Status of Noise Pollution in Mixed Areas of Dhaka City: a GIS Approach

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Abstract

Noise pollution is one of the most harmful pollution. Uncontrolled noise of Dhaka city has made a serious and vulnerable situation for the dwellers. Mixed areas are used in multidimensional ways so the degree and intensity of noise pollution is often higher. In this regard, this study has been framed to explore the nature and vulnerability of noise pollution in mixed areas as well as to realize its impacts using GIS approach. Accordingly, an investigation has been carried out employing different field techniques in Ramna area which is a mixed area in nature and important part of the city. This study put an effort to determine the level of noise pollution and its zone of influence to know how far noise is affecting the socio-environment of the study area.

Keywords: GIS Approach, Noise pollution, Vulnerable area

Introduction

With rapid urbanization and industrialization, Dhaka city has become seriously noisy. Noise pollution is adversely affecting the environment of this city and causing physical and psychological problems, and thus become an alarming health hazard. In this densely populated city certain important areas are being used in multidimensional purposes that increase the potentiality for noise pollution. Environmental Conservation Act-1995 (ECA'95) and Environmental Conservation Rules 1997 (ECR'97), (Rule 12, Schedule-4) categorizes areas to point out standards of sound, and according to these legal instruments a "Mixed Area" is mainly a residential area, and also simultaneously used for commercial and industrial purposes. Ramna area has these certain characteristics. Ramna area is situated at the centre of Dhaka city and is one of the most vital parts of the city as well. A large number of important organizations, offices, hospitals, educational institutions, residences, park, etc. are situated in this area and associated major roads are very important for urban and national connectivity. As a result, many kinds of activities are practiced and many people are gathered in this place to participate in many types of activities. Consequently, a large number of vehicles are seen on the roads for transportation purpose. This situation leads the area to be one of the most vulnerable areas of the city in terms of noise pollution. The overall study objective was to explore various aspects of noise pollution in mixed areas of Dhaka city, particularly Ramna area. With a view to achieving this objective, this study aimed to identify the present level of noise pollution of the different points and important places of the study area and determining the extent of influence of noise pollution over various types of vulnerable institutions, offices, hospitals and residences along with the inhabitants to get a clear view of the impact of noise pollution.

Methodology

This particular study mainly depended on primary data sources where the data were collected through different processes. The processes are mentioned below-

Sound level data collection

The sound level data were collected from different points and vulnerable institutions, which were selected according to the importance and vulnerability. Data were collected from different points as well as 25 m apart from those points (most of the time) to determine variation of the influence of noise and to achieve representative mean value. The data collection process conducted in three-week days along with a holy day in every week over a month. Data collection process continued from 9 am to 8 pm in three shifts in a day. To determine the average sound value of the noise pollution, readings were taken repeatedly after certain interval. A-weighted sound levels were measured during the study. The 'A weighting' characteristic is simulated as 'Human Ear Listening' response. The data in every location were taken at three specific times of the day and they are: 9 am to 11 am, 12 pm to 4 pm, and 5 pm to 8 pm. The data were taken in two different day situations: working day and holidays. A location map and a sound level meter were always carried during the data collection period. All the data were recorded in computer for mapping and analysis. A portable digital sound level meter (model-Lutron-SL-4010) has been used to collect the data. The sound level

meter is built in the internal 'External calibration VR' on the front panel.

Data standardization

Several sound level data were taken at each location points and then, they were averaged to get the final value of sound level. The data were averaged because the sound level of a place varies due to different types of sources such as traffic signal, honking, crowd etc.

Data analysis and interpretation

For data analysis and interpretation GIS (Arc GIS 9.2) software was used. Noise level contour-lines and surface were generated on the basis of noise level data, which has been collected from the different points and important places of Ramna area. Noise level contour-lines were produced at the interval of 3dB and these contour-lines clearly depict the spatial variation of noise. The co-ordinate system projection was BTM. For tabular data analysis interpretation MS-Excel software was used.

Results and Discussion

a) The state of noise pollution in working days

In order to present the noise level status of the study area in working days two noise level maps have been produced. The first noise level map (Fig.-1) is derived on the basis of 'average highest value' of noise level at different points of the study area, while the second noise level map (Fig.-2) is derived on the basis of 'average lowest value' of noise level of the different points at study area (Ramna). Different aspects of noise pollution are mentioned below.

Most noisy points places

Fig.1 and 2, and Table 1 revealed that the most noisy places of the study area are (hav = highest average value and lav = lowest average value) Banglamotor (hav 86.7dB and lav 75dB), Shahbag - front of

BSMMU and BIRDEM (hav 85.6 dB and lav 75 dB), Maghbazar (hav 85 dB and lav 76.7 dB), Mouchak (hav 85 dB and lav 74.3 dB), Kakrail-Road Crossing (hav 84.6 dB and lav 73.7 dB), Hotel Sonargaon (hav 84 dB and lav 72 dB), Malibag-Road Crossing (hav 84 dB and lav 71.7 dB), front of Matsa Bhaban (hav 83.7 dB and lav 73.7 dB), Sheraton/Ruposhi Bangla (hav 83 dB and lav 71.3 dB), and Shantinagar-Road Crossing (hav 82 dB and lav 72.2 dB).

The impact zone of these noisy nodes influence many important and vulnerable institutions. The noise level maps (Fig.1 and 2) are very useful to identify the impact zones. The most noisy points along with their impact zones and the affected institutions, offices, residences and areas are described below along with their relevant level of noise.

Influence zone of Shahbag node covers vulnerable and important institutions like BSMMU and BIRDEM. According to Environmental Conservation Act-1995 (ECA'95) and Environmental Conservation Rules 1997 (ECR'97) the standard limit of sound for hospitals (up to radius of 100 meter) is 45dB, but the actual level is much higher than that (hav 85.6 dB and lav 75 dB, Fig. 1). The situation makes this zone more vulnerable as noise affects patients more harmfully.

Inside the impact zone of Shantinagar, clinics, mosques, Shiddheswari Girls School and residential areas can be found. According to the characteristics of the zone the standard sound limit is 45 dB to 50 dB (ECA'95 and ECR'97). But the actual highest and lowest average sound level (daytime) of this node is 82 dB and 72.2 dB (Fig. 1). So, this place is affected severely by noise pollution.

Kakrail impact zone also covers official and commercial as well as residential areas. The standard sound limit for this zone is 60 dB (According to ECA'95 and ECR'97 the standard limit of sound for mixed area is 60 dB). But the actual highest and lowest average sound level of this node is 84.6 dB and 73.7 dB, respectively.
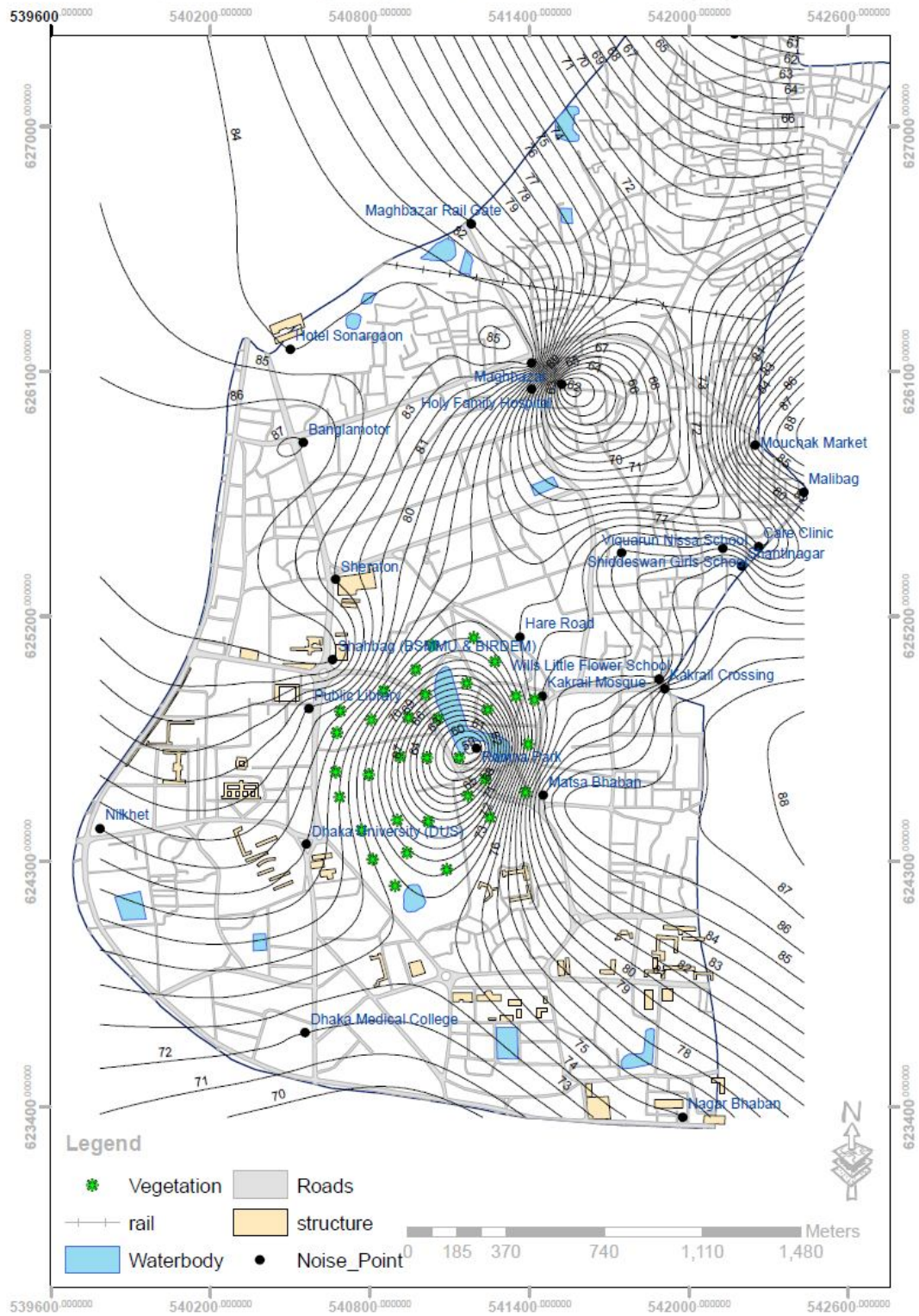
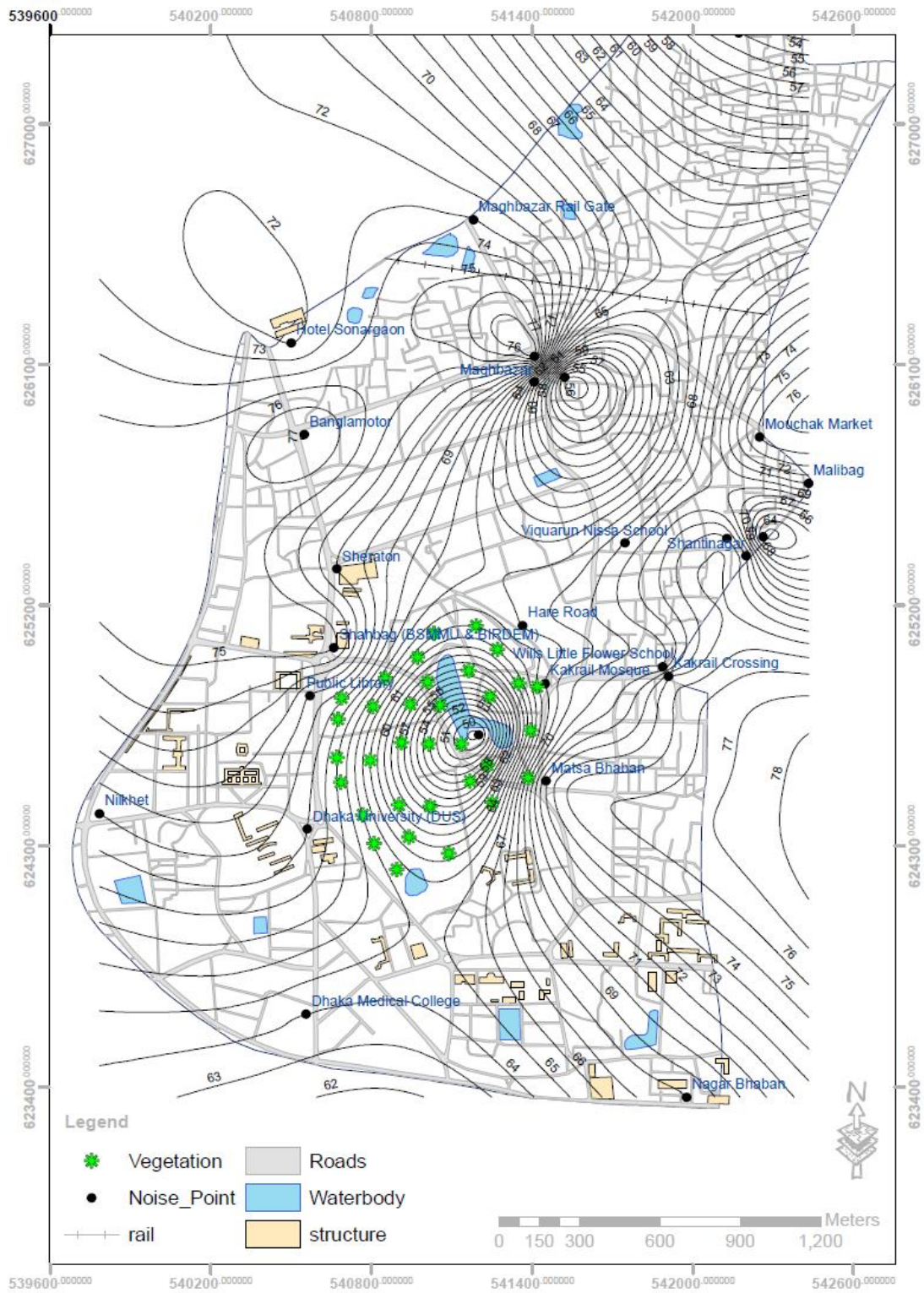**Fig. 1.** Noise pollution level in Ramna area (based on average highest value of noise on working day)

Fig. 2. Noise pollution level in Ramna area (based on average lowest value of noise on working day)

Table 1. Highest and lowest average value of noise level of three shifts and whole day (9am-8pm) in working days

	Places/Points	Morning (9am-11am)		Noon (12pm-4pm)		Evening (5pm-8pm)		Average Value (9am-8pm)	
		hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)
1	Malibag (Road crossing)	84.5	72	81	68	87	75	84	71.7
2	Shantinagar (Road crossing)	82	71	80	70.5	84	75	82	72.2
3	Kakrail (Road crossing)	85	75	82	70	87	76	84.6	73.7
4	Kakrail mosque	79	68	77	64	80	71	78.7	67.7
5	Front of Matsa bhaban	84	75	82	70	85	76	83.7	73.7
6	Shahbag (Front of BSMMU & BIRDEM)	85	75	84	71	88	79	85.6	75
7	Sheraton (Ruposhi Bangla)	83	69	81	70	85	75	83	71.3
8	Banglamotor	88	72	82	75	90	78.5	86.7	75
9	Maghbazar	85	78	83	77	87	75	85	76.7
10	Mouchak	86	74	85	71	85	78	85	74.3
11	Ramna park	59	50	56	50	62	51	59	50.3
12	Viquarun Nissa Noon school & college	79	67	81	72	80	70	80	69.7
13	Hare road	80	72	69	60	81.5	72	76.8	68
14	Maghbazar rail gate	81	72	80	71	83	75	81.3	72.7
15	Dhaka university (front of Public Library)	81	70	79	70	84	73	81.3	71
16	Dhaka university (front of DUS)	78	69	76	65	80	73	78	69
17	Dhaka medical college	72	64	68	61	72	66	70.6	63.7
18	Holy Family hospital	74	65	69	60	76	66	73	63.3
19	Ad-din hospital	63	55	58	52	65	58	62	55
20	Care clinic	77	65	72	60	78	67	75.7	64
21	Wills Little Flower school	81	73	77	66	82	72	80	70
22	Shiddheswari Girls school	80	73	79	70	82	74	80.3	72.3
23	Nilkhet	80	71	76	66	81	73	79	70
24	Front of nagarbhaban	76	69	72	63	77	72	75	68
25	Hotel Sonargaon	85	73	81	69	86	74	84	72
26	Madhubag	62	55	58	51	63	56	61	54

hav: highest average value; lav: lowest average value

Banglamotor zone mostly covers some commercial type of area. According to ECA'95 and ECR'97 the standard limit of sound for commercial area is 70 dB, but the lowest actual average value is 75 dB while the hav is 86.7 dB at Banglamotor. Mouchak is another commercial type of area, where the hav of noise is 85 dB and the lav is 74.3 dB. Situation like this makes the zone very much vulnerable. Matsa bhaban impact zone includes important official areas and organizations like Matsa Bhaban, Shilpakala Academy, and Public Works department etc. According to ECA'95 and ECR'97, standard for special establishments (up to a radius of 100 m) is 45 dB for daytime (6 am to 9 pm). But the actual lav (day time) exceeds the standard limit, while highest is 82.dB. Malibag and Maghbazar are the mixed areas, so the standard limit is 60 dB but the actual limit is too high (Malibag-hav 84 dB and lav 71.7 dB, Maghbazar- hav 845 dB and lav 76.7 dB). Hotel Sonargaon impact zone also covers official and commercial as well as residential areas. At this point, the hav and lav is 84 dB and 72 dB, respectively where the lav are much higher than the standard limit. So, the inhabitants of these areas are in vulnerable situation.

The result implies that, socio-environment linked with this noisy impact zones are polluted considerably and have become very much vulnerable for the inhabitants.

Moderately noisy points/places
According to Fig. 1 and 2, and Table 1, the moderately noisy points of the study area are Magbazar rail gate (hav 81.3 dB and lav 72.7 dB), Dhaka university- front of Public library (hav 81.3 dB and lav 71 dB) and in front of Dhaka university snacks-DUS (hav 78 dB and lav 69 dB), Shiddheswari Girls school (hav 80.3 dB and lav 72.3 dB), Wills Little Flower school (hav 80 dB and lav 70 dB), Viquarun Nissa Noon school and College (hav 80 dB and lav 69 dB), Nilkhet (hav 80 dB and lav 68 dB), Kakrail mosque (hav 78.7 dB and lav 67.7 dB), Hare road (hav 76.8 dB and lav 68 dB), Care clinic (hav 75.7 dB and lav 64 dB), Nagarbhaban (hav 75 dB and lav 68 dB), Holy Family hospital (hav 73 dB and lav 63.3 dB) and Dhaka Medical college (hav 70.6 dB and lav 63.7 dB). Thus, it is clear that Dhaka medical college hospital, Holy Family hospital along with two clinics are affected by the moderate noise pollution. Dhaka

university and other educational institutions including Viquarun Nissa Noon school and college, Wills Little Flower school and Shiddheswari Girls school are affected by the noise pollution moderately. Nilkhet is adjacent to Dhaka university, and Nagarbhan is not so far from it. Both of these places are affected by the moderate noise pollution. Hare road passes through the important residential area which includes the residences of the ministers, policy makers and high Government officials. This residential area is also affected by the noise pollution, having 76.8 dB hav and 68 dB lav that usually exceed the highest standard limit (45 dB) apparently. This situation increases the state of vulnerability of the related socio-environment.

Relatively quiet points/places
Fig. 1 and 2, and Table 1 also shows that the less noisy or relatively quiet point/place of Ramna area is Ramna park. The hav of noise at this place is 59 dB while the lav is 50.3 dB. In this case, the vegetation cover of Ramna park acting as a barrier to noise waves and that significantly reduces the effect of noise.

b) The state of noise pollution in holidays

Holidays are comparatively less noisy than the working days, as most of the institutions remain closed and the amount of traffic flow also remains moderate. Table 2 shows the state of noise pollution in holidays and it clearly depicts that the situation is not satisfactory. In holidays, the high noise level influences most of the places/points that are influenced by the high noise level in working days too. Associated major roads of the study area play a vital role in urban and national connectivity, consequently the traffic flow remains moderately high in those roads even in holidays. Many of the city dwellers and day laborers perform jobs and business in holidays and they have to travel by buses and other vehicles, and people come to this area to visit park, to attend conference and for marketing purpose in holidays. Moreover, most of the time, many types of fairs and events are organized in this important area. Serious patients come to the hospitals in ambulances with honking siren in holidays too. Moreover, the hospitals are also adjacent to major roads that remain always busy. Consequently, the noise level remains serious even in holidays.

Table 2. Highest and lowest average value of noise level of three shifts and whole day (9am-8pm) in holidays

	Places/Points	Morning (9am-11am)		Noon (12pm-4pm)		Evening (5pm-8pm)		Average Value (9am-8pm)	
		hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)	hav (dB-A)	lav (dB-A)
1	Malibag (Road crossing)	74	62	70	59	79	68	74.3	63
2	Shantinagar (Road crossing)	72	62	68	59	78	69	72.7	63.3
3	Kakrail (Road crossing)	73	61	69	58	78	64	73.3	61
4	Kakrail mosque	67	51	67	52	75	67	69.7	56.7
5	Front Of Matsa bhaban	70	60	68	61	78	67	72	62.7
6	Shahbag (front of BSMMU & BIRDEM)	76	58	72	61	80	70	76	63
7	Sheraton (Ruposhi Bangla)	75	57	69	58	78	70	74	61.7
8	Banglamotor	77	61	68	59	81	69	75.3	63
9	Maghbazar	74	60	67	58	77	67	72.7	61.7
10	Mouchak	72	61	70	60	82	71	74.7	64
11	Ramna park	56	50	54	45	60	52	56.7	49
12	Viquarun Nissa Noon school & college	64	57	60	52	74	66	66	58.3
13	Hare road	65	58	61	53	71	61	65.7	57.3
14	Maghbazar rail gate	67	58	65	54	75	66	69	59.3
15	Dhaka university (front of Public library)	65	59	61	52	76	65	67.3	58.7
16	Dhaka university (Front of DUS)	62	50	60	49	75	63	65.7	54
17	Dhaka medical college	66	59	64	58	67	60	65.6	59
18	Holy Family hospital	66	58	62	53	74	60	67.3	57
19	Ad-din hospital	58	50	56	48	60	52	58	50
20	Care clinic	70	59	68	54	72	63	70	58.7
21	Wills Little Flower school	70	61	67	60	76	64	71	61.7
22	Shiddheswari Girls school	70	61	67	56	78	67	71.7	61.3
23	Nilkhet	71	61	68	60	79	64	72.7	61.7
24	Front of Nagarbhaban	69	59	67	57	73	62	69.7	56.3
25	Hotel Sonargaon	73.5	62	71	61.5	79.3	71	74.6	64.8
26	Madhubag	59	51	57	52	62	55	59.3	52.7

hav: highest average value; lav: lowest average value

As a result, in holidays at Ramna area, most of the roads and associated socio-environment is affected by the noise pollution. The most noisy points/places of Ramna area.

(in holidays) are Shahbag-Front of BSMMU and BIRDEM (hav 76 dB and lav 63 dB), Banglamotor (hav 75.3 dB and lav 63 dB), Mouchak (hav 74.7 dB and lav 64 dB), Malibag-Road crossing (hav 74.3 dB and lav 63 dB), Sheraton/Ruposhi Bangla (hav 74 dB and lav 61.7 dB), Kakrail-Road crossing (hav 73.3 dB and lav 61 dB), Maghbazar (hav 72.7 dB and lav 61.7 dB), and Shantinagar-Road crossing (hav 72.7 dB and lav 63.3 dB) and front of Matsa bhaban (hav 72 dB and lav 62.7 dB).

c) Noise pollution in educational institutions and hospitals

Hospitals and educational institutions are important and integral part of our socio-environment and these are also the most vulnerable places in terms of noise pollution as because noise can cause more harm to the patients, school going children and students. For this reason, ECA-'95 and ECR-'97 categorizes these places as silent zone where the standard sound limit is 45 dB (daytime) in this areas. Both hospitals and educational institutions are mainly much affected by the noise pollution in five working days. So in this case, only working days situations are considered. Observing the noise level maps along with Table-1, it can be realized that the hospitals and educational institutions are much adversely affected by the noise pollution in working days.

In the Ramna area, noise level data were collected from the front of large hospitals and clinics (within 100 m radius). Those areas are front of BSMMU and BIRDEM (hav 85.6 dB and lav 75 dB), Holy Family hospital (hav 73 dB and lav 63.3 dB), Dhaka medical

college (hav 70.6 dB and lav 63.7 dB), Care clinic (hav 75.7 dB and lav 64 dB), and Ad-din hospital (hav 62 dB and lav 55 dB). Most of the hospitals and clinics are affected by the influence of high noise level. This situation makes the patients most vulnerable and it would cause serious problems for the patients who are suffering from heart and brain diseases. The standard limit of sound for hospitals (up to radius of 100 m) is 45 dB, but it can be seen from the above-mentioned data that most of the cases the level of noise in front of those hospitals and clinics are far above the standard level. Even the lav are much above the standard.

Most of the educational institutions are adjacent to the major roads and that is why they are more affected by noise pollution. The affected educational institutions are Dhaka university- front of Public library (hav 81.3 dB and lav 71 dB) and in front of Dhaka university snacks-DUS (hav 78 dB and lav 69 dB), Shiddheswari Girls school (hav 80.3 dB and lav 72.3 dB), Wills Little Flower school (hav 80 dB and lav 70 dB), Viquarun Nissa Noon school & college (hav 80 dB and lav 69 dB). Standard level for educational institution is 45 dB at day (ECA'95 and ECR'97).In all the cases, the actual levels are much higher than that of standard limit and the lav is also not satisfactory. This situation increases the vulnerability of the students and noise can disturb the attentiveness of the learning of the students. So it is observed in this study, that this kind of important and integral part of socio-environment are affected by the noise pollution severely and become much vulnerable in the 'Ramna area'.
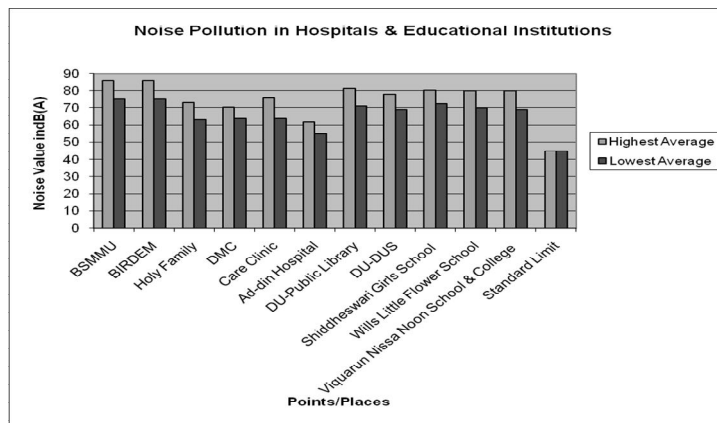

Fig. 3. Noise pollution in hospitals and educational institutions (in working days) at Ramna area

d) Time of highest and lowest level of noise

It is observed that noise level remains higher at morning (9 am to 11 am) and evening (5 pm to 8

pm), remains low at noon (12 pm to 4 pm). Noise level reaches at pick in evening (5 pm to 8 pm). Noise level increases at morning, as it is the beginning of office hours. That's why huge number

of people goes to office by many kinds of vehicles that create noise. At the evening and twilight hours, noise level reaches at the pick as traffic flow reaches a pick at that time. It is the closing time of offices and schools, more over a large number of people come out for marketing and other purposes in this time. Noontime is free from the opening and closing session, so the traffic flow at this time remains relatively lower than that of morning and evening.

Conclusions

With the increase of industrialization and urbanization, noise pollution has become more pervasive in urban settings of Bangladesh. As a mixed area and central part of Dhaka city, Ramna area is seriously affected by this phenomenon. This study reveals the current status of noise pollution as well as vulnerability due to it. Noise is adversely affecting most of the inhabitants of Ramna area. Though the level of noise fluctuates, most of the time it remains harmful. Consequently, fatal diseases like from deafness to heart attack caused by uncontrolled noise have become common.

Noise level exceeds the standard limit all most at every points of Ramna area that increases the vulnerability especially in hospitals and educational institutions. Noise is inducing different types of health hazards and creating more dangerous situations for the people who spend much time near the roads, like drivers, traffic police, roadside businessmen, patients and school going children as well.

As noise is an invisible killer, most of the people are unaware of this hazard. Even the policy makers are not well informed and thus the problem remains out of focus and due attention. A significant change in viewpoint of administrators, legislators, elites of the society, high officials etc. towards noise pollution is very much essential for the proper control of noise pollution. The drivers, traffic polices and all other concerned citizens must be aware of his role in mitigating noise from roads and other sources. The role of government is very important towards the control of noise pollution. The government may take initiative in making proper legislations and regulating measures for this purpose and can take measure like import of required sound control machineries, research materials, and silencers etc. At present, there is very little propaganda against noise pollution and commoners are not aware of the severe consequences of noise pollution, so electronic and print media can make an effort to aware the people about this problem.

References

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