Noise Mapping Using Q-GIS: A Case Study of Nasik City

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Abstract: Noise is becoming one of the major issue now a days in Nasik city. Noise refers to unwanted sounds in the environment that threatens the health or welfare of human or animal inhabitants. Environmental noise pollution continues to pose a significant threat to human health and the quality of life for millions of people worldwide. The broad aim of the present work is driven by the desire to look into the impact of noise pollution on environment. Nasik, a city situated in the northern part of Maharashtra .The District has great mythological background. It has been declared one of the fastest developing city of India. Due to this many people are migrating towards Nasik. This ultimately affects the population density of the city. People are in search of better life style and hence utilize various resources leading to pollution.

*Keywords — **GIS, Nasik city, Noise Mapping, Q-GIS, Traffic Noise, Zoning.***

I. INTRODUCTION

In our modern, rapidly expanding environment one of the developing problems is that of noise. This particular problem is becoming a source of serious concern to industrial corporations, trades. Basically, noise is sound, while under some circumstances sound is noise. Noise is conveniently and concisely defined as "Unwanted Sound", an essentially personal definition. The object of this part is to discuss the concept of noise, problems of noise and its effect on man and environment both as annoyance and as a danger to health. The major sources of noise are:

1. Industrial noise
2. Traffic noise
3. Community noise

Out of above three parameters, the source that affects the most is traffic noise. In traffic noise, almost 70% of noise is contributing by vehicle noise. Vehicle noise mainly arises from mainly two parameters, Engine noise and tyre noise. The major concern is to study development of a road traffic noise model.

The objective of the work was to measure the noise pollution range at different locations in Nasik urban area and analyze the impact of noise pollution and to compare the noise levels with permissible limits specified by CPCB. This work was intended to create a map using GIS software of the study area and the spatial plans so that the trend of the noise pollution can be assessed for future development plans.

Enock Abe Wawa and Galcano Canny Malaku studied the Noise Pollution mapping using GIS at Kenya, a city in Nairobi in 2015, they measured and calculated the noise levels at various locations in Nairobi CBD (central business district). Noise maps were being prepared which consisted of areas showing noise hotspots[1]. Karthik K and Prasad Raju from Chennai city had a research on Development of Noise prediction models using ArcGIS, the research showed that traffic is a significant part of urban environment contributing about 55% to the total urban noise[2]. Wazir Alam conducted the study for the noise levels in the city of Guwahati for different zones and locations according to the land use, the conclusion of the research was that the noise levels in both commercial and residential areas of Guwahati were alarming[3]. Dermot Geraghty and Margaret O'Mahony in 2011 conducted a yearlong study to find the seasonal variation in the noise levels and the other factors that affect the noise levels[4].

Ali Asghar Alesheikh and Manouchehr Omidvari (2010) studied the noise generated by the traffic and they found traffic noise is a major cause for hearing disorders[5]. F. Farcas and A. Sivertun conducted a study in the Skane region of Sweden for creating noise maps by using Nordic Prediction method[6]. The study conducted in Skane was used to formulate the number of males and females by different noise levels[6]. Jigan Patel and Mitali Shah studied the different methods used for noise mapping and noise prediction, presenting a comparative study of the methods according to the region of study[7].

Q-GIS

The latest version of Q-GIS, i.e. QGIS 2.18.16 (Las Palmas) is an open sourced software that is freely available for use as opposed to ArcGIS. QGIS functions as geographic information system (GIS) software, allowing users to analyze and edit spatial information, in addition to composing and exporting graphical maps. QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images.

II. Noise Mapping Tools

Input Data

The input data of noise levels, GPS co-ordinates and traffic volume were recorded at each location in consideration.

Noise levels

Noise levels were measured at the location for the peak hours in the morning and evening. The readings were observed, for every one minute of interval at the considered location. The instrument used for measuring was HTC SL-1350, a sound level meter with the least count of 0.1dB and accuracy of 1dB. The noise levels were measured at elevation of 1.5 meters[6] for the ground surface and at least 2 meters apart from any other reflecting surface. Wind screen was used to get noise levels unaffected by the wind.

GPS Co-ordinates

The spatial data of GPS Co-ordinates of the locations considered for the study of noise were recorded up to the accuracy of 8 meters by a hand held instrument Garmin-eTrex-H.

Traffic Volume Study

Traffic volume study was conducted for the duration of study of noise levels at the locations of consideration. The study was conducted with bifurcation of the traffic into four categories; 2-wheelers, 3wheelers, 4-wheelers and heavy vehicles. Traffic study was conducted to find the correlation between the traffic and the noise intensities.

Location	2-Wheeler	3-Wheeler	4-Wheeler	Heavy Vehicles
ABC				
DEF				

Table 1: Table for traffic volume study.

III. The Nasik Study

Study Area

The areas of study were the busy and crowded locations in the city of Nasik. Nasik city is in the state of Maharashtra in India located at 19.9975º N and 73.7898º E. The area of the city is 300 square kilometers and the average population density is 4954 people per square kilometer. Nasik is one the fastest growing cities in Asia but the infrastructure is not enough of the population. The road networks are old and incapable of handling the heavy traffic. With the increasing number of vehicles this problem seems to get bigger.

Methodology

The relevant data sets required for the noise mapping were collected. The noise levels were measured at the location using sound level meter and the GPS co-ordinates were recorded using a handheld GPS instrument. The maps showing the road network and different institutional buildings were collected from Google Maps.

The study was conducted for a short period during the rush hours in the morning and the evening when the traffic is maximum. The days with variation in traffic flow such as festivals, national holidays and days with unfavorable weather conditions were not considered for the study. The duration between the readings at each location was 1 min. L_{eq} was computed for the noise levels at each location. The formula used for L_{eq} is;

$$L_{eq} = 20 log_{10} \sqrt{(\frac{P_1}{P_0})^2 + (\frac{P_2}{P_0})^2 + (\frac{P_3}{P_0})^2 + (\frac{P_4}{P_0})^2 + (\frac{P_5}{P_0})^2}$$

$$L_n = 20 log_{10}(\frac{P_n}{P_0})$$

L_{eq}: Equivalent noise level
L_n: Noise level or the particular reading
P_n: Sound pressure due to the particular reading of noise level
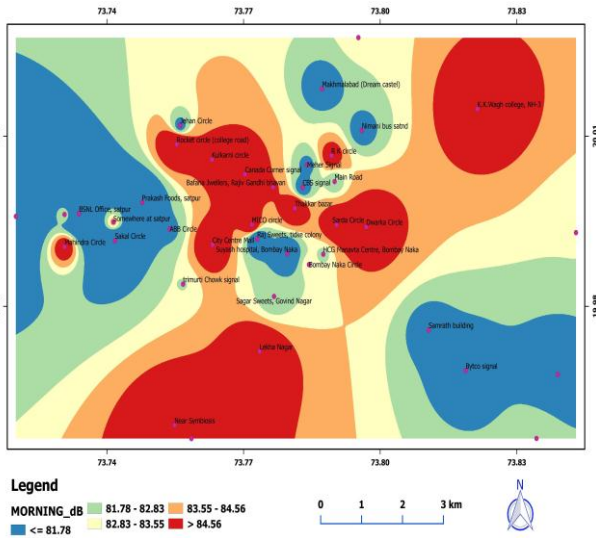P_0= Reference sound pressure level

Noise Maps

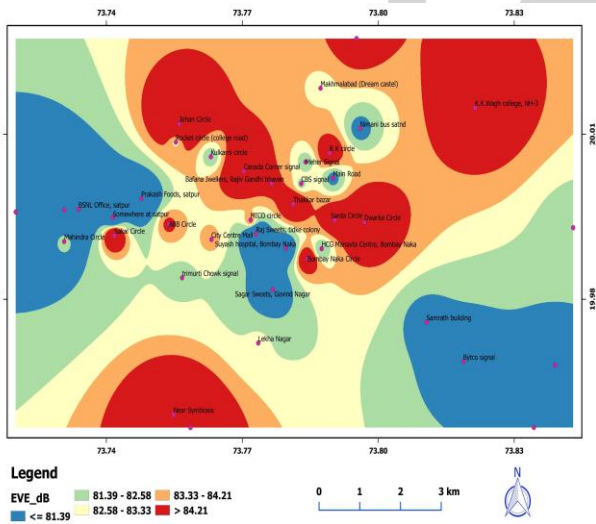**Fig. 1: Noise intensities during the morning.**

Fig. 2: Noise intensities during evening.
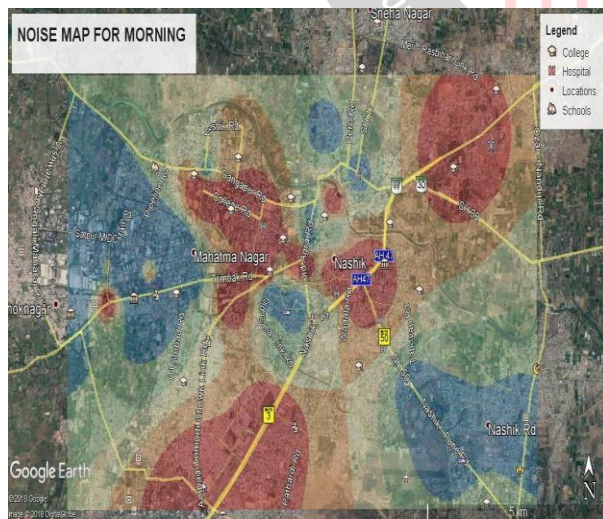

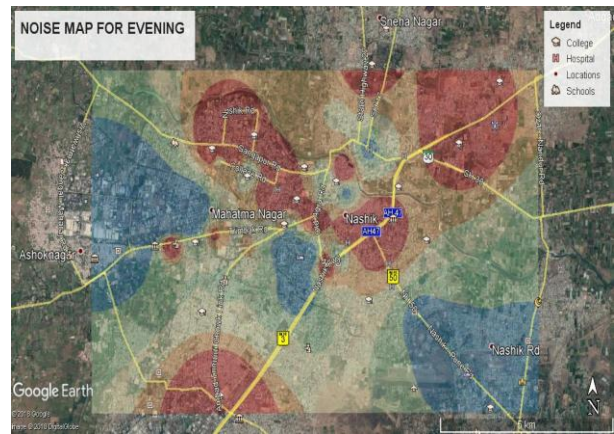**Fig. 3: Noise map for the noise intensities during morning.**

Fig. 4: Noise Map of the noise intensities during evening.

IV. RESULT

Figure 1 and figure 2 show the noise intensities at different locations in the morning and evening respectively. Figure 3 and figure 4 are the noise maps of morning and evening respectively showing the noise intensities, road networks and the location of different institutional buildings. Figure 5 indicates the highest, lowest and average sound levels recorded.
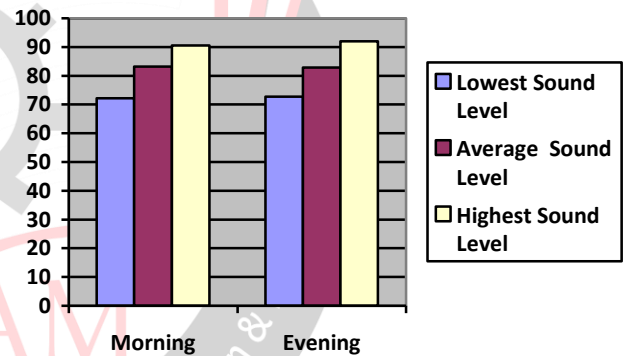

Fig.5: The average sound levels recorded.

V. CONCLUSION

The paper represents the results of the noise mapping study in the city of Nasik. The noise levels in the city during the rush hours are in the range of 72.13dB and 91.96dB. According to the limits specified by Central Pollution Control Board of India, the allowable day time noise levels in the residential zones are 48dB to 51dB so the mean equivalent noise level generated by the traffic in this area exceeds the maximum allowed noise level specified by the CPCB by 25dB. The allowable nose level according to the CPCB for silence zone is 60 dB thus the mean noise levels generated by the traffic exceed the permissible levels by 10dB. In the commercial zone the noise level exceeds the allowable noise level by 25dB. The noise levels observed in the city are alarming as they exceed the advised noise levels by the Ministry of Environment. This study can be helpful to the city authorities for further planning of the city and

restructuring the current road network. An extension to this study for more locations, greater duration and different seasons would be a recommended way ahead. QGIS proved to be an effective tool for creating maps from both spatial and non-spatial data. QGIS is an efficient tool to create noise maps as it is user friendly and open source.

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