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The Effect of Vegetation in Reducing Traffic Noise Around the Selagalas Green Open Space

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ABSTRACT

This study aims to analyze the effect of vegetation in reducing traffic noise around the Selagalas Green Open Space in Mataram City. The research method employed is a quantitative descriptive approach, with primary data collection consisting of noise level measurements using a Sound Level Meter, vegetation density analysis, and visitor perceptions gathered through questionnaires. Noise measurements were taken at 15 observation points in the morning and afternoon, and then analyzed using equivalent noise values (Leq). The spatial distribution of these measurements was mapped using the Inverse Distance Weighted (IDW) interpolation method. The results showed that the average noise level in Selagalas Green Open Space was 57.31 dB(A), which exceeded the noise quality standard for green open spaces. High-density vegetation, especially broad-canopied trees, was able to reduce noise levels by up to 19.91 dB(A) with a reduction effectiveness of 10.35%. Visitors' perceptions of the Selagalas RTH were positive and quite satisfactory. The conclusion of this study reveals that vegetation plays a crucial role in mitigating noise and enhancing the comfort of the urban environment

INTRODUCTION

The city of Mataram, as the capital of West Nusa Tenggara Province, plays an important role as a center of administration, education, and community services. Rapid urban change in Mataram poses challenges in managing green open spaces and infrastructure, requiring the government to provide Green Open Spaces to improve air quality, temperature, reduce noise, and provide recreational areas. RTH is defined as an elongated area, path, or group dominated by vegetation such as trees, shrubs, grass, and other ground cover, with a minimum area of 0.25 ha and a minimum percentage of 10% of the urban area. The Selagalas Green Open Space , located in the Selagalas neighborhood, Sandubaya District, Mataram City, on Jalan Ahmad Yani in front of the Mutiara Sukma Mental Hospital, is often visited by various groups of people and is affected by noise from vehicle traffic.

Noise is unwanted sound that disturbs health and comfort, with standards based on the Decree of the Minister of Environment No. 48/MENLH/11/1996. Human hearing frequency ranges from 4-120 dB, and exceeding the limit can interfere with communication, concentration, and cause irritation. Green Open Spaces (GOS) have the potential to reduce noise through their use as a natural barrier, although they are often viewed primarily as aesthetic or recreational elements. Therefore, research is needed to examine the ability of vegetation in the Selagalas Green Open Space to reduce traffic noise and to determine visitors' perceptions of the comfort level of the Selagalas Green Open Space ..

METHODS

his research was conducted in May 2025 at the Selagalas Green Open Space , Sandubaya District, Mataram City. The research method used was quantitative descriptive. The equipment used in this research consisted of a Smart Sensor AR-824 Sound Level Meter, batteries, a stopwatch, a tripod, a camera, writing instruments, a meter, a hagameter, and a tally sheet. The materials used in this study were image data, Google Earth Pro Selagalas Green Open Space , Surfer 11.0 software, and ArcGIS 10.8 software. The sample was determined using purposive sampling. The research respondents consisted of visitors to the Selagalas Green Open Space . Data was collected through observation, interviews, questionnaires, and literature studies. The research variables included comfort level, sound intensity (db), type of noise, distance from the noise source, sound intensity difference (db), type of vegetation, and distance of vegetation barriers to the source.

RESULTS AND DISCUSSION

Perceptions of the Selagalas Green Open Space

Based on the analysis results, it is known that visitors to the Selagalas Green Open Space are dominated by 16 men and 14 women. Most of the respondents are aged 17–33 years, namely 23 people, indicating that the younger age group visits the Green Open Space the most as a space for social interaction and recreation. Therefore, to determine visitors' perceptions of the Selagalas Green Open Space as a whole, the following was conducted:

Table 1. Visitors' Perceptions of the Selagalas Green Open Space

Criteria Interval	Criteria Interval (Age)	Number (people)	frequency
Very Unsatisfactory	18-32	0	0
Unsatisfactory	33-46	0	0
Satisfactory	46-60	0	0
Fairly Satisfactory	60-74	27	90.00
Very Satisfactory	75-90	3	10.00

Based on Table 1, visitors' perceptions of the Selagalas Green Open Space as a whole show that 27 respondents (90.00%) rated the condition of the Green Open Space as satisfactory, while 3 respondents (10.00%) rated it as very satisfactory. No respondents rated it as "unsatisfactory" or "very unsatisfactory," which means that the majority of the community has a positive perception of the existence of the Selagalas Green Open Space . These results indicate that the vegetation, facilities, and environmental comfort in the Green Open Space are able to fulfill their ecological and social functions. This is in line with the findings of Pradana et al. (2021), which state that the public's positive perception of Green Open Spaces is influenced by thermal comfort, cleanliness, and vegetation diversity. Additionally, research by Yuliastuti and Setiawan (2020) shows that visitors' positive perceptions of Green Open Spaces in Mataram City are influenced by factors such as visual beauty, environmental comfort, and good accessibility.

Noise Levels in Selagalas Green Open Space

The role of vegetation in reducing noise

The selection of vegetation types in Green Open Spaces is an important aspect that determines the success of the ecological and aesthetic functions of the area. Vegetation not only serves as a greening element but also functions to improve air quality, lower environmental temperature, reduce noise, and support urban ecological balance. Based on the results of the study conducted, the vegetation density is as follows:

Table 2. Vegetation

No	Class	Species	Latin Name	Family	Number of Species	K (Ind/Ha)	Kr (%)
1	Pohon	Dadap Merah	*Erythrina crista-galli*	Fabaceae	10	7.692	5.376
2		Glodokan	*Polyalthia longifolia*	Annonaceae	16	12.308	8.602
3		Ketapang	*Terminalia catappa*	Combrateceae	2	1.538	1.075
4		Mahoni	*Swietenia mahagoni*	Meliaceae	44	33.846	23.656
5		Mangga	*Mangifera indica*	Anacardiaceae	1	0.769	0.538
6		Trembesi	*Samanea saman*	Fabaceae	113	86.92	60.75
		Jumlah	5	4	186	143.08	100
1	Tiang	Glodokan	*Polyalthia longifolia*	Annonaceae	23	17.69	32.39
2		ketapang kencana	*Terminalia mantaly*	Combrateceae	11	8.46	15.49
3		Mahoni	*Swietenia mahagoni*	Meliaceae	16	12.31	22.54
4		Mangga	*Mangifera indica*	Anacardiaceae	4	3.08	5.63
5		Mara	*Macaranga tanarius*	Euphorbiaceae	4	3.08	5.63
6		Matoa	*Pometia pinnata*	Spindaceae	1	0.77	1.41
7		Sawo	*Manilkara zapota*	Sapotaceae	4	3.08	5.63
8		Tanjung	*Mimusops elengi*	Sapotaceae	7	5.38	9.86
9		Trembesi	*Samanea saman*	Fabaceae	1	0.77	1.41
		Total	9	8	71	54.62	100.00
1	Pancang	Mahoni	*Swietenia mahagoni*	Meliaceae	2	1.54	22.22
2		Sawo	Manilkara zapota	Sapotaceae	1	0.77	11.11
3		Tanjung	*Mimusops elengi*	Sapotaceae	6	4.62	66.67
		Total	3	3	9	6.92	100.00

Description: K = Density; Kr = Relative Density

The density analysis results show that the density of tree vegetation in the Selagalas Green Open Space is 143.08. The tree species with the highest density is Trembesi *(Samanea saman)* at 86.92 with a relative density of 60.75%, which is in line with the most commonly found species. The pole class shows a density in the Selagalas Green Open Space of 54.62. The pole species with the highest density is Glodakan tiang *(Polyalthia longifolia)* at 17.69, with a relative density of 32.39%. In the stake class, the density in the Selagalas Green Open Space was 6.92. The stake species with the highest density was Tanjung *(Mimosops elengi)* at 4.62 with a relative density of 66.67%.

Vegetation density in Green Open Spaces plays a very important role in noise control and microclimate regulation in urban environments in Indonesia. In the regression model, vegetation density can reduce noise by up to 7.6 dB(A), while branch-free stem height contributes to a reduction of around 1.186 dB(A) (Yosieguspa, 2015).

Noise Levels

Based on the results of the research conducted, the noise levels for each repetition are as follows:

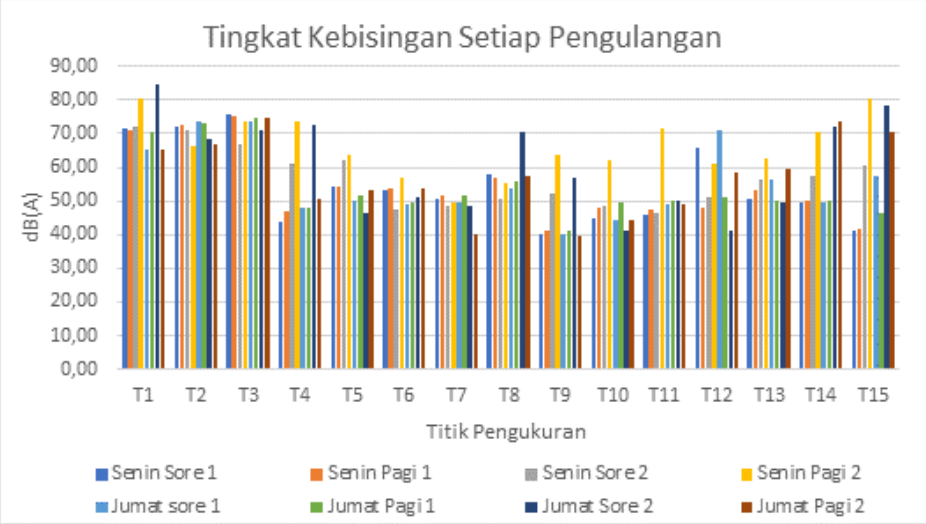

Figure 1. Noise Levels for Each Repetition

The results of noise level measurements in green open spaces ranged from 39.77 to 84.90 dB(A). Referring to the Minister of Environment Decree No. KEP-48/MENLH/11/996, the noise threshold in green open spaces is 50 dB(A). The measurement results show that 38 measurements were below the threshold (<50 dB(A)), while 82 measurements exceeded the threshold (>50 dB(A)). This is because the Selagalas Green Open Space is located close to a highway. In line with the research by Kamandang et al. (2020), it was found that the cause of noise in public spaces is traffic. Then we can see the results of the measurement analysis at each point as follows:

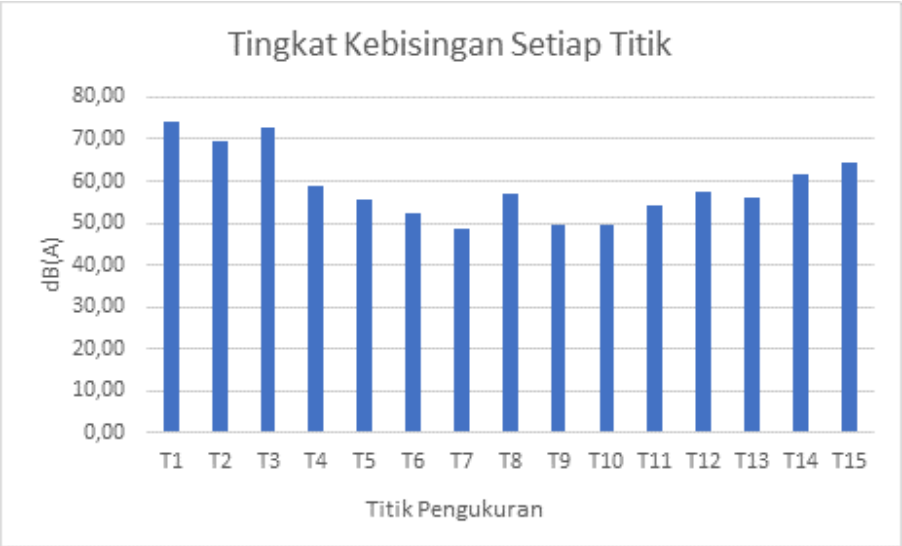

Figure 2. Noise Level Graph for Each Point

The noise levels at each measurement point show that measurement points 1, 2, and 3 have the highest noise levels. This is because these measurements are closest to the source of noise, namely, traffic. Then there is a decrease in sound waves as they move away from the source of noise, namely measurement points 4, 5, 6, 7, and 9, but there is an increase at point 8. This occurs because measurement point 8 is close to a soccer field, which tends to be a place of activity for many visitors who can generate other noises. Furthermore, points that are further away from traffic, namely points 10 to 14, show an increase in noise levels. This is because even though the measurement points are further away from traffic, which is the main source of noise, they are closer to residential areas, which are suspected of increasing noise levels. Finally, point 15 is an exception, having a high noise level even though it is far from traffic, but point 15 is located outside the Selagalas Green Open Space, so it is not affected by vegetation.

Noise reduction

Based on the results of the noise reduction analysis in this study, see Table 3.

Table 3. Noise Reduction Values

Area	Noise Level dB(A)	NRv	ER (%)
Front	71.60		
Front center	53.15	19.91	10.35
Rear center	50.98		
Rear	51.69		

Description: NRv = Noise Reduction Value; ER = Noise Reduction Effectiveness

Based on Figure 1, the noise level increases with the proximity of the measurement point to the sound source, namely, vehicle traffic, with the highest value reaching 71.60 dB(A). This is in accordance with the spherical spreading principle proposed by Bishop et al. (1976), in which sound waves spread in all directions, and their intensity decreases with increasing distance from the source. Thus, the closer the distance to the sound source, the higher the noise level received.

Noise reduction in the area behind the Selagalas Green Open Space is not only influenced by

distance, but also by the presence and density of vegetation. In the Selagalas Green Open Space , the NRv value of 19.91 dB(A) and ER of 10.35% indicate that the vegetation has a fairly good ecological function in reducing traffic noise, although it is not yet optimal. Overall, these reduction values are considered good and indicate that the further away from the noise source and the denser the vegetation structure, the greater the sound attenuation capacity.

Spatial Distribution of Noise

Based on the results of the interpolation analysis in this study, the following spatial distribution results were obtained.

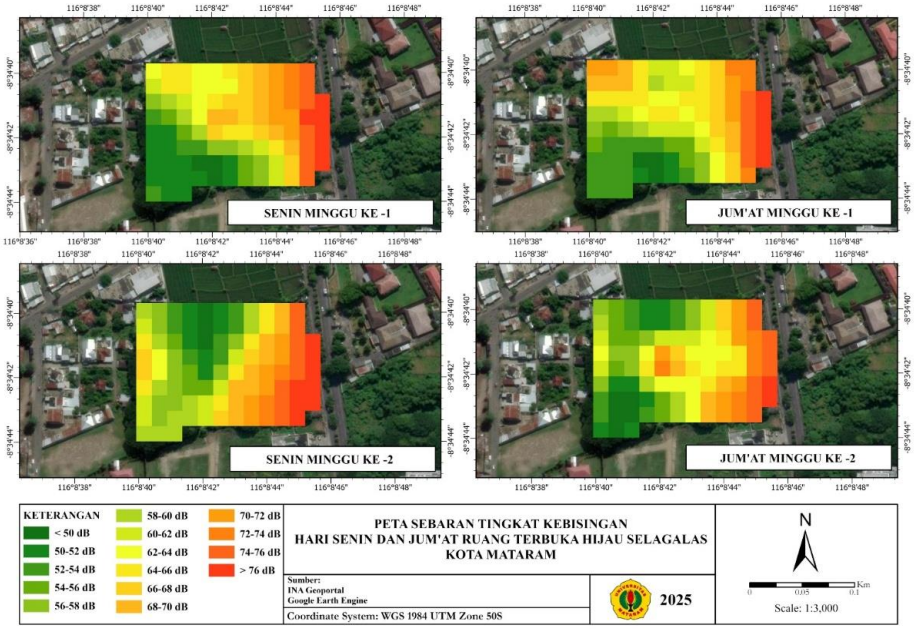

Figure 3. Noise Level Map of Selagalas Green Open Space

Based on Figure 3, the noise level in the Selagalas Green Open Space shows that the area closest to traffic has the highest noise level (>70 dB(A)) on both Monday and Friday, as well as in the first and second weeks. This confirms that traffic is the main cause of noise in the Selagalas Green Open Space , in line with the findings of Kamandang et al. (2020). In addition, human activities within the Green Open Space area, such as conversations, laughter, children's screams, and recreational activities, also contribute to noise, which is categorized as human sounds and can affect the quality of the urban park soundscape (Hidayati & Sugiarto, 2020).

The further the distance from the source of traffic noise, the lower the noise level tends to be, up to <56 dB(A), which is influenced by increasing distance and the presence of vegetation. The decrease due to distance can be explained by the principle of spherical spreading, where sound intensity decreases with increasing distance from the source. Meanwhile, vegetation plays a role in reducing noise through the interaction of sound waves with trunks, branches, twigs, and leaves through the mechanisms of absorption, reflection, and sound scattering, thereby reducing the acoustic energy transmitted (Li et al., 2020).

The effectiveness of vegetation in reducing noise is influenced by planting distance, plant height, canopy density, and vegetation type. Vegetation with dense canopy and leaf structure has better attenuation capabilities because it forms an effective physical barrier to sound propagation. Conversely, sparse vegetation creates acoustic gaps that allow sound waves to propagate without significant obstruction, so that noise levels behind the vegetation tend to be higher (Hamidun et al., 2020).

CONCLUSION

1. Visitors' perceptions of the Selagalas Green Open Space are generally positive, with the majority of respondents rating the condition of the area as satisfactory to very satisfactory. This shows that the vegetation, facilities, and environmental comfort have been able to fulfill the ecological and social functions of the Green Open Space as a public space.
2. The noise level in Selagalas GOS ranges from 39.77 dB(A) to 84.90 dB(A), with most values exceeding the GOS quality standard of 50 dB(A) due to the strong influence of traffic activity. Nevertheless, vegetation is able to reduce noise by 19.91 dB(A) with an effectiveness of 10.35%, which is considered good, through the mechanisms of absorption, reflection, and scattering of sound waves, although there is still potential for improvement through more optimal vegetation management.
3. The spatial distribution of noise shows that the highest levels (>70 dB(A)) are in areas close to traffic as the main source of noise, with additional contributions from human activities within the area. Noise levels decrease to <56 dB(A) in areas further away from the source due to the influence of distance and the presence of vegetation, where attenuation effectiveness is largely determined by plant density, height, and type, thus making the Selagalas Green Open Space crucial in reducing urban noise.

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