A STUDY ON VEHICLE INDUCED NOISE POLLUTION USING GIS IN DHAKA CITY

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ABSTRACT

In this study, overall roadside environment of selected locations in Dhaka city has been focused concentrating on degradation of the environment through noise. For the study of noise pollution, noise level was measured at some severely exposed as well as sensitive locations of the city. It is inferred that average level of noise at roadside exceeds the allowable limit to a great extent at all the locations and sensitive locations like hospital, school, mosque etc. The deviation from standard limit was found high. The collected data were analyzed by GIS symbological analysis & plotting several graphs and comparisons were made with acceptable level of noise provided by Department of Environment (DOE), Bangladesh (ECR, 1997). Comparison showed that noise pollution at all the locations is higher than the acceptable limit. Several measures were proposed to reduce the level of noise pollution in the city as well as stabilizing the existing condition which include enhancing mass consciousness, construction of noise barriers and implementation of proper monitoring system to reduce traffic noise.

Keywords: Aggregate; crushed stone; aggregate-cement bond; crushing method.

1.0 INTRODUCTION

Noise, commonly defined as unwanted sound, is an environmental phenomenon to which we are exposed before birth and throughout life. Noise pollution (or environmental noise) is displeasing human or machine created sound that disrupts the activity or happiness of human or animal life. A common form of noise pollution is from transportation, principally motor vehicles. If the prevention of environmental pollution and the preservation of the nature i.e. environment are to be achieved, then consideration for the environment must become an indispensable part of the development of road plans. Especially for a city like Dhaka which has over the years grown into a mega city, the roadside pollution problem is acute and is reported to be serious and damaging to public health.

1.1 Roadway Noise

The intensity of roadway noise is governed by the following variables: volume of traffic flow, traffic speed, and proportion of heavy vehicles, distance between source and receiver, roadway surface, tire type, roadway geometries, terrain, micrometeorology, and the geometry of area structures. Noise on roads is caused by engine of the vehicles, its exhaust, horn, brakes, friction between tires and road surface.

1.2 Noise Problems in Bangladesh

Vehicles horns are abused by drivers, horn is used to get right of way, strength of horn decides the power of vehicles, existence of non motorized vehicle on the same track encourage the use of horn, many vehicles have no side/rear view mirror especially non motorized vehicles- compel follower to use horn, use of hydraulic horn, most drivers like horn signal than light indicator signal for lane changing.

1.3 Health Effects in Dhaka City

The survey regarding noise pollution was performed by Geography & Environment department of Jahangirnagar University. 100 people were interviewed among different professionals like doctor, traffic police, driver, teacher, student, businessman & service holders. It was found that all of them were invaded with diseases due to excessive exposure of noise pollution. (Jahangirnagar university, Geography & Environment department. 2001-02).
The diseases which attacked among 100 people were as follows:

Bad headache, temporary tear loss = 12.31. %, fatigue = 17.58%, insomnia =14.36%, irritability = 27.57%, hear diseases = 25.80%, others = 2.64%
The acceptable noise level for different areas recommended by Bangladesh Department of Environment (DOE)

1.4 Acceptable Limits of Noise (Bangladesh Standard)

Description of area	Noise level dB (A)	
	Day Time	Night Time
i) A sensitive area where quietness is of primary importance	45	35
ii) Residential areas	50	40
iii) Mixed areas, which are, used as residential areas as well as	60	50
iv) Commercial areas.	70	60
v) Industrial areas	75	70

Table 1**. Acceptable Noise Level for Different Areas: Source:** Environmental Pollution Report (1998), Department of Environment (DOE), Government of Bangladesh, Dhaka.

2.0 INTRODUCING GEOGRAPHICAL INFORMATION SYSTEMS (GIS)

GIS provides a comparatively new mechanism for capturing geographic knowledge.

A GIS is a system for management, analysis and display of geographic knowledge, which is represented using a series of information sets.

These information sets include the following:
Maps and globes, geographic datasets, data models, processing and work flow models, metadata, descriptive attributes.

The Steps in a GIS Project

In a typical GIS analysis project, it is identified the objectives of the project, created a project database containing the data needed to solve the problem, using GIS functions to create an analytical model to solve the problem and presenting the results of the analysis.

a. Identifying the objectives

b. Creating a project database

c. Analyzing the data

d. Presenting the results

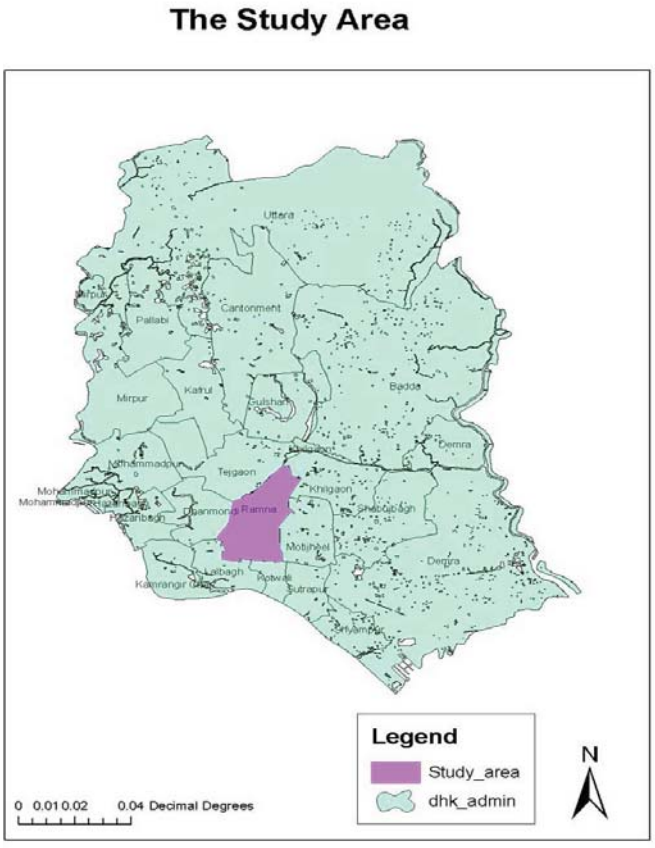

Figure 1. The Study Area in (Source: Department of Environment,)

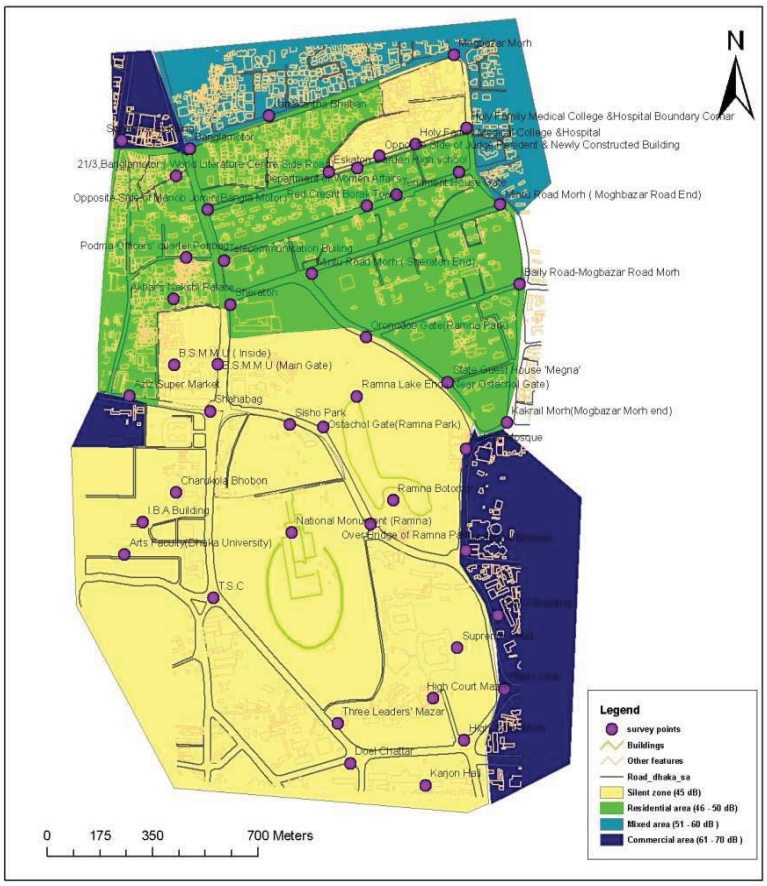

Figure 2. The Study Area with Survey Points in Dhaka City Based on Acceptable Noise level for Different Areas according to Department of Environment, Bangladesh

2.1 Site Selection & Location

The site selection was done in such a way that almost all categories of noise affected areas could be represented in this study so that the scenario of noise pollution in Dhaka city could be reflected. The study location was a part of Dhaka city which included mainly Ramna Thana. **Figure 1** and **Figure 2** shows the location map of the study area. Site location points were shown in the map. Data were collected at 48 places. The study area was one of the most important parts in Dhaka city; all these areas constitute the major commercial, social, educational and other activities in the city.

3.0 OBJECTIVES OF THE STUDY

The objective of this study is to investigate the level of noise pollution produced from traffic vehicle movement and to find out possible solutions for a selected zone in Dhaka city from the perspective of public health and transportation planning. Therefore, the specific objectives are as follows:

a. To show the hourly variation of noise level for working day and holiday.

b. To develop maps showing noise level at different locations in the study area at different time using GIS.

c. To evaluate whether the noise level at different points are alarming or non alarming with respect to acceptable limit for both working (W.D) and holiday(H.D)

4.0 METHODOLOGY

4.1 Field Survey and Data Collection

A preliminary survey was performed in order to get an overall idea of the study area and also to prepare a schedule of the data collection procedure of the entire area in a systematic way.

4.2 Noise Level Measurement

Noise level data were collected from the study zone using noise meter. The data showed by the noise meter was directly in decibel (dB). The instrument for measuring noise is the basic sound level meter, which consists of a microphone that converts the pattern of sound pressure fluctuations into a similar pattern of electrical voltage, amplitudes, and a voltage meter that is normally calibrated to read in decibels. Data were collected for different specific locations in the study zone in hourly interval. These were taken for both working day and holiday.
Decibels are measured, most commonly, on the A, B, and C weighting scales. There is also a G-weighting scale that is used to measure infrasound (extreme bass frequencies below 20 Hz).

A. Most commonly used. Basically, it indicates how annoying a noise source might be. This scale underestimates annoyance levels for frequencies that occur below about 200 Hz and is less sensitive to very low and very high frequencies. Boom cars emit high-intensity/low frequency sound, which this scale will not record accurately. This scale is sensitive to soft sounds at around 40 dB. Designated by dBA or dB (A).

B. Rarely used. It is sensitive to medium sounds around 70 dB. Designated as dBB or dB (B).

C. Sensitive to loud sounds at 100 dB and above. Most closely corresponds to the un weighted measurement of SPL. Also picks up low-frequency sounds given off by artillery fire and outdoor rock concerts. Written as dBC or dB(C).

In this study, A weighting scale was used.

5.0 DATA ANALYSIS & RESULTS

5.1 Hourly Fluctuation of Noise

The noise levels vs. time graphs of fourteen hours (6 am to 7 pm) for forty eight survey points were plotted for both working day and holiday.
It was found that at most of the places highest noise level occurred at 9 am to 10 am, at 12 pm to 2 pm and at 5 pm to 7 pm. Minimum noise level occurred at 6 am.
For working day the lowest noise level was found as 16.7 dB at Charukola Bhaban at 6 am and highest noise level was found as 99.8 dB at Aurunodoe Gate (Ramna Park) at 5 pm.
For holiday the lowest noise level was found as 12.8 dB at 6 am at Charukola Bhaban and highest noise level was found as 91.6 dB at Mogbazar Intersection at 1 pm.
Figure 3, Figure 4 & Figure 5 shows the Hourly variation of Noise Level at B.S.M.M.U (Main gate), T.S.C and Holy Family Medical College & Hospital for W.D & H.D

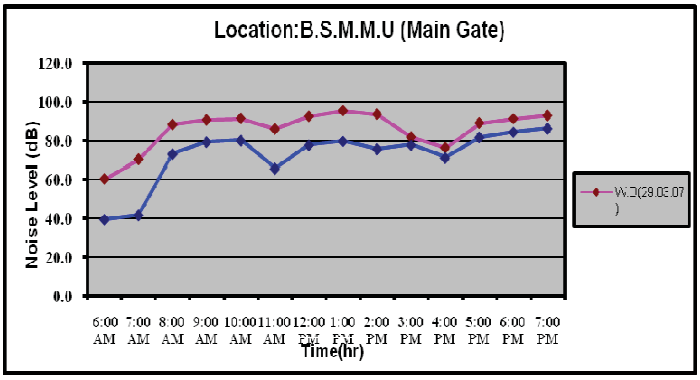

Figure 3. Hourly variation of Noise Level at B.S.M.M.U (Main gate) for W.D & H.D

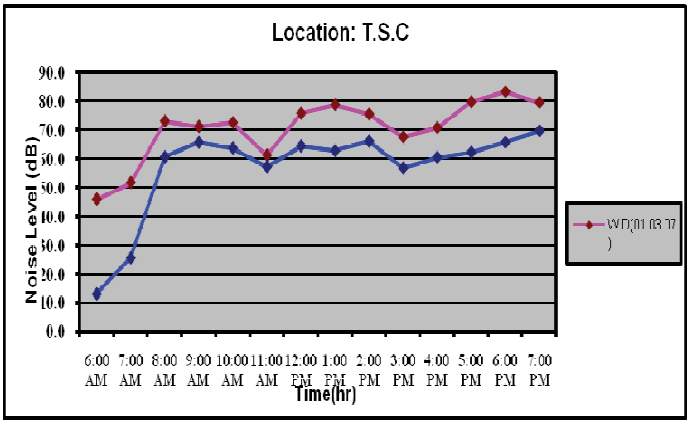

Figure 4. Hourly variation of Noise Level at T.S.C for W.D & H.D

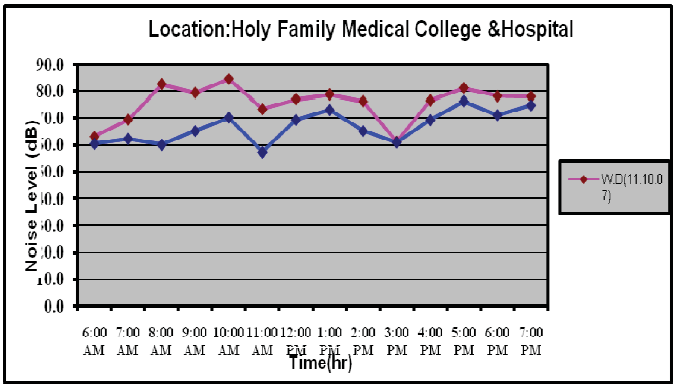

Figure 5. Hourly variation of Noise Level at Holy Family Medical college & Hospital for W.D & H.D

5.2 Spatial Variation of Noise Level

From GIS symbological analysis of the study area the spatial variation of noise level at survey points were examined.

The noise data were collected at forty eighty points in the study zone from 6 am to 7 pm and the noise level variation was classified into following ranges: <45 dB, 45-50 dB, 61-70 dB, 71-80 dB and >80 dB for working day and holiday.

The noise level at various points was represented as alarming or non-alarming with respect to the acceptable limit of that specific category of noise area from 6 am to 7 pm for working day and holiday.

From Figure 6, among 48 points 15 points had noise level above 80 dB, 10 points were within 71-80 dB, 13 were within 61-70 dB, 9 points were within 51-60 dB & 1 point was within 45-50 dB for working day.

Among forty eight point's 3 points had noise level above 80 dB, 16 points were within 71-80 dB, 11points were within 61-70 dB,11 points were within 51-60 dB, 3 point were within 45-
50 dB and 3 points had noise level less than 45 dB for holiday.

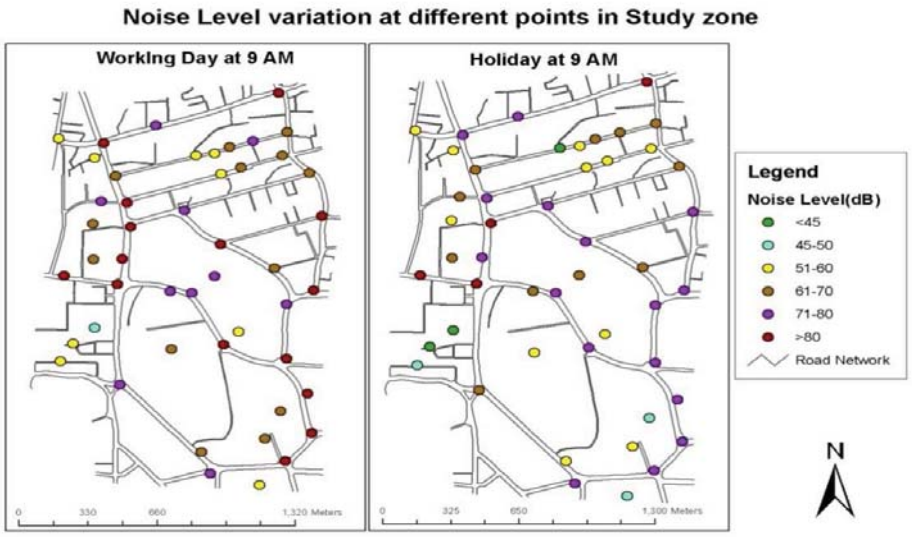

Figure 6. Variation of Noise Level at Different Points for W.D and H.D at 9am

From analysis of 14 hours data it was found that for working day among 48 points 11 points were within acceptable limit, these were B.S.M.M.U (inside) (at 6am,7am) , Telecommunication Building (at 6am,7am, 8am), Sonar Tori Building (at 7am,11am, 1pm, 3pm, 5pm, 6pm, 7pm), Opposite side of judge resident (at 8am), Mintu road intersection (Mogbazar end) (at 6am), Matshaw Bhaban (at 6am), Karjon hall (at 6am), Red Crescent Borak Tower (at 7am, 8am, 9am), Tenament House gate
(at 7am, 8am).

For holiday among 48 points 20 points were within acceptable limit, these were B.S.M.M.U(inside)(at 6am), B.S.M.M.U main gate (at 6am, 7am), Telecommunication Building (at 12pm), Sonar Tori Building (at 3pm), Matshaw Bhaban (at 6am, 7am, 8am, 10am, 5pm, 6pm), Karjon hall (at 6am, 7am, 8am, 7pm), Red Crescent Borak Tower (at 10am, 12pm, 2pm, 7pm), Tenament House gate (at 8am, 9am, 11am, 7pm), National Monument (at 6am), Eskaton garden high school (at 11am, 12pm), Department of Women affairs (at 1pm, 6pm), Sishu park (at 8am, 9am, 10am,12pm, 1pm, 2pm), P.W.D building (at 3pm), Three leaders Mazar (at 6pm), Eskaton Garden Officers' Quarter (at 6am), World literature Center side road (at 6am), Sheraton (at 12pm), Shah Bag (at 6am, 7am), Charukola Bhaban (at 9am, 10am, 2pm, 6pm).Figure 7 shows that only 2 places at working day and 4 places at holiday were within acceptable limit which indicated severe level of noise pollution.

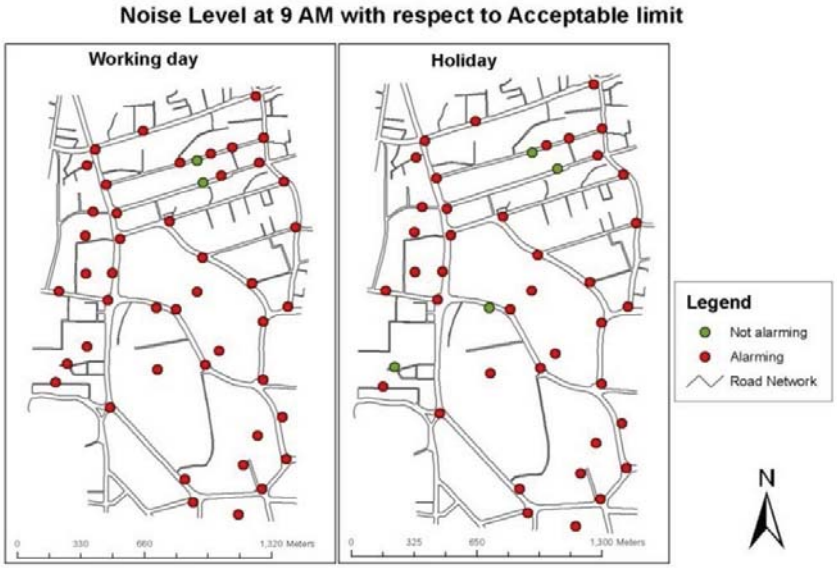

Figure 7. Survey Points at Acceptable Noise Level for W.D and H.D at 9 am

6.0 DISCUSSION

i. Due to heavy traffic load, excessive noise pollution was found in front of Holy family hospital which was a silent zone. In order to avoid excessive traffic jam during office hour, instead of using the road from Kakrail Mosque intersection to the straight ahead Magbazar intersection, a huge amount of traffic from Matshaw Bhaban intersection to Kakrail Mosque intersection and also from New Paltan to Kakrail intersection used the Mintu road and turned into the road in front of Holy family hospital and eventually took access into the Magbazar intersection.

ii. During holiday there were huge numbers of visitors in the hospital. As a result noise level crossed the acceptable limit of that zone in both working day and holiday.

iii. As B.S.M.M.U was in front of Shah Bag intersection, serious noise pollution occurred due to the heavy traffic load along Shah Bag to Banglamotor road, Shah Bag to Kataban intersection, Matshaw Bhaban to Shah Bag intersection and also from T.S.C intersection to the Shah Bag intersection in both working day and holiday.

iv. T.S.C in Dhaka university campus was also affected by noise pollution which was also a silent zone. A significant quantity of traffic was carried along the road from Shah Bag to T.S.C for educational as well as business purposes. Also a large amount of traffic from Gulistan which passed through High Court intersection and Doel Chattar as well as traffic from Bakshibazar area took access through the T.S.C intersection and eventually discharged into Nilkhet-New Market area for business purposes. As a result, noise level reached at a high alarming level.

v. Noise had severe effect on the Magbazar region. Also the reason was huge traffic movement along the roads connected to the Magbazar intersection. These were Mowchuk to Magbazar road, Satrasta to Mogbazar road, Banglamotor to Mogbazar road and New Kakrail to Mogbazar road.

vi. The Ramna Park and High Court & Supreme Court region which were silent areas were also severely affected by high level of noise pollution.

vii. The traffic from Gulisthan and Motijheel were carried through High Court intersection as well as Press club intersection and then traveled through Matshaw Bhaban intersection and reached Shah Bag intersection and increased the noise level at High Court region, at Shishu Park and at Ramna Park.

viii. Also the traffic movement along the road from Kakrail intersection to Mintu road intersection had significant influence to increase the level of noise pollution at Ramna Park.

7.0 CONCLUSION

Following conclusions can be drawn from the above analysis:

i. The peak value of noise level usually occurred at 9am to 10am, at 12pm to 2pm and at 5pm to 7pm in most of the places and ranged from 80-100 dB.

ii. The lowest level of noise was found <20db at Charukola Bhaban for both working day and holiday.

iii. At some places the noise level was at considerably lower level at 6am only.

iv. For rest of the hours almost all the places were within alarming level with respect to acceptable limit which indicated the severity of noise pollution level in the study area.

8.0 LIMITATIONS OF THIS STUDY

i. 24 hours data could not be collected, data collection times were 14 hours (6am-7pm).

ii. Data could not be collected on same working day & holiday at all the survey points.

iii. At each point for both working day & holiday data were collected on only one day each; therefore, long time monitoring may show different phenomenon.

9.0 RECOMMENDATION

i. Planned tree plantation along footpath and road divider will be effective but proper care should be taken so that these might not create any obstruction to the traffic as well as to the pedestrian.

ii. The exterior walls, window glasses and doors of the hospitals and other roadside buildings should be thick enough to reduce the intensity of noise. Use of heavy curtains in doors and windows can also reduce the intensity of noise.

iii. In the hospitals the cabins of post operative patients, severe ill patients, patients having chronic diseases and also operation theater, intensive care unit, coronary cardiac unit, neonatal unit should be distant from roadside.

iv. Strict regulations; particularly in Bangladesh enforcement of laws is very necessary.

v. Increasing people awareness; mass media like television, radio, newspapers may be helpful to a great extent in this purpose.

vi. Source control in roadway noise has provided little reduction in vehicle noise, except for the development of hybrid vehicle.

vii. The most fertile area of roadway noise mitigation is in urban planning decisions. Hospitals should not be placed adjacent to commercial roads. Also roadway design, noise barrier design, roadway geometries, surface pavement selection will be effective in this purpose.

viii. Therefore, in built up areas there could be strategic regulations which would be fruitful to reduce the level of pollution.

ix. The roads beside residential buildings such as Red Crescent Borak tower, hospitals such as Holy Family Hospital should be restricted for commercial traffic, particularly at office hour these roads should be banned for all traffic.

x. Staggered timing of various activities such as different timing of offices & schools may contribute to a significant reduction. Also job rotation, work scheduling may help to a great extent in this purpose.

xi. Speed control is effective since the lowest sound emissions arise from vehicles moving smoothly at 30 to 60 kilometers per hour. Above that range sound emissions double with each five miles per hour of speed.

xii. Noise barriers are probably the single most effective weapon in retrofitting an existing roadway, and commonly can reduce adjacent land use sound levels by ten decibels.

xiii. Noise barrier may be installed along the road beside B.S.M.M.U and Holy Family Hospital.

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