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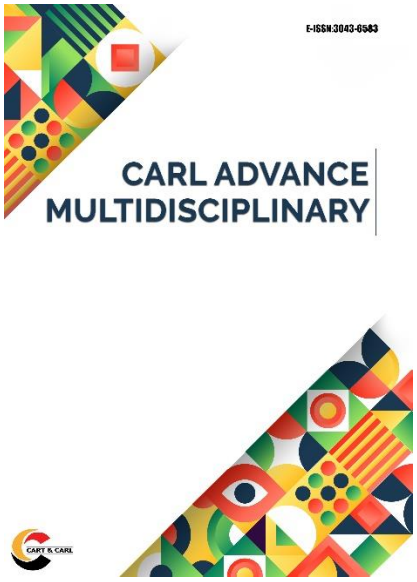

Evaluation of Noise Pollution Level around the Vicinity of Selected Airports in Southern Nigeria

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Abstract

Aircraft noise has been a significant source of environmental noise affecting communities near the airport site, which perform activities that are unrelated to airport activities. The study evaluates the noise pollution level around the vicinity of selected airports in South-South, Nigeria. The Port Harcourt International Airport, Margaret Ekpo International Airport and Benin Airport were selected for the study. Using a sound level meter, the noise level (NL) of the airport environment, such as tower area, arrival zone, departure area and runway, was measured at Natural Noise Level (NNL), Aircraft Landing (L_D) and Taking Off (T_O). Across the tower area of the various airports' environments, the NL ranged from 40.7 dB(A) to 70.1 dB(A) at Benin Airport, indicating "no risk" at NNL and "dangerous" noise quality status during L_D. At the departure area, the NL ranged from 42.5 dB(A) to 71.6 dB(A) at Benin Airport, indicating "no risk" at NNL and "dangerous" noise quality status during L_D. At other airports, the noise quality status ranged from "no risk" to "moderate risk" during L_D. At the runway area of the airports, the NL ranged from 60.1 dB(A) to 83.7 dB(A) at Benin Airport, indicating "moderate risk" to "extreme dangerous" during take-off (T_O). Overall, there was an indication that most NL was generated at the runway area while the least NL was around the tower area. Benin Airport had the highest generated NL, while Port Harcourt Airport had the lowest NL generation. Noise transmission reduction or prevention strategies should be encouraged.

Keywords : Noise Pollution, Airport, Noise Level, Environmental Noise, South-South

Introduction

Airports play an important role in shaping the economic activities of the communities they serve because they are among the most extensive public facilities in the world. It is well understood that a viable and efficient transportation system is a fundamental and necessary component of the economy of any region (Adamu & Ezra, 2020). The availability of air transportation and its associated airport infrastructure constitute a significant stimulus to economic and social development, not only for the community located in neighbouring areas of the airports but also for the region, state and the country as a whole (Stilwell & John., 2013; Adamu and Ezra, 2020). Noise from factories, highways and aircraft can be a source of displeasure for individuals, leading to stress, sleeplessness, irritation, etc. However, aircraft noise research has indicated that most of the population living around major airports is linked to annoyance and sleep disturbance due to the noise of night-operating aircraft (Momo et al., 2010).

Noise pollution has increased in this 21st century and has become an issue of serious global concern. It is a social problem with a public health impact that has become a part of urban culture (Olalekan and Adindu, 2019). Despite this apparent positive impact of air transport, there are

still negative impact associated with air transport, One of such impact is Aircraft noise. Aircraft noise has been a significant source of community noise. Of concern are impacts on people and communities near the airport site performing activities unrelated to airport activities (e.g., area residents, office workers, school children and hospital residents and staff). Over time, increased use of air transportation has resulted in a corresponding increase in aircraft noise, which has placed the health of residents of the airport vicinity at significant risk (Olalekan and Adindu, 2019). Several researchers have also exposed the health challenges resulting from airport noise exposure suffered by residents of the airport vicinity and have summarized the typical impacts of airports to include employment generation, wealth creation, world trade contribution, and tourism stimulation (Sondakh et al., 2014; Olalekan and Adindu, 2019).

Aircraft noise has been shown to affect the performance of children in schools (Momo et al., 2010). Stress has also been linked to noise from aircraft, and stress may be defined as a mechanism through which an individual's mental and physical health is affected (Momo et al., 2010). In general, noise from aircraft can constitute a significant source of annoyance, distraction, stress, and an aggressive tendency among the population (Momo et al., 2010). Half of the world's population currently lives in urban centres. These cities are collectively responsible for three-fourths of global economic output. As urbanization intensifies, communities are impacted by the global challenges and opportunities for sustainable development (Adindu et al., 2018). Several studies have been conducted on noise pollution generated by aircraft activities (Momo et al., 2010; Ogobiri et al., 2013; Urassa et al., 2014; Ibhadode et al., 2018; Ugbebor et al., 2018; Ogbonna et al., 2021; Ishaku and Avwiri, 2024) and their outcome suggested high risk to the environment and people within the proximity of the airport leading to headaches, sleep disturbance, noise annoyance, and speech intelligibility in the long term (Momo et al., 2010; Carugno et al., 2019; Orikpete et al., 2021; Athiah & Nurul Shahida, 2021). In line with previous studies, the present study evaluates the noise pollution level around the vicinity of selected airports in Southern Nigeria.

Materials and Methods

Study Area

The study area covers the entire South-South Region of Nigeria and the selected Airport of interest (Figure 1). The South-South region is located on 4021′ 43.2′′N, 70 40′ 52.8′′ N and longitude 50 8′ 42′′E, 90 30′7.2′′ E protruding towards the Gulf of Guinea on the Atlantic coast of West Africa (Shittu, 2014). Port Harcourt International Airport is an international airport located in Omagwa, a suburb of Port Harcourt, the capital city of the Rivers State in Nigeria. The airport has two terminals for both international and domestic flights. Calabar Airport, also known as Margaret Ekpo International Airport, serves Calabar, the capital of the Cross River State in Nigeria. The airport is named after Margaret Ekpo, one of Nigeria's pioneering feminist and anticolonial activists. Benin Airport serves Benin City, the capital of Edo State in Nigeria. The runway is in the middle of the city. The airport is located in the heart of Benin City, approximately 7 kilometres northeast of the city centre. It is easily accessible by taxi or car, with parking facilities for passengers and visitors.

Data Collection and Analysis

The noise pollution levels in the vicinities of the selected airports were measured using the sound level meter. This study's proposed sound level meter is a digital type with an auto range LCD 3½", a bar graph display of 50 dB and a resolution of 1 dB. It is of the A and C frequency weighting type and has a measurement range of 30 – 130 dB. The microphone is a 0.24-type Electric condenser. The sound meter was 256 x 80 x 38 mm and weighed about 240g. The noise level data were analyzed and presented in descriptive statistics, such as tables and charts, for easy observation and interpretation. The generated data was further classified based on the United States Environmental Protection Agency (USEPA), as presented in Table 1.

Result and Discussion

The noise level distribution around the airport's environment was analyzed and presented in Table 2 and Figures 2 to 4.

Port Harcourt International Airport: At the tower area, the NNL recorded was 41.7 dB(A), with the L_D and T_O were 57.1 dB(A) and 49.6 dB(A) representatively. At the arrival zone, the NNL recorded was 42.5 dB(A), with the L_D and T_O were 60.7 dB(A) and 56.6 dB(A) representatively, while at the departure point, the NNL recorded was 52.2 dB(A) while the L_D and T_O were 62.4 dB(A) and 60.4 dB(A) respectively. At the runway point, the NNL recorded was 68.2 dB(A), while the LD and TO were 79.2 dB(A) and 71.9 dB(A), respectively.

Calabar Airport: At the tower area, the NNL recorded was 48.3 dB(A), with the LD and TO being 61.9 dB(A) and 57.8 dB(A), respectively. At the arrival zone, the NNL recorded was 54.7 dB(A), with the L_D and T_O were 69.5 dB(A) and 52.3 dB(A) respectively, while at the departure point, the NNL recorded was 51.2 dB(A) while the L_D and T_O were 69.5 dB(A) and 66.4 dB(A) representatively. At the runway point, the NNL recorded was 73.6 dB(A), while the L_D and T_O were 60.6 dB(A) and 83.7 dB(A), respectively.

Benin Airport: At the tower area, the NNL recorded was 40.7 dB(A), with the L_D and T_O were 67.1 dB(A) and 70.1 dB(A), respectively. At the arrival zone, the NNL recorded was 64.6 dB(A), with the L_D and T_O being

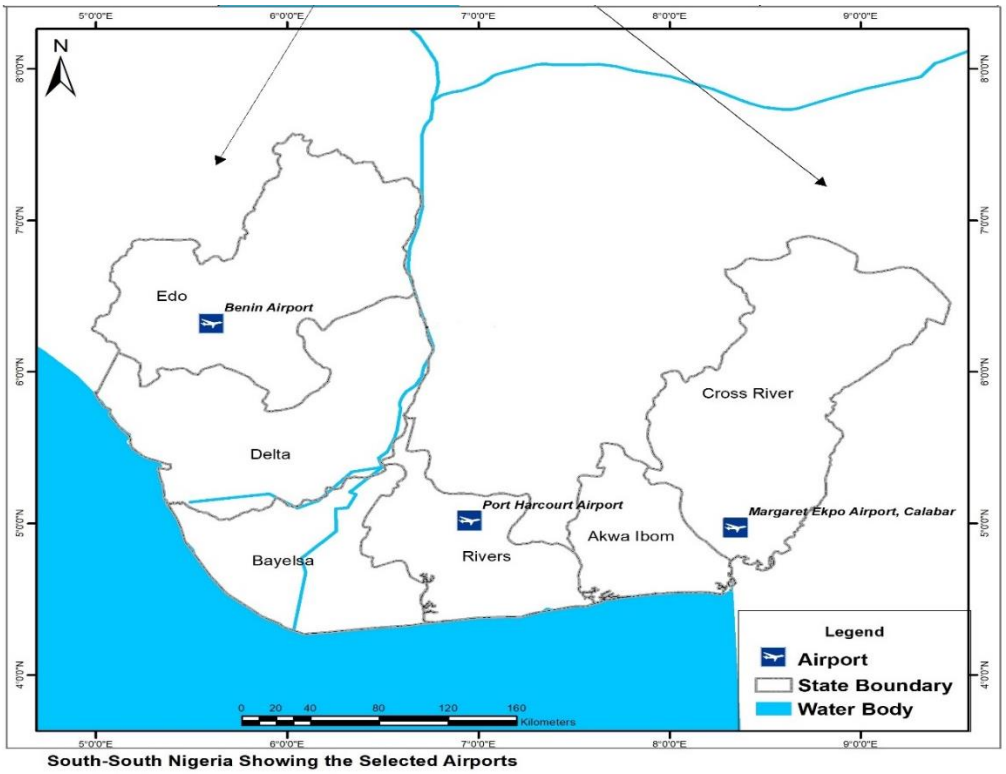

Figure 1: Overview of South-South Region and Selected Airports

Table 1: Noise Level Classification

Noise Level (dB (A)	Quality
55<60	Risky
60<65	Moderately Risky
65<70	Highly Risky
70<75	Dangerous
75<80	Highly Dangerous
>80	Extremely Dangerous

Source: USEPA, 2004; Olalekan and Adindu, 2019

60.1 dB(A) and 51.7 dB(A) respectively, while at the departure point, the NNL recorded was 42.5 dB(A) while the L_D and T_0 were 62.1 dB(A) and 71.6 dB(A) representatively. At the runway point, the NNL recorded was 60.1 dB(A), while the L_D and T_0 were 74.3 dB(A) and 79.5 dB(A), respectively.

Across the tower area of the various airports' environments, the NL ranged from 40.7 dB(A) to 70.1 dB(A) at Benin Airport, indicating "no risk" at NNL and "dangerous" noise quality status during aeroplane landing (L_D). However, the Port Harcourt and Calabar Airport had noise quality status of "no risk" to "moderate risk" during aeroplane landing (L_D). The outcome is similar to the NL reported by the study conducted by Ishaku and Avwiri (2024), which indicated "no risk to dangerous" status around the ticket/checking hall of the studied airport. At the arrival zone, the NL ranged from 42.5 dB(A) at Port Harcourt Airport to 69.5 dB(A) at Calabar Airport, indicating "no risk" at NNL and "highly risky" during L_D.

The NL quality recorded for the present study was similar to those reported by Urassa *et al*. (2014) for aircraft during the landing and suggested that the NL exceeded the allowable limit for commercial area. A similar outcome was reported in the study conducted by Okonofua et al. (2016), with NL exceeding the permissible limit for commercial areas. At the departure area, the NL ranged from 42.5 dB(A) to 71.6 dB(A) at Benin Airport, indicating "no risk" at NNL and "dangerous" noise quality status during L_D. At other airports, the noise quality status ranged from "no risk" to "moderate risk" during L_D. At the runway area of the airports, the NL ranged from 60.1 dB(A) to 83.7 dB(A) at Benin Airport, indicating "moderate risk" to "extreme dangerous" during take-off (T_0).

The outcome shares similarity with the study conducted by Ishaku and Avwiri (2024), which suggested that most NL at airports are recorded during the landing and taking-off activities of aircraft. The finding shares similarity with the study conducted by Moroe and Mobaso (2022), which suggested that NL during the landing and taking-off activities of aircraft exceeded the recommended limit for commercial activities.

Table 2: Noise Level Distribution around the Airports Environment

Location	Description	NL [dB (A)]	Min. NL [dB (A)]	Max. NL [dB (A)]
Port Harcourt Airport (Rivers State)				
Tower Area	NNL	41.7	44.9	69.8
	L_D	57.1	41.1	68.3
	T_O	49.6	49.2	68.1
Arrival Zone	NNL	42.5	41.0	71.6
	L_D	60.7	51.5	69.6
	T_O	56.6	39.9	68.5
Departure Area	NNL	52.2	51.7	70.1
	L_D	62.4	62.8	72.5
	T_O	60.4	57.6	79.5
Runway	NNL	68.2	49.5	71.3
	L_D	79.2	61.3	88.9
	T_O	71.9	54.1	69.3
Calabar Airport (Cross River State)				
Tower Area	NNL	48.3	39.5	61.2
	L_D	61.9	57.6	68.8
	T_O	57.8	52.8	69.9
Arrival Zone	NNL	54.7	48.1	65.2
	L_D	69.5	61.6	78.3
	T_O	52.3	42.5	77.4
Departure Area	NNL	51.2	51.7	69.6
	L_D	69.5	51.5	82.1
	T_O	66.4	59.7	82.8
Runway	NNL	73.6	72.4	76.0
	L_D	60.6	72.9	75.5
	T_O	83.7	86.7	89.1
Benin Airport (Edo State)				
Tower Area	NNL	40.7	51.1	77.3
	L_D	67.1	68.4	81.9
	T_O	70.1	84.7	72.6
Arrival Zone	NNL	64.6	54.8	71.8
	L_D	60.1	59.1	80.1
	T_O	51.7	45.2	75.6
Departure Area	NNL	42.5	34.9	72.3
	L_D	62.1	47.7	81.5
	T_O	71.6	57.8	79.4
Runway	NNL	60.1	57.8	81.3
	L_D	74.3	68.6	79.8
	T_O	79.5	70.6	76.2

NNL=Natural Noise Level, **NL**=Noise Level, **L_D**=Landing, **T_O=** Taking off

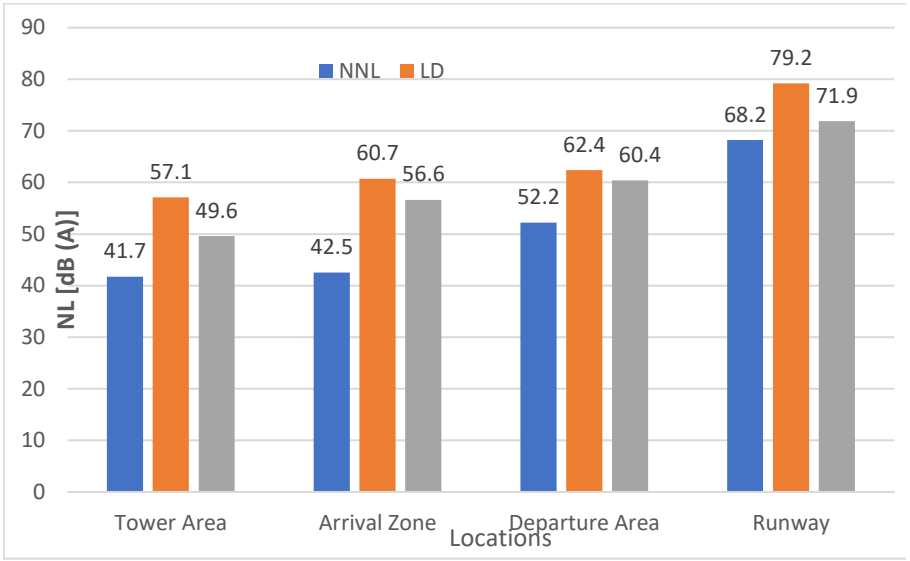

Figure 1: Noise Level Distribution around the Port Harcourt Airport Vicinity

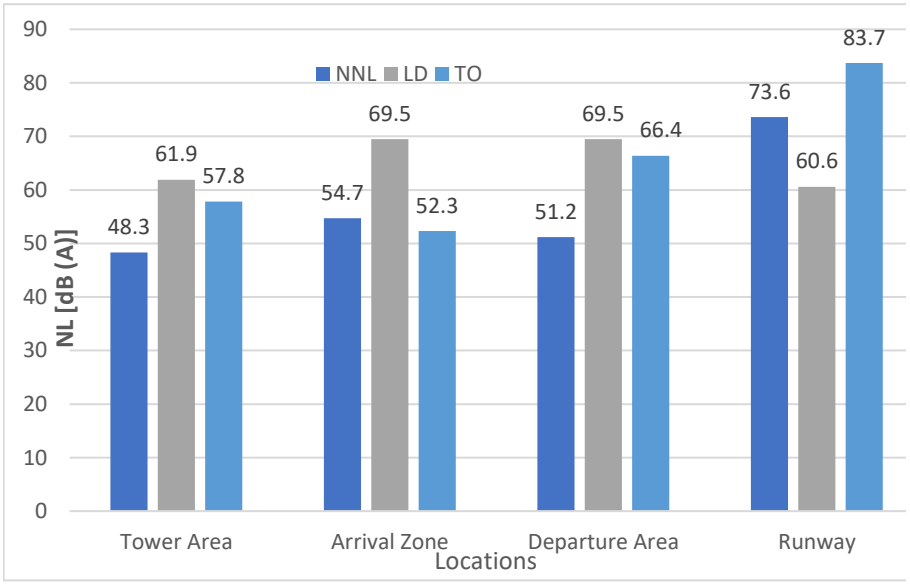

Figure 2: Noise Level Distribution around the Calabar Airport Vicinity

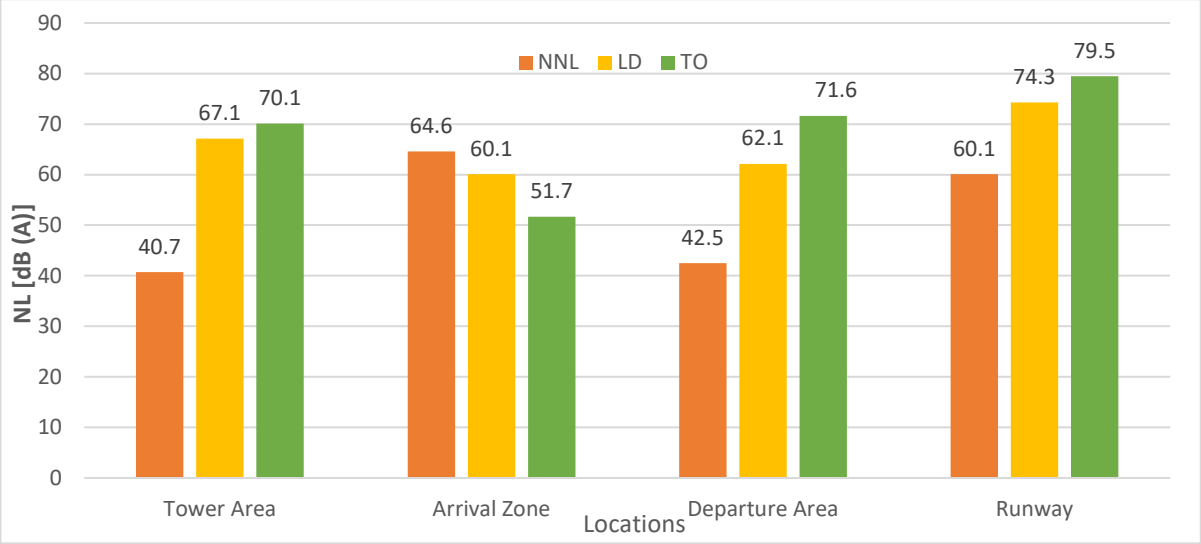

Figure 3: Noise Level Distribution around the Benin Airport Vicinity

Overall, there was an indication that most NL was generated at the runway area while the least NL was around the tower area. Benin Airport had the highest generated NL, while Port Harcourt Airport had the lowest NL generation. Based on this submission, the present study corroborates with the notion of Moroe and Mobaso (2022), which asserted that the most significant concern associated with long-term exposure to environmental noise pollution is the resultant noise-induced hearing loss, which has implications for the well-being of the individuals exposed to excessive noise, their families and the country at large.

Conclusion

The noise level of aircraft activities around the airport vicinities was measured using the sound level meter. The generated data were classified based on the United States Environmental Protection Agency (USEPA) noise quality status. Based on the outcome, it was concluded that noise pollution around the airport vicinity ranged from no risk to dangerous but extremely dangerous at the runway. Also, the generated noise pollution from aircraft activities such as landing and taking-off exposes communities to extremely dangerous noise level status and significantly impacts the environment, socio-economic and wellbeing of the people living near the selected airports. Noise transmission reduction or prevention strategies such as planting trees and double layering of window glass should be encouraged. Airport operators and aircraft owners should be encouraged to source the latest technology in their procurement activities with aircraft that produce less noise and support environmental sustainability.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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