CHAPTER-2

REVIEW OF LITERATURE

Noise pollution as it relates to traffic volume has been the subject mater for number of studies. Some models deal more with the calculation of traffic noise as it relates to the volume of traffic. Other models have looked at how spatial features influenced traffic noise impact locations. Several studies have also examined how barriers, such as building impact noise.In contrast to many other environmental problems, noise pollution continues to grow and is accompanied by an increasing number of complaints from people exposed to the noise (Ozer, S.et al,2009).

2.1 GROWTH OF MOTOR VEHICLES

2.1.1 India

In India, motor vehicles have increased from 0.3 million in 1951 to about 160 million in 2012.The total registered motor vehicles in the country grew at a Compound Annual Growth Rate (CAGR) of 9.9% between 2001 and 2011 (**MORTH 2012)**. The growth rate of registered motor vehicles in India is shown in Figure 2.1.

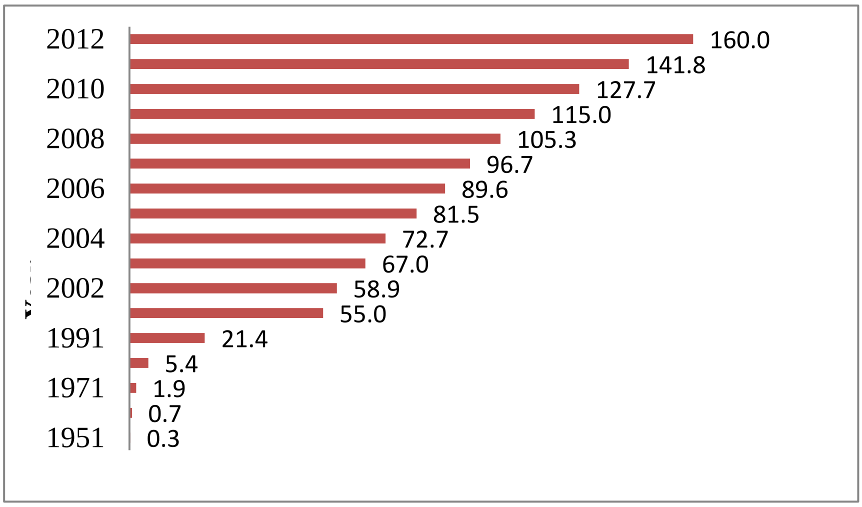

Figure 2.1 Total number of Motor Vehicles registered in India during the years 1951 to 2012

At the all India level, the percentage oftwo-wheeled vehicles in the total number of motor vehicles increased from 9% in 1951 to 69% in 1997, and the share of buses declined from 11% to 1.3% during the same period. This clearly points to a tremendous increase in the share of personal transport vehicles. In 1997, personal transport vehicles (two-wheeled vehicles and cars only) constituted 78.5% of the total number of registered vehicles.

The number of two wheelers registered has increased from 38.56 million in 2001 to 82.40 million in 2010 registering an increase of 114% over the period, while the number of Light Motor Vehicles (passengers) and Jeeps showed an impressive growth of 78% and 46% respectively during the same period. The total number of cars registered has been increased from 5.30 million in 2001 to 12.37 million in 2010 which shows a growth of 133% during the period.

2.1.2 Tamilnadu

The motor vehicles registered in Tamilnadu in the years 2002 to 2012 are shown in Figure 2.2 (Tamilnadu State Transport Authority, 2012).

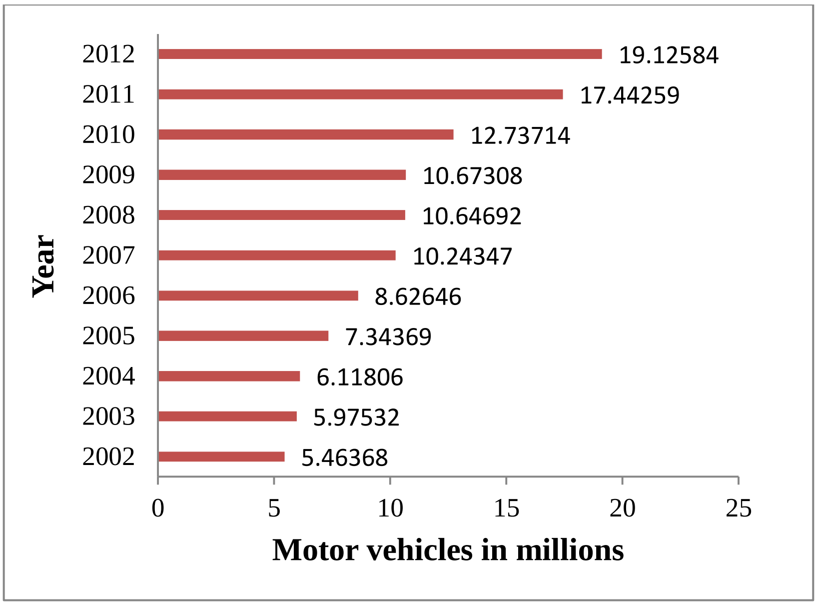

Figure 2.2The total number of Motor Vehicles registered in Tamilnadu during the years 2002 to 2012

Figure 2.3 shows a near stagnation of registered motor vehicles from the year 2008 to 2009.It synchronizes with the economic slowdown during that period. There is a tremendous increase in the purchase of motor vehicles from 2009 to 2010 and from 2010 to 2011 due to economic progress.During other years there is a gradual growth in purchase of motor vehicles.

2.1.3 Chennai

The growth of motor vehicles in Chennai has also been very palpable as shown in Table 2.1.

Table 2.1 Motor Vehicles Registered in Chennai during the Years 1981 to 2012

Year	Total Registered Vehicle
1981	120,000
1986	228,000
1991	544,000
1996	812,000
1998	975,000
2012	3,760,000

(**Source: DGP Office, Chennai**)

The motor vehicles registered in 1981 were 0.12 million only. There after within 3 decades it has been increased to 3.76 million by 2012 (about 31 times growth). The same is represented in graphical format in the Figure 2.3.

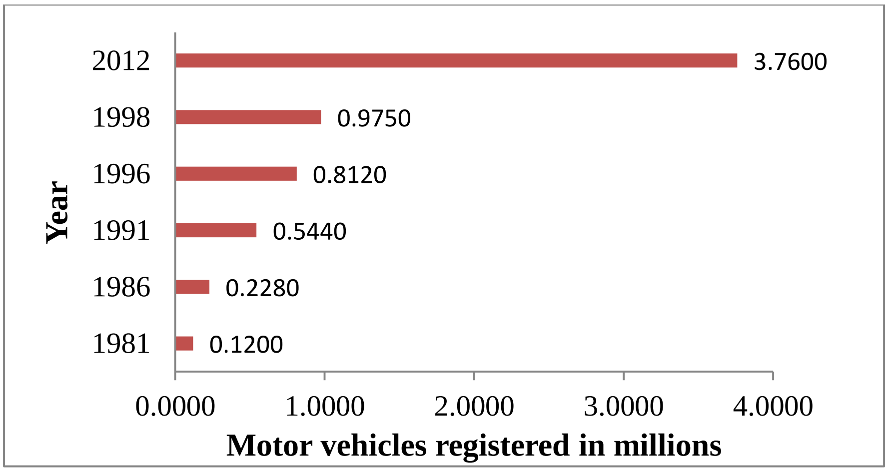

Figure 2.3 Total number of Motor Vehicles registered in Chennai during the years 1981 to 2012

The total Number of Registered Vehicles in Chennai as on 1st December 2013 are 40,75,756, out of which the two wheelers are 31,97,986.The motor vehicles growth during last 20 years in Tamilnadu is about 750 percent.In the entire Tamilnadu, there are 1.5 crore motor vehicles registered up to 1st December 2013.Thus the total numbers of motor vehicles in Chennai city is nearly 30 percent of whole Tamil Nadu State(**The Hindu – Tamil version, Dated 30-12-2013)**.

2.1.4 Increase in Noise Pollution due to Vehicular Traffic

The substantial increase in the number of vehicles has resulted in a significant increase in noise. The quantum of vehicular noise produced is highest in Delhi followed by Mumbai, Bangalore, Calcutta, Ahmedabad and Chennai**.**

"Excerpts from the reports published in daily news papers about the adverse effects due to noise pollution" are as under:

(i) Purasai Times, dated 28.06.2015."Traffic Noise leads to early death."

As per a research done by London School ofHygiene and Tropical Medicine, long term exposure to traffic noise of more than 60dB results in death in some cases.

(ii) PLOS ONE Journal of June 20,2014

. Residential exposure to road traffic noise was significantly associated with myocardial infarction or heart attack.

(iii) Times of India (daily news paper), dated April 3,2015

Patients at KMC Hospital are not able to sleep due to road traffic noise. Students of several schools on main roads find it difficult to concentrate due to traffic noise.

2.2 TRAFFIC NOISE ANALYSIS

Anirban kundu Chowdhury, Anupam Debsarkar, Shibnath Chakrabarty (2012) have conducted study on *Analysis of Day Time Traffic Noise Level: A Case Study of Kolkata, India*. They have monitored Road Traffic noise at 26 locations in the month of November and December" 2009 and findings of the data are presented in this paper. Analysis of noise indices revealed severe violation of day time ambient noise standard prescribed by Central Pollution Control Board of India during peakand non-peakhours. Fluctuation of road traffic noise levels was found higher in non-peak hour. Correlation analysis among equivalent continuous sound pressure level for one hour duration (Leq(1hr)), revealed that noise levels exceeded for 10, 50 and 90% of the time.

A study on *Ambient Noise Levels in Major Cities*By S. Sampath, S. Muralidas and V. Sasikumar carriedout for Kerala. Measurements of noise levels were carried out in the three major cities in Kerala, viz. Thiruvananthapuram, Kochi and Kozhikode to assess noise pollution. The measured sound level inside residential buildings at night during festival time exceeds the prescribed limit by 30 to 40 dB. Announcements from vehicles fitted with public address systems can cause sound levels above 100 dB(A) at distances of 10to 15 metres.

Keerthana, Gobinath.R, Neelima Singhvi, Chitravel.V, Saranya.S,and **Kannan.T**, have conducted **Evaluation of Urban Traffic Noise Pollution in Tirupur City.**This paper contains a study of traffic noise in Tirupur city has been done in the busy areas of the city which have high traffic flow in peak hours. Results obtained show that the entire city is affected heavily by noise pollution and in almost 90% of the area prevailing noise level is more than the ambient noise level. It has been found that in many areas the noise level prevailing averages around 85 dB at 90% of the busy points of the city. Most of the noise arises heavy movement of vehicles, Tirupur being a small and congested town, creates chronic issues related to noise pollution. This high level is attributed to vehicular traffic specially auto rickshaw with ineffective silencers (without filters) and frequent use of the pressure horns by buses, wagons and trucks. The city is rapidly developing, more and more vehicles are being used regularly which adds thrust on noise level in the city which in turn will create many health issues. Since the traffic noise is increasing more in this city day by day, this has to be analyzed and controlled so that there are no health hazards.

Diana Weinhold studied the health effects of loud neighbours and Urban din(2015). This paper extends the literature on residential noise and health by (a) including a broader set of environmental and socio-economic control variables in cross sectional analysis than previous studies on self-reported residential noise and health; and (b) by providing the first (to this author"s knowledge) analysis of self-reported residential noise and health in longitudinal panel data, using fixed effects to control unobservable time-invariant characteristics of individuals (such as a tendency towards annoyance) and restricting the analysis to respondents who are initially healthy to mitigate the possibility of reverse causality, both potential problems that could confound cross sectional analysis.

Thus strong suggestive evidence indicates significant correlation of residential noise annoyance, especially neighbourhood noise, with health. The results indicate association of noise annoyance with increased likelihood of cardio-vascular disease through disturbed sleep, higher cholesterol levels, arthritis and other joint and bone disorders, and that loud neighbour is highly related with increased headaches. As urbanization spreads across the world, residential noise pollution deserves much more academic and policy attention.

Explaining Car Drivers" Intention to Prevent Road-Traffic Noise(2016). An Application of the Norm Activation Model was performedby V. Elisabeth LauperStephanie MoserMaja Fischer. Strengthening car drivers"intention to preventroadtraffic noise is a first step toward noise abatement through voluntary change of behaviour. They have analyzed predictors of this intention on the basis of norm activation model (i.e., personal norm, problem awareness, awareness of consequences, social norm, and value orientations). Moreover, the effects of noise exposure, noise sensitivity, and noise annoyance on problem awareness have been studied. Data came from 1,002 car drivers who participated in a two-wave longitudinal survey over 4 months.

Personal norm had a large prospective effect on intention, even when the previous level of intention was controlled and mediated the effect of all other variables on intention. Almost 60% of variance in personal norm was explained by problem awareness, social norm, and biospheric value orientation. The effects of noise sensitivity and noise exposure on problem awareness were small and mediated by noise annoyance. Four communication strategies for strengthening the intention to prevent road-traffic noise in car drivers were proposed.

S.Sampath, S.Muralidas and V.Sasikumarhas indicated the traffic noise has known to contribute the maximum. Hence, as a first step towards assessment of noise pollution, measurement was taken up with emphasis on traffic noise. Measurements of noise levels were carried out in three major cities in Kerala, viz. Thiruvananthapuram, Kochi and Kozhikode to assess noise pollution.A sound level meter with accuracy of 2 dB was used to measure noise levels. All measurements were A weighted.

Measurements of noise levels were carried out in the commercial zones of the three cities. The results indicate the noise levels as higher than the limits prescribed by the Ministry of Environment & Forests, Government of India. The silence zones in the cities also showed higher levels. The measured sound level inside residential buildings at night during festival time was found to exceed the prescribed limit by 30 to 40 dB.Announcements from vehicles fitted with public address systems can cause sound levels above 100 dB(A) at distances of 10to15 metres.

2.3 TRAFFIC NOISE MAPPING

Road Traffic Noise Mapping and A Case Study for Delhi Region was conducted by Nasim Akhtar, Kafeel Ahmad and S. Gangopadhyay (2012). They prepared noise maps showing various important locations of Delhi city using GIS and predictor software. Sound level measurements have been carried out during a working day and under ideal meteorological conditions. The original map of Delhi has been scanned and registered/georeferenced to specify its location by inputting coordinates. The equivalent noise levels measured at various locations have been ranging from 53dB (A) to 83dB (A). Horizontal and vertical noise profile, exposure during day, evening and night has been shown through noise mapping, using predictor software.

Yasuo Oshino, Keisuke Tsukui, Hisatomo Hanabusa, Ashish Bhaskar, Edward Chung, and Masao Kuwahara (2006) have conducted.**Investigation into the Noise Map Based On Traffic Flow Prediction In The Citywide Road Network.**According to the authors, the model for predicting the traffic flow in the citywide road network is necessary. In this study, the existing model named AVENUE was used as a traffic flow prediction model. The traffic flow model was integrated with the road vehicles" sound power model and the sound propagation model, and the new road traffic noise prediction model was established. As a case study, the prediction model was applied to the road network of Tsukuba city in Japan and the noise map of the city was made. The calculated values of the noise at the main roads were compared with the measured values for examining the accuracy of the calculation of the noise map. As a result, it was found that there was a possibility of the high accuracy noise map of the city being developed by using the noise prediction model developed in this study.

Environmental Noise Mapping Study for Heterogeneous Traffic Conditions was undertaken by R.Kalaiselvi, and A.Ramachandraiah (2010). According to these authors, the traffic noise characteristics in cities belonging to a developing country like India vary slightly due to the composition of the traffic is heterogeneous associated with variance in road geometrical features, surface characteristics, honking conditions and varying density of the building on the either side of the road. A noise mapping study has been attempted for studying the propagation and spread of the traffic noise in same areas. In this study, noise mapping through computer simulation model (sound plan software) is used by considering several noise sources and propagation of noise to the receiver point. Some of the prediction models such as UK"s CORTN, US"s TNM and their modified versions have a limited applicability for heterogeneity. Therefore a separate multiple regression model is discussed to find suitability of the heterogeneous traffic conditions for noise mapping purposes.

Advancement Of Three-Dimensional Noise Mapping In Hong Kong has been given byChi-wing Law,Chee-kwan Lee,Aaron Shiu-wai Lui,Maurice Kwok-leung Yeung and Kin-cheLam. Traditional commercially available noise modelling toolsare incapable of handling the complex topography, building geometry and noise screening structures of Hong Kong. 3D presentation tools integrating noise modelling, GIS and computer graphics are needed for portraying the noise environment in the unique high-rise townscape of Hong Kong. This paper outlines the development of advanced 3D GIS tools, information technologies and how they were put into trials and implementation in Hong Kong. Specific attention is given to the dissemination of noise information to the community, be it for public education, engagement or consultation; and recent advances in the availability of such information interactively, and in a user-friendly manner, through the internet.

3D noise mapping is developed through advancement of modelling GIS and computer graphics technologies. Accuracy of modelling results and effectiveness in the communication of noise mapping are enhanced.

2.4 GIS NOISE MAPPING

Noise Mapping And GIS: Optimizing Quality, Accuracy And Efficiency of Noise Studies were conducted by H. De Kluijver and J. Stoter (2003) who provided the following conclusions**.**Noise caused by industry and infrastructure is a major source of dissatisfaction with the environment in residential areas. Since important decisions are based on the results of studies on noise effect, it is not only important to quantify noise effects, but also to have information on the quality and the reliability of the results. The quality of the results of studies on noise effect depends on the quality of the data and models used. The integration of Geographical Information Systems (GIS) and noise models makes it possible to increase the quality of noise effect studies by automating the Modelling process, by dealing with uncertainties and by applying standardized methods to study and quantify noise effects.

Road Traffic Noise: GIS Tools For Noise Mapping And A Case Study for Skane Region was undertaken by F.Farcaş, A. Sivertun (2009). According to them, traffic noise pollution is a growing problem which affects the health of people to a great extent. Regulation of traffic and construction of noise barriers is necessary for copying with this problem. In order to implement effective measures against traffic noise, the information about its distribution is imperative. In this paper a noise calculator software package is created which can generate noise maps. The noise calculator is based on the noise model described in Nordic prediction method for road traffic noise. As a case study, the noise calculator was used to build both large noise maps for Skane region in south of Sweden and detailed noise maps for smaller areas in the city of Lund.

Mapping of Noise Pollution By Using Gis on Busy Corridors in Chennai was done by Akiladevi A.R. Renganathan T. Aravind kumar R. Banupriya R. Vanisri S. The**y** have studied noise pollution integrating with GIS at the busiest places (Adyar, Thyagaraya nagar, Velachery, Porur and Anna

Nagar areas) in Chennai. The traffic noise levels were observed in the range of 65-86 dB during peak and non-peak hours. Further the noise levels decreased with increase in distance and height, that is noise level, is lower in the first floor of buildings compared to the ground floor. The noise level also decreased when the distance from the carriage way increased. These noise levels are in excess of the prescribed limits. 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.

Bhaven Tandel and **Karthikey Tiwari**have undertaken study on **AGISBasedApproach for Mapping of Urban Road Traffic Noise.** The data was measured only on working days (Monday-Saturday). The data in every location was taken during the hours9.30 am - 12.00 pm (Morning) 2.00 pm – 4.00 pm (Afternoon) 5.30 pm-8.00 pm (Evening). After data collection, sound emission contour maps are drawn using Arc GIS 9.3.The maximum sound level measured from 9.30am to 12.00pm study is 85.7 dB (A). The maximum sound level measured frosq.km.00pm to 4.00pm study is 85.4dB (A) and during evening,it was 86.4dB (A).This study reveals that noise levels are escalating upto 86dB (A) which exceeds the permissible limits of CPCB Rules2000.

Strategic Noise Mapping with GIS was done by Sarah Eason.The Comparisons of smart phone measurements with the professional sound level measurements revealed incomparable quality. Each ANOVA and t-Test revealed statistically significant differences. The phone used for doing the fieldwork for this thesis recorded decibel levels consistently five decibels higher than the other model. Otherwise, the measurements seemed to vary randomly, indicating that crowd sourced noise data is subject to variations in mobile devices. The author successfully applied sound attenuation equations to create a multiple noise source propagation and combination interpolation toolset in ArcGIS. This has not been done before and the model created can be used for an infinite number of noise sources.

Sunday Olayinka Oyedepo"s work on **Development of Noise Map for Ilorin Metropolis, Nigeria**was aimed at development of noise map for Ilorin metropolis. In this study, a total of 42 locations were selected for collection of data. The noise map developed reveals high noise exposure at the nucleus of the metropolis where commercial activities, high traffic volume and clustered buildings with high population exist.This work enables one to know areas that are noisy and ones with low noise.

The study also provides adequate information for technical controls in line with the noise emission standards which were upheld in Nigerian urban settings. The noise map showslocations near busy roads/road junctions, commercial centres and passengers loading parks ashaving higher background noise level and peak noise level than locations near residential areas.Hence, the noise pollution in Ilorin metropolis poses a severe health risk to the residents. It was suggested that noise maps should be developed for every big city to serve as a noise control measure.

Enock Abe Wawa and Galcano Canny Mulaku conducted studies on Noise Pollution Mapping Using GIS in Nairobi, Kenya with a view to generate a noise map over the study area in addition to identifying areas of high noise intensity or noise hot spots. The study revealed variation in noise levels, on average, varied from 61 db to 78 db, increasing from the west to the east of the CBD, and emanated mainly from vehicular traffic; several noise hotspots were also identified, and they are located mainly to the east of the CBD. The paper concludes that although the study was not city-wide, the noise levels observed are high enough to warrant further research and action by the environmental authorities.

In addition, noise levels, especially from traffic, are bound to vary with time of day or night and therefore continuous noise recording would give even more representative results.

2.5 MATHEMATICAL NOISE MODELS

A Compact Model for Predicting Road Traffic Noise was developed by R.Golmohammadi, M. Abbaspour, P. Nassiri, H. Mahjub (2009). Theyhad carried out research in the city of Hamadan with the ultimate objective of setting up a traffic noise model based on the traffic conditions of Iranian cities. Noise levels and other variables have been measured in 282 samples to develop a statistical regression model based on A-weighted equivalent noise level for Iranian road condition. The results revealed the average LAeq in all stations as 69.04± 4.25 dB (A), the average speed of vehicles was 44.57±11.46 km/h and average traffic load was 1231.9 ± 910.2 V/h. The developed model has seven explanatory entrance variables for achieving a high regression coefficient (R=0.901). Comparing means of predicted and measuring equivalent sound pressure level (LAeq) showed small difference less than -0.42 dB (A) and -0.77 dB (A) for Tehran and Hamadan cities, respectively. The suggested road traffic noise model can be effectively used as a decision support tool for predicting equivalent sound pressure level index in the cities of Iran.

Environmental Modelling for Traffic Noise inUrban Areas was developed by Francis Cirianni and Giovanni Leonardi (2012). They have proposed a methodological approach for the quantitative analysis of traffic noise in urban settings in their study. They presented an analysis of the acoustic data measured in the city of Villa S. Giovanni (Italy). The results show how the neural network approach provides better performance than the classical solution based on statistical analysis.

The Design of a Vehicle Traffic Flow Prediction Model for a Gauteng Freeway Based on an Ensemble of Multi-Layer Perceptron was done by Tebogo Emma Makaba, Barnabas Ndlovu Gatsheni(2016).

The cities of Johannesburg and Pretoria are both located in the Gauteng province are separated by a distance of 58 km. The traffic queues on the Ben

Schoeman freeway which connects these two cities can stretch for almost 1.5 km. Vehicular traffic congestion impacts negatively on the business and the commuter"s quality of life. The goal of this paper is to identify variables that influence the flow of traffic and to design a vehicle traffic prediction model, which will predict the traffic flow pattern in advance. The model will unable motorist to be able to make appropriate travel decisions ahead of time. The data used was collected by Mikro"s Traffic Monitoring (MTM). Multi-Layer perceptron (MLP) was used individually for construction of the model and the MLP was also combined with Bagging ensemble method to training the data. The cross—validation method was used for evaluating the models. The results obtained from the techniques were compared using predictive and prediction costs. The cost was computed using a combination of the loss matrix and the confusion matrix. The predicted models designed show the possibility of predicting status of the traffic flow on the freeway using the following parameters travel time, average speed, traffic volume and day of month. The implications of this work is that commuters will be able to spend less time travelling on the route and spend time with their families. The logistics industry will save more than twice what they are currently spending.

Development of A Road Traffic Noise Prediction Model was done by R.T. Sooriyaarachchi and D.U.J. Sonnadara. Environmental noise was seen as undesirable by-product of urbanization.Despite the absence of notice, this unwanted or excessive sound makes a significant damage to the health of the people and has hazardous impacts on the environment as observed from interaction with noise sources.Perhapsthe most invasive and difficult to avoid noise source is the transportation noise. The majorcontributor to the transportation noise is highway traffic noise.

The objective of this work is to develop a road traffic noise prediction model for the roads of SriLanka. The developed model is capable of predicting the combined traffic noise generated from vehicles in highways. Traffic flow data used for constructing this model consisted of vehicle noise, vehicle class, vehicle speed and the distance from the traffic.

2.5.1 About GIS

Geospatial Information Systems (GIS) can be effectively used in the gathering, weighting, analyzing and presenting spatial and attribute information for facilitating the management of environmental pollutions. GIS provides various tools to incorporate new models for decision making process.

Numerous traffic noise prediction models have been developed, some of which are highly specific with ability to solve problems of a reduce class. The more popular ones include the CRTN model in the UK, the FHWA-TNM model in the US, the RLS90 model in Germany, the OAL model in Austria, the Statens Planverk 48 model in Scandinavia, the EMPA model in Switzerland, and the ASJ model in Japan.FHWA-TNM is arguably the most widely used noise model. The FHWA-TNM (Federal Highway Administration Traffic Noise Model) is a computerized model used for predicting noise impacts in the vicinity of highways. It uses advances in acoustics and computer technology to improve the accuracy and ease of modeling highway traffic noise, including the design of efficient, cost-effective highway noise barrier

ArcGIS 1 software was used mainly for mapping the recorded noise levels. These values were mapped as points data relative to the specific location. A contouring method was used based on IDW (inverse distance weighted) spatial interpolation technique for capturing the adjoining area and covering the study entirely. Generally, interpolation predicts cell values in a raster format using a given albeit limited number of sample data. It is a veritable tool for prediction of unknown values for a given geographic point data which in this study is noise (Pamanikabud 1996,). IDW however explicitly implements the law of geography, which is pivoted on the hypothesis that closer.

2.6 GIS NOISE MODELS

PichaiPamanikabudand **Marnpong Tansatcha**have done**3D Analysis and Investigation of Traffic Noise Impact, from a New Motor way on Building and Surrounding Area.**A traffic noise simulation model in 3D form was applied on a GIS system. Noise impact was investigated on the basisof 3D noise mapping in L_{aeq} noise contours. The investigation shows that there is high traffic noise impact on foreground and front façade of the building. The ground area by the sides of the building receives a lower noise impact. The backyard and back side of the building together with roof top have the lowest traffic noise impact. This impact investigationalso shows that building height does not effectively reduce the noise impact from the motorway on the upper part of the building.

Timothy VanRenterghen and Dick Bottel Doorenhave conducted **3D Numerical Assessment of Road Traffic Noise Reduction byordered Planting Schemes** in vegetation belts with limited depth for road traffic noise reduction using a3D Finite-Difference Time-Domain (FDTD) numerical model.An absorbing soil as typically found under vegetation was included in the numerical model. Only a representative strip of the vegetation setup was considered for relaxing the conventional cost of such calculation. In a series of preliminary 2D calculations, the non-inclusion of approach not inducing errors for symmetric planting was shown. The effect of tree trunk planting scheme, stem diameter and tree spacing were also studied. The presence of ordered rows of trees (in a 15-m deep belt) increases traffic noise shielding for inter-stem distances of 2 m and tree diameters of 0.22 m. This is one of the measures for decreasing road traffic noise in a city.

Development of an Open Source Road Traffic Noise Model for Exposure Assessment was conducted by John Gulliver, David Morley, Danielle Vienneau, Federico Fabbri, Margaret Bell, Paul Goodman, Sean

Beevers, David Dajnak, Frank J Kelly, Daniela Fecht. This paper describes the development of a model for assessing Traffic Noise Exposure (TRANEX) in an open-source geographic information system. Instead of using proprietary software a new model is developed for two main reasons: (i) The treatment of source geometry, traffic information (flows/ speeds/spatially varying diurnal traffic profiles) and receptors matched as closely as possible to that of the air pollution modelling being undertaken in the TRAFFIC project, and (ii) To optimize model performance for practical reasons of needing to implement a noise model with detailed source geometry, over a large geographical area.

Noise estimates were compared with noise measurements made in the British cities of Leicester and Norwich for evaluating TRANEX. High correlation was seen between modelled and measured $L_{Aeq,1hr}$ (Norwich: r ¼ 0.85, p ¼ .000; Leicester: r ¼ 0.95, p ¼ .000) with average model errors of 3.1 dB. TRANEX was used to estimate noise exposures ($L_{Aeq,1hr}$, $L_{Aeq,16hr}$, L_{night}) for the resident population of London (2003e2010). Results suggest that 1.03 million (12%) people are exposed to daytime road traffic noise levels _ 65 dB(A) and 1.63 million (19%) people are exposed to night-time road traffic noise levels _ 55 dB(A). Differences in noise levels between 2010 and 2003 were on average relatively small: 0.25 dB (standard deviation: 0.89) and 0.26 dB (standard deviation: 0.87) for $L_{Aeq,16hr}$ and L_{night}.

Jantien Stoter (1999) conducted study on Noise Prediction Models and Geographic Information Systems, A Sound Combination.

GIS is increasingly important in the study on the possible effects of planned infrastructure on the environment. When planning a new infrastructure, noise is one of the most important factors to be considered. GIS can be a very useful tool to monitor the noise effects on the environment. The use of GIS can increase the quality of the study on noise pollution The aim is to improve the study on noise effects supporting the environmental management and to reduce the costs of these studies as well.

Application of GIS in Urban Traffic Noise Pollution was undertaken byAli Asghar Alesheikh and Mouchehr Omidvari. Geospatial Information Systems (GIS) can conveniently be adapted to gather, analyze and present noise information. The objectives of this research were to measure urban traffic noise levels, analyze temporal and spatial dynamics of urban traffic-induced noise pollution in the first district of Tehran, estimate the noise for pollution concentration, assess the results of Federal Highway Administration Traffic Noise Model (FHWA-TNM) and Iranian Traffic Noise Predictor (ITNP); and represent them in a GIS environment. Measurements were taken at the traffic peak time and also when the traffic was at its minimum, during three successive months. In this study, the results demonstrated most of commercial and residential regions surrounding the main streets are suffering from severe noise pollution. Processed data, spatial analysis and models are integrated within the framework of ArcGIS software environment, providing adequate tools to address noise issues

In this research, traffic-induced noise levels of the city of Tehran district 1 were measured during the peak and low traffic times and compared with the national and international limit values for noise. The results showed that the measured noise levels exceeded the limit values except for 5% of points. The statistical assessment showed that there exist significant spatial-temporal variations of traffic noise in the study area.

3D Analysis and Investigation of Traffic Noise Impact From Hemmat Highway located in Teheran on Buildings and Surrounding Areas was conducted byHamid Reza Ranjbar, Ali Reza Gharagozlou and Ali Reza Vafaei Nejad. In this study, a 3D traffic noise simulation model is applied on a GIS system. Visualized noise levels were formulated by the proposed model for noise mapping on all surfaces of the buildings and surrounding ground in a 3D platform. The investigation shows the presence of a high traffic noise impact on the foreground and front facades of buildings, rendering these areas unsuitable for residential purposes. The ground area by the sides of buildings and the building side panels receive a lower noise impact. Most of these areas are still not acceptable for residential and even commercial use. It also shows that the building height is not an effective factor for reducing motorway noise on the upper part of the building. Finally, construction cantilever barriers with a height of seven meters, close to the outer edge of the high-way was presented as an effective way to reduce noise within the allowable range of noise pollution for commercial and residential purposes. Consideration of the natural condition of the study area and even economical aspects,could me installation of cantilever barriers could be an effective approach for noise attenuation in this area.

A Model for Predicting Highway Noise Using A Geographicinformation System: Interstate 73 in Guilford county, North Carolina was developed bySean Michael Kelly. The model developed for this study predicts traffic volume noise in an area of future highway construction on the basis of sound propagation and physical attributes which would affect sound levels. This model attempts to give an accurate prediction of traffic noise levels for the future Interstate 73 corridor through northwest Guilford County., it is clear from this study, that many residents and businesses will be affected by the traffic volume noise levels generated by this new interstate.

The model developed in this research shows the potential impact of highway volume on noise levels in a region within a mile of future Interstate 73. The model captured the blueprint for the future interstate from its junction at North Carolina 68 to its junction at U.S. Highway 220. Landcover was categorized and used for adjusting sound levels from a baseline sound map based on the type of landcover. Within the study area there were several areas which were dramatically affected by the noise caused by traffic. Three of these areas were studied and properties affected by the traffic noise saw decibel levels of greater than 60 decibels for the overnight model, 63 for the daytime model and 65 for the heavy traffic model. In each of these areas there were many properties, a majority residential, which showed a large increase in sound level. Overall, the results of this model showed that there is a significant impact from future highway traffic on the noise levels of properties within a mile of future Interstate 73.

2.7 INFERENCES FROM LITERATURE REVIEW

Traffic Noise Pollution is considered as a serious environmental hazard. The noise levels in many cities of India and abroad countries are affected heavily by noise pollution. Results from various studies show that the noise levels in many areas exceed the permissible limit. Noise pollution causes deafness and cardiovascular diseases. The noise effects are high near ground floor area of multi storey buildings. Noise levels in Chennai during peak and non-peak hours were in the range of 65-86dB(A).

Noise pollution studies also reveal building height as an effective factor for reducing motorway noise on the upper part of the building. In the context of these effects it is necessary to formulate a noise prediction model. In this research, time factor is considered for the noise prediction model which has not been considered in the previous studies.