Assessment of Noise Exposure Indices at Kanchijhuli and Townhall Moor in Mymensingh City

S. Afrin[1], M. A. Farukh[1*], M. N. Uddin[1] and M. Rahman[2]

[1]Department of Environmental Science, Bangladesh Agricultural University
[2]Department of Geology, University of Dhaka
[*]Corresponding email: farukh_envsc@bau.edu.bd

Abstract

Mymensingh, one of Bangladesh's most densely populated and urbanized cities, could not avoid a noise-related problem that has now turned out into a severe environmental issue. It is indispensable to assess the current noise propagation scenario and its repercussions for urban planners to manage the noise problem. This research endeavours to construct noise pollution indices viz. noise levels (L_{10}, L_{50}, L_{90}), noise climate (NC), equivalent continuous noise level (L_{eq}), noise pollution level (L_{np}), and noise exposure index (NEI) were computed for two important particular locations, namely Kanchijhuli and Townhall moor. It was also observed that most of the time, the noise level exceeded 80 dB, which is beyond the recommended level of silent zone, commercial zone and traffic zone according to the DoE (1997). The indices indicated that the noise level of the study area surpassed the normal noise level in all indices. NC, L_{eq} and L_{np} were estimated to have a maximum value of 17.32 dB, 94.29 dB and 110.30 dB, respectively, while the minimum value of the study area were 10.71 dB, 82.07 dB and 95.5 dB, respectively. Therefore, it can be stated from the assessment that both Kanchijhuli and Townhall moor are under alarming noise pollution conditions. This research may aid in taking necessary measures to cut off the noise propagation and subsequent noise pollution control for the urban planners and related authorities.

Key words: Equivalent continuous noise level, Noise pollution, Noise exposure index, Noise pollution level, Noise climate

Introduction

Human civilization and sound are juxtaposed from the archaic age as human connection is primly dependent on this as a form of conversation. In a simple perspective, noise is defined as a sound that adversely affects human health and the environment due to an excessive sound level (Nunez *et al.,* 1998). In a broader point of view, 'Noise pollution' refers to the elevation of natural ambient noise levels due to sound-generating human activities, which may have detrimental consequences for humans and animals (Kato *et al.,* 2015). The concept of noise pollution is newer as the detrimental level of sound propagates from mainly anthropogenic activities. Thus, the concern over noise pollution has exponentially risen in most metropolitan areas across the globe.

Rapid population growth, fast expanding urban civilization, and accelerating transportation are the prime source of noise outside the home. Domestic sound sources like playing music, the television, human conversation, and electronic appliances also induce noise inside the home. Considering the source and propagation of noise, traffic and transportation are by far the most active reasons for sound pollution worldwide. The root cause of this nose pollution in mega city as well as Dhaka city is its traffic congestion (Gershone *et al.,* 2006). Accordingly, traffic congestion results in higher human gathering that augments the noise level. The increase in magnitude and severity of traffic noise depends on population growth and urbanization (Bjork *et al.,* 2006).

Like the numerous sources of noise pollution, it has a wide range and long-term consequences on human and adjacent environmental components. According to the World Health Organization (WHO, 1995), about 5% of the world's population is subjected to various types of health risks due to noise pollution. Bangladesh is also undeniably suffering from noise. The Department of Environment (DoE) statistics conducted in 2017 stated that approximately 11% of the total population are affected as a result of noise pollution. Aside from human health, urban environment like birds and other animals dwells around the source of noise are also hampered. The influx of migrant birds has fallen significantly for the last decades as a token of noise pollution. Higher noise level disturbs nesting and regular movement of those birds (Clinton *et al.*, 2009). Moreover, marine life is also losing balance due to higher frequency levels of sound besides the high traffic cities (Simmonds *et al.,* 2014). The study over botany indicates that higher noise disrupts the growth of plants and intakes of nutrition. Sound waves can change the cell cycle (Wang *et al.*, 1998). Sound waves vibrate the plant leaves and speed up the protoplasmic movement in the cells (Godbole, 2013).

Through the Bangladesh Sound Pollution (Control) Rules (2006), the government is taking steps to curb noise pollution. The guidelines state that exceeding the maximum noise level in a specific area is punishable. Furthermore, stonebreaker machines are prohibited in residential areas. An event that may generate loud noise in residential areas requires a permit from the DoE. However, there is a need to properly implement the rules since several studies have shown that the primary cause

of urban noise pollution is traffic and loud horns (Nadir *et al.,* 2018).

In those circumstances, this is obvious to find a sustainable and feasible solution to cut off noise pollution to a promising extent. Thus, spatial and temporal assessment is required to understand the trend of noise fluctuation in noisy areas. In that case, complete and detailed noise exposure research work is undoubtedly indispensable.

In that regard, the noise exposure index could be a threshold to unfold the noise frequency distribution and fluctuation curve construction. Average noise level, Noise Climate (NC), Equivalent Continuous Noise Level (L_{eq}), Noise Pollution Level (L_{np}) are well-known indices for assessing the noise exposure index. Once all the results were compiled, a proper level of noise pollution could be enumerated for legislation and developed further to minimize noise pollution levels. An integral index is assessed from baseline data acquisition to compare, analyse and portray the index in this study.

The study was conducted in Kanchijhuli and Townhall moor under Mymensingh, one of the oldest and the newly introduced divisional cities. The city is among the most rapidly industrializing and urbanizing cities in the country after Dhaka and Chittagong. Situated alongside of Brahmaputra river, pleasant climate, availability of space and freshwater, rich natural resources, and first-rate road and railway network are some of the key features of Mymensingh. Apart from being an old and frequently developing region, Mymensingh also has many renowned educational institutions. Because of the increase in population, industrial areas, vehicles, and other artificial activities, the city has started facing noise pollution. Moreover, the severity of the noise pollution problem will increase in the years to come.

Material and Methods

Mymensingh is the newest divisional city of Bangladesh which is situated by the side of the Brahmaputra River. In terms of latitude, it lies between 24°15' and 25°12' north and 90°04' to 90°49' east longitudes and it has tropical to subtropical weather. The area of the district is about 4363.48 sq. km. The area is bordered by the Garo Hills due north and the Indian state of Meghalaya, on the south by Gazipur district, on the east by Netrokona and Kishoreganj districts, and on the west by Sherpur, Jamalpur, and Tangail districts.
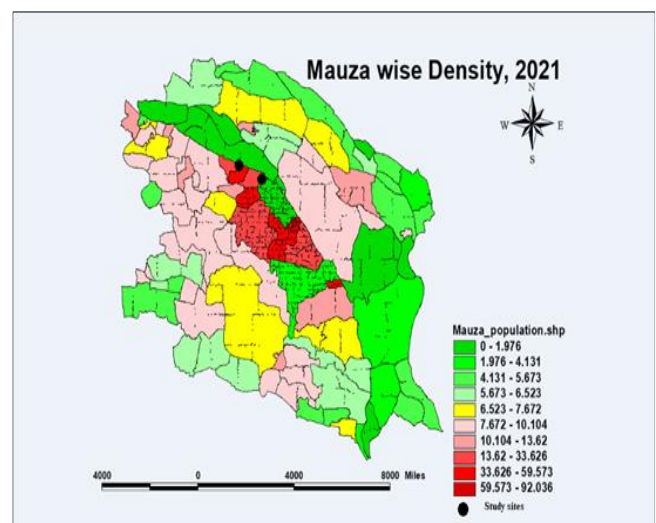
Sound level meters are commonly used in noise pollution studies to quantify different kinds of noise, especially for industrial, environmental, traffic, and aircraft noise. In this research work, CEM DT-8850 meter was used.

Battery cover is opened and installed a 9 V battery in the battery compartment. All the measurements were made manually on 'A – weighting' scale and the sound level meter was switched to slow response position. Sound level has been measured every 4 – 5 feet distance from ground and 10 – 12 feet away from source point of noise. A – Weighing is selected for general noise sound level and C – weighing is selected for measuring sound level of acoustic material. The measurement is turned off and battery is removed when not in use.

At the two study locations, data were recorded on both working days and holidays from October 2020 to February 2021. The weather was dry, and the wind speed was negligible for most of the days. Data were collected from 9:30 am to 5:30 pm with one-hour intervals. Data were collected when a vehicle was passing or made a noise by the driver, or a crowded situation occurred. After collecting data, those were recorded in the Microsoft Excel spreadsheet, and output was compiled.
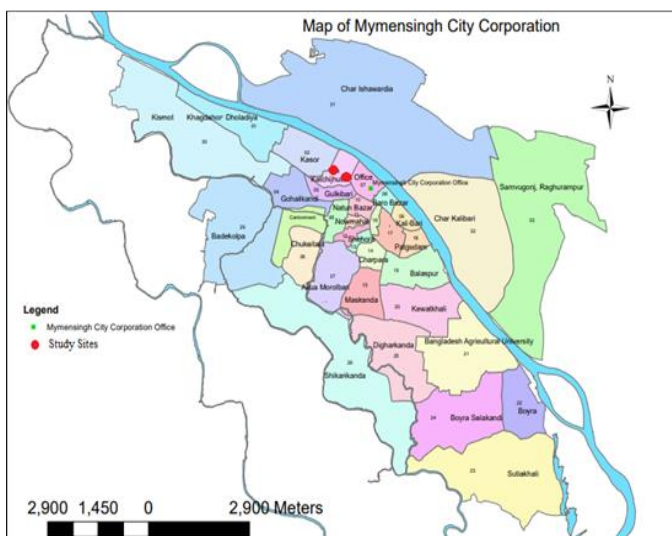
Fig.1. Map of Mymensingh City Corporation

Fig. 2: Mouza wise population density of study area

[Sources: Mymensingh City Corporation (MCC) Office, Mymensingh Strategic Development Plan (MSDP)]

Table 1. Recommended Noise Level Standard

Category of Area	Sound level, dB (Day time)
Silence Area	45
Residential Area	50
Mixed Area (Mainly residential area and also simultaneously used for commercial and Industrial purpose)	60
Commercial Area	70
Industrial Area	75

[Source: World Health Organization (WHO, 2002) and Bangladesh Department of Environment (DOE, 1997) (Ashish *et al.,* 2015)]

Table 2. Effect of Noise Pollution on Different Ages of People

People	Age Range	Sound Level	Probable Deficiency
Child	Below 3 years	100 dB	Loss of auditory power
Child	Below 6 years	Above 75 dB	Somatic effects, crippled, deformed and immature children
Pregnant mother	Any age		
Any people	Any age	Above 67-70 dB	Hypertension
Any people	Any age	50 dB	Myocardial infarction
Any people	Any age	100 dB	Permanent deafness

[Source: Pronob *et al.,* 2017]

Results and Discussion

Data taken from October, 2020 to February, 2021, noise exposure index enumerated. From the recorded noise level data L_{eq}, NC, average noise level was calculated to portraying the noise level condition of Kanchijhuli and Townhall moor.

Table 3. Average noise level of Kanchijhuli and Townhall Moor

Time	Average	Kanchijhuli Moor (dB)	Townhall Moor (dB)
Morning (9:30-11:30 am)	High value	89.82	89.02
	Low value	75.56	75.40
Noon (12:30-2:30 pm)	High value	95.16	95.07
	Low value	78.78	78.86
Afternoon (3:30-5:30 pm)	High value	96.21	96.64
	Low value	80.88	80.82

Figure Table-3, clearly shows that the highest average noise level observed during afternoon which was 96.21 dB and minimum average noise level was 75.56 dB for Kanchijhuli. Similarly, for Townhall moor, it was recorded 96.64 dB at afternoon and lowest was identified as 75.40 dB. So, the range for Kanchijhuli is lied between 75.56 to 96.21 dB and for Townhall which ranges 75.40 to 96.64 dB.

From Table-4, it is identified that the highest value of L_{eq} was 94.20 dB for Kanchijhuli moor and 94.13 dB for Townhall moor at 5:30 pm. On the other hand, the lowest value of L_{eq} is 82.34 dB and 82.07 dB at 9:30 am. This may be resulted for lower number of vehicles passed through in comparison to the number of vehicles passed through the road during afternoon (Hossain and Islam, 2018).

L_{np} takes into account both NC and L_{eq} indices. It gives an idea of noise pollution with fluctuations in the noise level. It is considered as the best indicator of physiological and psychological impact of noise (Hossain and Islam, 2018). The highest observed L_{np} was 110.31 dB during 1.30-2.30 pm at Townhall moor and 95. 52 dB was the lowest value during the 9.30-10.30 am at Townhall moor.

Table 4. Noise Exposure Index (L_{eq}, NC)

Time	L_{eq}		NC	
	Kanchijhuli (dB)	**Townhall (dB)**	**Kanchijhuli (dB)**	**Townhall (dB)**
9:30 AM	82.34	82.07	14.06	13.46
10:30 AM	85.07	84.61	15.78	14.87
11:30 AM	88.91	89.34	15.16	16.01
12:30 PM	91.39	92.33	15.13	16.89
1:30 PM	92.18	92.93	16.03	17.38
2:30 PM	87.63	87.55	16.49	16.35
3:30 AM	84.53	84.60	12.81	12.95
4:30 AM	92.05	91.41	12.36	10.71
5:30 AM	94.20	94.13	11.99	11.82

The difference between peak noise level (L_{10}) and residual noise level (L_{90}) is called noise climate (Hossain and Islam, 2018). The maximum NC was 17.38 dB between 1.30-2.30 pm at Townhall moor, while it was minimum (10.71 dB) between the time period 4.30-5.30 pm. The maximum value of NC on Kanchijhuli moor was recorded 16.49 dB and least value recorded 11.99 dB.

From Table 1, the comparison of the WHO (2002), the educational institute like the college in Townhall is regarded as the silent area. Both Kanchijhuli and Townhall moor is higher than the silent limit of 45 dB.

Considering the study area's traffic scenario, it is also high as WHO prescribed that the traffic area should not exceed the value of 7-75 dB where the study estimated more than 80 dB of noise level.

In contrast, for residential and commercial area the recorded value exceeded the standard value of WHO (2002).

In Bangladesh, the Noise Pollution (Control) Rules (2006) says that, the acceptable sound limit in the silent areas is 50 dB for the daytime and 40 dB for night; in residential areas 55 dB for day and 45dB for night; in the mixed areas 60 dB for day and 50 dB for night; in commercial areas 70dB for day and 60 dB for night; and in the industrial areas 75 dB for day and 70 dB for night. The guidelines say exceeding the maximum noise level in certain areas is a punishable offence.

In both the experimental sites, the noise level exceeds the Noise Pollution (Control) Rules (2006), which is punishable offence in Bangladesh context.

Noise pollution is becoming a severe problem in the urban environment and Mymensingh city has no exception to it. Furthermore, looking towards the current and future developmental trends of Mymensingh city, it is the high time for the local government to take precautionary actions to save people from the risk of noise pollution.
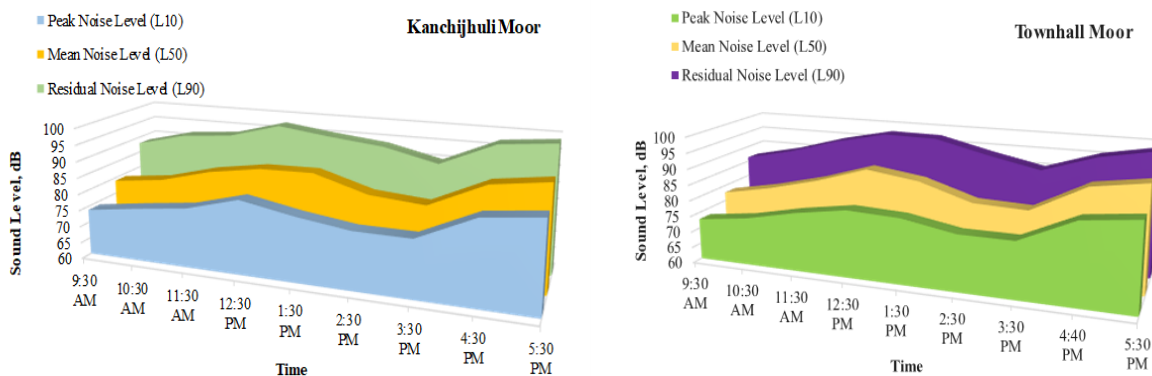
Fig. 3. Exploration of daily noise level trend at Kanchijhuli and Townhall moor
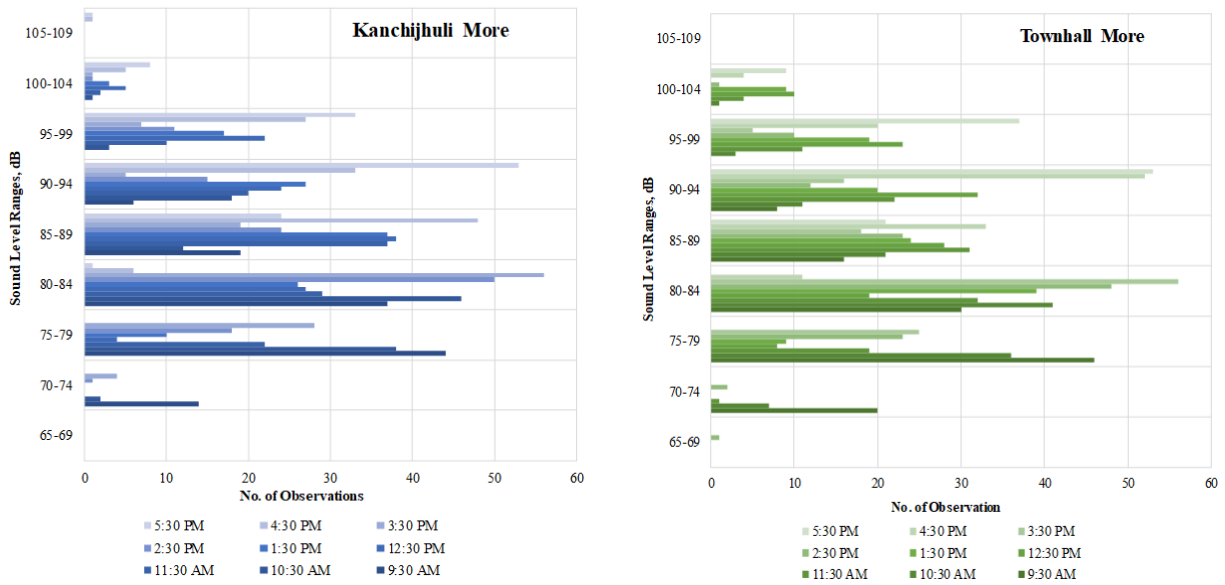
Fig. 4. Frequency distribution of sound level ranges with time at Kanchijhuli and Townhall moor
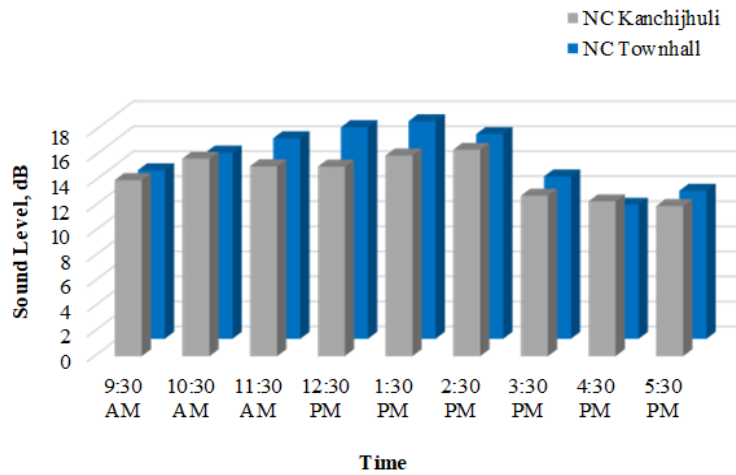

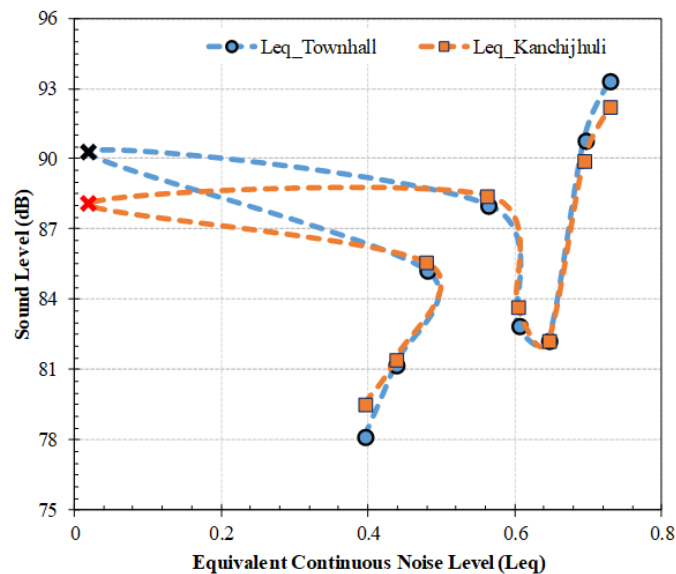**Fig. 5.** Comparison of noise climate between Kanchijhuli and Townhall moor

Fig. 6. Equivalent continuous noise level (L$_{eq}$) at the experimental sites

23

Conclusion

The noise assessment of Mymensingh city indicated that the noise levels in the city are escalating at an exponential rate with a growing population and heavy traffic accumulation. Noise levels obtained at Kanchijhuli and Townhall Moor of Mymensingh city were detected to be exceeding the noise level prescribed by the WHO (2002) and DoE (1997). It was also observed that most of the time, the noise level exceeded 80 dB, which is beyond the silent zone, commercial zone, and traffic zone. In the study area, the equivalent continuous noise level (Leq) was ranging from 82.34 to 94.20 dB for Kanchijhuli and from 82.07 to 94.13 dB for Townhall moor, respectively. The root cause of the greater noise levels in the studied regions is the exponential expansion of urbanization, resulting in a higher influx of people from surrounding areas, a shortage of sufficient parking places, and the excessive number of private and public cars in the city. Narrow connecting roads and the lack of bypass in the studied areas of the city are all factors that contribute to a large concentration of cars, creating a turbulent and loud environment.

Thus, it is felt that the noise environment of Mymensingh city may pose a threat to the health of dwellers of Mymensingh city in the long term. This noise may not cause severe or immediate effects, but it may impact the population in many ways if such a noisy environment prevails. Therefore, strict enforcement of law and regulation is undeniable. Additionally, establishing a diversion for heavy vehicles outside of the city, planting more trees along the roadside for sound absorption, widening the roadways, and adding additional parking spaces are other remedial and preventative actions that may improve the noise environment of Mymensingh city. It is also suggested that specific, precise, and extended data sets for monitoring and vigilant assessments of all Mymensingh city locations can be used to manage noise propagation and the associated adverse outcomes of noise.

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