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IDENTIFICATION OF MOST CRITICAL, MODERATE CRITICAL AND NON-CRITICAL REGIONS REGARDING ENVIRONMENTAL NOISE POLLUTION FOR UNIVERSITY ROAD, PESHAWAR PAKISTAN

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Abstract

Our modern era doesn't mean only that we have industrialized or have advancements in technology but the increment in pollution is also the result of modernization. With the increase in population, the burden on the urban infrastructure of city centers is increasing with each passing day. This increased burden is specially manifested in the increase in traffic density on roads and traffic flow and is mainly known for the production of noise pollution. University Road, Peshawar Pakistan which is a very dense and important hub for education, hospitals and other commercial markets was studied for noise pressure levels and identification of vulnerable regions. Among 30 regions of section 8 were categorized as non-critical,17 were found moderate critical and 5 were found most critical regions.

Keywords: environmental noise; noise pressure levels; critical regions

I. Introduction

Noise pollution is the invisible pollution which human face before birthing till after death. When sound exceeds some sort of limits it becomes a nuisance to the human ear. Noise is commonly stipulated as undesired sound pressure in an environmental phenomenon [VI]. By [V] it can be scrutinized as the wrong sound in the wrong place at the wrong time. Noise pollution generally can be categorized into two major components i.e. Atmospheric noise pollution and other is environmental noise pollution. Atmospheric noise pollution is naturally produced like volcanoes and

thunderstorms on the other side environmental noise pollution is mainly produced by humans like vehicle usage, industries, bombast, firecrackers, airplanes, air vehicles, trains, loudspeakers, woofers etc. The expression of magnitude or sound pressure when expressed in decibels is sound pressure level (SPL) [I]. Decibel (Db) is the unit of sound to be measured [II].

With the advancements of technology, this mechanized world becomes more polluted day by day. Any unpleasant thing which affects humans and the environment is pollution so the same is here with sound when it exceeds limits it becomes unpleasant and becomes noise pollution to the environment. From the 19th Century by[III] noise causes irritation and affect daily routine to a recent era in which unwanted sound which gets dispose of in a healthy environment and makes it unhealthy by [IV]. Noise pollution is being a problem from past decades to the recent modern era and by [IV] noticeably changes in noise levels have been recognized since the mid-twentieth century. Mostly developed countries suffer from noise pollution due to high volume traffic, which disturbs the quality of life and causes health problems as people living adjacent to dense roads to have higher ear-related health problems [V]. A statement by [IV] supports the idea of high vehicular flow that noise pollution level has raised mainly because of the rapid growth of population, high migration, heavy transportation system including air traffic, railways, roads and worldwide use of machines.

Pakistan is located in South Asia and is one of the densest populated region in the world making it 6th ranking population wise. Pakistan has five major provinces in which major and pollution exposed cities are Karachi in Sindh, Quetta in Baluchistan, Lahore in Punjab, Peshawar in Khyber Pakhtunkhwa and Gilgit in Gilgit Baltistan. Peshawar (KPK) is the most dense district of the province making it 6th ranking population wise in Pakistan. Some of the previous case studies of Peshawar by[VII]stated in their comments section that noise pressure levels in all sampling locations (28 locations) were higher than National Environmental Quality Standards (NEQS).

II. Materials and methods

II. i. Study area

University road is one of the largest road section of district Peshawar. The corridor is 12km long and is present in the latitude of 34.025917 and longitude of 71. 560135. The region is bounded in the east by Kharkhany markets and to the west by Aman chowk. The average climate of the region is 22.9°C [XII] with semi-arid in nature. The section is the main hub for hospitals and educational institutes, offices, recreational parks and other commercial activities. The study area is mainly categorized as commercial but also a place for educational institutes and hospitals. The city of people about 4,269,079 in which 1,970,042 lived in the urban category [X]. This overpopulation and rapid urbanization of a city make the major road of University road not fair enough to cope with the traffic flow of vehicles results in severe traffic jams and irregularities during the commuting time which is the most important factor to enhance community noise pollution in urban regions.

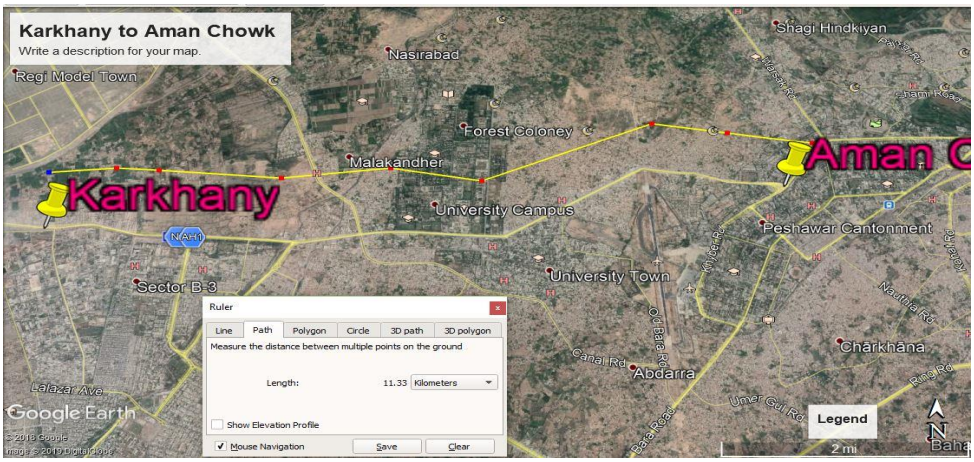

Figure 1: Main University /G.T road from Kharkahny to Aman Chowk using (www.googleEarth.com)

II. ii. Methods

To estimate environmental noise pollution for the University road section, noise pressure level data was required for most vulnerable points. For this purpose, direct field recording activity was carried out on the selected section.

Fig 2: Mid points along with laterals for study area using (www.googlemap.com)

Initially we selected about 30 stations on the section of University road including major intersections, curves, markets, nearby educational institutes and hospitals, offices, important junctions, segments of road and lastly common traffic congested areas. These 30 points not only include major stations but also some lateral point also for assessment.

For these, all section noise values have been recorded for each station respectively. The approach for data was to record values for morning, afternoon and evening.

These three portions of the day were further divided into peak and non-peak timings. Morning (8-9am) was considered as peak morning, (11am-1pm) was considered as non-peak afternoon, Afternoon (1pm-3pm) was considered as peak afternoon, (5pm-6pm) was considered as peak evening, (8-9pm) was considered as non-peak evening. This peak and non-peak division of time was introduced on the basis of public activities like schedule of offices, educational institutes, hospitals and other public necessaries. The frequency of this recording for both peak and non-peak values was to record data two times for 5 minutes for 20 intervals and the distance between intervals would be 15 seconds. For each station 200 values were gathered and then exported to excel sheets.

Very reliable, convenient and pre calibrated instrument sound level meter (IEC651 type2, ANSI 1.4 type2) with the capacity of (30-130Db) was used with a noise logging system for recording noise levels in Decibels (dB). The instrument was provided with foam to catch regular frequency. Weighted (A) frequency along fast response option was used. Special software noise logger software was used to transfer data from instruments to a computer. Special care was done that instrument should be above ground on the uniform level at an elevation of 130 cm and should be carried with the right hand and left hand should be with laptop while taking measurements. Mobile GPS was used to locate coordinates for each station.

II. iii. Selection of non-critical station / point

After getting data of 30 stations graphs have been drawn for each of them and compared with NEQS standard for noise pollution on the spreadsheet. Firstly, fluttered graphs showing non uniform behavior i.e 50 % total value of which is below or equal to threshold of 65 Db (A). Whereas 65 Db(A) is the National Environmental Quality Standards (NEQS) standard for commercial regions.

Mathematically

Let x_{ij} is the noise level recorded at a particular station "i" and at a particular time "j"

Let n_i = total reading at station "i"

$$NCP = \frac{Count\ (x_{ij}\ \leq\ 65dB)}{n_i} * 100 \leq 50\% \quad (1)$$

So

Whereas NCP = Noncritical point

II. iv. Selection of moderate and most critical stations

In the 2nd stage for selection of critical station most of the graphs were showing uniform behavior i.e. exceedance behavior beyond the minimum threshold. So a very reliable technique for this statistically dispersed value modified range technique i.e.

maximum value of interval in that time interval minus minimum value beyond 65dB (minimum threshold) of interval. This modified range was found for each interval of timings and then was averaged respectively. So after getting one average value of the modified range for each station. These values were again averaged to create a minimum threshold to sort out moderate and most critical locations. For this average value which came to us, 14.64 was equalized to 14 and all maximum average range of each station was checked whether it is below that criteria or above that criteria if it is below then 14 it is separated as a non-critical location.

Mathematically

Let x_{ij} is the noise level recorded at a particular station "i" and at a particular time "j"

So maximum range =$x_{ij}max$, minimum range beyond =$x_{ij}min$ ($where\ x_{ij} \geq 65$)

$$MR_{ij} = (x_{ijmax} - x_{ijmin}) \tag{2}$$

Whereas MR = modified range

Let OSV = One solid value per station

For

$$OSV = \frac{MR_j}{j_n} \tag{3}$$

Where as jn is the total number of time slots at the station.

Therefore

$$TH = \frac{OSV_i}{i_n} \tag{4}$$

Whereas TH= Threshold, i_n=number of station

$$So\ Moderate\ Critical\ P = Count(OSV)_i \leq TH) \tag{5}$$

II. v. Most critical point/station

For the selection of most critical stations four important factors i.e. modified average range, road width, traffic jams and vicinity to the road were considered to make a decision. The table has been made for each factor and values has been awarded to each factor i.e obtained modified range was added in the table, road width by the measurements with the help of tape, for traffic jams stoppage frequency for the 10 minutes for specified section, and lastly important commercial infrastructures were counted and values were plotted in the table. Another table has been drawn to give weightage to each factor except traffic jams by following the rule of allotting 0=non

effective,10=most effective and 5 is given to remaining values. For traffic jams 0 was given to zero number of traffic jams, greater than 0 and lesser than 10 was given weightage of 5 and more than 10 value was given 10 weightages respectively. At last most weighted stations were considered as the most critical location.

Table:1 Showing each factor value for a station whose crossing minimum average threshold range value

S.No	Locations	Avg. Range over threshold	Road width m	Vicinity to Infrastructure (Commercial)	Traffic Jams (Stoppages Frequency)
1.	Malik Taj market	21.34	3.7	0	20
2.	Normal to Malik Taj market	17.7	3.7	0	14
3.	Kacha Ghary	14.34	3.7	0	6
4.	Board Canal road	17.42	3.4	2	16
5.	Rahatabad(Islamia College)	15.59	8.0	2	0
6.	UOP gate	14.18	7.5	3	15
7.	KTH gate	14.25	3.7	1	6
8.	Spin jumat stop	14.9	3.7	3	9
9.	Tambvanou Mor stop	15.47	3.5	0	11
10.	KFC	14.95	8.2	2	0
11.	Aman Chowk towards Saddar	15.01	4.0	3	7

Table:2 Allotted weightage of factors showing most critical location of a section

S.No	Locations	Avg. Range over threshold	Road width m	Vicinity to Infrastructure	Traffic Jams	Sum
1.	**Malik Taj market**	10	5	0	10	**25**
2.	Normal to Malik Taj market	5	5	0	10	20
3.	Kacha Ghary	5	5	0	5	15
4.	**Board Canal road**	5	10	5	10	**30**
5.	Rahatabad(Islamia College)	5	5	5	0	15
6.	**UOP gate**	0	5	10	10	**25**
7.	KTH gate	5	5	5	5	20
8.	**Spin jumat stop**	5	5	10	5	**25**
9.	Tambvanou Mor stop	5	5	0	10	20
10.	KFC	5	0	5	0	10
11.	**Aman Chowk towards Saddar**	5	5	10	5	**25**

For values, If 0= Non effective, if 5= moderate effective, if 10 =most effective

For Traffic jams 0= Non effective, if >0 &≤10 = moderate effective, if >10 =most effective

III. Results

As a result of the non-critical points the following eight stations were obtained as non-critical stations out of 30 observed stations i.e. Normal to Bank of Khyber, Nasir Bagh Road, Board bazaar, Inside Islamia college, Khyber medical college, normal to Tambvanou mor, Palosi road, MM academy.

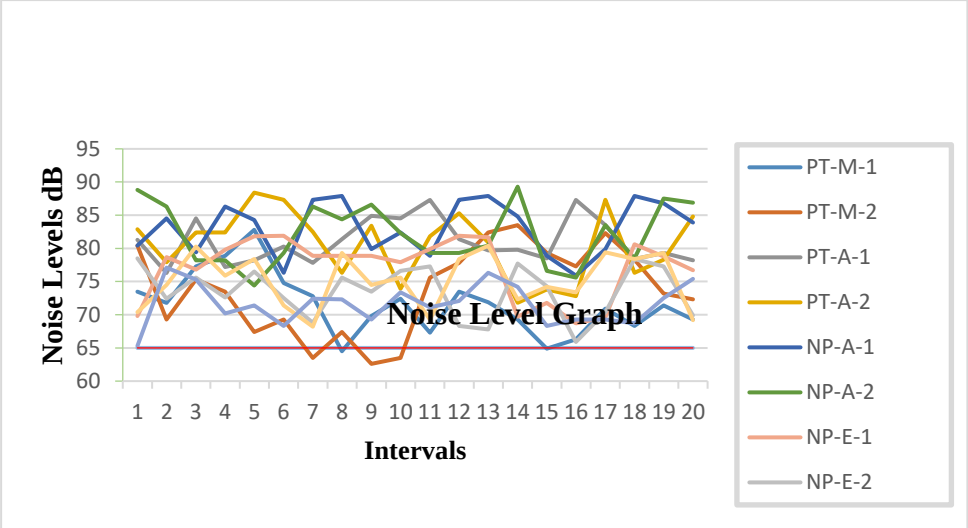

Fig 3: Comparison graph of one station of non-critical station category (PT=Peak Timing, NP=Non Peak Timing, M=morning, A=Afternoon=Evening)

For moderate critical point following stations were obtained i.e.

Table:3 Moderate critical stations separated (a). Stations separated on threshold basis method (b). Stations separated on weightage method

a)

S. No	Location Name	Average Maximum Range
1	Khalid Plaza	13.74
2	Marco polo Hotel	9.37
3	Jalil Kabab	11.53
4	Phase 3 Chowk	13.43
5	UPS School	13.56
6	KTH road	12.51
7	Jawad Towers	13.84
8	Gora Kabristan	12.23
9	Aman Chowk towards Warsak	13.07
10	Aman Chowk towards Hayatabad	12.16
11	Bank of Khyber	13.96

b)

S. No	Location Name	Average Maximum Range
1	Normal to Malik Taj Market	17.7
2	Kacha Ghary	14.34
3	Rahatabad (Islamia College)	15.95
4	KTH Gate	14.25
5	Tambvanou Curve Stop	15.47
6	KFC	14.95

For the most critical station following five stations were observed as below in following category.

1. Malik Taj market

2. Board Canal road

3. University of Peshawar gate

4. Aman chowk towards Saddar

5. Spin jumat stop

IV. Conclusion

In conclusion firstly it came into being that a major road for district Peshawar is being badly affected by noise pollution. In this study area which is considered as the backbone for Peshawar comprises offices, educational institutes, hospitals and other important markets and parks etc. is being greatly influenced by this noise pollution.

It is also founded that it is not that only one factor gives us selection liberty to decide any area as a critical or non-critical region but several important factors like traffic density, road width, noise pressures dB, road features, peak and non-peak timings, vicinity to infrastructure, weekdays and the surrounding environment. On the other hand, it has also been investigated that there is no obstacle or any type of arrangement to reduce noise levels at a certain level.

Conflict of Interest:

There was no relevant conflict of interest in this paper

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