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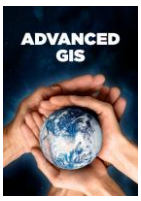

Comparative analysis of noise pollution in high traffic zones of Faisalabad and Lahore

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Abstract

The chaotic and loud traffic in crowded and densely populated urban areas poses challenges for environmental and urban experts in developing more efficient transportation plans that enhance both quality of life and environmental conditions. Lahore and Faisalabad, being prominent industrial cities in Pakistan, attract a large population due to their industrial importance. However, they encounter significant traffic problems, leading to a noisy and unpleasant environment. Using a Mesteth digital sound meter, noise level samples were gathered from various locations in Lahore and Faisalabad. In Lahore, sites included Jail Road, GPO Mall Road, Badami Bagh Bus Station, Thokar Niaz Baig, Gajumata Bus Station, Shahdra Metro Station, Kalma Chowk flyover, Mochipura Mor, and Babu Sabu toll plaza. In Faisalabad, sites such as GTS Square, Clock Tower, Railway Station, Santayana Road, Allied Mor Bus Stop, Narwala Road, McDonald's Road, D Ground Park, and Chenab Club were sampled. Fieldwork spanned from May 20th to June 23rd, 2022, conducted during morning and evening hours to capture peak and low traffic periods. Measurements were taken at a height of 1.2 meters from the ground and 1 meter away from the traffic flow line as per ISO standards. Data encompassed various zones, including heavy traffic, commercial, semi-commercial, and residential areas. The collected data was organized into Microsoft Excel sheets and subsequently inputted into ArcGIS 10.5 for mapping using Inverse Distance Weighting. After comparing the noise level values of both cities, it can be concluded that Lahore is facing more noise pollution as compared to Faisalabad due to the high noise pollution on the scale. The minimum amount of noise pollution recorded in these cities is 70 dB and the highest amount of noise pollution recorded in these is near 90 dB. This condition is very dangerous because according to the WHO the standard noise level in Pakistan is 75dB.

1. Introduction

Noise pollution is an environmental threat that disrupts human activities and stability. The noise is a phenomenon that has both psychological and physiological impacts on people. It is a major problem for the environment in numerous metropolitan regions. Additionally, there are several types of sources of noise. Particularly, traffic noise has a significant impact on citizens near densely populated areas. Noise pollution is rapidly increasing because of heavy traffic on the roads, vehicle dysfunction, a lack of awareness, and escalating transportation demands. High noise levels can have a negative impact on humans' heart health and worsen the effects of coronary artery disease. In comparison to other environmental issues, noise pollution has not received the same level of attention (Ali et al., 2022).

Extreme growth in the industrialization and urban development is affecting the environment in many ways. As the development is increasing day by day the environment is affecting through it (Bouzir et al., 2017). In many countries, there is inappropriate implementation of law against such issues. Like the example of Nigeria where there is no law for harmful noise levels (Frederick et al., 2019). Population is affecting day by day through the harmful effects of the noise pollution. Noise pollution is a major issue in the developing countries of world (Baqar et al., 2018; Bello et al., 2019).

In Pakistan many researchers noticed the noise pollution due to the traffic on roads and they declared it as the most prominent cause of noise pollution. Many scholars agreed when they made research in Pakistan that noise pollution is created by traffic on roads, machineries in industries, music systems in houses, loud speakers in different ceremonies, sound of train on railway tracks and at public places (Esmeray & Eren, 2021). If we saw the situation of Karachi, then we noticed that the noise pollution is partially lesser in the transport's strike day than the normal day when different buses and rickshaws are active in city of Karachi. The noise level was 75 dB in Karachi and in normal days the noise level was 98 db. So, the buses,

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rickshaws, coaches, lorries and motorbikes are the cause of noise pollution in Karachi. If we minimize the number of rickshaws in country then we will notice a huge change in the noise level of our country.

Being unfamiliar with vehicle impairment, industrial growth, inadequate urban planning, transportation, and development activities are the primary causes of noise pollution in urban regions. Hearing loss, circulating blood pressure, increased hostility, headaches, migraine, higher fat levels, and irritability Noise pollution poses significant health risks such as insomnia, gastric ulcers, and psychological disturbance. A study was conducted to determine the variation in traffic equivalent noise levels as the distance from the road connection increased. Even people in Katchehry Bazaar (Faisalabad), the town's heart and commercial center, were subjected to an average noise level of 93.5 dB for 10 to 12 hours per day (Zia et al., 2022).

Lahore and Faisalabad are Pakistan's most populous cities, housing a variety of industries. The population of these cities is gradually increasing. Demand for transportation vehicles is also increasing as the population grows, and as a result, traffic density increases linearly with population density. According to earlier research, people living in this environment with such high traffic density are at susceptible to loss of hearing (Zahra et al.,2022).

Therefore, the comparative analysis of Faisalabad and Lahore is essential for addressing the challenges posed by noise pollution in urban areas and for promoting sustainable and healthy living environments. This research focuses on mapping in detail the extent of noise pollution in high traffic zones of Lahore and Faisalabad. Such study findings can lead to the development of a framework for a sustainable transportation system to reduce the negative impact on the residents.

2. Study area

Faisalabad's population is exceeding, more than 3.5 million people and ranked 3rd largest city of Pakistan with wide range of manufacturing and industrial enterprises, factories, small and large private business. That's why it is regarded as industrial hub of a country. Faisalabad is located on 31.418715 latitude and 73.079109 longitude. It has Chiniot and Sheikhupura on the northern side, Sahiwal in East, Toba Tek Singh in south and Jhang city in the west. Main crops that are cultivated in Faisalabad are wheat, Pulses, Maize, Bajara and Jawar. Climate of Faisalabad is semi-arid followed by very hot and humid summer and dry cool winters. June is the hottest month while minimum temperatures are recorded in January with a dense fog. Monsoon season starts in the month of July and August and average rainfall is about 375 mm. Faisalabad District covers an area of 5857 km^2.

Lahore is the 2nd largest city of Pakistan with respect to population. It is the capital city of Pakistan which is situated on 31.58045 latitude and 74.329376 longitudes. River Ravi lies down on the northern side of Lahore, wagha on East, Kasur District on south and Sheikhupura in western side of Lahore. Lahore District covers an area of 1772 km^2 (Figure 1).

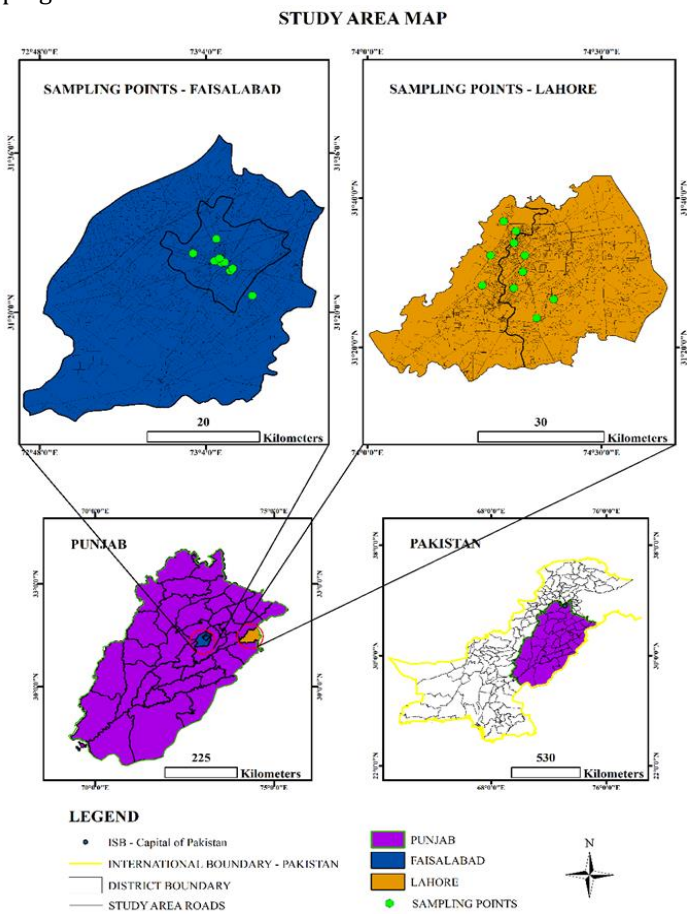

Figure 1. Location of Study Area

3. Methods and materials

A Mesteth digital sound meter was used to collect samples of noise levels in 2022 from different locations named as Jail Road Lahore, GPO Mall Road Lahore, Badami Bagh Bus Station, Thokar Niaz Baig, Gajumata Bus station, Shahdra Metro Station, Kalma Chowk fly over, Mochipura Mor and Babu Sabu toll plaza in Lahore and GTS square Faisalabad, Clock tower, Railway station, Santayana Road, Allied Mor Bus stop Faisalabad, Narwala Road Faisalabad, McDonalds Rd Faisalabad, D Ground Park Faisalabad and Chenab Club are sites in Faisalabad from where data was collected by Mesteth digital sound meter

The field work was carried out on consecutive days from 20th May 2022 to 23rd June 2022 on two different timings of the day. Morning and evening timings were selected to collect recordings from maximum to minimum in low and peak hours and data was collected by placing meter for 1 minute at height of 1.2 meter from the ground and 1meter away from the traffic flow line as it is suggested by ISO standard. Measurements were recorded in different zones from heavy traffic to commercial and semi commercial zones and residential areas.

Afterwards, this data was further inserted in Microsoft Excel sheet and database of noise levels were built. The Excel spreadsheet data which was collected from 18 locations of Faisalabad and Lahore as explained earlier, was inserted in ArcGIS 10.5 to use technique Inverse Distance Weighting to map different recordings of morning and evening. Figure no, 2 represents the methodological framework of this study which further elaborates the procedure of this research (Figure 2).

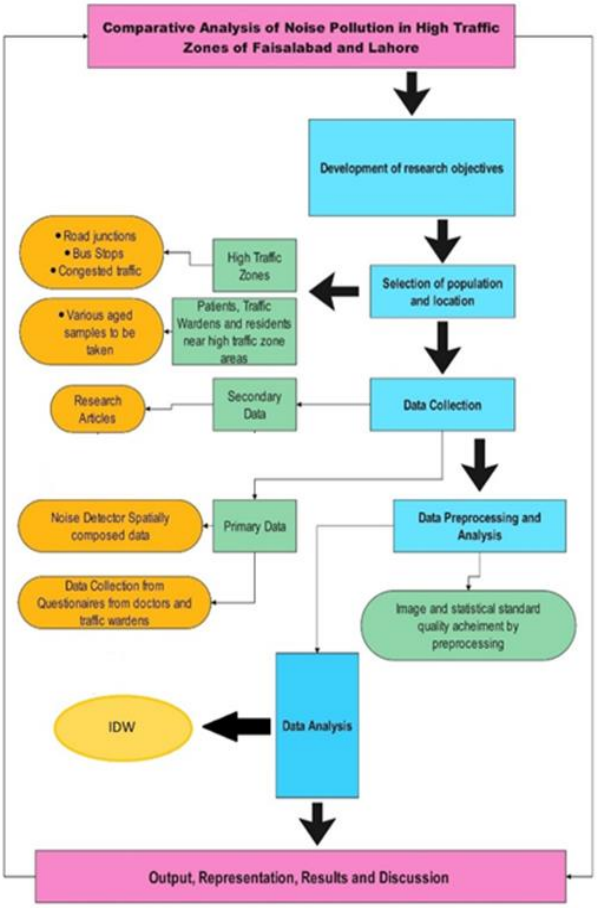

Figure 2. Methodology of the research

4. Results, analysis and discussion

4.1. First week analysis of noise pollution (Morning)

Comparing daily noise pollution values from May 20th to May 26th, 2022, reveals variations between Lahore and Faisalabad. On weekdays, Lahore exhibits higher pollution levels than Faisalabad, attributed to greater population density and traffic. Weekend days, May 21st and 22nd, show lower pollution levels due to reduced activity. However, on May 23rd, pollution rises in both cities with increased population movement. May 24th sees elevated pollution in traffic-heavy zones of both cities. On May 25th, noise pollution levels in Lahore and Faisalabad align more closely. By week's end, May 26th, both cities experience heightened pollution levels, yet Lahore consistently shows higher levels, especially during morning rush hours.

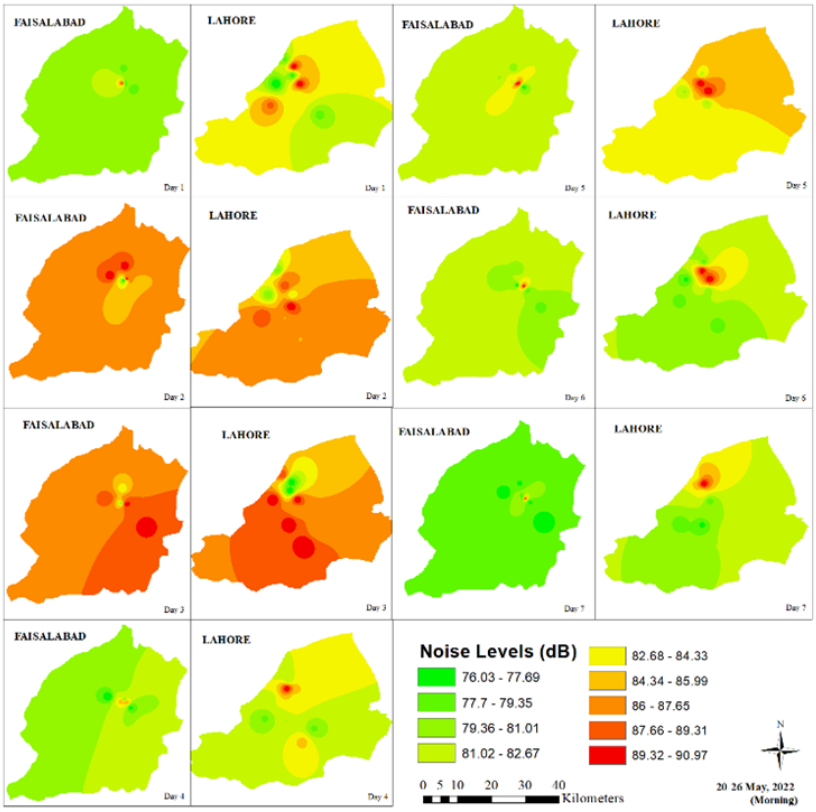

Figure 3. 20-26 May 2022 morning

4.2. First week analysis of noise pollution (Evening)

Figure 4 displays evening noise pollution data from high-traffic zones in Faisalabad and Lahore. On May 20th, Faisalabad shows higher pollution levels due to industrial activity, while on May 21st, Lahore records higher levels, likely due to weekend outings. Similarly, on May 22nd, Lahore's pollution surpasses Faisalabad's. On May 23rd, Lahore again records higher levels. Conversely, on May 24th, Faisalabad's pollution exceeds Lahore's. On May 25th, Lahore's pollution is higher, while on May 26th, Faisalabad's pollution surpasses Lahore's. Overall, from May 20th to 26th, 2022, Faisalabad consistently exhibits higher evening noise pollution levels than Lahore.

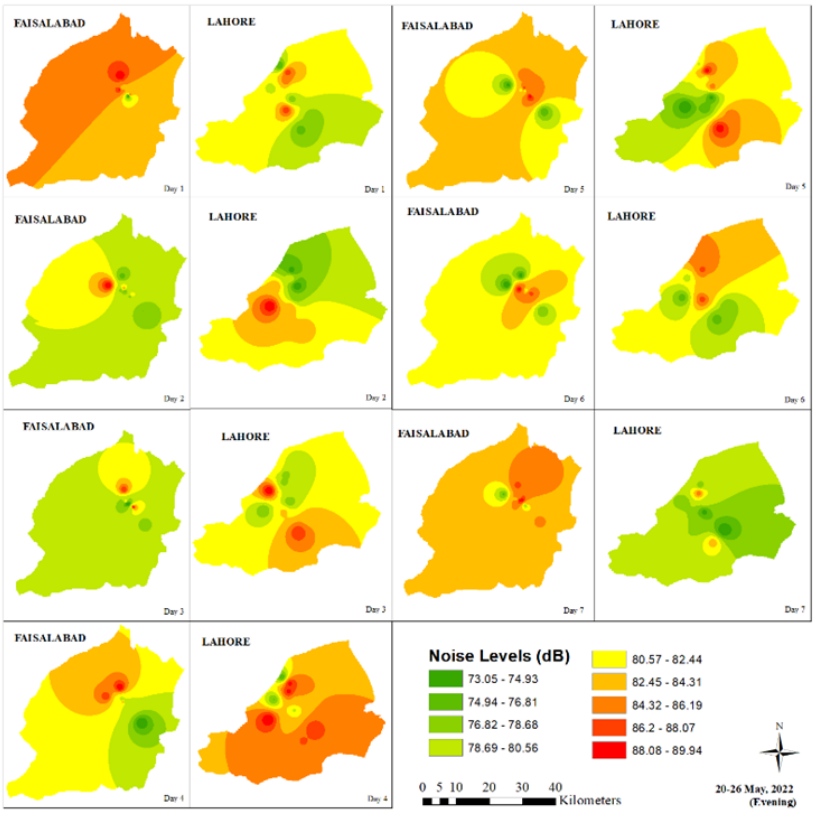

Figure 4. 20-26 May 2022 evening

4.3. Second week of analysis of noise pollution (Morning)

May 27th, 2022, both cities experience morning noise pollution. On May 28th, Faisalabad's high traffic zones face greater pollution than Lahore's. May 29th sees higher pollution levels in Lahore. May 30th shows Lahore with significantly higher pollution levels than Faisalabad. On May 31st, Faisalabad's areas exhibit higher pollution due to recording elevated noise levels. June 1st records higher pollution levels in Faisalabad compared to Lahore, indicated by intense colors in Figure 4. On June 2nd, Lahore's high traffic zones experience higher noise levels compared to Faisalabad. Overall, from May 27th to June 2nd, 2022, Lahore's high traffic zones are more affected by noise pollution than Faisalabad's.

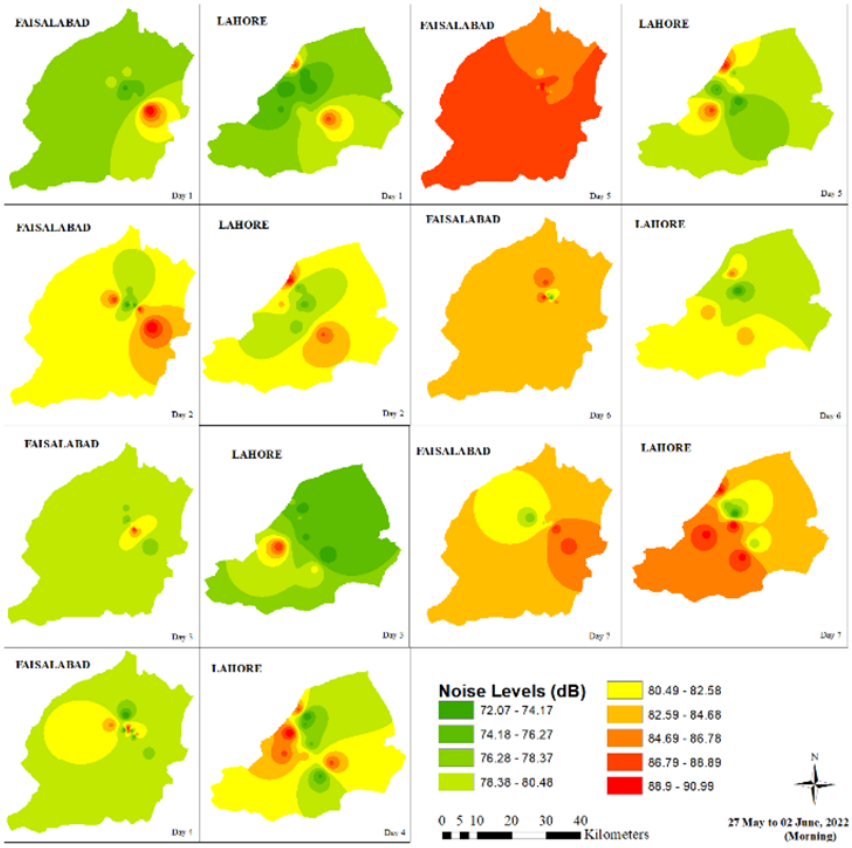

Figure 5. 27 May to 02 June 2022 morning

4.4. Second week of analysis of noise pollution (Evening)

Figure 6 depicts a map created using the Inverse Distance Weighting (IDW) technique in ArcGIS, illustrating evening noise pollution levels in the high traffic zones of Faisalabad and Lahore. Red areas indicate high noise pollution, while green areas indicate low pollution. Other colors represent varying pollution levels. On May 27th, 2022, Lahore's high traffic zones exhibit higher pollution levels compared to Faisalabad, though some points in Faisalabad also show elevated pollution. On May 28th, Faisalabad experiences higher pollution levels. Conversely, on May 29th, Lahore faces higher pollution. May 30th sees Lahore with greater pollution than Faisalabad. On May 31st, Faisalabad's high traffic zones experience higher pollution levels. June 1st and 2nd show Faisalabad with higher pollution levels. Overall, from May 27th to June 2nd, 2022, Lahore's high traffic zones consistently face higher noise pollution levels compared to Faisalabad's.

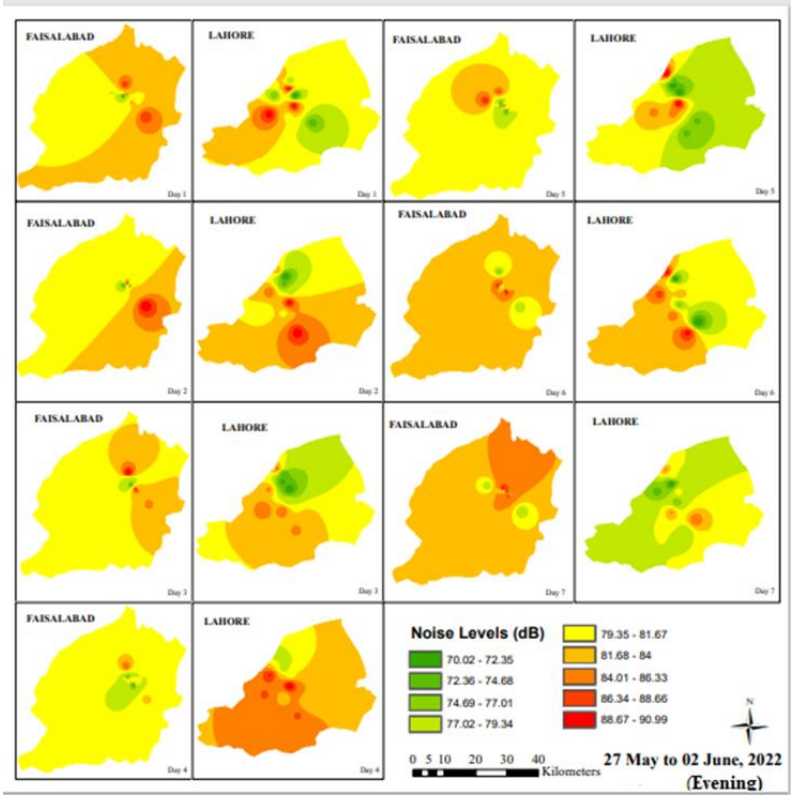

Figure 6. 27 May to 02 June 2022 evening

4.5. Third week of analysis of noise pollution (Morning)

Figure 7 illustrates a map generated using the IDW technique in ArcGIS, displaying morning noise pollution levels in the high traffic zones of Faisalabad and Lahore from June 3rd to June 9th, 2022. Red indicates high pollution areas, while green indicates low pollution. On June 3rd, Faisalabad experiences higher pollution than Lahore. Similarly, on June 4th, Faisalabad records higher pollution levels. Conversely, on June 5th, Lahore faces higher pollution. June 6th sees slightly higher pollution levels in Lahore. On June 7th, Lahore's high traffic zones have higher pollution levels. Conversely, on June 8th, Faisalabad experiences significantly higher pollution levels. On June 9th, Lahore's pollution levels exceed Faisalabad's. Overall, from June 3rd to June 9th, 2022, Lahore consistently faces higher morning noise pollution levels in its traffic zones compared to Faisalabad.

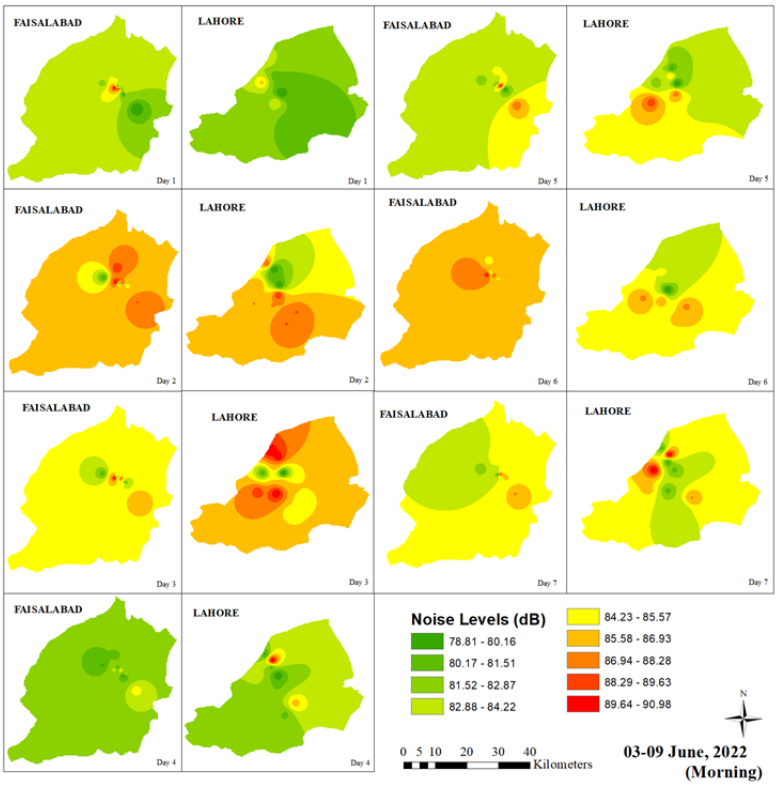

Figure 7. 03-09 June 2022 morning

4.6. Third week of analysis of noise pollution (Evening)

The evening of day 1 which is 03 June 2022 showing that the noise pollution in high traffic zones of Lahore is comparative more than the high traffic zones of Faisalabad. On the evening of day 2 dated 04 June 2022 the value of noise pollution is higher than the Faisalabad. On 05 June 2022, Day 3 the noise pollution in the evening is higher in the Lahore than the high traffic zones of Faisalabad. By comparing the noise pollution of evening of Day 4 that is 06 June 2022 the value of noise pollution is higher in the high traffic zones of Faisalabad. On the day 5th dated 07 June 2022 the value of noise pollution in the high traffic zones of Lahore is higher than the zones of Faisalabad. On the 08th June 2022 the value of noise pollution is higher in Lahore than Faisalabad. On the evening of day 7th dated 09 June 2022 the value of noise pollution is higher than Faisalabad. The figure 7 shows the value of noise pollution in the areas of high traffic zones of Lahore and Faisalabad. By comparing the value of both cities of whole days concluded that High traffic zones of Lahore faced the more noise pollution than the high traffic zones of Faisalabad (Figure 8).

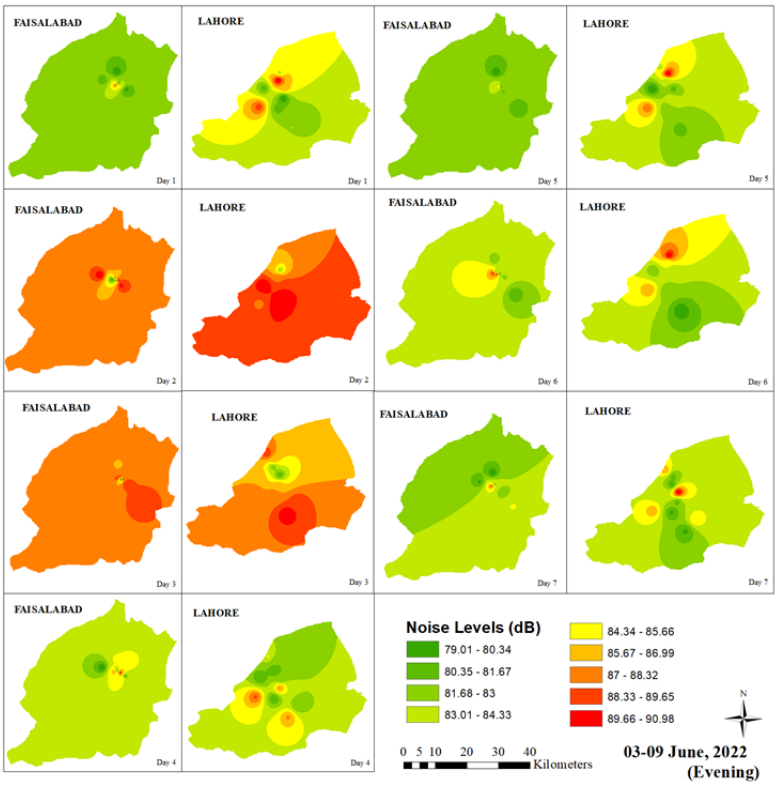

Figure 8. 03-09 June 2022 evening

4.7. Fourth week of analysis of noise pollution (Morning)

On the first day that is 10 June 2022 the map is showing the value of noise pollution high in the high traffic zones of Lahore than the high traffic zones of Faisalabad. Day 2 dated 11 June 2022 the value of noise pollution is high in the high traffic zones of Lahore in comparison of high traffic zones of Faisalabad. On the day 3 dated 12 June 2022 high traffic zones of Faisalabad faced much noise pollution than the high traffic zones of Lahore. Day 4 which is 13 June 2022 the areas of Lahore is facing much noise pollution than the areas of Faisalabad. On the day 5 which is 14 June 2022 the value of noise pollution is higher in the areas of Lahore than Faisalabad. Day 6 which is 15 June 2022 the value of noise pollution is higher in the areas of Lahore are facing the higher value of noise pollution than Faisalabad. 16 June 2022 which is the day 7 where map is showing the high number of noise pollution in the areas of Lahore in comparison of Faisalabad. Through comparison of values of days from 10 to 16 June 2022 concluded that the high traffic zones of the Lahore faced the more noise pollution than the high traffic areas of the Faisalabad (Figure 9).

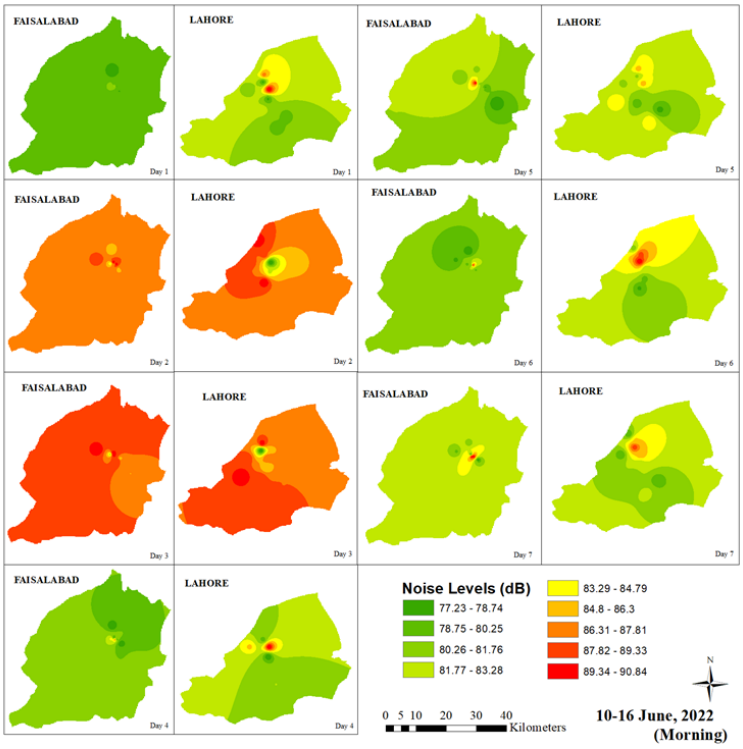

Figure 9. 10-16 June 2022 morning

4.8. Fourth week of analysis of noise pollution (Evening)

The evening of day 1 which is 10 June 2022 showing that the high traffic zones of Lahore faced much noise pollution than Faisalabad. Day 2 showing the evening of 11 June 2022 where the value of noise pollution in Lahore is higher than Faisalabad. On the evening of day 3 that is 12 June 2022, the figure showing the value of noise pollution is higher in Faisalabad than the high traffic zones of Lahore. The day 4 dated 13 June 2022 showing the value of noise pollution approximately same in both cities high traffic zones. Day 5 which is 14 June 2022 showed the value of noise pollution higher in the zones of Lahore than the Faisalabad. 15 June 2022 is showed by the day 6 where the noise pollution is higher in the high traffic zones of the Faisalabad in the comparison of Lahore. On the evening of 16 June 2022, the noise pollution is high in the high traffic zones of Lahore in comparison of Lahore. Through the comparison of all the values of High Traffic zones of Faisalabad and Lahore, the conclusion is the high traffic zones of Lahore are facing the high values of noise pollution than the high traffic zones of Lahore (Figure 10).

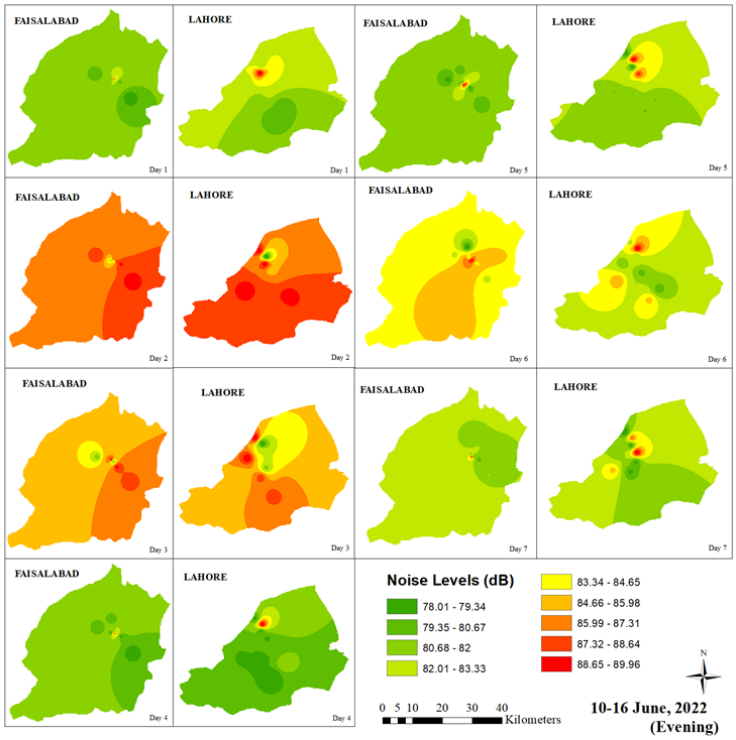

Figure 10. 10-16 June 2022 evening

4.9. Fifth week of analysis of noise pollution (Morning)

Figure 11 displays a map generated using the IDW technique in ArcGIS, illustrating morning noise pollution levels in the high traffic zones of Faisalabad and Lahore from June 17th to June 23rd, 2022. On June 17th and 18th, Faisalabad exhibits higher pollution levels than Lahore. Conversely, on June 19th, Lahore's traffic zones face higher pollution. June 20th sees higher pollution levels in Lahore. On June 21st, Faisalabad records higher pollution levels. Similarly, on June 22nd, Faisalabad experiences significantly higher pollution levels. On June 23rd, Faisalabad's pollution levels exceed Lahore's. Overall, from June 17th to June 23rd, 2022, Faisalabad consistently faces higher morning noise pollution levels in its traffic zones compared to Lahore.

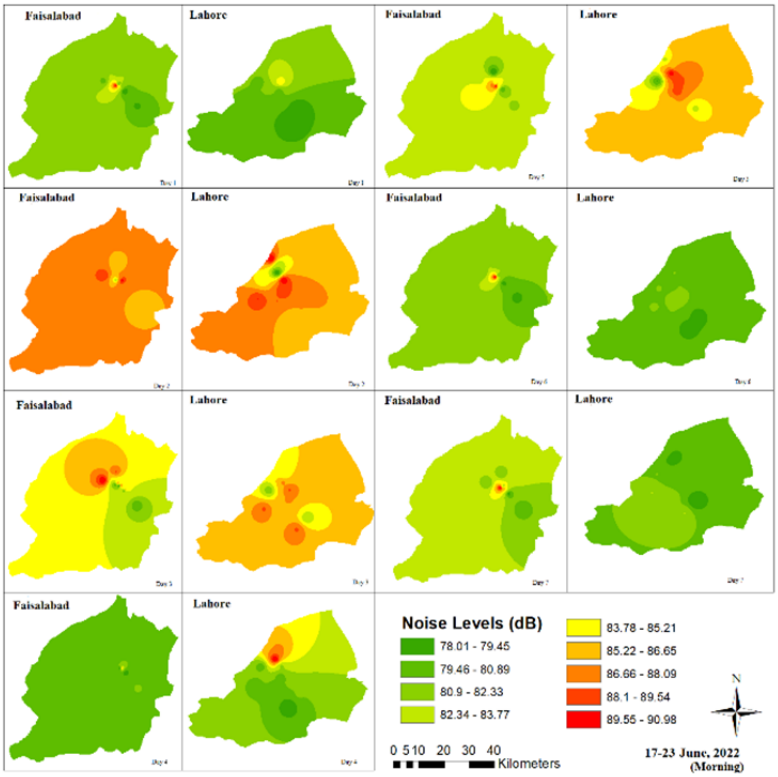

Figure 11. 17-23 June 2022 morning

4.10. Fifth week of analysis of noise pollution (Evening)

In Figure 12, Day 1 illustrates evening noise pollution levels on June 17th, 2022, with Faisalabad's high traffic zones showing higher pollution than Lahore's. Day 2, June 18th, records higher pollution levels in Faisalabad. Conversely, Day 3, June 19th, depicts higher pollution in Lahore's traffic zones. On June 20th, Day 4 shows higher pollution in Faisalabad. Day 5 highlights higher pollution levels in Faisalabad compared to Lahore. Similarly, Day 6, June 22nd, indicates higher pollution in Faisalabad. Conversely, on June 23rd, Day 7, Lahore experiences higher pollution levels. Overall, from June 17th to June 23rd, 2022, Faisalabad's high traffic zones consistently face higher evening noise pollution levels compared to Lahore's. Despite some close values, the collective comparison indicates that Faisalabad's traffic zones encountered more pollution than Lahore's during this week (Figure 12).

The IDW techniques portray the noise levels in high traffic zones of Faisalabad and Lahore. The colors of above maps showing the effects of noise pollution in those areas and al the areas where the noise pollution is high is in dangerous situation. The whole results are based upon the using the analytical technique that is showing the results that Faisalabad and Lahore both are under the dangerous conditions. This slow poison is dangerous for the lives of the people and environment. People taking this risk very low but after an age they can be affected by these problems. Lahore and Faisalabad, being major cities of Pakistan, both are the functional cities where a huge number of populations is living. They attract a large population seeking education, opportunities, and better living conditions. However, with this influx comes a significant challenge: noise pollution. Both cities struggle with high levels of noise due to heavy traffic, typical of densely populated areas. Faisalabad, known as the Manchester of Pakistan, hosts major industries contributing to the nation's progress. Unfortunately, inadequate facilities have adversely affected the health of residents and workers. Areas with heavy traffic, especially near markets, bear the brunt of noise pollution, primarily from trucks, rickshaws, and other vehicles transporting goods. In contrast, Lahore is renowned for its luxurious lifestyle, with many residents employed or studying. Morning traffic and high traffic zones experience elevated noise pollution, with bus stops particularly affected on weekdays and weekends. Residential areas generally experience lower noise pollution, but those near workplaces suffer adverse effects such as mood swings, headaches, and depression

due to the impact on their nervous systems and daily lives, according to hospital data.

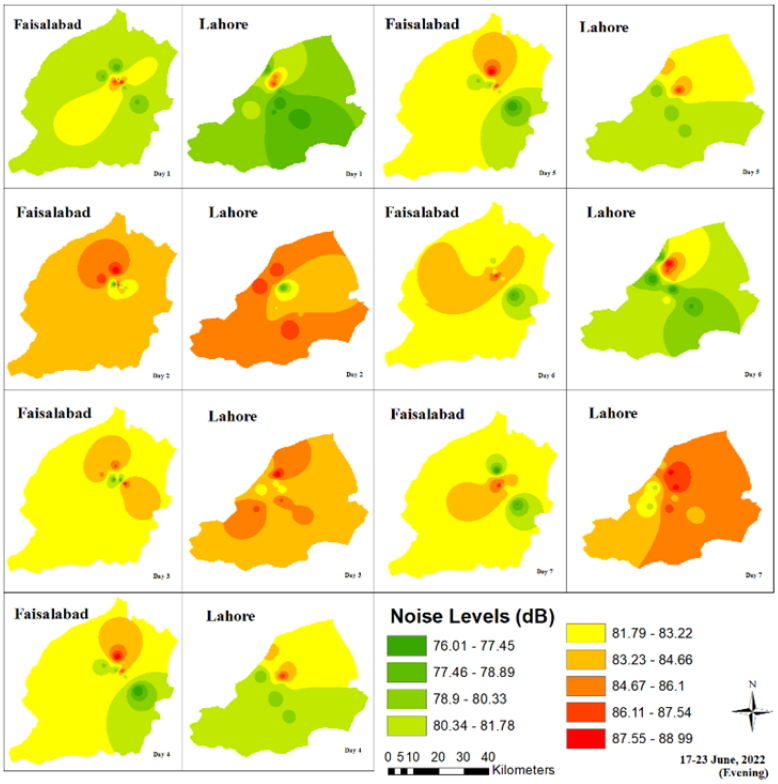

Figure 12. 17-23 June 2022 evening

In this study focusing on Faisalabad's sites, it is found that noise levels reached a peak of 85.9 dB(A) at two locations, with a minimum of 70.8 dB(A). The heavy usage of these roads by various forms of transportation, including public, commercial, loader trucks, and private vehicles, contributes to the elevated noise levels. The research also investigated traffic noise in Lahore, specifically at 18 busy intersections with high traffic flow during peak hours. It is observed that the average noise level during the day exceeded the permissible limit of 80 dB(A) in 90% of the city's busiest areas. The maximum average noise level recorded in Lahore was 90 dB(A). This heightened noise level is primarily attributed to vehicular traffic, particularly autorickshaws equipped with ineffective silencers, as well as the frequent use of pressure horns by buses, wagons, and lorries.

The researchers examined urban noise levels and traffic density in Chiniot and Jhang to assess the non-auditory health impacts of noise on residents. Urban noise data revealed that 82% of locations in Jhang exceeded Pakistan's National Environment Quality Standard (NEQS-Pak) and the World Health Organization's (WHO) noise limitations, with levels reaching 87 dB. In Chiniot, 95% of sites exceeded these standards, with noise levels peaking at 95 dB. The study attributed higher noise levels in Chiniot to excessive road traffic and dense population. Strategies such as vehicle maintenance and urban planning are recommended to mitigate urban noise pollution. The equivalent noise levels recorded at several places in Delhi ranged from 63 dB(A) to 83 dB(A) (Rahman Farooqi et al., 2017).

5. Conclusion

The growth of urban populations worldwide leads to greater demand for transportation. Consequently, more roads are constructed to accommodate this heightened need for mobility. This trend holds true for Pakistan as well, where increasing mobility necessitates expanded infrastructure. Lahore and Faisalabad are Pakistan’s fastest-growing metropolitan cities, with several professional, industrial, educational, and medical organizations. Both cities are plagued by severe noise pollution from the noise of motorcycles, autorickshaws, cars, and increased traffic volumes. Utilizing a Mesteth digital sound meter, noise level samples were collected from various locations in both cities. Fieldwork conducted from May 20th to June 23rd, 2022, during morning and evening hours, aimed to capture peak and low traffic periods. The collected data underwent analysis and mapping using ArcGIS 10.5. Comparative analysis revealed that Lahore to have higher noise pollution levels compared to Faisalabad, with noise ranging from 70 to 90 dB, exceeding WHO standards. This study aims to pinpoint high-traffic zones to aid administration in formulating targeted strategies to combat noise pollution.

6. Recommendations

Noise levels recorded at all study sites surpassed the recommended limit set by the Punjab Environmental Protection Department (45-55 dBA). To mitigate traffic noise reaching residential areas, it is advised to install noise barriers. Options include tree plantations, precast reinforced cement concrete walls, and brick walls.

Among these, tree plantation emerges as the preferable choice due to its various environmental benefits. It is essential for the government to identify areas where sound pressure levels exceed the threshold and take appropriate measures to address this issue. People their selves should properly maintain their vehicles and install good silencer in their vehicles those are soundless. Thorough investigations into noise pollution across major cities in Pakistan would offer a comprehensive insight into its prevalence and variations. Such research could pave the way for tailored recommendations and policies specific to each region, addressing the distinct challenges encountered in various urban settings. Additionally, studying the design and materials used in noise barriers could offer valuable insights for effective noise mitigation strategies.

Author Contributions

The contributions of the authors to the article are equal.

Statement of Conflicts of Interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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