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NOISE POLLUTION ASSESSMENT STUDY: CONSTRUCTION OF METRO-RAIL STATIONS AT DHAKA, BANGLADESH

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ABSTRACT

Noise pollution is an additional effect of the technological era. Due to its physiological and psychological effects on humans and animals, its negative effects are of great significance. Additionally, noise is a danger to marine and terrestrial ecosystems. Noise-related health issues are associated with both vehicular and industrial activity. Using descriptive methodologies, this study intends to assess the level of noise pollution at several Dhaka metro rail stations. Samples from a total of 16 locations were collected. Every station's noise level has been measured while adhering to all precautions and standards. It has been confirmed that the Leq measured 90.47, whilst the highest noise level measured 117.80 dBA and the minimum noise level measured 43.20 dBA, as well as L10 - 88.00, L50 - 75.80, and L90 - 58.24. The highest Leq recorded was 101.68 at Kawran Bazar station, while the lowest was 60 at Uttara Depot. However, it was determined that the average noise level surpassed the National Standard Level in all of the study's locations. As the frequency of construction noise grows owing to unscheduled work stations, so does the necessity for appropriate noise pollution control and prevention techniques, according to the findings of this study.
Keyword: *Noise Pollution, Leq, Metro rail, Dhaka, Bangladesh*

INTRODUCTION

Metro Rail, which is made of steel or concrete, is a rapid train system. Although Mero rail is an environmentally friendly mode of transportation because it is powered by electricity, there are certain pollution-related issues [2]. It will be convenient for the millions of commuters that live in the capital city [3].

Due to their distinct characteristics and large informal economy, developing nations like Bangladesh are especially susceptible to noise pollution [17]. Due to the increased demand for tourists as well as the enormous growth in the number of cars and industries, Dhaka city is more susceptible to noise pollution [18]. To reduce the congestion caused by vehicles, the Bangladeshi government has launched a significant effort to create a metro rail system. The noise level created when a running wheel makes contact with a rail is increased by the employment of industrial and construction equipment [1]. The only source of noise, at over 70%, is from vehicles. Additionally, it was observed that 500–1,000 vehicles in Dhaka were concurrently honking their horns (Noise Act 2006 Dhaka). A level of noise is present in almost all work-related tasks, although some of them have extremely high noise levels. Tasks requiring impact processes, handling particular types of materials, and flying commercial airplanes rank as the most significant of these. The industries most at risk for noise-induced hearing loss include manufacturing, transportation, mining, building, agriculture, and the military (NIHL). The road is getting much smaller as metro rail construction continues. Because of this, noise pollution is worse as it reflects in a smaller space. There is no physical distinction between sound and noise. Noise is an unwelcome sound, which is a sensory perception [14]. Therefore, any needless disturbance that occurs within a useful frequency band is considered noise. The traffic police are among the high-risk groups to be impacted by the health risks of noise pollution [4-6, 8-11, 15], especially at crossroads with lots of traffic. In a study of the prevalence of occupational disorders across the globe, the World Health Organization (WHO) universally identified 25 risk factors [13].In the United States of America (USA), about 30 million

workers are subjected to hazardous noise [7]. In Germany, 4-5 million people (12–15 percent of the labor force) are subjected to noise levels that the WHO deems harmful [12]. People exposed to noise levels of 80 dB for more than 15 minutes are likely to experience hearing loss, according to medical authorities [6]. If appropriate legislation is not implemented, 50% of the population of Dhaka city will lose their hearing ability within 20–25 years. (Manju, 2000).

With this background, the present study has been carried out to assess Noise Pollution's status in Different Zones of Dhaka city. Taking proper measures that align with both construction work and vehicles can help reducing the problem to a moderate level.

The main objective of the present study was to evaluate the Noise pollution assessment study: Construction of metro-rail stations at Dhaka to observe the state of noise pollution in Dhaka Metro-rail stations; To identify the noise relationship between various parameter; Spatial distribution of noise pollution in Dhaka Metro-rail stations.

MATERIALS AND METHODS

Site selection

The study area for this research is Dhaka city Metro-rail station area (Map). The reason behind choosing Metro-rail station is that it has gone through high traveler demand and rapid urbanization and predict to a massive increase in the number of travelers. This has potential adverse impacts on the environment and the health of people. The absolute location of the study area is between latitude 23.873751 and 23.7330° N to the longitude is 90.396454 and 90.4172° E.

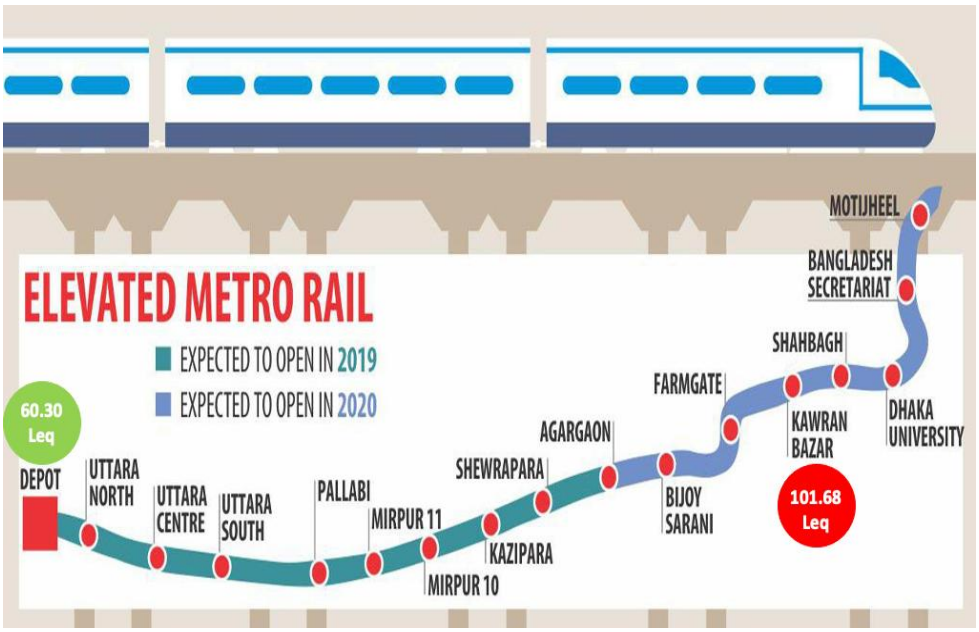

Figure 1 Station line of Metro-rail Station

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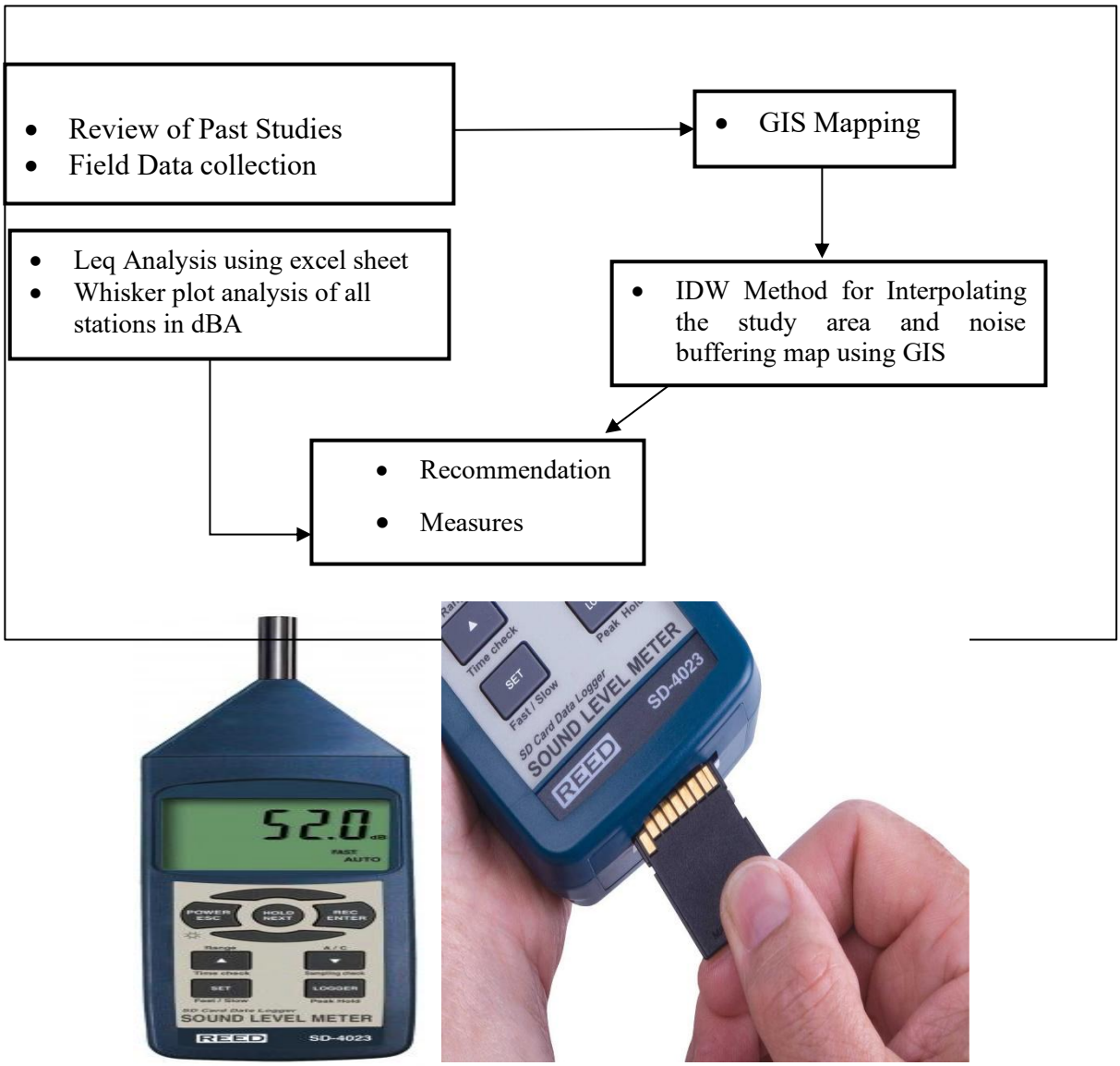
Methods

Noise Measuring Instrument



A noise level meter (REED SD-4023) was used for ambient sound pressure level monitoring in the concerned area. The survey was performed on working days. The sound pressure level measure by A-weighting.

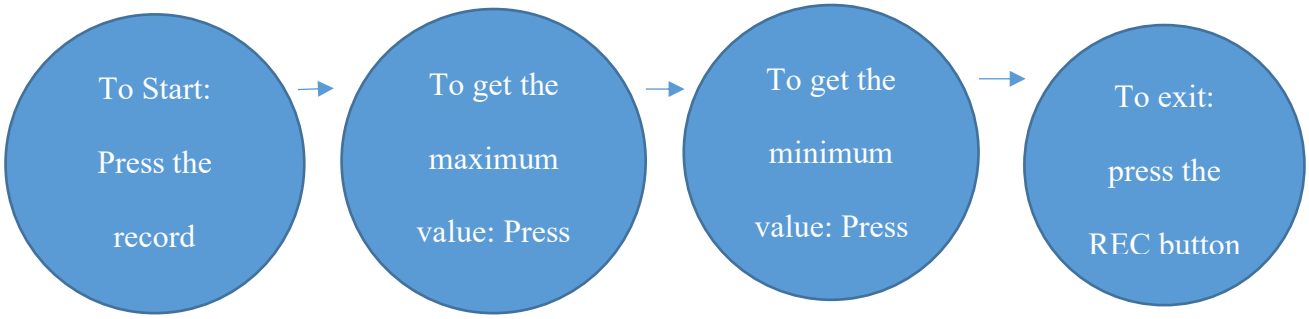


Figure 2 Sound level meter (noise instrument)

Data was collected above 1.5 meter of the ground and the data was taken by standing on the roadside. Any kind of noise barriers was avoided for measuring the actual sound level. Every second data was taken for the sampling and total sampling time for each station was 5 minutes. Recorded data were stored in MicroSD car (memory card). Collected data were analyzed in Microsoft Excel v.2010 and IBM SPSS v.20. All data are visualized different graphs and tables according to different ArcGIS v.10.2.1 was used to make study area map and noise buffering map. IDW interpolation method was used to make the noise buffering map of the metro rail stations of both north and south part of Dhaka.

Result and Discussion

Analysis of data from **figure 3** shows that highest Leq recorded Kawran Bazar station (101.69), and lowest recorded Uttara Depot (60.31). Whereas, after separation of different two city corporation area found, the highest and lowest noise reported from North Dhaka. And the South Dhaka shown that the Leq are within 85 to 90 at four stations. The North part of Dhaka has higher noise level compared to the South part of Dhaka city.

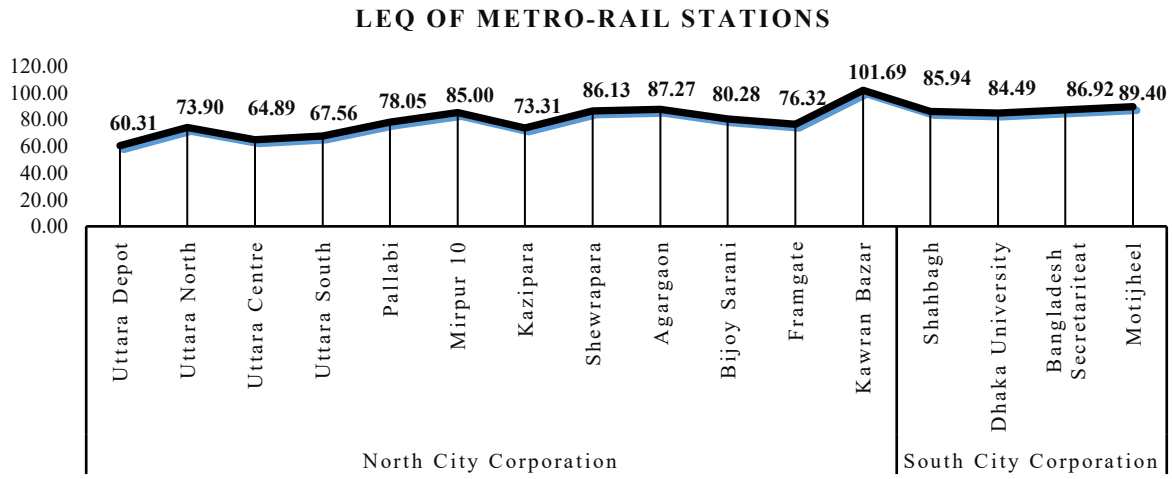
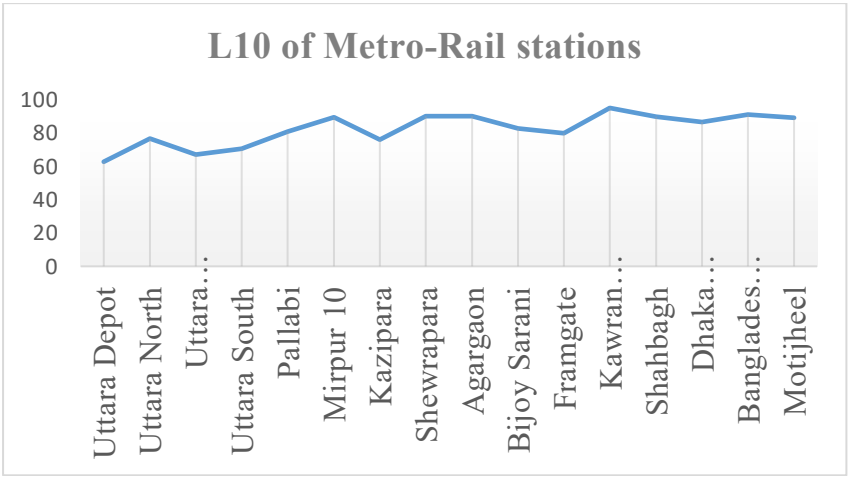
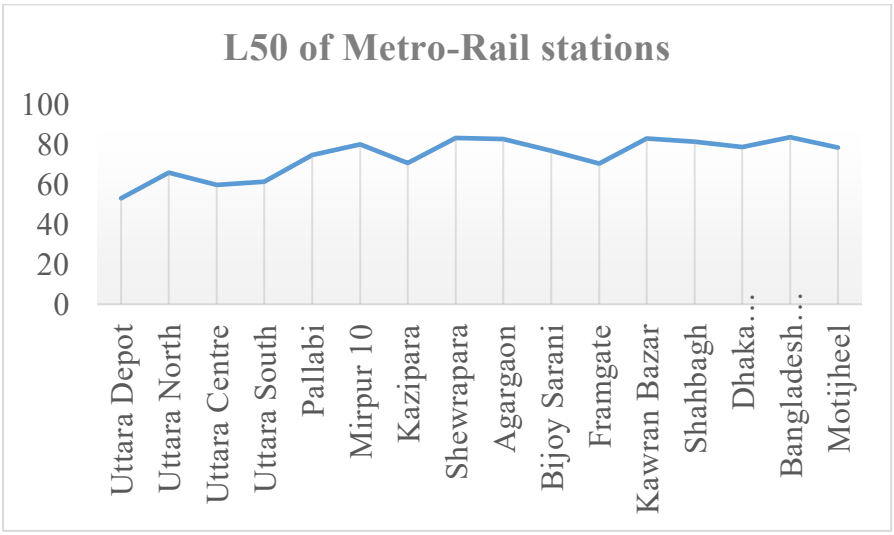


Figure 3 Leq of Metro-rail Stations

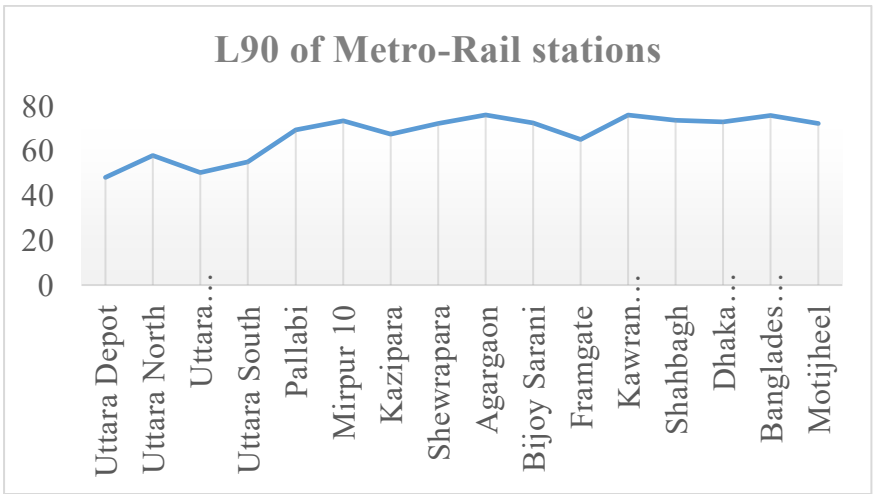
In Dhaka North City corporation, the leq level of noise is between 60-88 except Karwan bazar area that is 101.69. In the surrounded area of Kolkata metro rail, the Leq level exceeded the Federal Transit Administration standard for both day and night which is 50 dbA [19].



(A)



(B)

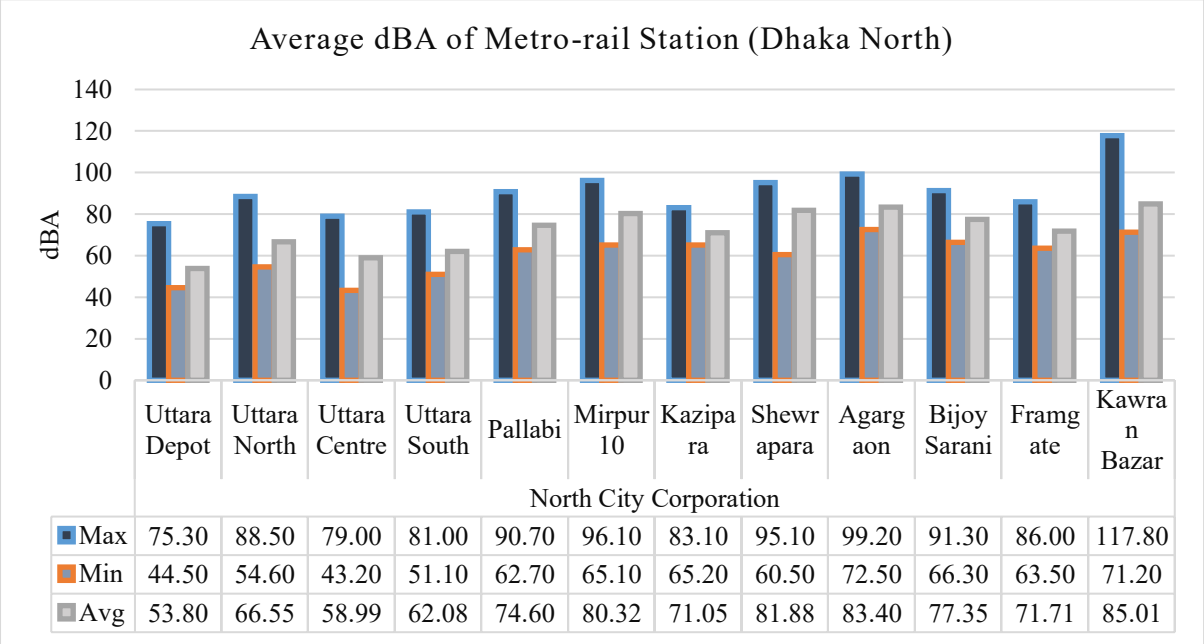


(C)

Here L10, L50 and L90 indicate the exceeded level for 10%, 50% and 90% respectively. Leq is the noise parameter which is the equivalent sound level received by the ear. In the above A, B and C leq10 is maximum range and the minimum range is seen in leq90. From this parameter noise climate can also be obtained. The noise climate formula is-

NC= L10-L90 (dbA)

The noise climate also helps to understand the fluctuation of sound level. L50 indicates the background noise and L90 is the peak of the noise. Background noise is between 40 to 70 (dbA) in the surrounded area of metro rail stations. On the other hand, the peak noise is 60 to 90 (dbA).



	Uttara Depot	Uttara North	Uttara Centre	Uttara South	Pallabi	Mirpur 10	Kazipara	Shewrapara	Agargaon	Bijoy Sarani	Framgate	Kawran Bazar
Max	75.30	88.50	79.00	81.00	90.70	96.10	83.10	95.10	99.20	91.30	86.00	117.80
Min	44.50	54.60	43.20	51.10	62.70	65.10	65.20	60.50	72.50	66.30	63.50	71.20
Avg	53.80	66.55	58.99	62.08	74.60	80.32	71.05	81.88	83.40	77.35	71.71	85.01

Figure 4 Average dBA of Metro-rail Stations (North)

In Farmgate, highest noise level was detected around 71.71 dBA and in Bijoy Sharani 77.35 dBA in the daytime. Both Farmgate and Bijoy Sharani is considered as mixed area. According to DoE, the acceptable noise level of mixed area in Dhaka city is 60 dBA. Mirpur 10, Kazipara, Shewrapara is known as residential area and their noise level are 80.32 dBA, 71.05 dBA and 81.88 dBA respectively. Whereas in our present study, maximum noise level is 86.00 dBA. Additionally, in the Karwan Bazar area its usually average sound level is around 80-110 dB (Noise Pollution Act Dhaka 2006). This persists in the current study also that is 85.01 dBA. Karwan Bazar is a hub of commercial area in the Dhaka North City Corporationas consists plenty of office, wholesale market etc. Commercial area noise level recommended within 70 dbA that Karwan Bazaar exceeded.

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Table 1 Dispersion of Noise quality in different metro-rail stations

Land Use	Location	Leq	L10	L50	L90	Max	Min	Avg	Rank by Leq
North City Corporation	Uttara Depot	60.31	62.66	52.95	48.03	75.30	44.50	53.80	16
	Uttara North	73.90	76.60	65.90	57.90	88.50	54.60	66.55	12
	Uttara Centre	64.89	66.90	59.60	50.20	79.00	43.20	58.99	15
	Uttara South	67.56	70.38	61.30	54.91	81.00	51.10	62.08	14
	Pallabi	78.05	80.60	74.50	69.30	90.70	62.70	74.60	10
	Mirpur 10	85.00	89.40	79.90	73.36	96.10	65.10	80.32	7
	Kazipara	73.31	75.80	70.60	67.30	83.10	65.20	71.05	13
	Shewrapara	86.13	89.98	83.25	72.04	95.10	60.50	81.88	5
	Agargaon	87.27	90.10	82.70	75.80	99.20	72.50	83.40	3
	Bijoy Sarani	80.28	82.50	76.80	72.30	91.30	66.30	77.35	9
	Framgate	76.32	79.89	70.40	64.95	86.00	63.50	71.71	11
	Kawran Bazar	101.69	94.90	82.90	75.86	117.80	71.20	85.01	**1**
South City Corporation	Shahbagh	85.94	89.81	81.30	73.56	97.00	68.70	80.96	6
	Dhaka University	84.49	86.37	78.65	72.91	98.40	67.50	79.11	8
	Bangladesh Secretariat	86.92	90.88	83.50	75.70	95.90	69.30	83.21	4
	Motijheel	89.40	88.90	78.30	72.20	105.50	70.30	79.46	2

The subsequent **Table 1** presents the descriptive statistics for the Noise quality of the study. 16 stations of metro-rail in Dhaka. All of the station Karwan Bazar is ranked first for highest level of noise both in NCC and SCC. The Leq of Karwan Bazar is 101.69. Even the highest range is seen in the area of Karwan Bazar. Kazipara has the lowest range that implies little variation is observed in the noise level of the particular area. On the other hand, the leq of Uttara Depot is 60.31. Even though there are more stations in the North city corporation but the South city corporation has the highest ranked area in terms of noise pollution.

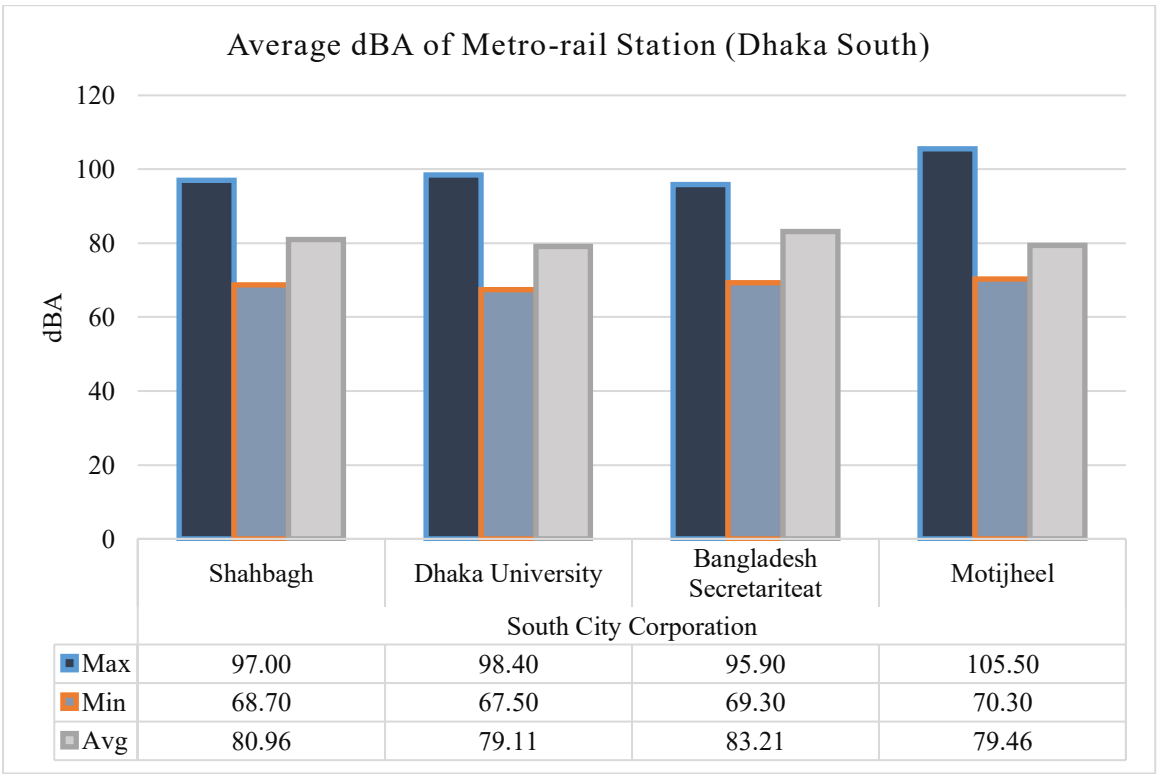

Figure 5 Average dBA of Metro-rail Stations (South)

Dhaka University is an educational institution that falls under sensitive area. The average noise level of Dhaka University is 79.11 dBA which is very high for a sensitive area. DoE recommended noise level for sensitive area is 45 dBA. In the Dhaka University area, it is usually 65-75 dB in the weekdays whereas in the weekends it reduces to 55-65 dB [20]. Figure 4 and 5 Average maximum noise level found at the area Kawran Bazar (85.01 dBA), and minimum average noise listed at Uttara Depot (53.80 dBA). The North Dhaka's Stations average noise level was same as figure 4 but figure 5 average noise level highest found at Bangladesh Secretariat (83.21 dBA) and minimum at Dhaka University (79.11 dBA). Maximum Noise found at Kawran Bazar (117.80 dBA) and minimum Uttara Centre (43.20 dBA) both are located at North city corporation's area.

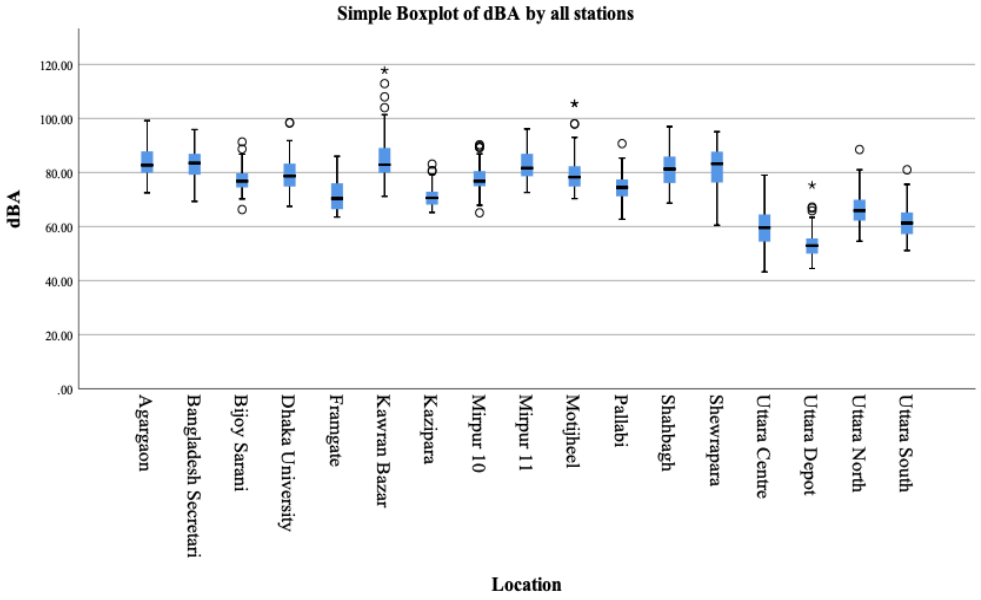

Figure 6 The whisker box plot shows metro-rail stations noise data

Whisker box plot Figure-6 shows noise of in metro-rail stations. A horizontal black line marks the median. The lower boundary of the box indicates the 25th percentile. The upper boundary of the box indicates the 75th percentile. The whisker represents the maximum (upper whisker) and minimum value (lower whisker). Points above the whiskers indicate outliers. Karwan Bazar area has the most outliers which implies the highest noise level among the other rail stations. As it has multiple outliers with positively skewed distribution. Uttara Depot area has the lowest noise level. It also has the lowest dispersion which is why the area shows least variation. In North, Karwan Bazar area has positively skewed and three outliers which makes it very much high in noise level. Uttar Depot is most clustered and less variation is noticed, hence it can be considered as noise pollution excluded area. Lower dispersion is also seen in the area of Kazipara but with two outliers. Shewrapara area has negatively skewed distribution which means there are moderate or low-level noise pollution. In the South part of Dhaka, Shahbagh has the highest dispersion in compare to the three stations. Motijheel station has positively skewed distribution with one outlier. Also, Dhaka University has one outlier which implies these stations have higher noise level.

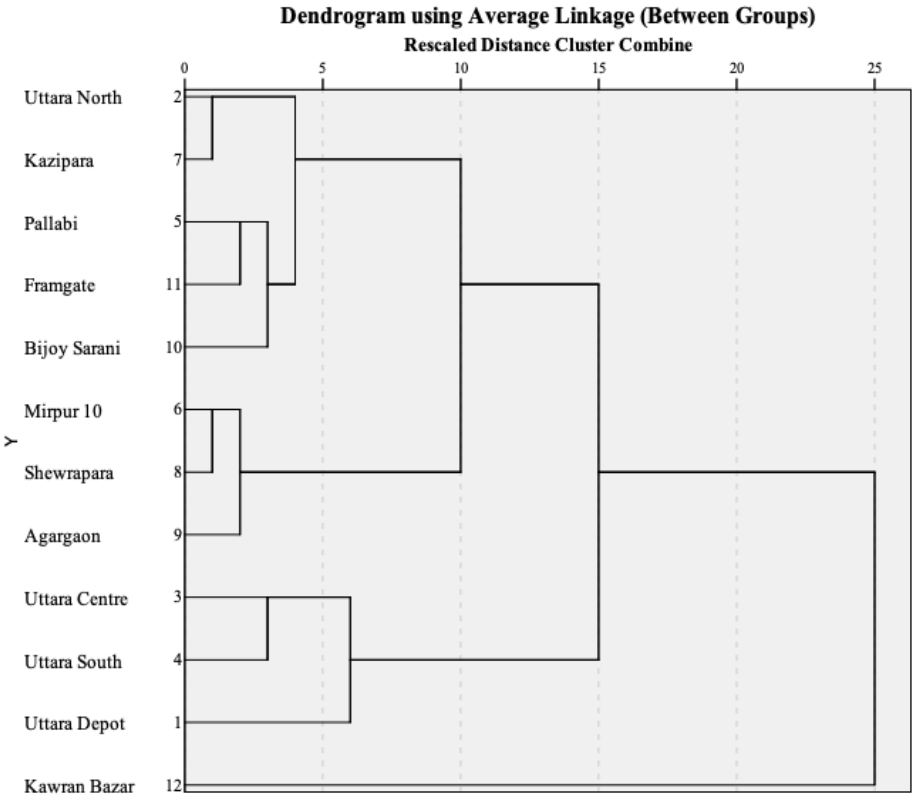

Figure 7 The Station used based cluster, in terms of dBA (North)

Figure 7 shows the station (North) based cluster, in terms of Leq, there is three. First cluster shown that, Uttara North, Kazipara, Mirpur 10 and Shewrapara; second cluster shown just Agargaon station connected to the first cluster at the distance of 2. The third cluster shown that, Pallabi, Bijoy sarani, South Uttara and Uttara Center. And final cluster shown Uttara north station.

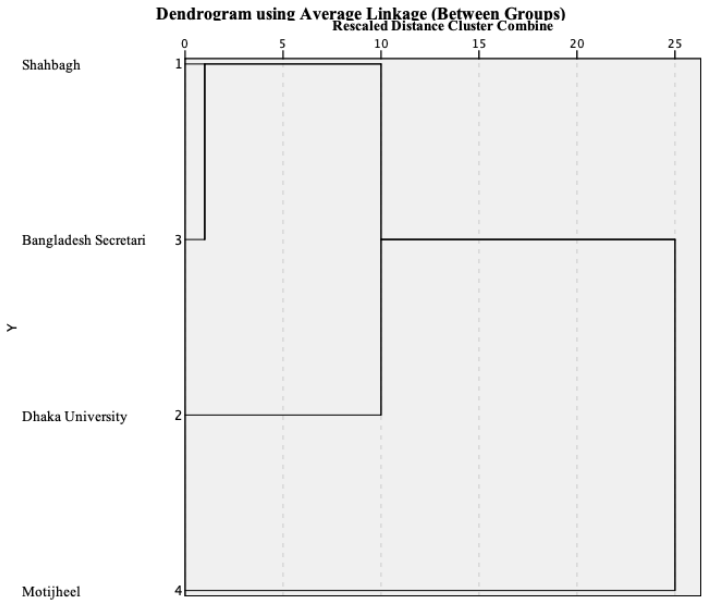

Figure 8 The Station used based cluster, in terms of dBA (South)

Also Figure 8 shows the station (South) based cluster, in terms of Leq, there is single cluster Shahbagh and Bangladesh Secretariat. Second cluster is Dhaka University individually joined at the approximate distance of 2. Motijheel area is included in the third cluster that joins with the second cluster at approximate distance of 25.

CONCLUSION

Noise pollution has become one of the worst environmental problems affecting about ten million inhabitants in Dhaka. A study confirms that noise pollution is emerging problem in the Metro-rail stations due to construction work. Schools, colleges, hospitals, and other sensitive facilities should be situated at least 60 meters from the main road [16]. Avoiding metal-on-metal contact, use new equipment, ensure Proper Saw Cutter Practices can help reducing noise pollution from the public transport. Government should be able to get along with non-governmental sectors on reporting environmental research and development in a comprehensive policy on noise quality Bangladesh is required.

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