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RESEARCH ARTICLE

Road Traffic Noise Pollution: Present Scenario and Potential Noise Attenuation Strategy for Pabna Municipality, Bangladesh

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Abstract

This study was conducted in Pabna Municipality with the intention to identify the temporal and spatial dynamics of urban traffic-induced noise pollution, and to find out potential noise pollution attenuation strategy. Noise level data was collected from fourteen major locations with sound level meter in four distinct time namely, morning (6 am to 11 pm), noon (11 am to 4 pm), afternoon/ evening (4 pm to 9 pm), and night (9 am to 6 pm). Average noise level in that four times was observed 93.09, 89.30, 90.71, 80.17 dB (A), respectively. In the morning, noon, afternoon/evening, and at night the maximum noise level was observed in Singa morr (bent/curve), Bypass terminal, George court (Kachari morr), and Traffic morr, respectively; which was 106.7, 106.8, 94.8, and 87.4 dB (A), respectively. On the contrary the minimum noise level in morning, noon, and at night was recorded in Gaspara morr which was 82.2, 82.3, and 76.1 dB (A), respectively. But in the afternoon/evening, minimum noise was measured in Edward college gate which was 84.3 dB (A). Most striking finding was that noise pollution level was above the standard in all the points in that four times compared to the standard for road traffic noise. Finally several ecological, engineering, infrastructural, institutional, and behavioral approaches were recommended that could be applied to attenuate noise pollution problem in Pabna Municipality.

INTRODUCTION

Noise pollution has become a significant source of irritation, disturbance and health risk with the uncontrolled urbanization and industrialization. Urbanization can affect the ambient environmental situation through increased noise (Rashid, 1991). Noise in the cities is the result of a number of activities such as road traffic, aircraft, railways, and industrial and constructional works. Road traffic noise constitutes the major source of urban noise pollution (Jamrah, Al-Omari and Sharabi, 2006; Saxena, 2004).

Traffic noise was ranked second among the selected environmental stressors evaluated in terms of their public health impact in six European countries (Fritschi, 2011). The elements that contribute to the generation are the engine, inlet, exhaust, propulsion and transmission (including gears), breaks, horns, chassis, body structure, loads in the vehicle, and door slamming (Kadiyali, 2006). Traffic noise is increasing over the years with increase in the number of road vehicles. Traffic speed is the major cause of noise. The noise volume is enhanced with increase in traffic speed (De and De, 2009).

Noise pollution impacts can be categorized as subjective, behavioral, and physiological. The subjective effects are annoyance, disturbance, dissatisfaction, bother and noisiness. Behavioral effects cover interference with sleep,

speech or any general task. Noise can cause disturbance in studies and intellectual pursuits. The efficiency of performing general tasks involving mental activity can be impaired by noise. Lastly, physiological effects are those that cause startle and fright phenomena. Exposure in an extremely high level of noise for long periods of exposure may produce deafness (Kadiyali, 2006). The tolerable conversation level is 65 dB at a distance of 1 metre, 125 dB gives the sensation of pain in the ear and 150 dB might be a killer (De and De, 2009).

Pabna Municipality inhabits 116305 people in an area of 27.23 sq. km. that is divided into fifteen wards (Banglapedia, 2012). This vast people require numerous vehicles for their daily transportation. The number of registered rickshaw, van, easy-bike and auto-rickshaw, and tempo are 4112, 2521, 516, and 165, respectively. Apart from this, the number of unregistered rickshaw, van, easy-bike and auto-rickshaw, tempo, *nochhimon/korimon/bhotvoti* (locally produced diesel engine driven vehicle) are 2612, 2632, 1736, 250, and 718, respectively (BBS, 2013). In addition to this large number of bus and trucks, ambulance, police vans also produce an intense noise pollution problem in this municipality area.

Several studies have been conducted regarding road traffic noise pollution and its impact in Bangladesh and abroad. Alesheikh and Omidvari (2008) conducted a study on the traffic noise pollution of Tehran, Iran. They observed that most of the commercial and residential regions surrounding the main streets are suffering from severe noise pollution. But no studies had yet been conducted regarding the noise pollution level of Pabna Municipality. Therefore the objectives of this study were to identify the temporal and spatial dynamics of urban traffic-induced noise pollution in Pabna Municipality, and to find out potential noise pollution attenuation strategy.

1. Study Area

Pabna Municipality is located to the south-west of Dhaka-Pabna Highway. It has 4.30 km. CC road, 151 km. carpeting road, 17.90 km herringbone road, and 18.80 km. *katcha* road (Pabna Municipality, 2011). Around 116305 people of this municipality generate lot of trips everyday that produces intense road traffic noise and causes suffering to adjacent people. The name and coordinates of data collection points is provided in the following **Table-1** and the map is represented in **Figure-1**.

2. Materials and Methods

The unit of measurement of noise is the decibel (dB), which is the unit of sound pressure level. To account for the ear's response at low and high frequencies, different weighing filters, A, B, and C are used. A weighted decibel, dB (A), is commonly employed for measuring the relative levels of noise produced by different traffic conditions (Kadiyali, 2006).

Sound pressure level is calculated by the formula (1) below, where the reference sound pressure is the minimum sound pressure that can be perceived by the human ear. Its value is equivalent to 20μPa (20×10^{-6} Pa) (Zannin, Ferreira & Szerametta, 2006).

$$SPL = 10 \log (p^2/p_o^2) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where, p= sound pressure, p_0= reference sound pressure=20μPa ($20\times10-6$ Pa).

Sound pressure level was measured by using the Sound level meter (Madel: Lutron SL-4010, Taiwan). Noise level data was collected from fourteen major locations of Pabna Municipality namely Bypass Terminal, Meril Bypass, Singa Morr, Gaspara Morr, Moktabpara Morr, Edward College Gate, Traffic Morr, Indra Morr, George Court (Kachari morr), Ananta Morr, Mujahid Club, Panchmatha Morr, Govt. Girls School Morr, and Library Bazar.

In the urban roads there are distinct traffic peaks in the morning and evening (10 A.M. and 6 P.M.) as people travel to and fro workplaces (De and De, 2009). For this reason sound level was measured in four distinctive times, morning (6 am to 11 pm), noon (11 am to 4 pm), afternoon/ evening (4 pm to 9 pm), and night (9 am to 6 pm). To assess the pollution level of noise, the collected data was compared with the maximum permissible noise levels standard provided by (De and De, 2009), which is provided in **Table-2**. In addition, the factors underlying noise pollution was identified and possible management strategy was recommended by prudent judgment and accounting local peoples concern.

3. Results

Table 1: Names and Coordinates of Data Collection Locations

Sl. No.	Location Name	Latitude & Longitude	Sl. No.	Location Name	Latitude & Longitude
1.	Bypass Terminal	N 24º00′27.9″ E 089º15′30.9″	8.	Indra Morr	N 24º00′24″ E 089º14′13.6″
2.	Meril Bypass	N 24º01′20.6″ E 089º14′58.5″	9.	George Court (Kachari Morr)	N 24º00′01.8″ E 089º13′56.7″
3.	Singa Morr	N 24º01′31″ E 089º14′48.3″	10.	Ananta Morr	N 23º59′57″ E 089º14′43.7″
4.	Gaspara Morr	N 24º01′56.3″ E 089º13′33.9″	11.	Mujahid Club	N 24º00′22.9″ E 089º14′57.1″
5.	Moktabpara Morr	N 24º00′58.2″ E 089º14′4.9″	12.	Panchmatha Morr	N 24º00′26.3″ E 089º14′21.2″
6.	Edward College Gate	N 24º00′43.5″ E 089º14′18.4″	13.	Govt. Girls School Morr	N 24º00′14.2″ E 089º14′18.8″
7.	Traffic Morr	N 24º00′27.4″ E 089º14′17.2″	14.	Library Bazar	N 24º00′02.9″ E 089º13′32.5″

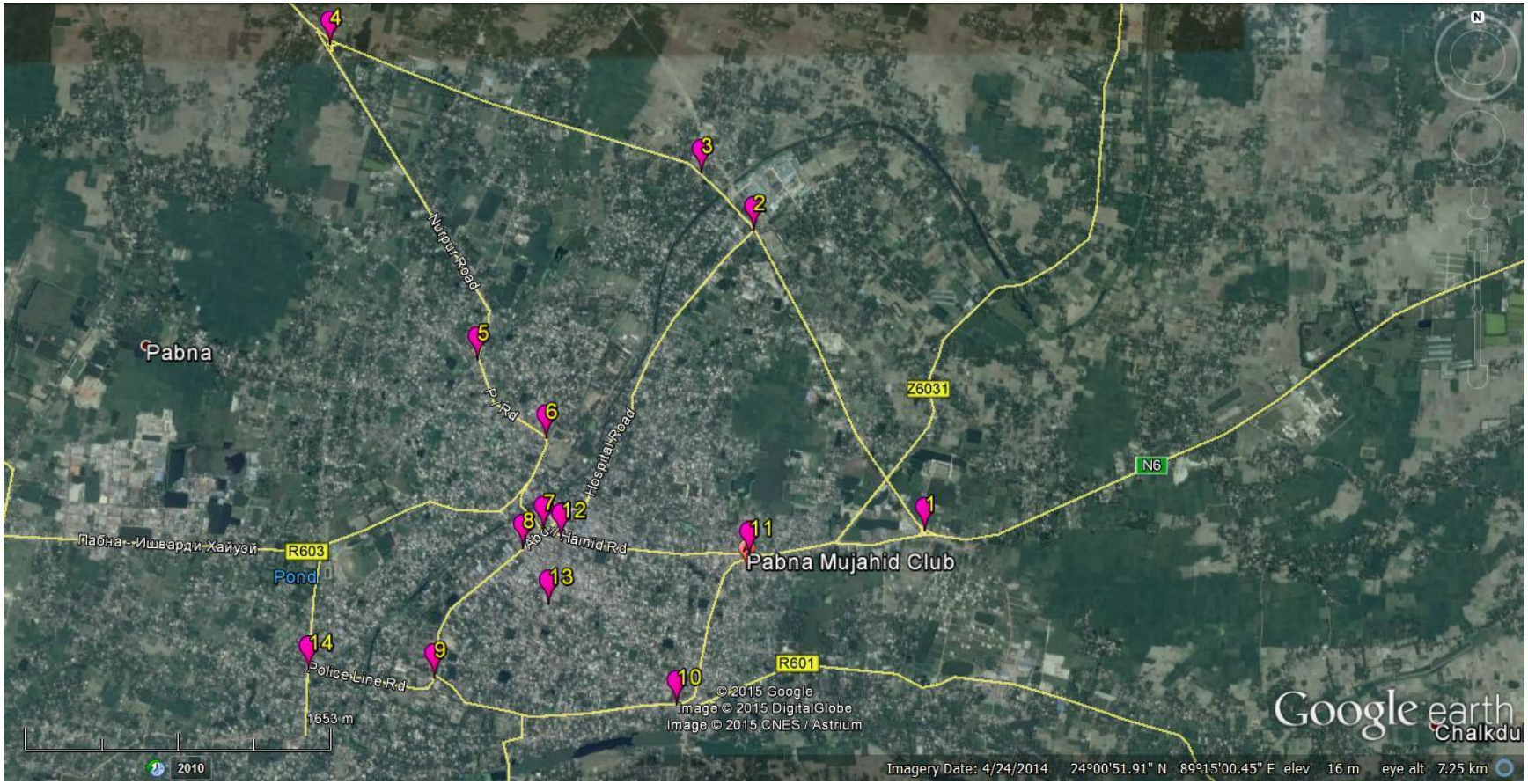

Figure 1: Google Earth Image of the Study Area Indicating Sound Level Measuring Locations

Table 2: Maximum Permissible Noise Levels

Situation	Permissible Level
Road traffic near residential areas	70
Ear protection required	85
Factory work (48 hr. week)	105
Prolonged noise causing permanent damage	100
Threshold of pain (30 secs duration)	120
Maximum for sonic boom	150
Ear drum rupture	180

Noise pollution level was measured in fourteen major locations in Pabna Municipality in four distinctive times namely morning, noon, afternoon/evening, and night which is provided in the following **Table- 3**. The graph containing comparison of noise level in fourteen major locations is depicted in the following **Figure-2**.

It was observed that in the morning, noon, afternoon/evening, and at night the maximum noise level was observed in Singa morr, Bypass terminal, George court (Kachari morr), and Traffic morr, respectively; which was 106.7, 106.8, 94.8, and 87.4 dB (A), respectively. On the contrary the minimum noise level in morning, noon, and at night was recorded in Gaspara morr which was 82.2, 82.3, and 76.1 dB (A), respectively. But in the afternoon/evening, minimum noise was measured in Edward college gate which was 84.3 dB (A).

Average noise level in morning, noon, and afternoon/evening and at night was observed 93.09, 89.30, 90.71, 80.17 dB (A), respectively that is represented in the following **Figure-3**.

Table 3: Sound Pressure Level (dB) in Fourteen Major Locations of Pabna Municipality

Sl. No.	Location Name	Sound Pressure Level (dB)			
		Morning (6 am to 11 am)	**Noon** (11 am to 4 pm)	**Afternoon/ Evening** (4 pm to 9 pm)	**Night** (9 pm to 6 am)
1.	Bypass Terminal	99.6	106.8	94.5	79
2.	Meril Bypass	92.1	84.8	90	82.9
3.	Singa Morr	106.7	84.4	94.3	77.6
4.	Gashpara Morr	82.2	84	84.3	76.1
5.	Moktabpara Morr	92.6	87.7	92.2	80.7
6.	Edward College Gate	86	81.3	89.4	79.7
7.	Traffic Morr	92.4	85.7	88.1	87.4
8.	Indra Morr	92.3	96.7	92	86
9.	George Court (Kachari Morr)	96.9	93.3	94.8	83.1
10.	Ananta Morr	94.6	100.4	96.2	77.6
11.	Mujahid Club	92.6	87.1	84.2	75.6
12.	Panchmatha Morr (Chapa Mosque Morr)	95.2	91.2	94.4	85.5
13.	Govt. Girls School Morr	83.7	82.4	91.7	74.9
14.	Library Bazar	96.4	84.6	83.8	76.4
Average		**93.09**	**89.30**	**90.71**	**80.17**

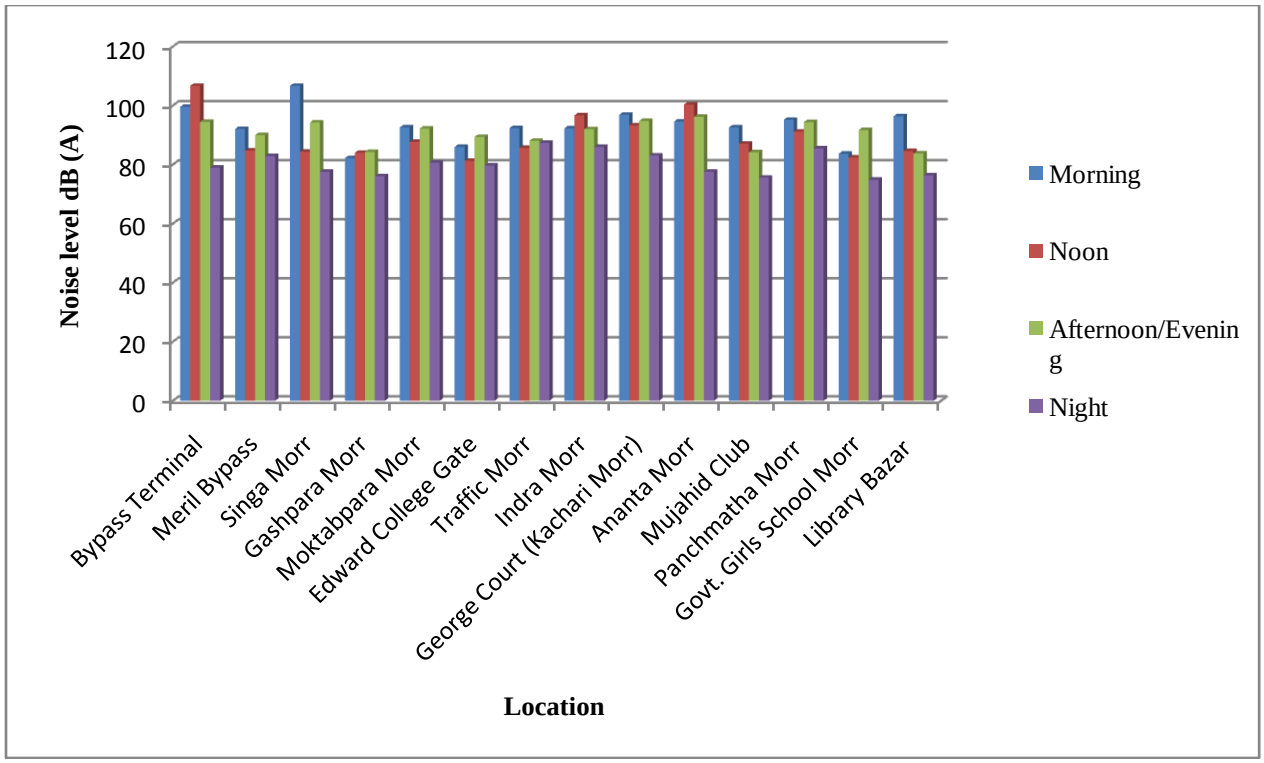

Figure 2: Comparison of Road Traffic Noise Level in Fourteen Major Locations of Pabna Municipality

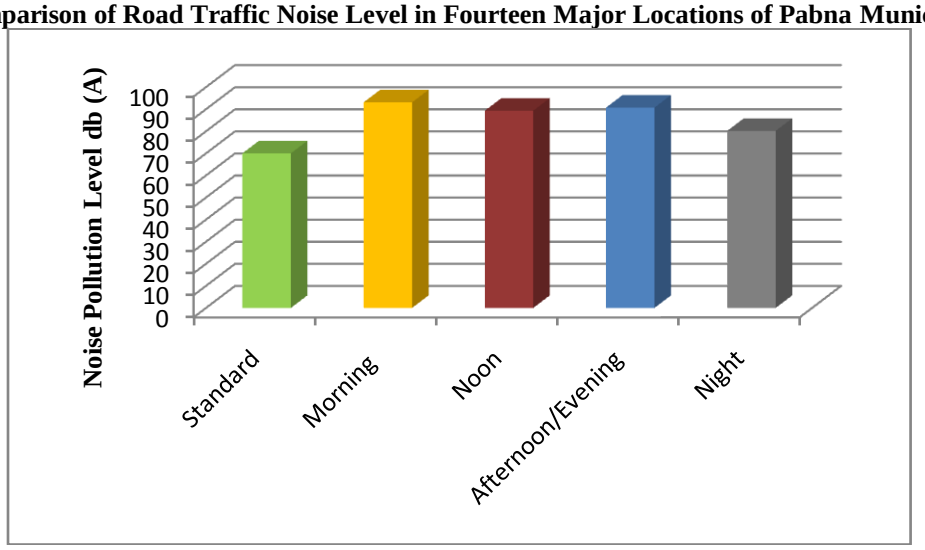

Figure 3: Average Noise Pollution Level Compared with Standard in Four Distinctive Times

4. Discussion

It was observed that noise pollution level was the highest in morning and afternoon/evening followed by noon, and lowest at night. This is due to the intense rush of people in the morning when the people of this populated city headed for their offices, schools, and their working stations; and afternoon/evening is the time when they come back their home.

Noise level was recorded maximum in Singa morr and Bypass terminal in morning and noon, because these two points are located on Dhaka-Pabna highway where heavy vehicles like bus, truck, auto-rickshaw, *nochhimon/korimon/bhotvoti* always moves. George court (Kachari morr) is the place where noise pollution level was highest in the afternoon/evening, because there two schools namely *Zila* School and Police Lines Schools is located on the north and south-west side. In the afternoon when these two schools closes, it creates a huge traffic

jam in this area and vehicles produce noise by honking. At night some temporary shops sit around Traffic morr and people do shopping there that hinder free moving of vehicles and obvious result is the noise pollution.
However, most striking findings was that noise pollution level was always above the standard in all the points compared to the standard for road traffic noise which is evident from Table-3 and Figure-3.
It was reported that High intensity noise for continuous periods is the major cause for ear damage. Children, exposed to excessive noise, show signs of behavioral disorder which in later age develop into destructive nature and neurotic disorders in the adult. If a noise level exceeding 90 dB in the mid-frequency range reaches the ear for more than a few minutes, then the sensitivity of the ear is reduced. In residential areas even low frequency noise of 50–60 dB at night disturbs sleep, particularly among the aged people, causing adverse effect on health. People who work and live in environment with no hazardous noise level, but over the years they suffer from progressive hearing loss and psychological hazards (De and De, 2009).

5.1 Noise Pollution Attenuation Strategies for Pabna Munnicipality

Pabna Municipality is an old city where population density is very high; around 4271 people are living in every sq. km (Banglapedia, 2012). The roads in the center of the municipality were not developed in a well-planned fashion and are very narrow. However, the following strategies could be adopted to reduce the noise pollution level:

Ecological Approach

Plants could be used to reduce the noise pollution level. Bushy ornamental plants might be planted to the both sides of road that will prevent the propagation of sound wave. Gratani (2013) was found that *P. tobira* and *L. nobilis* were the most efficient species in both CO_2 sequestration capability and noise attenuation.

Engineering Approach

Road side barrier structure could be developed by using built in piezo-material to convert mechanical wave energy of sound to electric energy.

Infrastructural Approach

I. Expansion of the road :

The roads in the inside the municipality near Panchmatha morr, Traffic morr and Govt. Girls School morr is so narrow that vehicles could not move smoothly, and it creates traffic congestion and as a consequences noise pollution.

II. Developing alternative traffic routes:

Some substitute traffic routes should be developed to reduce the burden of traffic congestion, such as adjoining Edward College gate morr and Thana morr.

III. Relocation of the illegal parking spots:

There are illegal parking spots on Bypass terminal, Panchmatha morr, Govt. Girls School Morr etc. that should be relocated in other place so that it couldn't be the problem of traffic congestion.

IV. Building design should be improvement:

The road side buildings should construct in such a way so that it could reduce the noise pollution problem.

Institutional Approach

I. Shifting of some institutions to another place:

Pabna Municipality is compacted within a small area with all the major Government and non-government institutions with the city. Therefore, shifting some institutions to other place will attenuate the level of sound.

II. Opening of school/colleges and other institutions in different time of a day:

When many people start their journey to the destination at a time, the vehicles creates noise pollution. For that reason, school/colleges and other institutions should start their activity in at least one hour later.

III. Checking the fitness of vehicles routinely:

Most of the vehicles don't have fitness certificate. Therefore it should be checked time to time.

IV. Banning local vehicles inside the Municipality:

Locally produced vehicles like *nochhimon/korimon/bhotvoti* create lot of noise. There is no silencer pipe or such other mechanism in these vehicles. Therefore, this type of vehicles should be banned inside the Municipality.

Behavioral Approach

People are not aware about the adverse impact of noise pollution. Therefore awareness and motivation program should be launched from the Government and other institutions.

5. Conclusion

Noise pollution level has augmented in developing countries with the enlarged number of vehicles which is the result of population growth. Noise pollution level was measured in fourteen major locations of Pabna Municipality.

Result revealed that noise level was always above the standard in all the points compared to the standard. Average noise level in morning, noon, and afternoon/evening and at night was observed 93.09, 89.30, 90.71, 80.17 dB (A), respectively.

It was observed that in the morning, noon, afternoon/evening, and at night the maximum noise level was observed in Singa morr, Bypass terminal, George court (Kachari morr), and Traffic morr, respectively. The minimum noise level in morning, noon, and at night was recorded in Gaspara morr, but in the afternoon/evening it was measured in Edward college gate.

Finally the author recommended that growing bush like ornamental plants to the both sides of road, piezoelectricity production from noise, expansion of the road, developing alternative traffic routes, relocation of the illegal bus-stops, and building design should be improvement to reduce noise. In addition shifting of the some institutions to another place, opening of school/colleges and other institutions in different time, checking the fitness of vehicles routinely, monitoring overloading of vehicles, banning local vehicles such as *nochhimon/korimon/bhotvoti* inside the Municipality, and raising awareness regarding noise pollution could be invaluable strategies to develop the Pabna as noise pollution free healty Municipality.

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