

An Analysis of Noise Pollution Based on its Causes and Effects over Commercial Areas in Rajshahi City

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Abstract

Noise pollution has become a significant concern with urbanisation in the Rajshahi City of Bangladesh. Like many other Metropolitan Cities, the Commercial activities of Rajshahi is flourishing rapidly all over the city. Herewith, this paper has been explained how noise pollution is closely related to commercial activities. Shaheb Bazar and Its Surrounding areas, the nucleus of the commercial activities, have been selected as study areas. This research aims to identify the leading cause of noise pollution and highlight the variation of sound effects in the specified areas. Data were collected using a questionnaire survey. The 'Stratified sampling' method was applied with a 90% confidence level and 10% margin of error. The collected data were analysed using graphs and charts with the help of Microsoft Excel. From the observation, it has been seen that almost 63% of vehicles cause

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noise pollution most. Among them, Auto Rickshaws (27%) and Private Cars (17%) are the primary sources of noise pollution. During some particular times, especially at 5–8 pm (37%) and at 8–10 pm (41%), noise pollution exceeded the acceptable limit at almost all the locations. This paper will be a future possibility to conduct further studies on this field. Besides, it will help to find the strategies to reduce excessive noise and provide some techniques for improving the traffic system.

JEL Classification Q53 · Q56 · O18

Keywords Noise Pollution · Urbanization · Industrialization · Metropolitan City · Stratified Sampling

Background of the study

Noise pollution is the unacceptable level of sound that creates annoyance, mental hamper, headache, physical disorder, stress on the auditory and nervous system, and induces severe damage. As Rajshahi is one of the largest and divisional cities of Bangladesh, Noise pollution in Rajshahi is becoming more and more acute, and other pollution like air, water, and odour, waste. As a Metropolitan area, commercial and other activities is developing rapidly all over the city. With the increase of urbanisation, population, the number of industries, market place, crowdie recreational place and even vehicle movement in the city is increased causing noise pollution- closely related to commercial and other activities.

This research study determines the significant causes of noise pollution of Shaheb Bazar, the nucleus of the commercial activities of Rajshahi City, and also its surrounding areas to show the relationship between the commercial area and noise pollution. Then, every data under the noise pollution was analysed. The research is expected to deal with the commercial area's sound pollution and cover every highly noise-able area.

The survey area was not available to express the noise pollution mainly because we were picked only five locations for this research. On the other hand, our survey sample size was not too large. So, we cannot increase the sample size for the shortage of timing. Resources and workforce both were limited for this purpose. Health complexes and residential areas could not be joined because of the time restrictions.

Literature Review

Noise pollution displeases human, animal or machine-created sound that disrupts human or animal life (Wikipedia, 2010). According to the World Health Organization (WHO) statement, noise is considered the third most hazardous pollutant in large cities. Nearly 5% of the world population faces several kinds of

health hazards due to the complexities related to noise pollution. Around 11.7% of the population in Bangladesh have already lost their hearing due to noise pollution, says the DoE study, which was conducted in 2017. According to the guidelines, exceeding the maximum noise level in a particular area is a punishable offence.

Table 1: Human tolerance for different noise levels

Noise Level	Maximum duration of exposure
75dB	Comfortable for human hearing
90dB	Two and half hours
100dB	15 minutes
110dB	30 seconds
120dB	9 seconds
140dB	1 second

Source: World Health Organization, (2002). *The World Health Report 2002: Reducing Risks, Promoting Healthy Life*, World Health Organization.

Microsoft Encarta (2007) defines environmental noise pollution as the exposure of people or animals to the level of sound that is annoying, stressful or damaging to the ears. In order to check noise pollution, the government has introduced Bangladesh with the Sound Pollution (Control) Rules, 2006. The WHO also declared that "Worldwide, noise-induced hearing impairment is the most prevalent, irreversible occupational hazard". It is estimated that 120 million people worldwide have disabling hearing difficulties. In 2002, the European Union adopted the Directive 2002/49/CE20[8] regarding the management and assessment of environmental noise to reduce and control sound pollution using a common approach and prevent or avoid the harmful effects of noise exposure. A

Table 2: Noise Levels in Major cities in Bangladesh

City	Highest	Lowest
Dhaka	132dB	47dB
Sylhet	131 dB	50dB
Khulna	132dB	42dB
Barishal	131dB	54dB
Rangpur	130dB	46dB
Rajshahi	133dB	56dB
Mymensingh	131dB	54dB
Chattogram	133dB	47dB

Source: Environmental Conservation Report (1997) *The Environment, Conservation Rules 1997*, Ministry of Environment and Forest, Govt. of the People's Republic of Bangladesh, Department of Environment, Bangladesh.

government survey shows that sound levels in every divisional city of Bangladesh have surpassed their permitted limits.

Conservation Rules 1997, Ministry of Environment and Forest, Govt. of the People's Republic of Bangladesh, Department of Environment, Bangladesh.

The major sources of noise pollution in urban areas are traffic and loud horns. Other causes of noise pollution include loud music during social, political, and religious programs, construction work, and factory noise.

US-based Center for Hearing and Communication (CHC) founded this yearly event in 1996, to be observed on the last Wednesday of April, to raise awareness about the harmful impact of noise pollution, both after short-term and long-term exposure and to encourage people to do something about bothersome noise where they work and live.

Table 3: Maximum noise levels in different areas

Areas	Maximum noise level
Residential zones	55dB at 6am-9pm; 45dB at 9am-6am
Hospital, education, institutions, place of worship	40-50dB
Public areas, i.e. markets, playgrounds, parks	60-70dB
Commercial or industrial areas	70-75dB

Source: Bangladesh Noise Pollution (Control) Rules, 2006

Methods and Materials

Exclusiveness of study area

Rajshahi metropolitan city is known as an educational city, mid-western city of Bangladesh. Three large, renowned public educational institutions and other schools and private universities. Vehicles and other commercial activities produce so much noise in the Shaheb Bazar area, one of the most commercial points of all necessary needs. That is why various points of Shaheb Bazar such as Alupotti, zero point, 'Moni chattar, Shonadhigir mor, Batar mor are selected for the study area. This commercial zone has different commercial shops and services. Such as, Alupotti has various types of shops (Grocery, Bakery). Zero-point is highly populated and has many vehicles plying on the road, which creates intolerable noise. Moni chattar is crowded because of Kacha Bazar and one school and college also very close to this place. Shonadhigir mor road is connected with Moni chattar, and this road has many book shops, many photocopies and Photostat shop. Batar mor consists of the shoe shop, boutique shop, homoeopathy chamber. Thus it is clear that these points are so crowded with people for following activities. For this reason, the study is conducted to analyse these perspectives.

Rajshahi, nicknamed Silk City in Bangladesh and major urban, commercial & educational centre of North Bengal. The city is located on the north bank of Padma River, near the Bangladesh-India border. Rajshahi district was established in 1772. The total area of the district is 2,425.25 sq. km. The city has a population of over 763,952 people. It also has two satellites- Nowhata and Katakhal, which build an urban agglomeration of about 1 million people. Rajshahi city is bounded by Naogaon district on the north, west Bengal of India, the Padma and Kushtia district on the south, Natore district on the east and Chapainawabganj district on the west. The city consists of one city corporation, including four metropolitan thanas, 30 wards, 170 mahallahs and 9 Upazilas, 71 unions. The economy of the Rajshahi district is agriculture, but the urban area of this district has other economic activities, so the city is growing and getting populated day by day. The city is also assuring modern urban facilities to the people.

In the survey area, analysing the demographic condition, it is found that males were comparatively greater than females. As Shaheb Bazar is a commercial area, male people go there more for their occupation, but female people do not. 51% were male and 49% female.

Age range: Age group is also a part of the demographic survey as the analysis work for the effect of sound on the level of people, and different age group of people suffer from various effect. For proper analysis purposes, age was classified into five ranges: 10-18, 19-25, 26-30, 31-40, 40 - above. The age range is classified based on their work purpose at Shaheb Bazar area- it is seen that age between 10-18 year of people is 26%. 26-30 years is 17%, 31-40 years is 15%. 40, or to above-aged people is 31%.

Occupation: Peoples occupation is also analysed in the demographic part. From the pie chart, it is seen that a significant number of people who go there are businessmen or students, people of other occupation are also observed at the area like a banker, hawker, service holder, salesman, teacher, shopkeeper. The people in business were 28%, the student was 26%, the shopkeeper was 4%, the teacher was 9%, salesman were 11%, bankers, hawker, retired, doctor, day labourer are significantly less in number like 2%, 4%, 4%, 4%, 2%. Respectively (see Table 4). people of all occupations go to Shaheb Bazar for various purposes as it is a city.

Existing road condition

Road condition means various factors that influence the overall experience of the people who use it and those who stay around the road. For the study, it is essential to analyse the impact of road conditions on noise pollution.

Table 4: Survey results

Indicator	Value (%)
1. Occupation	
Student	26
Retired	4
Banker	2
Teacher	9
Day labour	2
Business	28
Shopkeeper	4
Doctor	4
Hawker	4
Salesman	11
2. Status of human congestion	
Yes	69
No	31
3. Sources cause sound pollution most	
Vehicles	90
Speakers	6
Mike	2
Machine	1
Others	1
4. Types of vehicles that cause sound pollution most	
Car	5
Bus	11
Truck	4
Auto rickshaw	36
Easy bike	12
Laguna	14
Motorbike	18
5. Purpose of coming at Shaheb Bazar and its surrounding	
Shopping	48
Recreation	19
Ad Word	11
Others	22
6. Physical difficulties faced by people	
High BP	8
Deafness	10
Headache	45
Heart disease	4
Lack of concentration	10
Insomnia	10
Short temper	13

Source: Authors' survey, 2019

Road surface: Rahman and Hasnat's study (2018) showed that in Rajshahi, 13% of roads were in primary broken condition, 28% of roads were in intermediate broken condition, and 8% of roads were in the tertiary broken condition in every 10km road length. Nowadays this broken road condition is not improved every area.

Road width: At the particular area, most of the people provided that the width of the road is sufficient for the moving of transport. Almost 57% of people say "Yes". Besides, 43% of people say negative reviews about the sufficiency of the road and ramp. People said that Alupotti to Shaheb Bazar road width was sufficient for transport movement and other work. Most of the people provided that the width of the Alupotti to Shaheb Bazar road was sufficient, but Shonadhigir Mor and Batar Mor road were not sufficient for the moving of transport and other work.

Road intersection: In this study, every route has an intersection point. In this study, there have not no signal facilities in these intersection points. So, the sound level is higher in the intersection points and create noise pollution most. It may be possible to remove sound pollution in a small amount by providing good traffic rules, signals, and traffic police at the intersection point of the road.

Days of high sound level: we noticed that during the working day, the level of sound is very high. Because all types of Workshops, Market, Bazar, Schools are open in the working day. Different types of people are going to the Zero point, Alupotti, Shaheb Bazar area for different reasons by Auto rickshaw, easy bike, motorbike, car, leguna. So, these all journey's mediums were created a high sound level in the working day. On the other hand, during the weekend day, the level of sound was shallow. Because all types of workshop, Market, Bazar, School are not open in this day.

Time of high sound level: During some peak hours, the sound level was very high. Mainly 5–8 pm, the level of sound was as it is high level. However, we can see the same percentage of sound level at 10 am-2 pm, which is 12%. At 5–8 pm, the sound level was extremely high because every type of people came to the Shaheb Bazar, Alupotti, Moni chatter, Shonadighi Mor and Batar Mor for different types of work. At 2–5 pm, the level of sound was 13%.

Signal: We observed five major intersection points of Alupotti mor, Zero point, Moni Chattar, Shonadighir Mor and Batar mor. Almost all vehicles run here like Auto rickshaw, rickshaw, bus, truck, motorbike, car. Especially the number of Auto rickshaws gets too much in pick hours. However, the width of the road is only 20 feet with just two lanes. About 100 meters before the intersection point, there is a foot over the bridge for the passers-by, and there is a vital road divider made of hard iron. However, people want signal facilities too: Shonadighir mor

and Batar mor create less traffic and sound. So people have mix mindset here about the signal post. So the overall estimation stands that 85% of people think signals are not efficient and only 15% are satisfied with the present condition.

Parking: Parking facilities are pretty good in some areas. However, most of the area has not well-decorated parking. On-street parking is the most attackable problem in Rajshahi city. It is the leading cause of traffic jams and traffic congestion.

Existing commercial activities

To analyse the influence of commercial activities on noise pollution of Shaheb Bazar, the existing commercial activities is critical as a complex variable. Rajshahi is called 'The City of Education'. Two major Universities, one public medical, National universities, private universities, schools, and colleges are the city's major features. So a big part of the population of Rajshahi City is covered with the students. Also, Rajshahi is a Metropolitan city. So the students are one of the main factors for business here. Apart from students oriented business, general commercial activities also run here fluently. Saheb Bazar and its surrounding area are mainly known for its commercial activities as it is the city's nucleus. Different types of commercial activities are run here by the people. Many types of shops, offices, banks, restaurants, residential hotels are the main features of this area. So, people are closely engaged with this activity in different ways. From the above chart, we observed that. In this particular area, a large number of people were working in the shop. Almost 51% of the population engaged with this activity. Besides, there were a good number of people works in various types of activities such as Restaurants (25%), Offices (14%), Banks (8%) as well as shops (2%).

Results and Discussions

Causes of noise pollution: To identify the leading causes of noise pollution, the study requires identifying the possible causes that affect the selected points. Road facilities and human congestion are some of the significant traits of the Shaheb Bazar area.

Noise pollution is closely related to road facilities and a well-organised transportation system. Road facilities indicate the road's width, the efficiency of signals, pedestrians' facilities, parking facilities, traffic control system, foot over bridge, impact of hawkers and street food court. These all are part of a sound transportation system. The intensity level of noise depends much on the transportation system and how the road facilities are designed. It has a profound impact on noise pollution. If this indicates that it cannot be adequately maintained, the traffic system collapses, and traffic congestion increases. So, the level of sound also increases with the increase in traffic congestion.

Human congestion also influences noise pollution. 69% of people think human congestion is one of the reasons for producing noises. However, 31% of people think human congestion is not a big deal and vehicles, mike and others create noise. Our study area is the core area of Rajshahi city, and many people gather there every day for a different purpose. So human congestion is widespread there.

According to the survey, 5-8 pm is when human congestion is too high because within this time people usually return from their office work and it is 47%. It becomes 27% when the time duration is 2-5 pm which is slightly lower. At 12-2 pm, the flow of humans is 13% as everyone has already engaged with their work at the office or other workplaces. At 10 am-12 pm, 8% of human flow within our survey area.

It is the time when people start for their respective from home. 8-10 am the time with of very early morning. So it is noticeable with the low human flow. Thus we can see gradually decreased human flow as time decreases.

Variation of sound

Sources: According to the people, different sources play a vital role in producing sound pollution. Among them, vehicles are the primary source of the noise. As our target area is full of different vehicles and these keep passing with numerous sounds, 93% think that vehicles pollute the sound most. On the other hand, 6% has said noise creates due to speaker.

In that area, different shops use speakers for different reasons and sometimes for no reason, which makes the sound polluted. Just 1% said mike. However, we have seen machine shops and other activities that may create noise, but according to those people, these things do not.

Vehicles: The people of Rajshahi are widely used auto-rickshaws for movement purposes. For this reason, a large number of Auto rickshaws (36%) cause sound pollution most by giving unbearable horns. Besides, many people are using Motor Bikes for their daily activity, and these also bears a great significance for sound pollution (18%). As Laguna is one of the cheapest transport, this has been widely used in Rajshahi City and also bears great importance for polluting sound (14%).

Besides, many buses (Specially University Buses) cross through the Shaheb Bazar area, also creating sound pollution (11%). At last, there are also trucks (4%) and cars (5%) who bear a great significance for sound pollution. Lack of proper parking facilities also bears a great significance for creating traffic congestion by providing proper traffic facilities, such as adequate traffic signal, traffic policies, and a temporary parking area. Among the five areas, zero point is the most congested and noisiest area.

Intensity: Most people face various types of problems on a large scale due to noise pollution. However, their knowledge about sound level standards, as we found, was low. The research also found that the people are unaware of the Noise Pollution (Regulation and Control) Rules, 2006 and very few have seen the implementation of this law.

Secondary data and literature review have determined the average intensity noise level (dB) of each study area as followings:

Table 5: Acceptable Noise level for different areas according to the Noise Pollution (Regulation and Control) Rules, 2006

Area	Daytime (6.00 am-9.00 pm)	Night (9.00 pm- 6.00 am)
Residential area	55 dB	45 dB
Quiet places	50 dB	40 dB
Mixed areas	60 dB	50 dB
Commercial areas	70 dB	60 dB
Industrial areas	75 dB	70 dB

Source: Secondary Data, Pronob Das, Zaikrul Haque, Akhter, 2017

Average noise intensity level (dB): (According to selected point)

Intensity (in respect of time):

The intensity in respect of time according to the selected area is given below:

Zero-point: The graph shows that during 8-10 am, 10-12 am, 12-2 pm, 2-5 pm and 5-9 pm, the intensity of noise level exceeds the acceptable limit. Among these, during 2-5 pm, the intensity is too much, and it is 115 dB.

Moni chattar: The graph shows that during 10-12 am, 12-2 pm, 2-5 pm and 5-9 pm, the noise level intensity exceeds the acceptable limit. Among these, during 2-5 pm, the intensity is too much, and it is 105 dB.

Alupotti: The graph shows that the noise level intensity exceeds the acceptable limit during 6-8 am, 8-10 am, 10-12 am. Among these, during 12-2 pm, 2-5 pm, 5-9 pm, the intensity is too much, and it is 115 dB.

Shonadighir mor: The graph shows that during 12-2 pm, 2-5 pm and 5-9 pm, the noise level intensity exceeds the acceptable limit. Among these, during 2-5 pm, the intensity is too much, and it is 90 dB.

Batar mor: The graph shows that during 6-8 am, 8-10 am, 10-12 am, the intensity of noise level exceeds the acceptable limit. Among these 2-5 pm and 5-9 pm, the intensity is high at 98dB and 80 dB, respectively.

Purpose of coming to Shaheb Bazar: Shaheb Bazar and its surrounding is commercial area. There are various libraries, Stores, Groceries, Katcha Bazar,

Market (RDA Market), pharmacy, Pastry Shop, and Hawkers shops. Most of the people are coming here for shopping purposes (48%).

Physical difficulties: Sound pollution causes various types of physical difficulties. People working or visiting the Shaheb Bazar and its surrounding areas are affected mainly by headaches (46%). Besides, those are working in these areas also affected by short temper (14%), lack of concentration (10%), as well as insomnia (10%). Most of them are below 40. the people who are above 40 are affected mostly. They are also affected by Deafness (10%), High BP (8%) as well as Heart Diseases (2%). Because of this difficulty, they cannot correctly concentrate on their work. It also causes an excellent hamper for their body as well as health. Besides, many people said that they were not affected by any types of difficulties as they were used to with these troubles. Most of them were middle-aged. By taking the proper necessary steps, we can reduce noise pollution and get rid of this problem.

Conclusion

The study has found some interesting findings. During the survey, it is found that the sound level is very high in the working day due to all types of workshops, market places, Bazar, school. As our study area is the CBD of Rajshahi city, people have to go there for different reasons, the leading cause of noise during working days. The road width is insufficient, according to the survey data. Available transport mode is an easy bike that has no particular stoppage.

For this reason, a considerable number of easy bikes and their wrong parking spaces create traffic jams in that area. Surprisingly, about 31% of people do not consider human congestion the main reason for noise pollution. The study has stated that at 5–8 pm, more humans congested our study area, which makes the sound polluted. Different types of physical difficulties are faced. Headache, insomnia, lack of concentration, heart diseases are some of them. There was no traffic signal or particular traffic role of vehicle transportation there.

The survey's primary recommendation is to widen the road, construct over bridge and speed breaker, provide perfect traffic signal, maintain the traffic rules strictly, provide proper parking facilities, and release hawkers from the footpath.

To conclude, we must take noise pollution very seriously. There are a lot of harmful effects of noise pollution on human health, and we must do all we can to help prevent, control, and manage noise pollution in our environment. We must employ various noise control techniques and do the best we can in stopping noise pollution. We can control noise pollution through proper urban planning and separating residential areas from industrial areas. We must protect our environment from noise pollution.

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