The term "road traffic noise" refers to the overall sound that comes from the various components of motor vehicles, including the engine, tire, exhaust, and breaking elements (Drudge *et al.,* 2018; Pathak *et al.,* 2018). Due to the proximity of urban traffic to people, it has been known that the sound generated by vehicles along these roads can have detrimental effects on their physical, emotional, and environmental health (Pallavi & Sohit, 2019; Lin *et al.,* 2018).

In urban areas, noise pollution is regarded as one of the most hazardous types of air pollution. Road traffic noise is a significant contributor to this issue (Zerihun *et el.,* 2017). It can lower the property values and quality of life of people residing in areas with high traffic levels (Wang, Chen & Cai, 2018). People in developing regions such as India, China, and Nigeria are more prone to experiencing harmful levels of noise (Pathak *et al.,* 2018). This is attributed to inadequate planning and strategies for controlling the noise levels in their areas (Chaichan, Kazem & Abed, 2018).

Due to the increasing number of people living in areas with high traffic levels, the issue of traffic noise has become a global concern. According to a report by the WHO, around 65% of the European Union's population lives in places where the noise levels are consistently unacceptable (Paiva, Cardoso & Zannin, 2019). In Hong Kong, about 80% of the city's residents are affected by this issue (Wong *et al.,* 2019). In India, about 60% to 85% of the population claimed that road traffic noise is a major source of this issue, which results in annoyance for some (Kumar *et al.,* 2018). Bhaven (2011) claims that about 67% of noise pollution within urban areas can be attributed to road traffic noise.

The city of Jos, which is located in central Nigeria, is known for its various industrial, commercial,

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

transportation, and political activities (Aliyu & Amadu, 2017). It has also experienced a high influx of people in recent years due to its economic growth and urbanisation. Due to the easy access granted to land-use corridors within the city of Jos, high traffic volumes can be expected. This study aims to analyse the effects of land use on traffic noise levels in the area.

LITERATURE REVIEW

Impact of Noise on Urban Land Use

Transportation is an important part of the built environment because it connects other land uses through road networks and allows for interaction between them. On a daily basis, land uses such as residential creates trips, which are then distributed to other land uses such as commercial, recreational, educational, industrial, and other places of work. The appearance of potential conflicts between amenity and traffic noise in an ideal land use plan, as well as maintaining suitable buffer lengths between major roads and residential neighbourhoods, is highly expected, according to Burgess and Macpherson (2016). In most cases, urban development begins and grows in close proximity to roadways. As the population grows, so does the traffic on these routes. As a result, construction along major roads becomes increasingly exposed to traffic noise.

Urban land uses may be significantly impacted by noise, which can have an influence on many elements of human life, the environment, and economic activity. Long-term exposure to loud noises can cause cardiovascular difficulties, sleep disorders, and health concerns associated with stress (Shin et al., (2020). In poorer areas, noise pollution is more prevalent, which contributes to environmental injustice and health inequities. Heavy traffic roads may be a significant source of noise pollution, which can have an effect on neighbouring residential and business districts. Road design and location are influenced by noise issues in urban planning and the construction of traffic infrastructure. For example, in residential land use, excessive noise in residential neighbourhoods can degrade inhabitants' quality of life (Burgess & Macpherson, 2016). It can disrupt sleep, induce stress, and have a bad influence on general health (Gilani & Mir, 2022). On the property value front, large levels of noise pollution can depress property prices in impacted regions by discouraging potential purchasers.

Noise may disrupt corporate activities in commercial locations, particularly in sectors that demand concentration and focus, such as workplaces, educational institutions, and healthcare facilities (Vibhav *et al.,* 2018). Noisy settings can distract from the consumer experience in the retail and hospitality industries, perhaps resulting in losses. Prolonged exposure to excessive noise levels in industrial zones can result in hearing loss and other health risks for employees (Obisung *et al.,* 2016). Environmental noise pollution rules may provide regulatory obstacles and limits for industries that produce a lot of noise. Public usage and enjoyment of recreational places and open spaces may decline as a result of noise. High noise levels have a detrimental effect on animals, disrupt natural ecosystems, and reduce biodiversity in urban settings.

A variety of strategies, such as noise barriers, traffic management, urban design enhancements, and the enforcement of noise pollution legislation, are needed to address the effects of noise on urban land uses. Planning cities sustainably and using noise reduction techniques can help make cities more livable and healthier. To guarantee that incompatible land uses are segregated, noise levels must be taken into account by urban planners when creating zoning restrictions. Land uses that are sensitive to noise may be situated carefully to reduce exposure to regions with excessive noise levels.

MATERIALS AND METHOD

The Study Area

This study was conducted in the Jos Metropolis, which is located in the Plateau State, Nigeria. It was composed of the Jos South and Jos North local government areas. The study area is

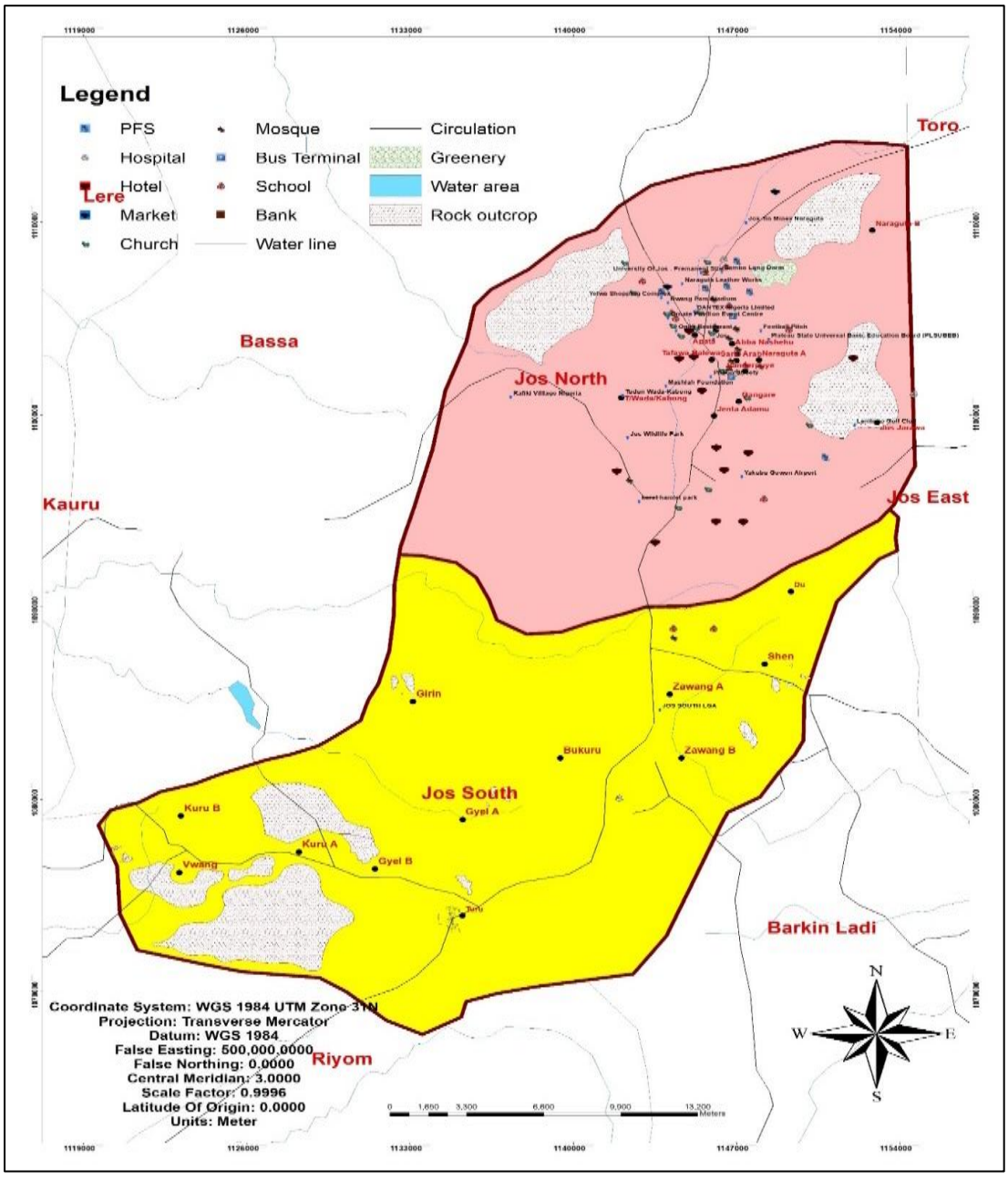
 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

regarded as the state capital and serves as a centre for various industries, political, educational, and residential activities. The study area provided a good opportunity to collect information about the volume of road traffic and the residents' opinions about the noise levels generated by road traffic.

Geographically, Jos North is located between latitude 9º 55'N and longitude 8º 54'E. It is a heterogeneous Local Government Area and has a total land mass of 291 km^2 and a population of 437,217 (NPC, 2006). Jos South is located between Latitude 9º 46'N and Longitude 8º 43'E. Its headquarters is located in Bukuru town and it has an area of 510km^2 with a population of 311,392 as of 2006. The metropolis is a hub for political, economic, industrial, educational, and administrative activities in the state. The present total estimated population of Jos Metropolis stands at 1,134,806. As the city continues to increase in size and population, traffic volume and its associated challenges, such as noise and air pollution, become a major challenge to the residents and passersbyers.

Figure 1: The Study Area in its Local Settings

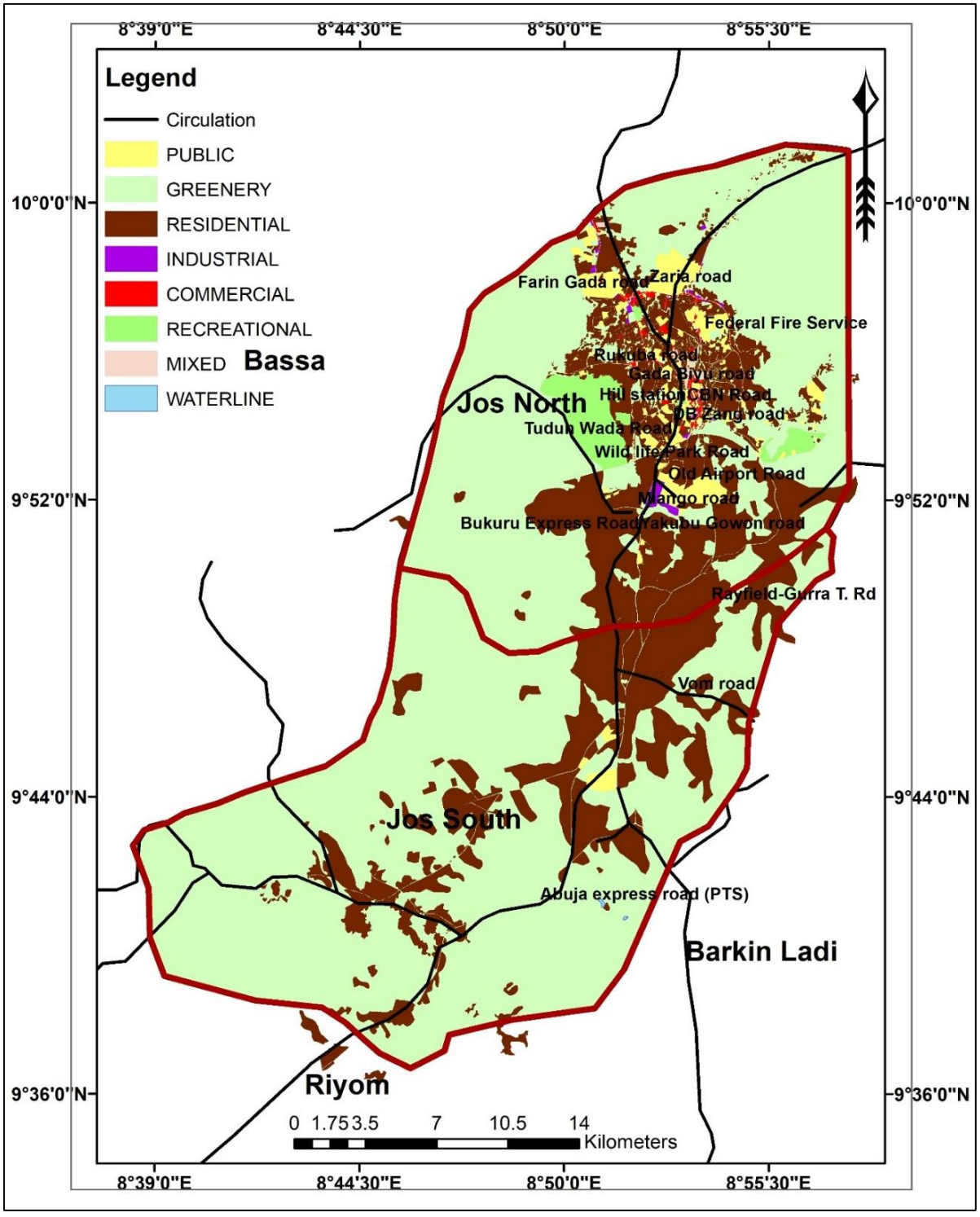


Source: Plateau State Ministry of Housing and Urban Development (2019)

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Figure 2: Land Use Map of Jos Metropolis.



Source: Plateau State Ministry of Housing and Urban Development. (2021)

Method of Data Collection

This research adopted a survey research design (Astalin, 2013). Both quantitative and qualitative approaches were employed to carry out the study. This mixed method of research is believed to be rooted in critical realism (Zachariadis, Scott, & Barrett, 2013). A total of twenty-five (25) roads and streets, corridors, five in each of the land use areas in Jos Metropolis, represented the sample frame for the study. This study employed both purposive sampling and random sampling techniques for data collection. Purposive

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

sampling was adopted to select roads/streets corridors and land uses that were perceived to have high traffic volumes. The measurement points, known as the points of interest, were randomly selected to measure the level of road traffic noise. The instruments used for the collection of primary data included; Sound Levels Meter and a Global Positioning System (GPS). These instruments were used to obtain information on traffic noise (in decibels), traffic volume (based on type/class) and coordinates of the measurement points, respectively.

The traffic noise levels data were collected at sampled locations along the selected road corridors using Graiger TL-200 Digital Sound Level Meter (SLM) at a 1.5 accuracy level and measurement range of 30-130 dB. The decibel (dB) measurements were set on an A-weighting scale as recommended for anthropogenic noise study. Several studies, such as Sulaiman *et al.* (2017), Das, Parida, and Katiyar (2015), Lin-Hua, Cai, and Li (2013), measured the road traffic noise levels at a distance of 7.5 m, 10 m, and 7.5 m respectively from the road median of the closest travel lane to the edge of the road. The limitations of these measuring methods (points) are that other forms of noise, external to traffic, may have infiltrated the noise measured due to the distance of the Sound Level Meter (SLM) from the centre of the road. Secondly, the level of traffic noise decreases with increased distance from the measurement position (Adeke *et al.,* 2018). Therefore, in an attempt to determine the measurement distance for this study, the sound level meter was positioned at a distance of 6.5 m from the centreline of the nearest travel lane of the road. A steel measuring tape was used to measure the linear distance of 6.5 m from the centreline of the nearest travel lane to where the Sound Level Meter was positioned.

The sound level meter was held at about 1.5 m high from the ground level corresponding to the ear position of an average human being, with its microphone pointing towards the road (Adeke *et al.,* 2018; Jadaan *et al.,* 2013). The SLM was calibrated prior to and after the measurement to ensure a reading error within the permissible value of ±0.5 dBA. The road traffic noise levels data were collected from twenty-five (25) locations along the selected road corridors three times a day during peak hour periods of 7:00 - 9:00 am, 12:00 noon - 2: 00 pm, and 4:00 - 6 pm from Monday to Saturday. Within each peak period, noise data were measured for 15 minutes at an interval of 6 seconds in each location for six days, making a total of 18 measurements per location (Adeke *et al.,* 2018). The locations of the measurement points were obtained using a hand-held Global Positioning System (GPS) to help compare noise location data with traffic noise level data. Sampling locations were randomly selected in such a way that none was close to airports, factories, rail lines, construction sites/factories, or any other sources of heavy noise levels other than motor vehicles. This was to avoid undue influence on road traffic noise level by other noise sources. Measurement locations were chosen to reflect roads with high and low road traffic noise.

The data sourced from the field survey were subjected to bivariate analytical techniques. Regression and correlation 'r' tests were used to measure the strength and direction of the linear relationships between variables. Analysis of variance (ANOVA) was used to determine the significant variations in the mean noise level among the different locations and times of measurement (morning, afternoon, and evening) at $p<0.05$ significant levels. Also, it was used to determine the significant variation in the noise level among the days of the week at $p<0.05$ significant level. All analyses were computed using Statistical Package for the Social Sciences (SPSS) version 23.0 and Microsoft Office Excel (2019).

RESULT AND DISCUSSION

Level of Traffic Noise in Major Land Uses of Jos

Table 1 presents the mean noise levels among different land uses along the selected road corridors in the Jos Metropolis at different times

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

of the day. The analysis indicates that the highest noise level of 88.4 dB (A) was recorded in the industrial area along Yakubu Gowon Road. This was followed by Miango Road with 86.9 dB (A) and Zaria Road with 85.0 dB (A) of recreational and industrial areas, respectively. Bauchi ring road in the residential land use was observed to have the lowest mean noise level per day at 77.4 dB (A). The high level of traffic noise recorded along Yakubu Gowon and Zaria roads was attributed to the presence of industries such as NASCO company which attracted heavy-duty vehicles. Also, Yakubu Gowon and Zaria roads are express roadways on which heavy vehicles ply on a regular basis, and this caused high levels of noise emitted into the surrounding environment. Miango Road is the major road that serves as a link to Wildlife Park, which is one of the major recreational areas of Jos.

The analysis also revealed that the lowest noise level during the study was recorded in the residential area of the metropolis along Bauchi ring road, which had 77.9 dB (A) in the morning, 76.6 dB (A) in the afternoon, 77.6 dB (A) in the evening, and average 77.4 dB (A). The low noise level recorded along this road was linked to the fact that the road is a bye-pass to decongest the traffic volume in the Central Business District of Jos. Yakubu Gowon Road had the highest noise level; it measured 87.5 decibels (A) in the morning, 88.7 decibels (A) in the afternoon, 89.1 decibels (A) in the evening, and mean 88.4 decibels (A).

Generally, all these noise levels were far above the minimum permissible noise level of 50dB and 45dB (day and night) for residential areas and 70dB and 65dB (day and night) for industrial respectively, as recommended by WHO (1995). This implies that residents and road users along these areas in Jos Metropolis were regularly exposed to noise levels that were harmful to their health and wellbeing. This finding aligns with that of Okokon (2018a) who reported that, in most cities, both developed and developing countries such as; America, India, Nigeria, and others, a larger part of the urban population is exposed to high traffic noise levels. This was further validated by several studies such as Adeke, Atoo and Zava (2018); Okeke and George (2015); Anomohanran (2013), Oyedepo and Saadu (2010) that road traffic noise levels in many Nigerian cities exceed standard limits of the safe threshold of 55dB(A) as specified by FEPA and WHO.

In terms of daily traffic noise level variation among the land uses and within the days of the week from Monday to Saturday, the noise level along the selected road traffic corridors ranges from 72.4 to 89.3 decibels. *Table 2* presents the daily land use variation of road traffic noise levels (dB) in Jos Metropolis. The overall maximum daily mean noise level was recorded on Wednesday in the industrial area along Zaria Road. While the overall minimum noise level was recorded on Monday, this could be attributed to the fact that people do rush to work on Mondays (Adeke *et al.*, 2018).

Worthy of note is the fact that all the mean noise levels recorded from Monday to Saturday along the traffic corridors of all the various land uses exceeded the maximum permissible noise levels recommended by both WHO and FEPA. The implication of this is that the noise level in Jos Metropolis was generally higher than the maximum permissible noise levels recommended by WHO and FEPA. This could have a devastating effect on the health and wellbeing of the residents (Okeke & George, 2015)

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Table 1: Mean and standard deviation of land use variation of road traffic noise levels (dB) in Jos Metropolis

Land use	Locations	Morning			Afternoon			Evening			Overall Average ± SD (dB)A
		Min	Max	Mean±SD (dB)A	Min	Max	Mean±SD (dB)A	Min	Max	Mean±SD (dB)A	
Commercial	Ahmadu Bello way	71.5	77.3	75.1±2.09	76.1	82.1	79.3±2.07	74.3	81.8	78.6±2.52	77.6±2.23
	Murtala Muh'd Way	75.6	78.7	77.5±1.23	77.7	81.8	80.1±1.49	76.9	81.9	79.2±1.97	78.9±1.56
	Tafawa Balewa road	72.9	84.9	79.6±4.56	72.1	82.2	76.3±3.74	73.5	84.5	78.4±3.75	78.1±4.02
	Beach road	81.6	87.6	85.3±2.43	72.3	85.2	78.7±4.99	82.1	90.4	86.7±3.07	83.6±3.50
	Farin Gada road	75.5	87.4	81.1±4.23	74.5	86.7	81.2±4.73	72.2	86.5	79.5±6.22	80.6±5.06
Industrial	Bukuru Express Road	77.5	88.2	82.2±3.86	74.4	85.2	78.9±4.66	76.3	82.9	79.6±3.06	80.2±3.86
	Yakubu Gowon road	86.3	89.3	87.5±1.03	88.1	89.4	88.7±0.49	88.1	90.8	89.1±1.04	88.4±0.85
	Zaria road	75.6	88.2	84.1±4.75	78.6	88.6	85.5±3.74	81.5	87.1	85.4±1.99	85.0±3.49
	Abuja express road (PTS)	71.7	87.2	82.3±5.40	75.7	84.6	79.3±3.54	75.6	85.9	80.8±5.05	80.8±4.66
	Gada Biyu road	75.9	86.5	80.5±4.08	74.7	81.6	77.7±2.28	76.8	84.3	80.8±2.65	79.7±3.00
Residential	Bauchi ring road	72.5	87.2	77.9±5.57	73.5	80.2	76.6±2.58	73.1	81.6	77.6±3.16	77.4±3.77
	Rukuba road	75.6	86.7	83.0±3.87	75.5	85.6	81.1±4.12	82.3	86.5	84.6±1.50	82.9±3.16
	Vom road	75.3	87.7	82.8±5.10	76.5	81.5	79.1±2.20	73.9	87.7	82.2±5.28	81.4±4.19
	Old Airport Road	81.8	86.2	83.7±1.61	81.1	85.1	82.8±1.37	83.6	85.6	84.5±0.67	83.7±1.22
	DB Zang road	73.3	89.6	78.2±6.35	72.7	83.1	78.8±3.69	73.3	87.9	78.7±5.47	78.6±5.17
Public/Institutional	Bauchi Road (Main campus)	76.4	81.6	78.5±1.87	73.4	86.2	82.4±4.52	78.8	84.9	82.5±2.44	81.1±2.94
	CBN Road	74.2	80.1	77.6±2.52	77.4	84.1	79.7±2.47	77.6	80.1	78.3±0.91	78.5±1.97
	British-America Road	80.7	85.4	83.2±1.74	81.3	84.8	83.4±1.52	83.3	85.6	84.2±0.99	83.6±1.42
	Dogon Karfe road	81.4	84.4	82.6±1.07	78.6	83.6	81.6±1.87	82.8	89.9	84.7±2.65	83.0±1.86
	JD Jang road	82.1	84.2	83.5±0.91	82.8	85.1	84.1±0.96	77.5	87.1	82.8±3.14	83.5±1.67
Recreational	Miango road	84.7	88.4	86.5±1.61	84.7	89.1	86.9±1.82	84.5	91.2	87.3±2.21	86.9±1.88
	Hill station	78.7	86.6	83.6±2.90	71.5	77.8	75.1±2.29	74.2	84.6	79.1±4.27	79.3±3.15
	Tudun Wada Road	71.5	89.6	82.5±4.37	74.9	88.4	79.8±3.88	74.2	88.1	81.8±4.29	81.4±4.18
	Rayfield-Gurra T. Rd	73.3	87.9	82.0±4.17	72.7	89.1	81.4±4.71	73.4	91.2	81.7±4.33	81.7±4.40
	Wildlife Park Road	74.1	89.3	81.0±5.95	76.9	84.1	79.9±2.94	72.0	81.5	76.4±4.18	79.1±4.36

Source: Field survey, 2021

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Table 2: Daily variation of road traffic noise levels (dB) among land uses in Jos Metropolis

Land Use	Location/Road	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Commercial	MM WAY	74.0	78.0	78.1	78.7	79.8	77.6
	AMB Way	78.2	79.1	78.9	78.1	79.7	79.6
	Beach Road	81.3	85.4	83.2	80.2	84.0	87.3
	Tafawa Balewa Rd	79.9	76.8	76.9	72.8	81.4	80.9
	Farin Gada Rd	79.8	81.7	79.8	82.4	80.9	83.2
Industrial	Bukuru Exp. Rd	82.5	83.6	79.4	78.1	76.2	81.6
	YGowon Rd	88.0	88.5	88.3	89.3	87.5	87.0
	Abuja exp. Rd	83.5	83.3	83.5	78.3	74.7	81.4
	Zaria Road	80.6	87.8	87.1	87.1	82.4	85.0
	Gada Biyu Rd	80.0	85.8	87.0	84.5	82.8	75.0
Residential	Bauchi Ring Rd	76.4	73.6	79.5	79.6	77.1	78.2
	Rukuba Road	81.1	84.5	83.8	84.6	79.4	83.9
	Old Airport Rd	82.4	84.8	84.6	83.5	82.5	84.1
	Vom Road	83.4	85.6	82.2	78.7	77.4	80.8
	DB Zang Road	83.2	78.4	73.1	75.7	80.9	79.8
Public/Institutional	Bauchi Rd	83.2	77.3	80.5	81.6	82.0	82.1
	CBN Road	78.8	79.4	78.6	77.4	77.8	79.4
	JD Jang way	88.0	78.5	78.3	79.3	83.5	85.0
	Dogon Karfe Road	82.3	85.4	82.8	83.4	81.6	82.3
	British America	83.5	83.1	83.7	84.6	82.6	84.2
Recreational	Miango Road	85.4	87.0	79.3	87.7	86.5	75.5
	Hill station Road	78.4	80.5	76.8	77.7	83.0	79.1
	Tudun Wada Road	72.4	74.8	76.3	80.5	80.9	86.4
	Rayfield-Gurra T. Rd	83.4	85.3	75.5	78.7	76.4	82.5
	Wildlife Park Road	83.2	78.4	73.1	75.7	80.9	79.8

Source: Field survey, 2021.

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Analysis of the Variation of Road Traffic Noise Levels (Db) Within the Peak Hours of the Day

The mean and standard deviation were computed to determine the significant variations in mean road traffic noise level between the peak hours of the day (morning, afternoon, and evening). *Table 3* presents the mean and standard deviation of road traffic noise levels measured during peak hours of the day. The results of the analysis indicated that the mean road traffic noise level was generally high as against the maximum permissible noise levels recommended by both WHO and FEPA. The analysis indicated that, overall, the highest noise level was recorded in the evening at Yakubu Gowon Road in the industrial area, which had a mean noise level of 89.1 dB (A). This was followed by Miango Road 87.3 dB (A) in the recreational area. The least mean noise level was recorded at Ahmadu Bello Way at 75.1 dB (A) and Hill Station at 75.1 dB (A) in the morning and afternoon in the commercial and recreational areas, respectively. This could be attributed to the fact that during the survey, there was a civil disturbance in Jos Metropolis as such commercial and other daily activities were usually started late hours in the day.

The analysis further revealed that, in the morning, the highest noise level was recorded on YGowon Road at 87.5 dB (A), while Ahmadu Bello Way had the lowest noise level at 75.1 dB (A). In the afternoon, YGowon Road had the highest noise level of 88.7 dB (A), with Hill station road (recreational area) having the least noise level of 75.1 dB (A) and, in the evening, YGowon Road had the highest noise level of 89.1 dB (A), whereas Bauchi ring road recorded the lowest noise level of 77.6 dB (A) as at the time of the measurements. This cannot be unconnected to the fact that Bauchi ring road is often regarded as one of the hot spots anytime there is a civil disturbance in Jos Metropolis; this normally forces commuters to avoid plying the road during the evening hours. Overall, this implies that more noise was generated in the evening (4-6 pm) than in the morning (7-9 pm) and afternoon (12-2 pm). Other factors that could be responsible for the high noise levels recorded may be due to calibration error, environmental and slight measurement distance variation from the centerline of the closest travel lane to the SLM. Also, in Jos, 4-6 pm is often a period that most of the schools, civil servants, traders and other workers close their activities for the day. This contributed to the high traffic volume and noise recorded in the evening around the residential areas. Evening hours are resting periods when people retire to their homes for sleep.

Significant Difference among the Mean Road Traffic Noise (RTN) Level in Land Uses of Jos

A one-way analysis of variance between subjects was conducted to explore the difference between the mean RTN level of the various land uses in Jos Metropolis. *Table 4* presents the results of the One-Way Analysis Of Variance, which was used in testing the hypothesis, which states that there is no significant difference among the mean RTN level of the various land uses in Jos. The $F(4, 145) = 3.996$, p-value $= 0.004 < 0.05$ indicates that there is a significant mean difference in RTN levels of the various land uses in Jos. Hence, the null hypothesis was rejected. The post hoc result is presented in *Table 4*.

A post-result comparison using the Duncan multiple range comparison test was carried out to compare the mean scores of the RTN level of the various land uses. *Table 5* indicates that the RTN level in Industrial land use was higher as compared to other land uses. Statistically, there was no significant mean difference in the RTN level in commercial and Residential land uses. Similarly, the RTN levels in Recreational and Public/Institutional land uses were statistically the same. This finding is a validation of the fact that both traffic volume and noise levels were generally high along the selected roads in the industrial area.

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Table 3: Analysis of the variation of road traffic noise levels (dB) within the peak hours of the day

Land use	Locations/Roads	Morning	Afternoon	Evening
Commercial	MM WAY	77.5	80.1	79.2
	AMB Way	75.1	79.3	78.6
	Beach road	85.3	78.7	86.7
	Tafawa Balewa Rd	79.6	76.3	78.4
	Farin Gada Rd	84.6	88.2	80.4
Industrial	Bukuru Exp. Rd	82.2	78.9	79.6
	YGowon Rd	87.5	88.7	89.1
	Abuja exp. Rd	82.3	79.3	80.8
	Zaria road	84.1	85.5	85.4
	Gada Biyu Rd	81.3	74.4	82.4
Residential	Bauchi Ring Rd	77.9	76.6	77.6
	Rukuba road	83.1	81.1	84.6
	Old Airport Rd	83.7	82.8	84.5
	Vom road	82.8	79.1	82.2
	DB Zang road	78.2	78.8	78.7
Public/Institutional	Bauchi Rd	78.5	82.4	82.5
	CBN Road	77.6	79.7	78.3
	JD Jang way	83.5	84.1	82.8
	Dogon Karfe road	82.6	81.6	84.7
	British America	83.2	83.4	84.2
Recreational	Miango Road	86.5	86.9	87.3
	Hill station road	83.6	75.1	79.1
	Tudun Wada road	73.4	73.3	78.1
	Rayfield-Gurra T. Rd	77.2	75.5	84.6
	Wildlife park Road	82.1	76.6	79.9

Source: Field survey, 2021

Table 4: One-way analysis of variance Results for RTN among land uses

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	235.650	4	58.913	3.996	.004
Within Groups	2137.839	145	14.744		
Total	2373.490	149			

Source: Computed using SPSS, 2021.

Table 5: Post Results using Duncan Multiple Range Test for RTN among land uses

	Land Use	N	Subset for alpha = 0.05		
			1	2	3
Duncan	Commercial	30	79.9233		
	Residential	30	80.7600		
	Recreational	30		81.0100	
	Public/Institutional	30		82.9400	82.9400
	Industrial	30			83.0867
	Sig.		.306	.054	.883

Source: Computed using SPSS, 2021.

CONCLUSION AND RECOMMENDATION

The findings of this study revealed that the traffic noise levels recorded in Jos Metropolis from Monday to Saturday along the traffic corridors in all the various land uses exceeded the maximum permissible noise levels of 55 Bb recommended by both WHO and FEPA. To reduce the traffic noise levels and its associated challenges, there is a need for the Plateau State Government through the Ministry of Lands, Survey and Town Planning and Ministry of Physical Planning and Urban

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Development to coordinate the dispersal of land uses through land use allocation. This should be done in line with their traffic generation activities and noise sensitivities. For instance, industrial land use areas should be zoned at the satellite settlement with buffers to emasculate noise levels in the metropolis.

Some traffic calming measures such as speed limits and speed bumps should be introduced to reduce speed and lessen corresponding noise in the metropolis. Similarly, new developers seeking approval, particularly in the high traffic attracting and noise-generating land uses can be made to provide Noise Impact Assessment (NIA) before their properties should be granted approval. In addition, decision-based traffic generation, such as the blaring of horns in commercial and residential areas, should be controlled through regulating codes and penalties.

REFERENCES

Adeke, P. T., Atoo, A. A., & Zava, E. A. (2018). Modelling traffic noise level on roadside traders at Wurukum market area in Makurdi town, Benue state–Nigeria. *Nigerian Journal of Technology*, *37*(1), 28-34.

Aliyu, A. A., & Amadu, L. (2017). Urbanisation, cities, and health: the challenges to Nigeria–a review. Annals of African medicine, 16(4), 149.

Anomolaran, O. (2013). Evaluation of environmental noise pollution in Abuja, the capital city of Nigeria. International Journal of Research and Reviews in Applied Sciences, 14(2), 470-476.

Astalin, P. K. (2013). Qualitative research designs: A conceptual framework. *International* Journal of Social Science and Interdisciplinary Research, 2(1), 118-124.

Ayo-Odifiri, O. S., Fasakin, J. O., & Okoko, E. E. (2018). Poverty implication of market patronage on traffic congestion in Benin City, Nigeria. The just city: poverty, deprivation and alleviation strategies. 46-54.

Basner, M. (2019). Noise: What is to be done? *Deutsches Ärzteblatt International*, *116*(14), 235.

Bhaven N. T. (2011). Importance of urban traffic noise pollution in sustainable transportation planning: *A Review*

Burgess, E.W. (1925). The growth of the city: An Introduction to a Research Project' *Publication* of the American Sociological Society, (18), 85-97.

Chaichan, M. T., Kazem, H. A., & Abed, T. A. (2018). Traffic and outdoor air pollution levels near highways in Baghdad, Iraq. *Environment, development and sustainability*, *20*(2), 589-603.

Das, P., Parida, M., & Katiyar, V. K. (2015). Pedestrian response to road traffic noise for medium size city in India. Int. J. Traffic Transport. Eng, 5.

Drudge, C., Johnson, J., MacIntyre, E., Li, Y., Copes, R., Ing, S., ... & Chen, H. (2018). Exploring nighttime road traffic noise: A comprehensive predictive surface for Toronto, Canada. *Journal of occupational and environmental hygiene*, *15*(5), 389-398.

Gilani, T. A., & Mir, M. S. (2022). A study on road traffic noise exposure and prevalence of insomnia. Environmental Science and Pollution Research, 29(27), 41065-41080.

Halim, H., Abdullah, R., Nor, M. M., Aziz, H. A., & Rahman, N. A. (2017). Comparison between measured traffic noise in Klang Valley, Malaysia and existing prediction models. *Engineering Heritage Journal*, *1*(2), 10-14.

Hawkins, J., & Nurul Habib, K. (2019). Integrated models of land use and transportation for the autonomous vehicle revolution. Transport reviews, 39(1), 66-83.

Ho, C. Y., & Tang, S. K. (2017, December). Noise Reduction Performance of Balconies on a

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

building façade. In inter-noise and noise-con Congress and Conference Proceedings, 255(2), 5661-5666.

Jadaan, K., Al-Dakhlallah, A., Goussous, J., & Gammoh, H. (2013). Evaluation and mitigation of road traffic noise in Amman, Jordan. *Journal of traffic and logistics engineering*, 1(1), 51-3.

Kumar, A., Kumar, P., Mishra, R. K., & Shukla, A. (2018). Study of air and noise pollution in mega cities of India. In *Environmental Pollution*, 77-84.

Lin, J., Wang, H., Yan, F., Tang, K., Zhu, H., Weng, Z., & Wang, K. (2018). Effects of occupational exposure to noise and dust on blood pressure in Chinese industrial workers. Clinical and Experimental Hypertension, 40(3), 257-261.

Lin-hua, X., Ming, C., & Er-da, L. (2013). Comprehensive evaluation of traffic noise pollution based on population exposure. *Procedia-Social and Behavioral Sciences*, *96*, 2179-2186.

National Population Commission. (2006). Nigeria national census: population distribution by sex, state, LGAs and Senatorial district: 2006 census priority tables (Vol. 3).

Oduwaye, L., Alade, W., & Adekunle, S. (2011). *Land use and traffic pattern along Lagos.* Badagry corridor, Lagos, Nigeria.

Okeke, P. N., & George, D. M. C. (2015). Evaluation of ambient noise levels in Port Harcourt metropolis, south-south, Nigeria. IOSR Journal of Environmental Science, Toxicology and Food Technology (IOSR-JESTFT) e-ISSN, 2319-2402.

Okokon, E. O. (2018a). Road traffic-related noise and air pollution: perceived and measured exposures, and health risks.

Obisung, E. O., Onuu, M. U., Menkiti, A. I., & Akpan, A. O. (2016). Road traffic noise-induced sleep disturbances in some cities in eastern Nigeria. *British Journal of Applied Science & Technology*, *12*(4), 1-15.

Oyedepo, O. S., & Saadu, A. A. (2010). Evaluation and analysis of noise levels in Ilorin metropolis, Nigeria. Environmental monitoring and assessment, 160(1-4), 563.

Paiva, K. M., Cardoso, M. R. A., & Zannin, P. H. T. (2019). Exposure to road traffic noise: Annoyance, perception and associated factors among Brazil's adult population. *Science of the Total Environment*, *650*, 978-986.

Pallavi C., & Sohit S. (2019). Assessment of noise pollution level in different sites of Dehradun City, Uttarakhand.

Pathak, S. S., Lokhande, S. K., Kokate, P. A., & Bodhe, G. L. (2018). Assessment and prediction of environmental noise generated by road traffic in Nagpur city, India. In *Environmental Pollution*, 167-180.

Plateau State Ministry of Housing and Urban Development. (2019). *Administrative map of Plateau* State.

Qi H, Wang W, Lu J. (2011). Study on the relationship between urban land-use and traffic generation with remote sensing and PLSR. 302–14.

Shin, S., Bai, L., Oiamo, T. H., Burnett, R. T., Weichenthal, S., Jerrett, M., ... & Chen, H. (2020). Association between road traffic noise and incidence of diabetes mellitus and hypertension in Toronto, Canada: a population-based cohort study. *Journal of the American heart association*, *9*(6), e013021.

Sulaiman, F. S., Darus, N., Mashros, N., Haron, Z., & Yahya, K. (2018). Traffic noise assessment at residential areas in Skudai, Johor. In *E3S Web of Conferences*, 34, 02024.

Uzondu, C., Jamson, S., & Lai, F. (2019). Investigating unsafe behaviors in traffic conflict situations: An observational study in

 This work is licensed under a Creative Commons Attribution 4.0 International License

Article DOI: https://doi.org/10.37284/ijar.6.1.1337

Nigeria. Journal of Traffic and Transportation Engineering (English Edition).

Vibhav S., Abhishek P., Atul & Asad I. (2018). Study of Effect of Traffic Noise on the Residentials of the Allahabad City. Journal of Engineering, 8(9), 68-75.

Wang, H., Chen, H., & Cai, M. (2018). Evaluation of an urban traffic noise–exposed population based on points of interest and noise maps: The case of Guangzhou. *Environmental pollution*, *239*, 741-750.

World Health Organization. (1995). Physical status: The use of and interpretation of anthropometry, Report of a WHO Expert Committee. World Health Organization.

Wong, P. P., Lai, P. C., Allen, R., Cheng, W., Lee, M., Tsui, A., ... & Barratt, B. (2019). Vertical monitoring of traffic-related air pollution (TRAP) in urban street canyons of Hong Kong. Science of the Total Environment, 670, 696-703.

Zachariadis, M., Scott, S., & Barrett, M. (2013). Methodological implications of critical realism for mixed-methods research. *MIS quarterly*, 855-879.

Zerihun, S., Mamo, H., Sitotaw, B., & Mengistu, E. (2017). Evaluation of the people perception on major noise source and its impact on health at dire Dawa city, Ethiopia. *Romanian J. Biophys*, *27*(2), 69-78.

Zubala, T., & Sadurska, U. (2016). The Use of Noise Maps and Planning Tools in the Management of an Acoustic Climate in an Urban Area. *Journal of Ecological Engineering*, *17*(4), 209-217.

 This work is licensed under a Creative Commons Attribution 4.0 International License