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Remote Sensing based Noise Level Assessment: A Case Study of Coimbatore City, India

E. Sarojini[1]*, S.D. Anitha Selvasofia[2] S. Kanchana[3] and B. Kamal[2]

Department of Civil Engineering, Sri Ramakrishna Engineering College, Coimbatore, Tamil Nadu, India

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ABSTRACT

Major cause of noise pollution is the improper design of city with mixed zones. Normally a city is defined by four major zones namely: Commercial, Industrial, Residential and Silence Zones respectively. The noise pollution occurs due to traffic and transport and when industrial zones mix up with residential or silence zones. So, noise pollution can be controlled efficiently when construction or progress of buildings are within their respective zones. Study area, Coimbatore is the largest non-metro city in India reported to face frequent noise pollution issues. It has many industries (Textile, Foundry, pumps etc), within the city and many of the industries are clubbed together with other zones as mixed. Noise monitoring is carried out in the city by dividing the city into five major regions. The important places of each region were monitored during regular time intervals (peak hours). The modelling of the localities predicts the Noise impacts in the form of map using the ArcGIS software. The summation of recorded noise levels gives the prevailing noise in the place, and helps to identify the risk areas. The results demarcate the considered regions into regions where noise level are within limits and regions where noise exceeds. The control methods are suggested to be implemented in the affected areas.

Key words : *Noise pollution, Zones of noises, Noise level meter, Monitoring, ArcGIS Modelling, Control and Remedial measures.*

Introduction

Noise Pollution is one of the major issues faced by the urban cities in almost every nation of the world. It has some of the most adverse effects on the environment and also effects on human beings and fauna. Noise pollution also affects the growth and development of a city (Sunday Olayinka Oyedepo, 2012). Many steps have been taken by the government and environmental organizations to control noise by Noise Regulations. Noise is defined as offensive sound that unreasonably intrudes into our daily activities. Noise is the unwanted sound judged to be unpleasant, loud or disruptive to hearing (Ron Chepesiuk, 2005). The principal sources of environmental noise include noise pollution due to traffic and transport, noise pollution due to industries and factories and domestic and neighbourhood sources (Murthy *et al.,* 2007; Baaj *et al.,* 2009).

Noise can be classified in to four types namely physical, physiological, psychological, and semantic. Noise levels can be controlled through certain activities and remedial measures (Narendra Singh and Davar, 2004). During last twenty years, there has been increasing concern with the quality of environment (Abdeen Mustafa Omer, 2009). Along with air and water contaminants, noise pollution has been recognized as a serious pollutant (Muhammad Idrees *et al.,* 2013). Effects of Noise Pollution on Human Health include emotional and psychological

([1*]Prof., [2]Assistant Prof., [3]Associate Prof.)

effects (hypertension, change of heart-beat, high respiratory rates), poor performance, annoyance, physical damage to the ear and the temporary hearing loss called as Temporary threshold shift (TTS), permanent loss, usually called Noise Induced permanent threshold shift (NIPTS), tired and exhaustion, disturbed sleep and reduced memory power (Thomas Munzel *et al.,* 2012; Keerthana *et al.,* 2013; Issam *et al.,* 2003; Belojevic, *et al.,* 2008). Below a sound level of 80dB, hearing loss does not occur. Temporary effects are noticed at sound levels between 80 and 130dB, about 50% of people exposed to 95 dB sound levels at work will develop NIPTS and most people exposed to more than 105 dB will experience permanent hearing loss. A sound level of 150 dB or more can physically rupture the human ear drum and ≥ 180 dB can kill a person (Joydeep *et al.,* 2018; Daniel, 2017). Noise has impact on living pattern of animals and it may push the rare species to extinction. Like humans, they also suffer from temporary or permanent disability of hearing. The paper presents the noise level mapping of Coimbatore city by measuring the noise levels at various localities and comparing the measured noise levels with the allowed levels. The scope of the project is to understand the impact of Noise by interpreting the parameters and to generate the GIS modeling. It is used to identify the safest and risk areas. The Control and remedial measures for excess noise levels are also suggested.

Noise Pollution Regulation

Noise pollution regulation includes statutes or guidelines relating to sound transmission are established by national, state or provincial and municipal levels of government. Creating noise is considered to be a public nuisance. Ambient standards in respect of noise for different categories of areas (residential, commercial, industrial) and silence zones have been notified under the Environment (Protection) Act, 1986. Regulatory agencies have been directed to enforce the standards for control and regulate noise pollution. Noise regulations restrict the amount of noise, the duration of noise and the sources of noise.

Table 1. Maximum Allowable Noise Level

Maximum Allowable Noise Level (dB)	Day Time	Night Time
Commercial Zone	65	55
Industrial Zone	75	70
Residential Zone	55	45
Silence Zone	50	40

Classification of Zones

Zoning shapes the city and regulates building size, population density and the way, land is used. However, the situation in most of the cities does not augur well and the impact will be felt in the future years. Urban planning as currently practiced in India is essentially concerned with planning the use and development of land in cities (Aman Randhawa and Ashwani Kumar, 2017; Avinash Satashia, 2014). An urban city can be classified into four major zones based on utility and nature of locality. They are commercial, Industrial, Residential and Silence Zones. Commercial zones are the regions where the parts of the city in which the primary land use is commercial activities, where shops, offices, theaters, restaurants, trade centers are located. Industrial zone is the area, in which industries are located, probably in the outskirts of city. Residential zone is the major region in which the people dwell in their houses which comprises buildings like villas, flats, multistory apartments etc. Silent zone is a highly noise sensitive zone in which hospitals, educational institutions, courts and research bases are located. Table 1 provides the maximum allowable noise level in various zones.

Noise Level Monitoring

Study Area

The site selected for the noise monitoring is a rapidly growing urban city located in the west of Tamilnadu and largest non-metro city in the nation, Coimbatore. It is one of the fastest growing tier I cities in India and a major hub of textiles, industries (Pump, motors, largest exporters of jewellery, wet grinders, poultry and auto components etc.,) commercial, education, information technology, healthcare etc. Coimbatore lies at 11° 1′6" N 76° 58′21" E in south India at 411 meters above sea level on the banks of Noyyal River, in Southwestern Tamilnadu. It covers an area of 642.12 km^2 and surrounded by Western Ghats mountain range with reserve forests of the Nilgiri, Anaimalai and Munnar Biosphere reserve. The dry eastern side of city includes majority of urban area of city. After Monitoring of noise level in different regions of Coimbatore, GIS modeling is carried out using the data. As

shown in Fig. 1, Major areas of different zones considered for study are given below.
North Coimbatore: Kavundampalayam; Thudiyalur; Kanuvai; Vadamadurai
South Coimbatore: Ukkadam, Podanur, Sundarapuram, Nanjundapuram
Central Coimbatore: Gandhipuram, Townhall, R.S.Puram, Race Course, Saibaba Colony
East Coimbatore: Ramanathapuram, Singanallur, Peelamedu, Ganapathy
West Coimbatore: Perur, Vadavalli, Thondamuthur, Kovaipudur, Vedapatti.

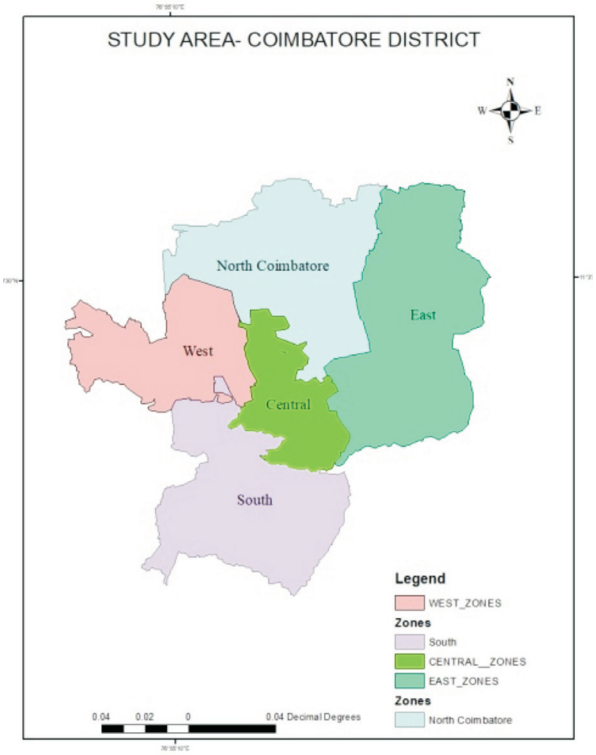

Fig. 1. Study area [Coimbatore region]

Noise Level Measurements

Many types of noise monitoring techniques can be used depending on the purpose, characteristics of sound and the extent of information desired. To measure loud noises, impulse noise level measurement procedure is used. Noise level meters with sound pressure averaged for 35ms are used for impulse noise level measurement. Non-impulsive measurement requires noise level meters with the fast or slow averaging method. Sound level meters or noise level meter consists of a microphone, electronic circuits and a readout display. The microphone detects the small air pressure variations associated with sound and transfer into electrical signals which are processed by the electronic circuitry of the instrument.

Fig. 2. Noise level meter

Noise levels in different regions of Coimbatore city are measured using noise level meter shown in Fig. 2 at regular intervals (9.30 to 12.30pm, 12-1pm, 5-6pm) for three months duration (January 2017 to March 2017).

Noise Mapping Using GIS

Geographic Information System (GIS) is a computer based information system designed to accept large volumes of spatial data derived from variety of sources and to efficiently store, retrieve, analyze, model and display (output) these data according to user defined specifications. GIS helps to visualize, analyze and interpret data to understand relationships, patterns and trends. GIS provides a strong framework for managing records with full transaction support and help as reporting tool in real estate site selection, route selection, evacuation planning, natural resource extraction site, natural resources conservation essential sites etc. GIS mapping system is used to analyze the results of noise monitoring with the corresponding zones and allowable limits of zone (Akiladevi, *et al.*, 2015; Anitha Selvasofia *et al.*, 2019; Anitha Selvasofia *et al.*, 2020). Type of zone, time and allowable limit are used for modeling of data. The results signify classification of commercial, industrial, residential and silence Zones. This representation of noise mapping easily helps to identify

the noise level polluted areas and control measures to be implemented in the region. Noise levels in different regions of Coimbatore city are measured at regular intervals (9.30 to 12.30pm, 12-1pm, 5-6pm) for three months duration. (January 2017 to March 2017). The measured data is used for GIS Modeling which represents the noise level of all regions of particular day. Table 2 provides the overall data of Noise level in all regions of study area. GIS Model developed as in Fig.3 using the Noise levels measured with allowable limits and time as input.

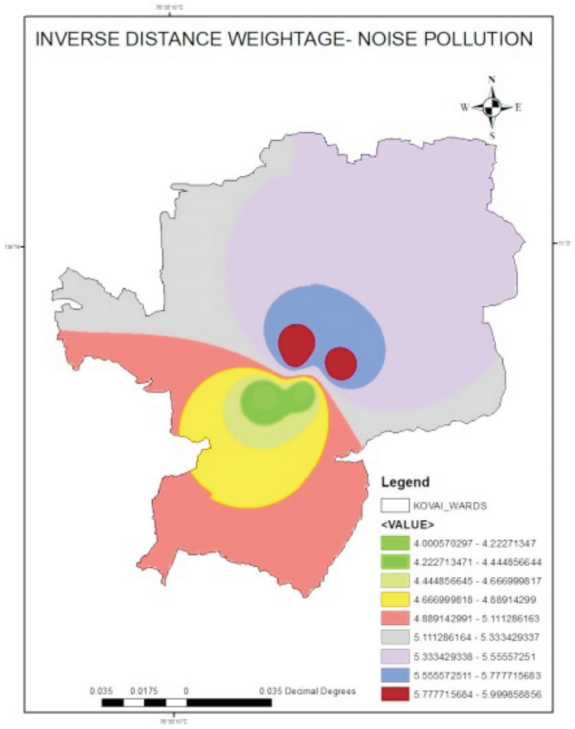

Fig. 3. GIS Model of Noise level in study area

Control and Remidial Measures

To prevent and control noise pollution, it is necessary to create public awareness. People must be aware of the harmful consequences of noise pollution. Legal policies need to be implement to residents, commercial and industrial building, owners need to limit the amount of noise produces.

Greenbelt vegetation and open spaces at regular intervals within densely populated areas must be developed. A 20 feet wide plantation strip inside the compound wall effectively protects the houses from noise pollution due to vehicular traffic. Local authorities can ensure that cities and towns are designed properly so that residential areas are situated far away from noisy industrial areas or areas of flight paths.

Noise muffling devices can be used on machinery or people can resolve noise problem from aviation and other industries entirely. Rooms may be designed with heavy glass partitions so that visual contact can be maintained without noise disturbances. Personal ear protectors should be used to reduce the noise levels by 10 to 45dB and improve speech communication.

The north region is hub for many industries where industries are clubbed together with residential and silence zones. The important reason for noise is due to mixing of zones. The north zone is filled with industries and noise can be controlled by planting trees around the compound. Noise proof walls can be installed. South region is actively performing commercial hub and kind of congested region. Many of the residential areas are not properly designed and have some small scale industries stuck within the region. The density of population and industries among residential area are the reasons for noise pollution. Proper planning of the township in future can reduce noise pollution. The central region is the commercial hub of city is the noise prone zone. Noise can be controlled by high precision techniques controlling traffic noises and over-crowding. East region serves as the major entrance to the city with major highways and important city roads circulating in the region. Due to presence of increased traffic in the region, the zone is polluted by noise. The presences of industries also serve as sources of noise pollution. The control measures in transport and traffic can reduce the noise pollution. The west zone act as the natural boundary, the urban development is a step lower than the other regions. The west region is moderately polluted due to small scale industries.

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