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Mapping of noise pollution by using GIS on busy corridors in Chennai

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ABSTRACT

Traffic noise pollution of urban areas is one of serious factors that the local agencies and state authorities have to consider in decision making processes. The spatial analysis and geo statistical methods of GIS can play an important role to control noise pollution. GIS provide framework to integrate noise calculation models with spatial data that can be used for building noise maps. Noise maps can be used to assess and monitor the influence of noise effects. In the reality, noise travels in all direction. Residents living in high rise buildings are also severely affected by traffic noise. It is therefore important to develop noise maps that can show influence of noise in all direction. A case study was illustrated using a noise maps. The results showed that the quality and accuracy of noise models can be improved with high density of observation points. The observation points selected in straight line with evenly spacing showed good visualization of acoustic situation. The noise models can be used for the scientific studies such as to study the phenomena of noise behavior.

KEY WORDS: noise, pollution, traffic, GIS.

1. INTRODUCTION

Noise pollution is excessive, displeasing human, animal or machine created environmental noise that disrupts the activity or balance of human or animal life. The response of the human ear to sound is dependent on the frequency of the sound. The human ear has peak response around 2,500 to 3,000 Hz and has a relatively low response at low frequencies. As such, the loudness of sound is commonly expressed in decibel (dB). Permitted noise level of different locations shown in Table 1

Table.1.Permitted noise level at different locations

Type of area	Day time	Night Time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence zone	50	40

One of the serious issues of environmental pollution is noise. Noise pollution in large urban areas is regarded as a growing problem of communities. Road traffic noise pollution is one of the major environmental problems encountered in our daily life. The exposure to noise from roads, affects more people than noise from any other source. It has become a major highway corridor. The noise produced by these vehicles is particularly disturbing due to wide variations in frequency and volume. Noise mapping is (a optimization technique) in its various forms can be derived for different periods of the day or night and by using different noise indicators, noise dose-effect relationships, calculation heights, calculation techniques.

The main uses of noise maps is to identify and quantify the scale of noise problems at local, regional, national level and provide information for town planning and traffic management. Urban noise is directly associated to human activities, in transport and industry development. New mapping approaches supported by a GIS can be combined with spatial data analysis and mathematical modeling that further improves the quality of noise maps. Noise maps provide spatial presentation of acoustic situation. Noise maps build in GIS can be used for analysis and management process. Noise effect can be determined in GIS by combining noise levels with the location of people living in the area and their sensibility to noise.

The objective of this work is to develop a road traffic noise prediction model for the busy corridors of Chennai. The developed model is capable of predicting the combined traffic noise generated from vehicles in highways. The main objective of this research is to build noise map within a GIS environment using ArcGIS. The main objectives are,

a. To collect the traffic noise data on different locations.
b. To generate the noise maps observation points which represents virtual microphone using ArcGIS and to calculate noise levels at each observation point.
c. To determine and compare the noise contours of each interpolation techniques used for Noise mapping.
d. To determine applications of ArcGIS in creating noise maps for the prevailing different noise levels in the study area.

2. MATERIALS AND METHODS

2.1. Study Area: Chennai is the capital of Tamilnadu forms one of the developed urban centers of India with a population of 4.8 million. It is one of the metropolitan city in India. It is located towards south East along the coastal plains of India. The vehicle population in Chennai as of 2013 is 3,881,850. Seven heavy to medium busy

commercial corridors of Chennai city were selected for this study. At each location, measurements were made between the time period of 6A.M to 9P.M. Sound meter having digital display was used to record the noise level at different locations. The noise level of ground level and 3m above the ground level was recorded. Over all methodology flow chart is given in the Fig 1. The map of seven locations were given in the Fig 2,3,4 and 5.

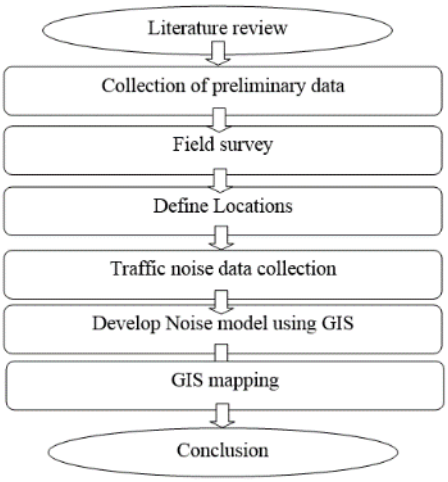

Fig.1.Methodology Flow chart

Fig.2.Location map of Guindy (Kathipara junction) and Parry's corner

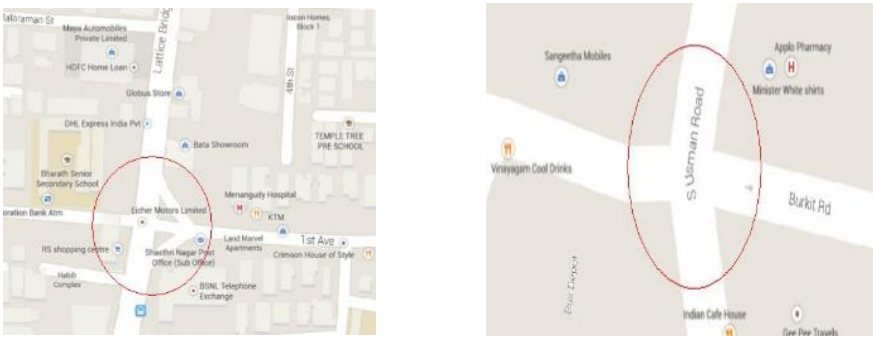

Fig.3.Location map of Adayar and Tnagar

Fig.4.Location map of Velachery and Porur

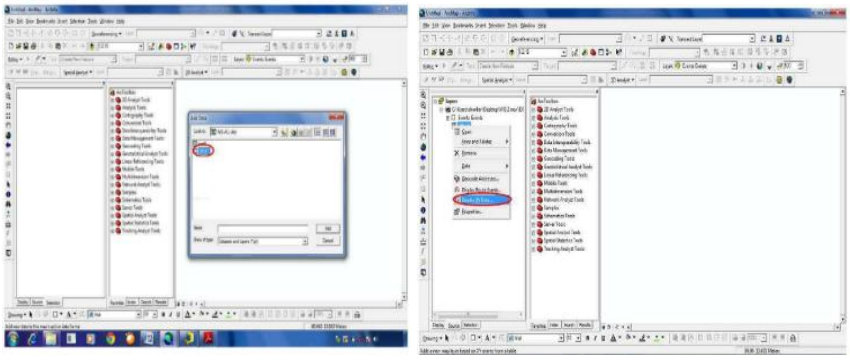

Fig.5.Location map of Anna nagar Fig.6.Loading shape files to map document and Display of X-Y data

2.2. Georeferencing: Geographic Information System (GIS) is a computer based information system used to digitally represent and analysis the geographic features present on the Earth surface and the events (non-spatial attributes linked to the geography under study) that taking place on it. A geographic information system may be defined as an integrated system designed to collect, manage and manipulate information in a spatial context. Ground control points (GCP) is a point with X,Y co-ordinates that fix location on terrain. A number of valid GCP is required to spatially reference a map with respect to ground. By fixing these points and rectifying them with data noise collected value is shown. Thus after rectifying the GCP with ground co-ordinates, the base map is projected. This base map is further processed for spatial variation on parameters to assess traffic noise pollution in Chennai. The steps for base map preparation in ArcGIS is given in Fig 6,7,8 and 9.

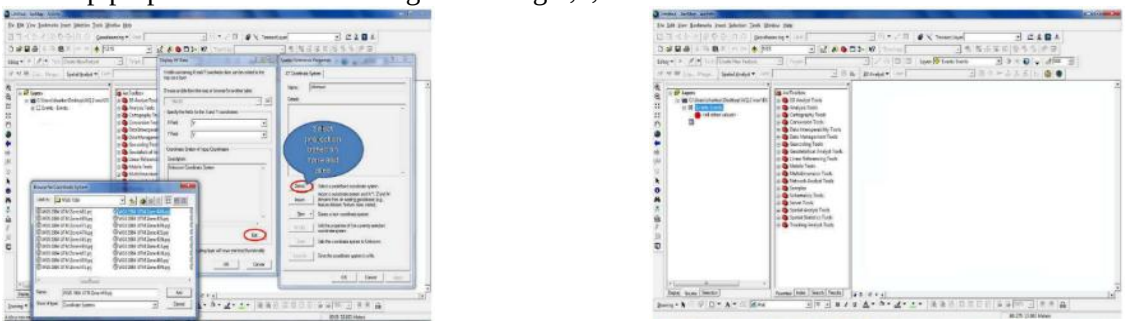

Fig.7.Projected coordinates system and projected location points

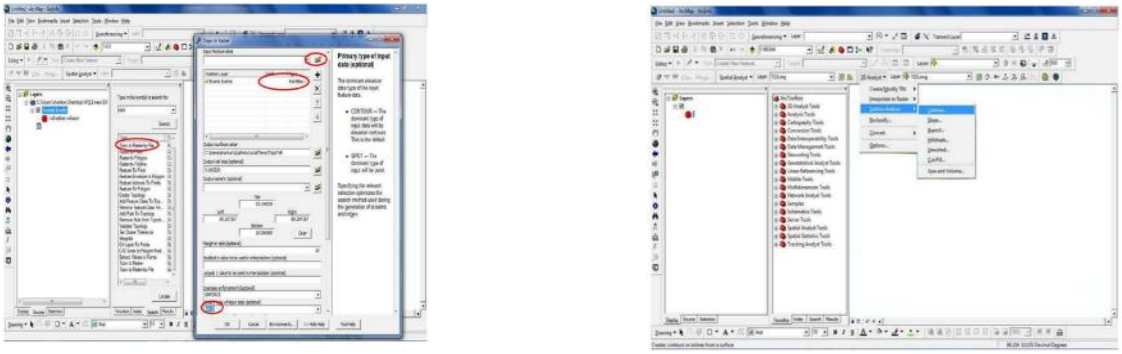

Fig.8.Conversion of data to raster and 3D analysis

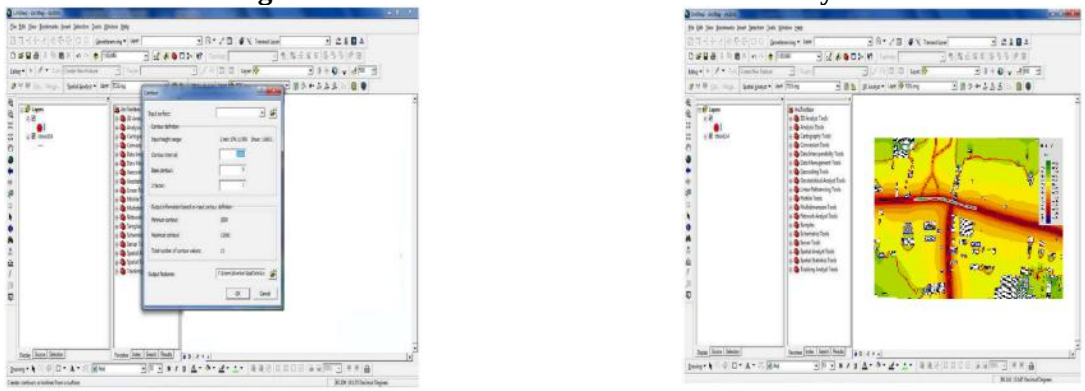

Fig.9.Preparation of contour and spatial variation map

3. RESULTS AND DISCUSSION

The noise levels recorded Near Guindy (kathipara junction), Tamilnadu, presented in Figure 10 and for ground floor and first floor respectively. It is observed that the noise level is maximum during evening peak hour between 4:00pm and 6:00pm. Noise level is gradually increasing from morning 6:00am to 10:00am and then reaching morning peak from 10:00am to 11:00am. Further the noise level is decreasing from 11:00am onwards till 2:00pm and 2:00pm to 4:00pm the noise level increases gradually. The noise level is higher on far noise is decreasing from 6:00pm onwards. It is also observed that the noise level is decreasing towards buildings from the source. The side than that of near side and the reason for this is the return trip to home is more.

Fig.10.Observed noise levels near Guindy (kathipara junction) at Ground level and height of 3m above the ground level

The noise levels recorded at Parry's Corner are presented in Fig 11 for ground floor and first floor respectively. It is observed that the noise level is maximum during evening peak hour between 4:00pm and 6:00pm. Noise level is gradually increasing from morning 6:00am to 10:00am and then reaching morning peak from 10:00am to 11:00am. Further the noise level is decreasing from 11:00am onwards till 2:00pm and 2:00pm to 4:00pm the noise level increases gradually. The noise is decreasing from 6:00pm onwards. It is also observed that the noise level is decreasing towards buildings from the source. The noise level is higher on far side than that of near side and the reason for this is the return trip to home is more.

The noise levels recorded at Adyar are presented in Fig 12 for ground floor and first floor respectively. It is observed that the noise level is maximum during evening peak hour between 4:00pm and 6:00pm. Noise level is

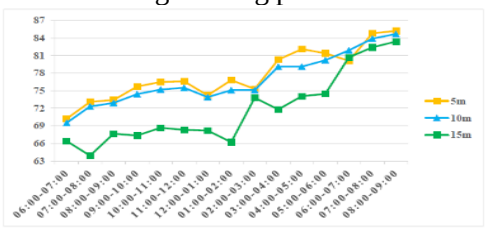

Fig.11.Observed noise levels near Parry's corner at Ground level and height of 3m above the ground level

gradually increasing from morning 6:00am to 10:00am and then reaching morning peak from 10:00am to 11:00am. Further the noise level is decreasing from 11:00am onwards till 2:00pm and 2:00pm to 4:00pm the noise level increases gradually. The noise is decreasing from 6:00pm onwards. It is also observed that the noise level is decreasing towards buildings from the source. The noise level is higher on far side than that of near side and the reason for this is the return trip to home is more.

Fig.12.Observed noise levels near Adyar at Ground level and height of 3m above the ground level

Fig.13.Observed noise levels near T.Nagar at Ground level and height of 3m above the ground level

The noise levels recorded at T-Nagar presented in Figure 13 for ground floor and first floor respectively. It is observed that the noise level is maximum during evening peak hour between 4:00pm and 6:00pm. Noise level is gradually increasing from morning 6:00am to 10:00am and then reaching morning peak from 10:00am to

11:00am. Further the noise level is decreasing from 11:00am onwards till 2:00pm and 2:00pm to 4:00pm the noise level increases gradually. The noise is decreasing from 6:00pm onwards. It is also observed that the noise level is decreasing towards buildings from the source. The noise level is higher on far side than that of near side and the reason for this is the return trip to home is more.

The noise levels recorded at Velachery are presented in Figure 14 for ground floor and first floor respectively. It is observed that the noise level is maximum during evening peak hour between 4:00pm and 6:00pm. Noise level is gradually increasing from morning 6:00am to 10:00am and then reaching morning peak from 10:00am to 11:00am. Further the noise level is decreasing from 11:00am onwards till 2:00pm and 2:00pm to 4:00pm the noise level increases gradually. The noise is decreasing from 6:00pm onwards. It is also observed that the noise level is decreasing towards buildings from the source. The noise level is higher on far side than that of near side and the reason for this is the return trip to home is more. The measured noise values are presented in Table.

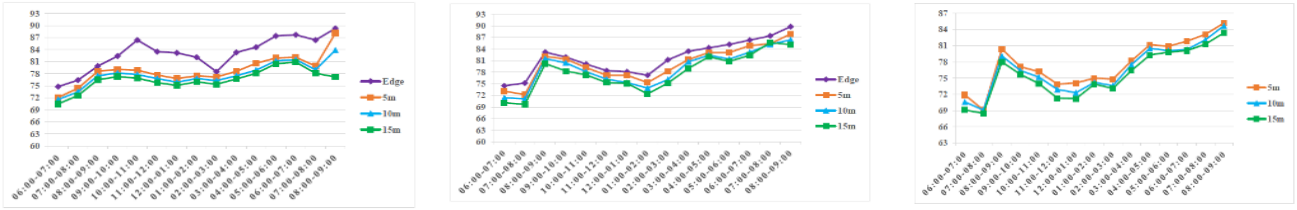

Fig.14.Observed Noise Level at Anna nagar at Ground level and height of 3m above the ground level

3.1. Noise interpretation using GIS: A GIS is an information system designed to work with data referenced by spatial/geographical coordinates. In other words, GIS is both a database system with specific capabilities for spatially referenced data as well as a set of operations for working with the data. It may also be considered as a higher order map. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprise for explaining events, predicting outcomes and planning strategies. The GIS has the power of organizing effective Social Information System (SIS) towards decision-making or resource management. The spatial information system comprises synthesis of spatial formation and non-spatial data within GIS framework. The GIS aims and works at bringing together, the diverse information, which is gathered from various different sources. Hence, this is also known as integrated analysis software. Fig 15,16,17 and 18 shows the noise mapping for different locations.

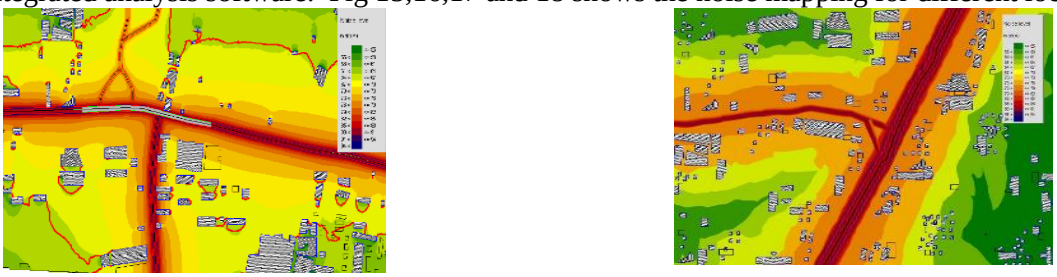

Fig.15.Detailed Noise level map on "Guindy" and "Parrys"

Fig.16.Detailed Noise level map on "Adyar" and "T Nagar"

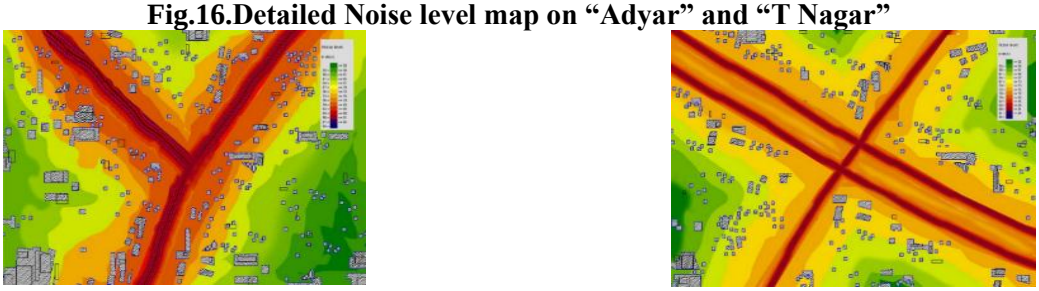

Fig.17.Detailed Noise level map on "Velachery" and "Porur"

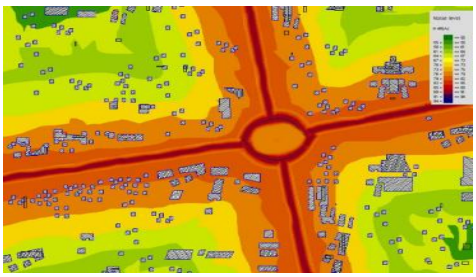

Fig.18. Detailed Noise level map on "Anna nagar"

4. CONCLUSION

In this study, we have observed the traffic noise level using sound meter in busy corridors of Chennai. Since traffic noise creates the peak sound pollution in urban areas. We have taken the study area as Guindy, Parry's corner, Adyar, Thyagaraya nagar, Velachery, Porur and Anna nagar. These areas are considered to be the busiest places in Chennai.

The traffic noise levels are observed in the range of 65-86 dB during peak and non-peak hours. Further the noise levels decrease with increase in distance and height, that is noise level, is lower in first floor of buildings compared to the ground floor. The noise level also decreases when the distance from the carriage way increases. These noise levels are in excess of the prescribed limits. Hence, the following recommendations are made for future study. Separate models were built for the all locations in a stretch in the study area. Finally a GIS model for Noise prediction was developed for a busy corridor in Chennai city. The noise pollution level in the study area of Chennai city has been plotted in spatial analysis map using ArcGIS software.

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