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Soundscape Assessment and Noise Pollution Analysis of Himachal Pradesh, India

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ABSTRACT

Himachal Pradesh, renowned for its pristine natural landscapes and tranquil environment, has witnessed rapid urbanization and increased human activities in recent years. This shift has sparked concerns regarding the potential impacts of noise pollution on the environment and public health. The objective of this study was to thoroughly evaluate the soundscape and map noise pollution levels across various regions of Himachal Pradesh. Employing a mixed-methods approach, the research has combined acoustic measurements, Geographic Information System (GIS) technology, and community surveys. Sound level measurements have been gathered at strategic points across urban, sub-urban, and rural areas of the state, capturing both ambient noise and specific events. Geographic data have been integrated to construct noise pollution maps, providing spatial insights into noise distribution and identifying hotspots. Additionally, community perception surveys was conducted to assess the impact of noise pollution on residents' well-being and quality of life. This research paper will contribute to the knowledge base by providing valuable insights into the current soundscape of the state and laying the groundwork for sound urban planning and noise management strategies. The findings have suggested for preserving the tranquillity of Himachal Pradesh's natural environment while safeguarding the well-being of its residents amidst growing urbanization and development pressures.

Introduction

The assessment of soundscapes and noise pollution mapping has become increasingly important in understanding the acoustic environments of urban and rural areas. In the context of Himachal Pradesh, a region known for its natural beauty and growing urbanization, this literature review explores the existing research on soundscape assessment and noise pollution mapping. While Himachal Pradesh has long been celebrated for its serene landscapes, the state has not remained immune to the effects of noise pollution. A study by Sharma et al. (2017) documented increasing noise levels in the state's urban areas due to expanding transportation networks and construction activities. Noise pollution has emerged as a concern,

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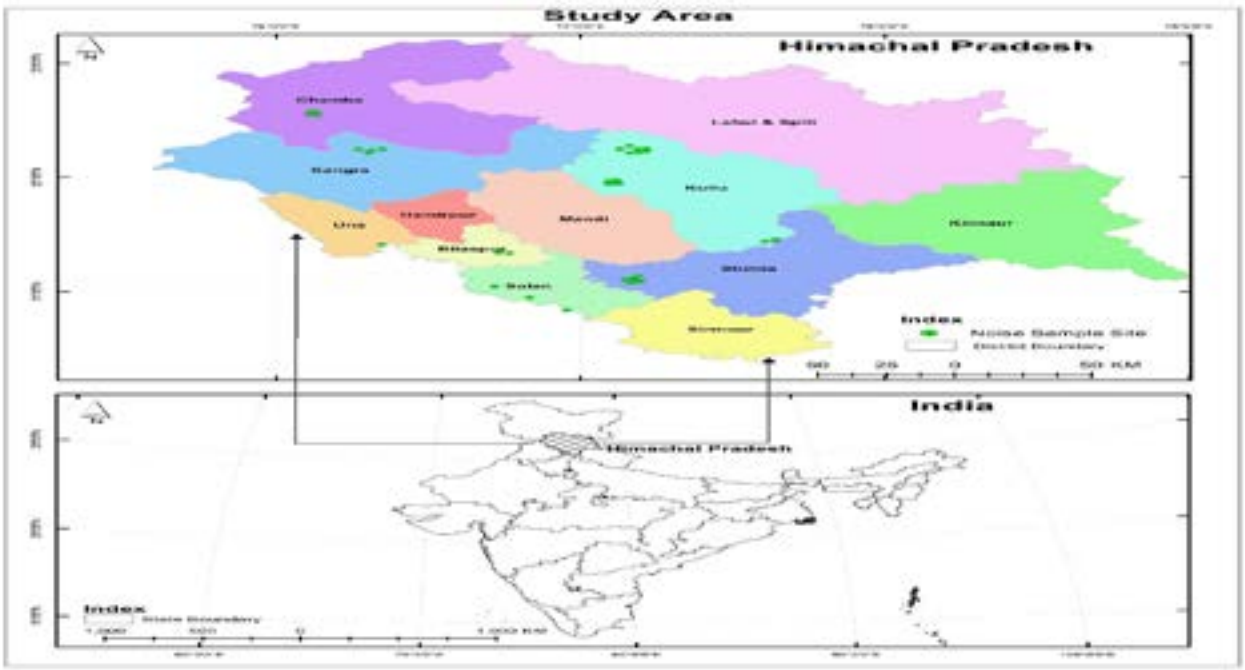
affecting both the environment and the well-being of its residents. The concept of soundscape assessment has gained prominence in recent years. Schafer's seminal work, "The Tuning of the World" (1977), introduced the idea of considering all sounds in the environment, both natural and human-made, as part of the soundscape. This approach emphasizes the importance of understanding the acoustic environment rather than merely focusing on noise pollution. Soundscape assessment has been applied in urban contexts worldwide. Kang and Zhang (2017) conducted a soundscape assessment in Beijing, China, using GIS-based approaches to analyse the distribution of soundscapes. Their study emphasized the significance of soundscape quality in urban planning. Geographic Information System (GIS) technology has played a crucial role in noise pollution mapping. In the Indian context, Shrivastava et al. (2019) employed GIS to create noise maps of Bhopal, revealing noise hotspots and guiding urban planners in mitigating noise pollution. A similar approach can be adopted for Himachal Pradesh. Transportation-related noise is a significant contributor to urban noise pollution. Mahendra et al. (2016) conducted noise mapping in the city of Pune, India, focusing on road traffic noise. Their findings underscored the importance of considering traffic management strategies to reduce noise emissions. Understanding the community's perception of noise pollution is vital for effective noise management. Lercher et al. (2002) explored the relationship between noise exposure and annoyance in urban areas. Their study emphasized the need to consider public perception when designing noise abatement policies. This literature review highlights the growing concern of noise pollution in Himachal Pradesh and the significance of soundscape assessment and noise pollution mapping. Drawing on international and national research, it underscores the potential for GIS-based noise mapping to provide insights into the spatial distribution of noise pollution in the state. Additionally, community perception studies can inform noise management strategies that consider the well-being and quality of life of residents. The synthesis of these approaches can contribute to preserving Himachal Pradesh's acoustic environment while accommodating its evolving urban landscape.

Noise pollution, often overlooked amid other environmental concerns, poses a multifaceted challenge to the well-being of both the environment and its inhabitants. It has the potential to disrupt ecosystems, affect wildlife behaviour, and, most significantly, impact the quality of life and health of the human population. Recognizing this, it becomes imperative to comprehensively understand the soundscape of Himachal Pradesh, delineate sources of noise pollution, and develop effective strategies to manage and mitigate its effects.

This research endeavours to delve into the intricacies of noise pollution in Himachal Pradesh, employing a holistic approach that combines soundscape assessment and noise pollution mapping. By harnessing the power of acoustic measurements, Geographic Information System (GIS) technology, and community perception surveys, this study seeks to unravel the acoustic tapestry of the state. Through the intricate interplay of data collection, analysis, and community engagement, it aims to paint a detailed picture of noise pollution's presence, sources, and implications in various regions of Himachal Pradesh.



Study Area The study is based on Himachal Pradesh. Himachal Pradesh has a geographical area of 55,673 sq. km supporting 68, 56, 509 population as per 2011 Census. Geographically, the picturesque state of Himachal Pradesh is located between 30° 22'44" north to 33° 12'44" north latitude and 75° 45'44" east to 79° 04'20" east longitude. The study area comprises of 12 districts namely Bilaspur, Chamba, Hamirpur, Kangra, Kinnaur, Kullu, Lahaul-Spiti, Mandi, Shimla, Sirmaur, Solan and Una. Geographically, the study area is enclosed on the west to southwest by Shiwalik ranges, on the northwest by Dhauladhar and Pirpanjal ranges and on the north by great Himalayan range. Zanskar range demarcates the boundary in north and northeast.

Objectives of the Research

- To assess the current state of the soundscape in Himachal Pradesh, capturing both ambient and event-specific noise levels.
- To create noise pollution maps using GIS technology, illustrating spatial patterns and hotspots of noise pollution.

Methodology

Data Collection Methods

Sound Level Measurements: To assess the soundscape in various regions of Himachal Pradesh, sound level measurements were conducted with the following steps:

Selection of Sampling Locations: A strategic selection of sampling locations has been made to represent different types of environments, including urban, suburban, and rural areas. These locations have encompassed a variety of land use patterns and potential noise Sound level measurements have been taken during both daytime and nighttime hours to capture diurnal and nocturnal variations in noise levels. Data collection sites were chosen across various districts and zones.

Day Time: At Bus Stand Nalagarh in Solan district, the permissible noise level set by the Central Pollution Control Board (CPCB) was 65 decibels (dB) on monitoring dates including 25-03-2022, 05-09-2022, 12-09-2022, 20-10-2022, and 03-11-2022. In Shimla district, Court Complex Rampur, PWD Colony Patbangla Rampur, Forest Colony/Residential Colony Forest Rampur, Industrial Area Mehatpur, College of Excellence Sanjauli, IGMC Shimla, Kamla Nehru Hospital Shimla, Deen Dayal Upaadhaay Hospital Shimla, Ayurvedic Hospital Chotta Shimla, H.P. Secretariat Chotta Shimla, H.P. Vidhan Sabha, Zonal Hospital Dharamshala, and HPPCB Office Complex Dari were monitored with permissible noise levels of 50 dB and 55 dB for Silence and Residential zones, respectively. In Kangra district, Kotwali Bazar Dharamshala was monitored with a permissible noise level of 65 dB on 08-04-2022, 06-08-2022, 22-06-2022, 02-07-2022, and 19-07-2022. In Bilaspur district, Zonal Hospital Bilaspur and Diara Sector were monitored with a permissible noise level of 50 dB for Silence and Residential zones, respectively. In Chamba district, District Hospital Chamba, Near District Court Chamba, and Near Market Chowgan Chamba were monitored with a permissible noise level of 50 dB for Silence and Residential zones. In Kullu district, District Hospital Kullu, Circuit House Dhalpur, and Bus Stand Kullu were monitored with a permissible noise level of 50 dB for Silence and Residential zones, respectively. In Manali, Lady Wellington Hospital, HPPCB Office Building, and The Mall Manali were monitored with a permissible noise level of 50 dB for Silence and Residential zones, respectively. Finally, in Baddi, Solan district, Malhotra Hospital Katha Baddi and SDM Office Nalagarh were monitored with a permissible noise level of 50 dB for Silence zones.

Night Time: The sites include Boys School Near Court Complex in Rampur, Bus Stand in Kullu, Circuit House in Dhalpur, District Hospital in Kullu, Govt. Hospital in Una, HPPCB Office Building in Manali, Lady Wellington Hospital in Manali, Malhotra Hospital Katha in Baddi, SDM Office in Nalagarh, The Mall in Manali, and Zonal Hospital in Bilaspur. These sites were selected to represent different noise zones (Silence, Residential, and Commercial) and to cover a range of permissible noise levels as specified by the Central Pollution Control Board. The monitoring was conducted at night time on various dates between January 2022 and October 2023.

Geographic Coordinates: GPS coordinates of each measurement location have been recorded to facilitate the integration of data into GIS for noise mapping.

Geographic Information System (GIS) Mapping: GIS technology has been utilized to create noise pollution maps, providing spatial insights into the distribution of noise pollution. The following steps have been taken:

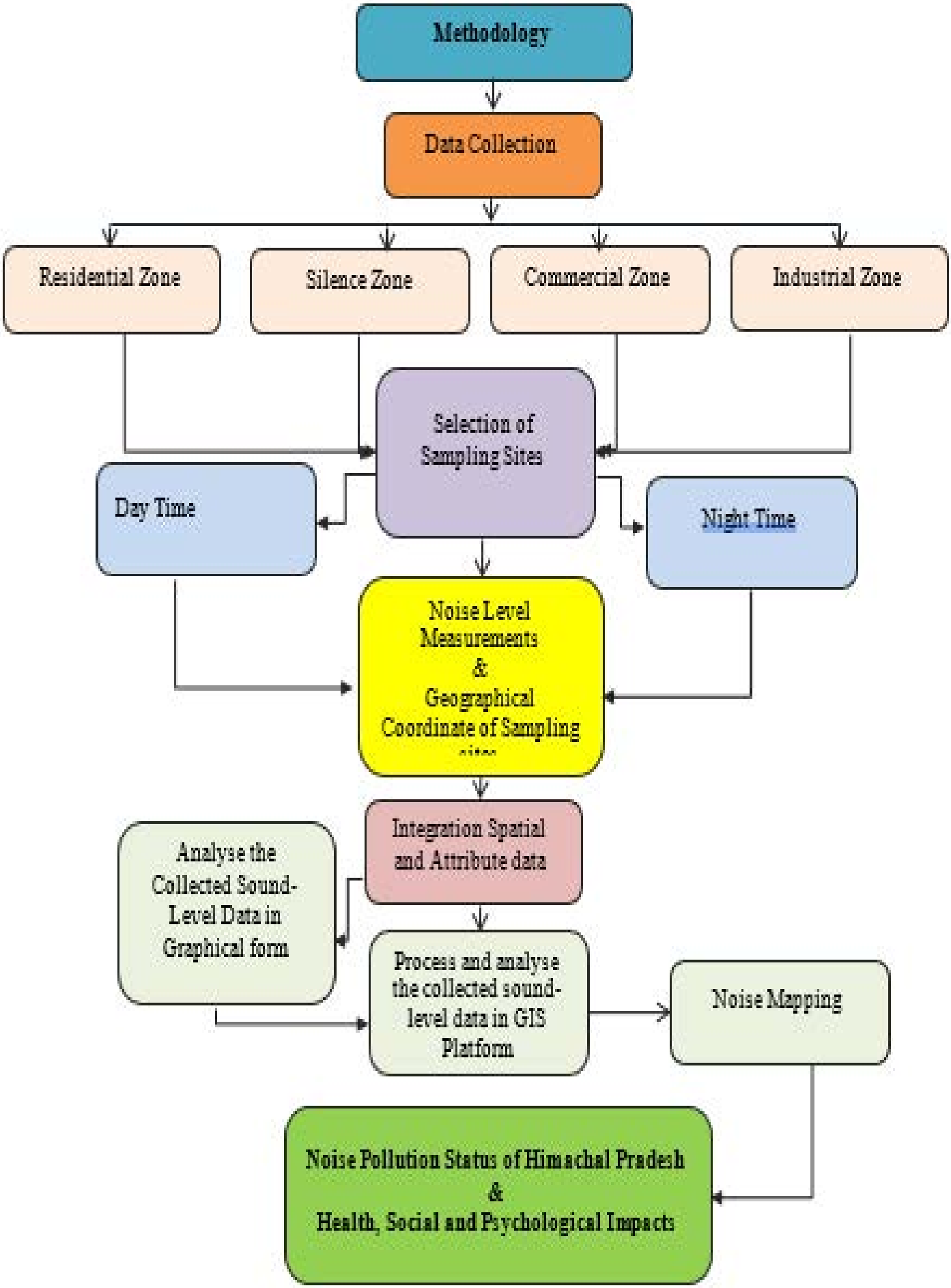
GIS Software: Specialized GIS software (Arc.GIS) has been employed to process and analyse the collected sound-level data.

Data Integration: Geographic coordinates from sound level measurements have been integrated with GIS layers representing land use, topography, and other relevant geospatial data.

Noise Mapping: Noise pollution maps have been generated using interpolation techniques to visualize the spatial distribution of noise levels, identifying noise hotspots and quiet areas.

Data Integration and Analysis

Collected sound level data, geographic coordinates, and survey responses have been integrated and analysed to


Methodology
Data Collection
Residential Zone
Silence Zone
Commercial Zone
Industrial Zone
Selection of Sampling Sites
Day Time
Night Time
Noise Level Measurements & Geographical Coordinate of Sampling
Integration Spatial and Attribute data
Analyse the Collected Sound-Level Data in Graphical form
Process and analyse the collected sound-level data in GIS Platform
Noise Mapping
Noise Pollution Status of Himachal Pradesh & Health, Social and Psychological Impacts

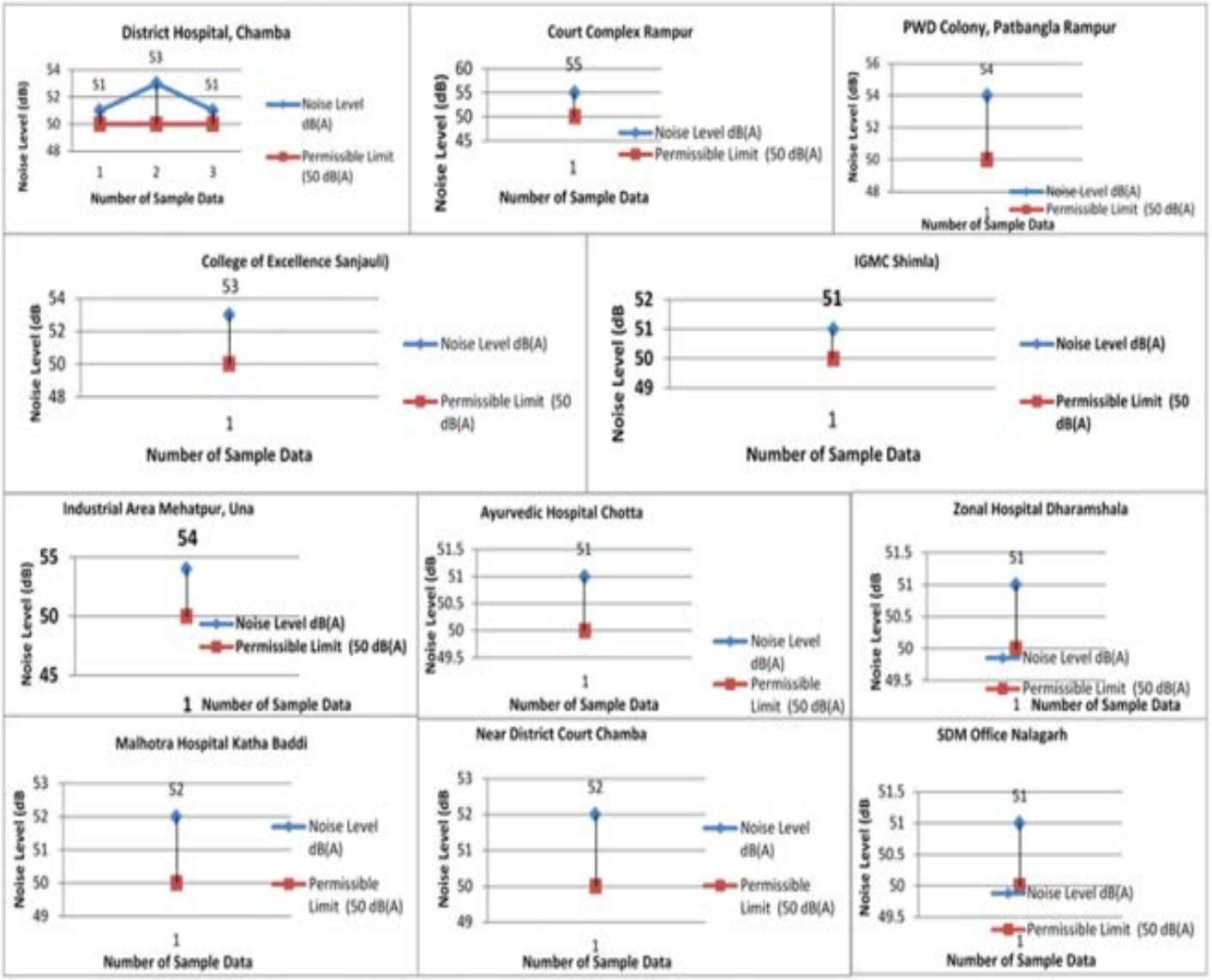
draw meaningful conclusions about the soundscape and noise pollution in Himachal Pradesh. This comprehensive methodology, encompassing sound level measurements, GIS mapping and ethical considerations, has enabled a thorough examination of the soundscape and noise pollution in Himachal Pradesh, facilitating a deeper understanding of this environmental issue.

Results and Discussion

Soundscape Assessment

Ambient Noise Levels: Sound level measurements conducted various location of Himachal Pradesh revealed significant variations in ambient noise levels. Urban areas, characterized by heavy traffic and commercial activity, exhibited the highest noise levels during both daytime and night-time. Suburban areas showed intermediate noise levels, while rural areas generally maintained lower noise levels, especially during night-time. These results align with the expected urban-rural gradient of noise pollution. Soundscape assessment is an emerging field that focuses on the acoustic environment and its impact on human well-being and ecosystems. Soundscape evaluation was performed by collecting noise samples from 36 different locations, for a total of 115 samples. All the samples were collected from several zones, including the commercial zone, the silence zone, industrial zone and the residential zone. The central pollution control board of the government of India determines the frequency of noise for each zone.

Status of Noise in Silence Zone (Day Time)



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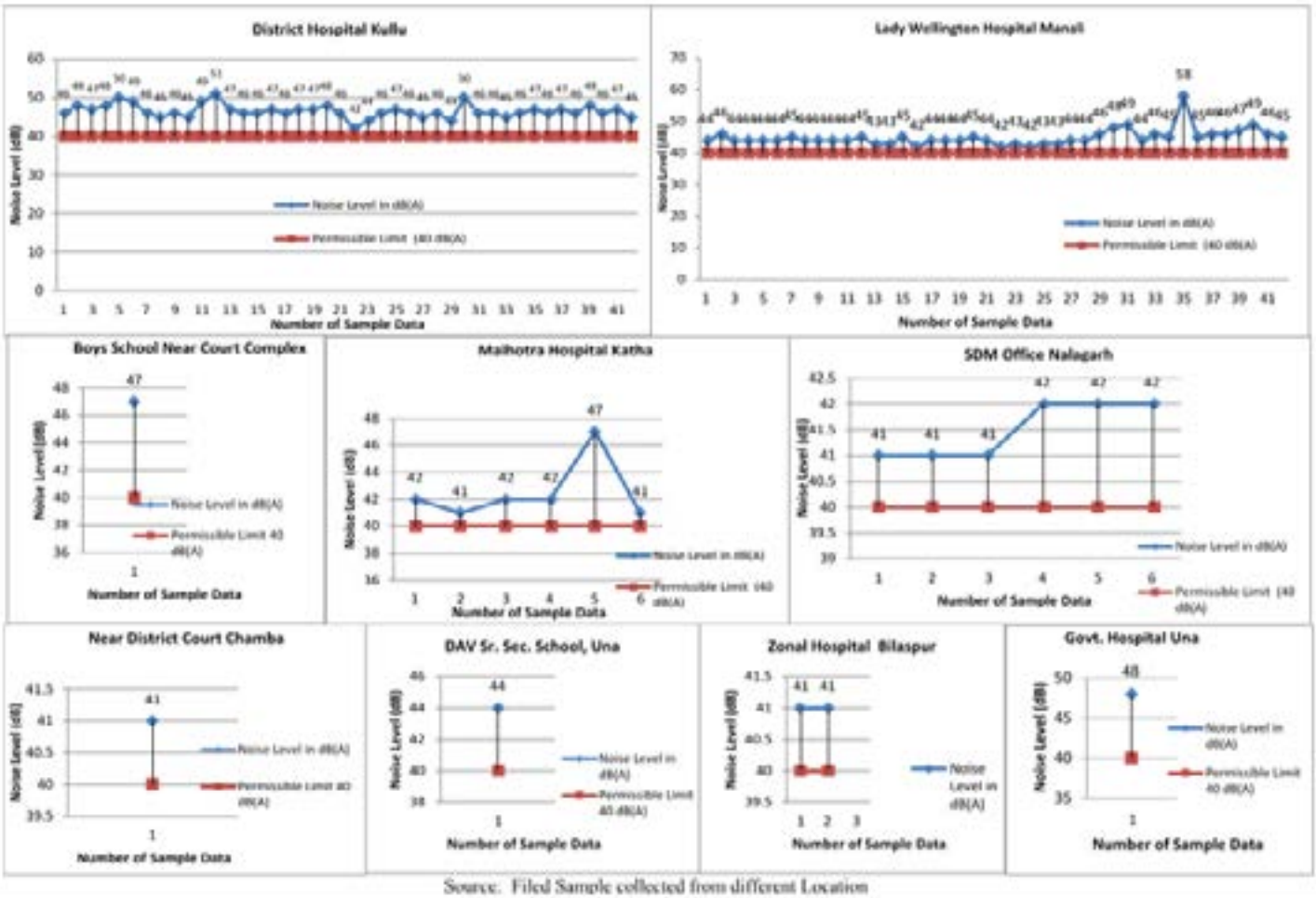
Status of Noise in Silence Zone (Night Time)



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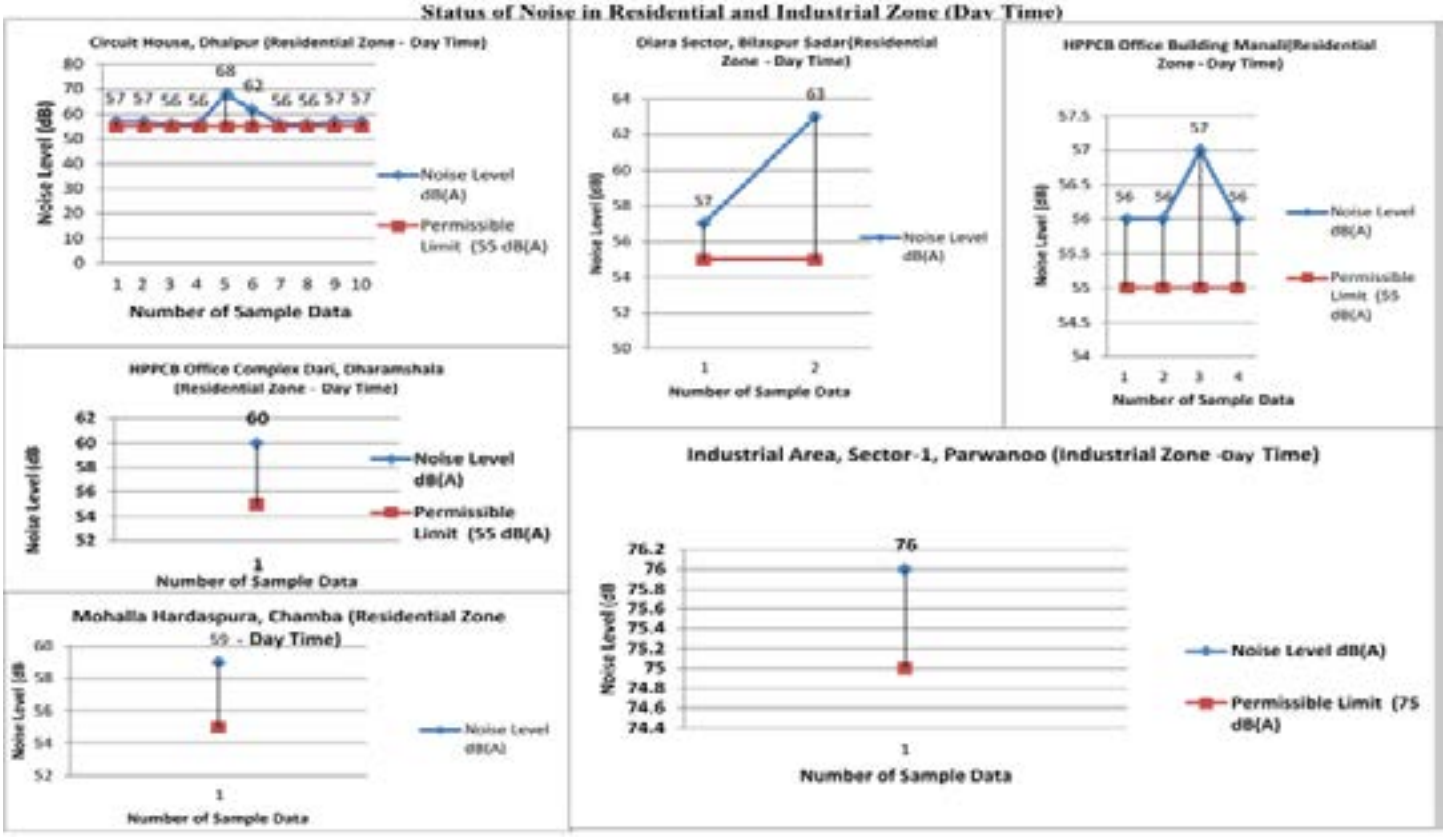
Status of Noise in Residential and Industrial Zone (Day Time)



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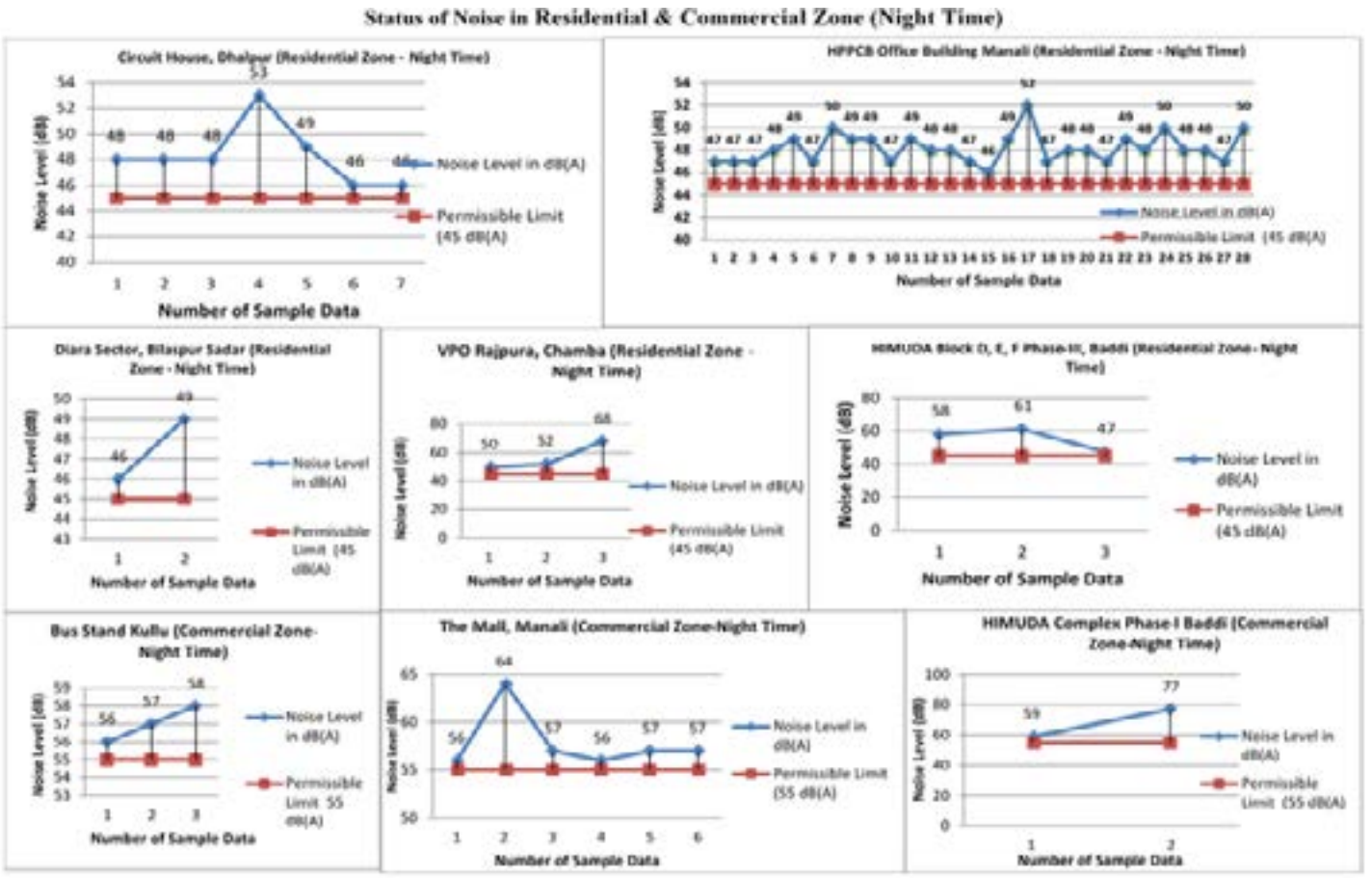

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During the day time, Bus Stand Nalagarh in Solan district, the noise levels ranged from 66 to 68 decibels, with an average of 67 decibels, which is within the permissible limit of 65 decibels. At the Court Complex in Rampur, Shimla, the noise level was 55 decibels, below the permissible limit of 50 decibels. At the College of Excellence in Sanjauli, Shimla, the noise level was 53 decibels, slightly above the permissible limit of 50 decibels. In the Industrial Area, Sector-1, Parwanoo, Solan, the noise level was 76 decibels, which exceeds the permissible limit of 75 decibels.

During the night time, several locations exceeded permissible noise levels for their respective zones. HIMUDA Complex Phase-I in Baddi recorded 68 dB(A), exceeding the 55 dB(A) limit for commercial zones. Bus Stand Kullu and The Mall in Manali recorded 57 dB(A) and 57.8 dB(A) respectively, both exceeding the 55 dB(A) limit for commercial zones. Circuit House in Dhalpur and Diara Sector recorded 48.2 dB(A) and 47.5 dB(A) respectively, within the 45 dB(A) limit for residential zones. HIMUDA Block D, E, F Phase-III in Baddi recorded 55.3 dB(A), exceeding the 45 dB(A) limit for residential zones. HPPCB Office Building in Manali recorded 48 dB(A), within the 45 dB(A) limit for residential zones. VPO Rajpura recorded 56.6 dB(A), exceeding the 45 dB(A) limit for residential zones. In silence zones, Boys School Near Court Complex in Rampur, Court Complex in Rampur, DAV Sr. Sec. School in Una, District Hospital in Kullu, Govt. Hospital in Una, Lady Wellington Hospital in Manali, Malhotra Hospital in Katha Baddi, Near District Court in Chamba, SDM Office in Nalagarh, and Zonal Hospital in Bilaspur all recorded noise levels within the 40 dB(A) limit. These findings suggest that noise pollution control measures may be needed, particularly in commercial and residential zones, to mitigate excessive noise levels during the night time.

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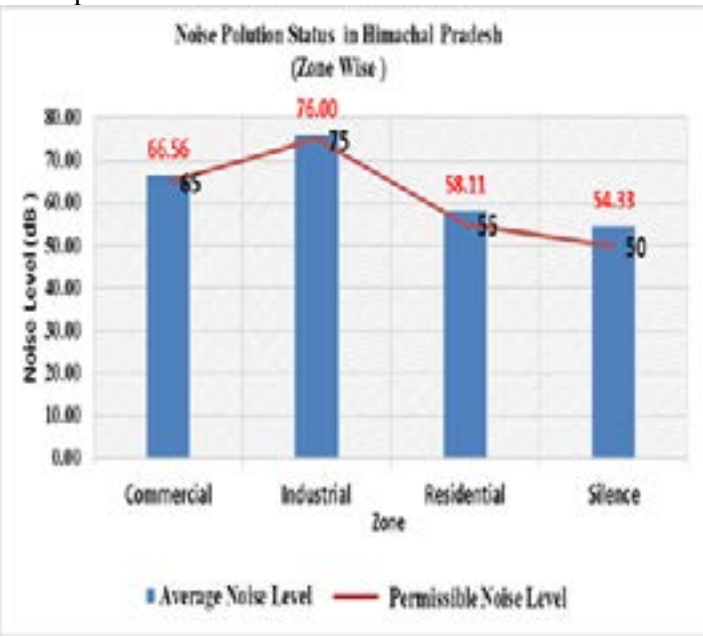

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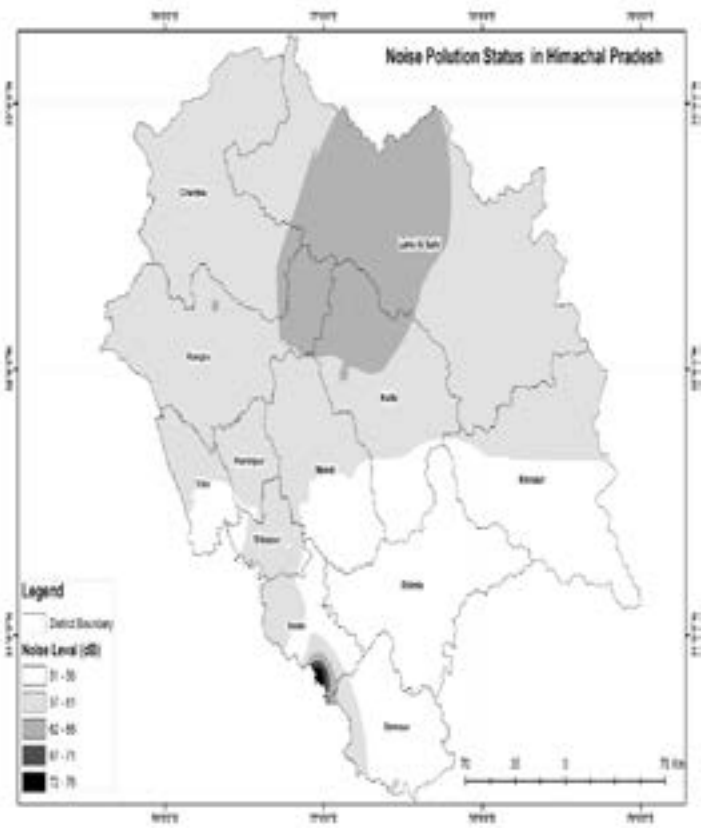

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Assessing soundscapes and analysing noise pollution in different zones of Himachal Pradesh, including commercial, industrial, residential, and silent areas, is crucial for understanding the potential negative impacts on human life. When noise levels in these zones exceed permissible limits, there can be various adverse effects on human well-being:

Health Impacts:

Stress and Anxiety: Elevated noise levels can lead to increased stress and anxiety, which can have long-term health consequences, including cardiovascular problems, disrupted sleep, and elevated blood pressure.

Sleep Disturbance: Noise pollution can disrupt sleep patterns, leading to sleep deprivation. Quality sleep is essential for physical and mental health.

Cognitive Effects:

Reduced Concentration: Excessive noise can make it difficult to concentrate and focus on tasks, affecting productivity and overall cognitive performance.

Impaired Learning: Noise pollution can hinder the learning process, particularly in schools and educational institutions, leading to decreased academic performance.

Social and Psychological Impacts:

Decreased Quality of Life: High noise levels can reduce the overall quality of life in affected areas. Residents may experience lower life satisfaction and a decreased sense of

well-being.

Social Isolation: Noise pollution can limit social interactions as people may avoid spending time in noisy areas, leading to social isolation and loneliness .

Physical Health Issues:

Hearing Impairment: Prolonged exposure to high noise levels can result in hearing impairment, which has a significant negative impact on one's overall quality of life.

Cardiovascular Problems: Noise pollution is associated with an increased risk of heart diseases due to elevated stress levels and the release of stress hormones.

Environmental Impacts:

Ecological Disruption: High noise levels can disrupt wildlife habitats, causing stress to animals, interfering with mating and communication, and potentially leading to population decline.

Economic Consequences:

Decreased Property Values: High noise levels can lead to decreased property values in residential areas, affecting homeowners' investments.

Safety Concerns:

Traffic Accidents: Excessive noise can mask important auditory cues, increasing the risk of accidents, especially in busy commercial and industrial areas.

Community Well-being:

Negative Social Dynamics: Noise pollution can lead to conflicts among residents and businesses, eroding community cohesion.

Conclusion

To address these issues, it is essential to implement noise abatement measures in each zone, such as stricter regulations, noise barriers, improved urban planning, and public awareness campaigns. Additionally, conducting regular sound level monitoring and assessments can help identify areas where noise pollution exceeds permissible limits and take appropriate action to mitigate the negative impacts on human life and well-being.

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