

Assessment of Noise Pollution Around Labuhan Ratu Railway Crossing: Implications for Health and Urban Development

Siti Munawarah Pangabean^{1*}, Dwi Sulis Tama², Suci Wulan Pawhestri³, Della Andandaningrum⁴

^{1,2,3,4}Biologi Education, Tarbiyah, Raden Intan State Islamic University of Lampung

*corresponding author: sitimunawarahpangabean@radenintan.ac.id

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*Correspondence email:

sitimunawarahpangabean@radenintan.ac.id

ABSTRACT

Noise pollution presents a serious challenge to community well-being, especially in rural areas, impacting health, technical functions, and psychological stability. This study aims to assess the level of noise pollution around the Labuhan Ratu railway crossing and analyze its impact on public health as well as urban development in the surrounding area. Using qualitative research methods, an exploratory survey was conducted with purposive sampling to measure disturbance intensity and its impacts. Results showed peak disturbance levels of 82.9 dB at a distance of 0-50 meters from the railway station, while the lowest disturbance measured was 55.7 dB at 100-150 meters. Both values are significantly above the SNI-03-6386-2000 threshold of 55 dB for community areas, indicating that the site is outside the standard. The findings highlight prevalent issues, including hearing impairment, communication difficulties, and psychological disorders among residents. Addressing these disturbances is crucial for improving community health and supporting SDG efforts to mitigate urban noise pollution, fostering a healthier living environment for affected populations, particularly in rural contexts.

Keyword: Community Health, Noise Pollution, Railway Crossing, Sustainable Development Goals, Urban Noise Standard

ABSTRAK

Polusi suara merupakan tantangan serius bagi kesejahteraan masyarakat, khususnya di daerah pedesaan, dengan dampak negatif terhadap kesehatan, fungsi teknis, dan stabilitas psikologis.

Penelitian ini bertujuan untuk menilai tingkat polusi kebisingan di sekitar perlintasan kereta api Labuhan Ratu dan menganalisis dampaknya terhadap kesehatan masyarakat serta perkembangan perkotaan di sekitarnya. Penelitian menggunakan metode kualitatif melalui survei eksploratif dengan purposive sampling untuk mengukur intensitas kebisingan dan dampaknya. Hasil penelitian menunjukkan bahwa tingkat kebisingan tertinggi mencapai 82,9 dB pada jarak 0-50 meter dari stasiun, dan terendah 55,7 dB pada jarak 100-150 meter. Kedua tingkat kebisingan tersebut jauh melebihi ambang batas SNI-03-6386-2000 sebesar 55 dB untuk wilayah pemukiman, menunjukkan bahwa area tersebut berada di luar standar. Temuan ini mengungkapkan berbagai masalah yang dialami penduduk, seperti gangguan pendengaran, kesulitan komunikasi, dan gangguan psikologis. Penanganan masalah kebisingan ini penting untuk meningkatkan kesehatan masyarakat dan mendukung upaya SDGs dalam mengurangi polusi suara perkotaan, guna menciptakan lingkungan yang lebih sehat bagi masyarakat terdampak, terutama di daerah pedesaan.

Kata Kunci: Analisis Kebisingan, Kesehatan Masyarakat, Pembangunan Berkelanjutan, Perlintasan Kereta Api, Standar Kebisingan,

INTRODUCTION

Noise pollution poses a significant threat to local residents' health and well-being, with excessive exposure linked to cardiovascular diseases, mental health disorders, sleep disturbances, and heightened stress. Non-compliance with noise regulations exacerbates these impacts, revealing gaps in environmental management (Hassan, 2024). As noise levels rise, understanding their effects on daily life and community well-being becomes increasingly critical (Chepesiuk, 2005)

Noise pollution is an environmental disruption caused by sounds or noise that creates discomfort for surrounding living beings (Basner, et al., 2014). Vibrations from the sound source can disturb the balance of air molecules

nearby, causing them to vibrate. Noise pollution arises from high-volume sounds that make the surrounding area noisy and uncomfortable (Goines & Hagler, 2007). Noise originates from sources such as motor vehicles, airplanes, industrial machinery, and other continuous operations over extended periods. Prolonged exposure can cause significant discomfort in human environments, potentially leading to various adverse effects like physiological disorders, psychological stress, communication interference, balance disorders, and hearing impairment (Hahad, et al., 2024)

Although the effects of noise pollution on health and urban environments have been extensively studied on a global scale, research addressing localized contexts, such as the Labuhan Ratu railway crossing, remains significantly underexplored.

For instance, the Environmental Noise Guidelines for the European Region published by the World Health Organization (WHO, 2019) emphasize the profound health consequences of noise, including sleep disturbances and elevated cardiovascular risks. However, analogous studies in local settings, particularly in developing regions like Indonesia, are notably scarce. Furthermore, prior investigations often focus solely on quantifying noise levels without establishing direct connections to public health implications, whether physical or mental (Basner, et al., 2014)

The absence of integrated methodologies that combine technical assessments, such as noise measurements, with social dimensions, such as community perceptions, further widens the gap in noise pollution research (D'Hondt, Stevens, & Jacobs, 2013). This issue is exacerbated by escalating transportation activities in the area, which could amplify noise levels and their subsequent impacts on public health and urban environments (Welch, Shepherd, Dirks, & Reddy, 2022). Consequently, the urgent need for relevant data and actionable recommendations tailored to current and future conditions cannot be overstated. This study endeavors to bridge these gaps through a holistic approach that not only assesses the impacts of noise pollution but also formulates strategic implications for public health and sustainable urban development.

According to SNI 35478:1069-SNI-03-6386-2000 regarding noise levels in residential areas—whether rural, suburban, or urban—the recommended average volume ranges from 30 dB to 50 dB (SNI, 2000). In

line with PERMENKES RI (Kemenkes, 1987), there are four zones with varying levels of noise tolerance. Zone A is designated for studies in hospitals, care facilities, health institutions, and similar environments. Zone B is allocated for studies in residential areas, educational institutions, recreational spaces, and so forth. Zone C is reserved for studies in office buildings, retail spaces, commercial centers, markets, and similar places. Zone D is intended for studies in industrial sites, factories, railway stations, bus terminals, and similar locations. The noise tolerance levels for each zone are as follows:

Table 1. Classification of Noise Zones by the Minister of Health

No.	Zona	Min dB	Max dB
1.	A	35	45
2.	B	45	55
3.	C	50	60
4.	D	60	70

METHOD

The Labuhan Ratu Station was built during the Dutch colonial period, around 1915 to 1917 (Anita, 2017). Alongside the increase in railway activities and the advancement of Bandar Lampung City, the area surrounding the station has undergone significant development, transforming into a densely populated residential zone. This situation has led to an increase in noise levels, which is expected to have a considerable impact on public health.



Picture 1. Labuhan Ratu Station

This research refers to a descriptive quantitative study, using noise level measurement methods and assessing its impacts with tools and instruments such as a sound meter and questionnaires.



Picture 2. Labuhan Ratu Station
Source: Google Earth

Noise level measurements using a sound meter were conducted at three distance intervals: location A at 0 to 50 meters, location B at 50 to 100 meters, and location C at 100 to 150 meters, considering the train departure and arrival times. Measurements were taken over 10 days, with two measurements each day at 11:30 AM and 7:12 PM. The main indicators used in this analysis are the equivalent continuous sound level (Leq), the peak sound level (Lmax), and the duration of noise exposure.

RESULTS AND DISCUSSION

Labuhan Ratu District, particularly the area near the station, is a densely populated residential zone. Labuhan Ratu Station is located on Jalan Untung Suropati, Kampung Baru, in Labuhan Ratu District, Bandar Lampung City, Lampung. This station is situated in the northernmost area of Bandar Lampung City and is part of the Regional Division IV in the Tanjung Karang region.

Table 2. Noise Level at Location A

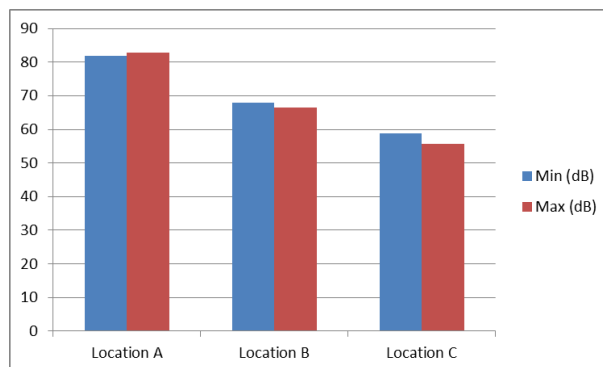
Day	Min dB	Max dB
1	85	82
2	85	82
3	84	82
4	83	82
5	81	81
6	83	82
7	83	82
8	82	82
9	82	82
10	81	82
Avg	81,9	82,9

Based on the measurement results above, location A recorded the lowest noise level at 81 dB and the highest at 85 dB. There was no significant difference in noise levels between daytime and nighttime measurements. Compared to the SNI standards, location A has exceeded the noise threshold considered tolerable and comfortable for humans.

Table 3. Noise Level at Location B

Day	Min dB	Max dB
1	79	75
2	63	60
3	68	70
4	63	60
5	69	70
6	68	70
7	67	67
8	63	60
9	79	75
10	61	59
Avg	68	66,6

Location B, situated approximately 50 meters from Labuhan Ratu Station, recorded the lowest noise level at 61 dB and the highest at 79 dB. Although the average readings showed no significant difference between daytime and nighttime noise levels, a notably lower value of 59 dB was recorded on the final day. When compared to SNI regulations, this value meets the criteria for an ideal noise level. However, the overall measurements indicate that Location B still does not fully comply with the ideal standards set by SNI.



Picture 3. Noise Level Comparison Graph Between Locations

The analysis results show a significant difference in noise levels across the three locations tested. Location A, located closest to the railway crossing, recorded very high noise levels exceeding 80 dB, posing a risk of long-term hearing problem for its residents. Meanwhile, Location B, although showing lower noise levels (around 66-68 dB), still presents a significant enough risk to affect quality of life of its residents. On the other hand, Location C, located more than 100 meters from the crossing, showed much lower noise levels (around 55-59 dB), which are within safe limits according to established noise standards. This indicates that the distance from the noise source plays a crucial role in reducing the negative health impacts, with increasing distance from the source leading to a lower risk of health disturbances experienced by residents (Clark, Crumpler, & Notley, 2020)

Table 4. Noise Level at Location C

Day	Min dB	Max dB
1	70	59
2	59	58
3	60	59
4	59	58
5	50	48
6	60	59
7	60	59
8	59	58
9	70	59
10	41	40
Avg	58,8	55,7

Noise levels at Location C showed a significant difference compared to the other two locations. The average noise level in this area was around 55 dB, making it the only location that meets the SNI noise level standards. Based on the measurement results, it can be concluded that the ideal distance for residential comfort regarding noise is a minimum of 100 meters from the station.

In addition to the measurements taken with equipment, there were also results from distributing questionnaires to a sample of the local community at the research site. The questionnaires were designed to directly identify the health impacts experienced by residents due to high noise levels

Table 5. Findings from the Survey on the Effects of Noise

Impact	SA	A	N	DA
High noise level	40	54	3	3
Hearing impairment	27	56	17	0
Emotional instability	17	33	50	0
Sleep disturbance	43	27	27	3
Disruption in activities	37	50	13	0
Difficulty concentrating	13	60	27	0

SA : Strongly Agree
 A : Agree
 N : Neutral
 DA : Disagree

The results of the questionnaire align with a growing body of research that highlights the profound effects of high noise levels on both physical and mental health. A significant 94% of respondents reported that high noise levels near the railway crossing are disruptive, with an increased risk of hearing impairment and stress. This finding corresponds with studies by (Basner, et al., 2014), which state that prolonged exposure to noise levels exceeding 80 dB can cause permanent hearing damage and is strongly linked to psychological disturbances, including anxiety and stress. The awareness of the potential harms of noise is further corroborated by the 83% of respondents who agree that high noise levels pose a risk to hearing, reinforcing earlier findings that exposure to such levels can result in permanent auditory damage (Basner, et al., 2014).

Moreover, nearly half of the respondents (50%) reported that noise disrupts their emotional stability, particularly through increased anxiety and stress. These effects are consistent with research by (Guski, Schreckenberg, & Schuemer, 2017), which emphasized the relationship between chronic noise exposure and psychological impacts such as heightened anxiety, stress, and frustration. Additionally, the 70% of

respondents who reported sleep disturbances directly reflect the findings of (Smith, Cordoza, & Basner, 2022), who found that noise-induced sleep disruption is a common consequence of high noise levels, contributing to fatigue and a deterioration in quality of life.

The study also revealed that 87% of respondents felt noise interfered with their daily activities, underscoring the broader implications of noise on productivity and overall well-being. This aligns with the work of (Jafari, Khosrowabadi, Khodakarim, & Mohammadian, 2019), who concluded that noise pollution negatively affects cognitive performance, concentration, and social functioning. The reported difficulties in concentration, experienced by 73% of respondents, further emphasize the cognitive strain induced by noise, which can lead to reduced productivity in both educational and workplace environments. In conclusion, the significant impact of high noise levels near the railway crossing on both the physical and mental well-being of the population underlines the need for effective noise control measures to mitigate these detrimental effects.

CONCLUSION AND RECOMMENDATIONS

The research on noise pollution around the Labuhan Ratu Railway Crossing highlights significant concerns for public health and urban development. The study demonstrates a clear relationship between proximity to the railway station and high noise levels, with Location A—closest to the station—recording noise levels consistently above 80 dB, raising concerns about potential hearing impairments and chronic auditory

stress for residents. Although Location B showed slightly lower noise levels, they were still sufficiently high to contribute to emotional instability and stress. In contrast, Location C, situated more than 100 meters away, exhibited noise levels within acceptable limits according to SNI standards, emphasizing the importance of maintaining sufficient distance from noise sources to reduce its harmful effects.

The questionnaire results further indicate that noise pollution significantly disrupts daily activities and concentration for most respondents, highlighting the widespread impact on the community. These findings underscore the urgent need for comprehensive noise mitigation strategies and urban planning policies that prioritize the health and well-being of residents. Measures such as sound barriers and public awareness campaigns should be implemented as part of the city's ongoing development to minimize the negative effects of noise pollution.

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