Perception and Preference of Noise Impacts on Housing Residents in IPB I Housing Baranangsiang, Bogor City

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Abstract. Noise is an unwanted sound and one of the problems that can’t be avoided due to an increase in the amount of transportation, which at a certain level can have an impact on the surrounding environment. This paper aims to analyze the perceptions and preferences of residents about the residential environment where they live, as well as analyze the relationship between noise intensity and the impact of the noise they feel. This was a survey research and using 30 respondent samples. The data collection method used a likert scale and the processed with bivariate analysis, using rank Spearman and Pearson correlation test. Noise measurement obtained noise intensity is about 52.95 dB to 72.47 dB. From the result, respondents who experienced physiological disorders such as headache 3.3%. Psychological disorders such as impaired concentration 53.3%, uncomfortable 73.3%, irritability 23.3%, and violated when sleeping 60%. Communication disorders such as talking loudly 40%, difficult to understand the voice 6.7%, and difficult to interpret the delivery of interlocutors 3.3%. The statistical test used to determine the relationship of noise level with physiological disorders using rank Spearman correlation obtained p value 0.43 at 5% confidence level, psychological disorders using Pearson correlation obtained p value 0.000 at 1% confidence level, and communication disorders using rank Spearman correlation obtained p value 0.02 at 1% confidence level. The results showed that there was a significant relationship between noise intensity with physiological, psychological, and communication disorders. Population preferences considered it very important to add plants to various trees and to arrange plants with a wide spread pattern on the home yard, also it is important to use the perforated type of wall barrier.

Keywords: noise impact, noise level, perception, preference

1. Introduction
The development of settlements and housing in Bogor City that is close to the road can cause noise problems. According to Lagonigro et al (2018), noise is an unwanted sound that can come from various sources, including noise from transportation and industry, which is considered an environmental pollutant and stressor that is a prominent feature of the urban environment [1]. Noise caused by heavy traffic can spread throughout the city, including housing areas. According to the Decree of the Ministry of Environment of the Republic of Indonesia Number 48/MENLH/11/1996, the noise threshold value in settlement and housing areas is 55 dB [2]. The research conducted by Hendro in 2004, produced noise levels in West Jakarta housing reaching 69.64 dB and for housing in Tangerang reaching 63.59 dB [3]. In the following year, the research conducted by Iswar and Siti Malkamah in 2005, at the UGM-Sekip Yogyakarta housing produced a noise level that reached 74.03 dB [4].

Noise exposure can cause a variety of disorders, including disturbance during sleep and...
psychological disorders, including anger, disappointment, unhappiness, and even depression [5]. According to Babisch et al (2013), noise also causes physiological disorders, such as increased blood pressure and heart disease [6]. This paper aims to analyze the perceptions and preferences of housing residents regarding noise in their neighborhood and analyze the relationship between noise intensity and the impact of noise they feel.

2. Methods
2.1. Study Location
The research was conducted at the resident of IPB Baranangsiang I, located in Baranangsiang, East Bogor sub-district, Bogor City. In Figure 1, there are 27 measurement points at the study site, where the points are adjusted to the distance of the house to noise source. In addition, the housing is close to the noise sources originating from the Jagorawi highway and Padi street in the north, as well as the Pandu street and Kolonel Ahmad Syam street in the east.

![Figure 1. Resident of IPB I Baranangsiang, Bogor City](source of map by Google Earth)

2.2. Data Collection
Sampling data with a purposive sampling method, which determines the sample to be taken by researchers based on research objectives. The number of samples taken 30 respondents based on the distance of the house by the point of noise measurement, which the house at a distance of 0 meter, 10 meters, 25 meters, and 50 meters from the source of the noise. It aims to determine the perceptions and preferences of residents about the influence of noise in their environment. Population perceptions of noise disturbance and audial comfort in the housing environment were assessed using a Likert scale, using indicator variables strongly agree (5), agree (4), doubt (3), disagree (2), and strongly disagree (1).
2.3. Statistical Analysis
At this stage carried out to determine a close relationship between noise intensity variables with noise disturbance perceived by residents of housing. The statistical test used is the Spearman and Pearson rank correlation. To find out whether or not there is a relationship between variables can be directly seen as the probability > 0.05 then H₀ is accepted, conversely, if probability < 0.05 then H₀ is rejected. In this study, the hypothesis (H₀) used is that there is no relationship between the noise disturbance from the local population.

3. Result and Discussion
3.1. Noise Disturbance Perception
Perception is the activity of feeling, interpreting, and understanding object both physical and social [7]. Human perception has different viewpoints in sensing which perceive something that will affect human action. The perception of the population is used to determine the attitude of the population towards noise disturbance in the housing environment of IPB I Baranangsiang. In this paper, the results of perception were divided into three groups, namely respondents who lived at a distance of ≤ 10 m, respondents who lived at distance of 25 m, and respondents who lived at a distance of 50 m. From the three groups of respondents, it can be seen the comparison of noise disturbance they feel while living in the housing based on the distance of the house from the source of the noise.

At home distance ≤ 10 m, the average noise level was 62.37 decibel (dB), which exceeded the noise level quality standard. Based on Table 1, it is known that the residents of IPB I Baranangsiang housing with a residence distance ≤ 10 m answered in agreement about noise disturbance, such as speak loudly (61.54%), uncomfortable (46.15%), and disturbing concentration (38.46%). Meanwhile, many residents who answered strongly agree on sleep disorders (61.54%).

| No | Statements                             | Response (%) |
|----|----------------------------------------|--------------|
| 1  | Headache                               | 0 92.31 0 7.690 0 |
| 2  | Tinnitus                               | 0 92.31 7.690 0 0 |
| 3  | Fatigue                                | 0 92.31 7.690 0 0 |
| 4  | Disturbing concentration               | 0 30.77 7.690 38.46 23.08 |
| 5  | Discomfort                             | 0 7.690 0 53.85 38.46 |
| 6  | Irritability                           | 0 69.23 7.690 0 23.08 |
| 7  | Sleep disorder                         | 0 7.690 0.000 30.77 61.54 |
| 8  | Speak loudly                           | 0 30.77 7.690 61.54 0 |
| 9  | Difficult to understand the voice      | 0 76.92 7.690 15.38 0 |
| 10 | Difficult to interpret the delivery of the other person | 0 84.62 7.690 7.690 0 |

Information:
1 = strongly disagree; 2 = disagree, 3 = doubt, 4 = agree, 5 = strongly agree.

Noise can cause interference in physiology, psychology, and communication. Physiological disorders can be in the form of cardiovascular disorders, headaches, fatigue [8], and tinnitus [9]. According to WHO (2015), tinnitus is a sound sensation such as buzzing without the presence of an external sound source [10]. Psychological disorders can include disturbing concentration, discomfort, irritability [11], and disturbed during sleep [12]. Communication disorders such as having to speak loudly, difficult to understand the voice when talking, and difficult to interpret the delivery of the other person. According to Yulianto (2013), someone who has a hearing loss will lose the opportunity to understand instructions given verbally and have difficulty making associations between sounds and letters [13].
At a distance of 25 m discovered that the average noise exceeded the quality standard noise level for residential areas which reached 56.46 decibel (dB). Table 2 shows the perceptions of the population answering agree to the noise disturbance they feel such as sleep disorders (50%), uncomfortable (70%), and disturbing concentration (50%).

Table 2. Perception of the population living within 25 m of noise disturbance

| No | Statements                                | Response (%) |
|----|-------------------------------------------|--------------|
|    |                                           | 1 | 2 | 3 | 4 | 5 |
| 1  | Headache                                  | 0 | 100 | 0 | 0 | 0 |
| 2  | Tinnitus                                  | 0 | 90 | 0 | 10 | 0 |
| 3  | Fatigue                                   | 0 | 100 | 0 | 0 | 0 |
| 4  | Disturbing concentration                  | 0 | 50 | 0 | 60 | 0 |
| 5  | Discomfort                                | 0 | 30 | 0 | 60 | 10 |
| 6  | Irritability                              | 0 | 80 | 0 | 20 | 0 |
| 7  | Sleep disorder                            | 0 | 60 | 0 | 40 | 0 |
| 8  | Speak loudly                              | 0 | 70 | 0 | 20 | 10 |
| 9  | Difficult to understand the voice         | 0 | 80 | 0 | 10 | 10 |
| 10 | Difficult to interpret the delivery of the other person | 0 | 80 | 0 | 20 | 0 |

Information:
1 = strongly disagree; 2 = disagree, 3 = doubt, 4 = agree, 5 = strongly agree.

At a distance of 50 m, it is known that the average noise reaches 56.10 dB. Table 3 shows the perception of the population answering agree on uncomfortable noise disturbance (71.43%).

Table 3. Perception of the population living within 30 m of noise disturbance

| No | Statements                                | Response (%) |
|----|-------------------------------------------|--------------|
|    |                                           | 1 | 2 | 3 | 4 | 5 |
| 1  | Headache                                  | 0 | 100 | 0 | 0 | 0 |
| 2  | Tinnitus                                  | 0 | 100 | 0 | 0 | 0 |
| 3  | Fatigue                                   | 0 | 100 | 0 | 0 | 0 |
| 4  | Disturbing concentration                  | 0 | 57.14 | 0 | 14.29 | 28.57 |
| 5  | Discomfort                                | 0 | 28.57 | 0 | 71.43 | 0 |
| 6  | Irritability                              | 0 | 71.43 | 0 | 0 | 28.57 |
| 7  | Sleep disorder                            | 0 | 57.14 | 0 | 28.57 | 14.28 |
| 8  | Speak loudly                              | 0 | 71.43 | 0 | 28.57 | 0 |
| 9  | Difficult to understand the voice         | 0 | 85.71 | 0 | 14.29 | 0 |
| 10 | Difficult to interpret the delivery of the other person | 0 | 85.71 | 0 | 14.29 | 0 |

Information:
1 = strongly disagree; 2 = disagree, 3 = doubt, 4 = agree, 5 = strongly agree.

From the results of perception above, it can be seen that most of the population who live at a distance of < 10 m, 25 m, and 50 m experience noise disturbance. Respondents who lived at a distance < 10 m more experienced noise disturbance compared to respondents who lived at a distance of 50 m. Noise disturbance felt by respondents, including disturbing concentration, feeling uncomfortable, disturbing during sleep/rest, and talking loudly. So it can be concluded that the closer the house distance to the noise source, the greater the impact of noise disturbance felt by the residential population.

According Anangga et al (2015), Noise can cause hearing loss, pregnancy, infant growth, communication disorders, resting disorders, sleep disorders, mental disorders, discomfort, and also disruption of daily activities [14]. Noise also causes psychological disorders and physiological disorders. Psychological disorders such as discomfort, lack of concentration, and
irritability, while physiological disorders can be disrupted blood circulation and increased heart rate. Differences in population perceptions can be caused by differences in respondent characteristics. Besides, each respondent's statement regarding noise disturbance is also subjective.

3.2. Relationship between Noise Level and Population Noise Disturbance

In this study, the variable of respondent characteristics used is the noise intensity variable. This variable is used to analyze the relationship of noise level with perceived noise disturbance, both physiologically, psychologically, and communication.

| Variable | Number of respondents | Physiological disorders |
|----------|-----------------------|-------------------------|
|          |                       | Headache | Tinnitus | Fatigue |
|          | n | % | p value | Corr. Coef. | p value | Corr. Coef. | p value | Corr. Coef. |
| Noise level | 30 | 100 | 0.043 | 0.205* | 0.525 | -0.065 | - | - |

Information:
* Spearman correlation test with the level of sig. 5%

Table 4 shows the statistical test using the Spearman rank correlation with α of 0.05, the p-value obtained in headache disorders was 0.043, with a correlation of 0.205. This shows that there is a significant relationship between noise intensity and headache disorders, and the relationship is weak. In tinnitus disorders and fatigue quickly there is no significant relationship with noise level.

| Variable | Number of respondents | Dist. concentration | Discomfort | Irritability | Sleep disorder |
|----------|-----------------------|---------------------|------------|--------------|----------------|
|          | n | % | p value | Corr. Coef. | p value | Corr. Coef. | p value | Corr. Coef. | p value | Corr. Coef. |
| Noise level | 30 | 100 | 0.107 | 0.164 | 0.000 | 0.515** | 0.405 | -0.085 | 0.000 | -0.368** |

Information:
** Pearson correlation test with the level of sig. 1%

The statistical test results in Table 5 use Pearson correlation with α of 0.01. From the results of the statistical test, the p-value obtained in the concentration disorder is 0.107 with a correlation of 0.164. This shows that the relationship between noise level and concentration disturbance is not significant. The p-value for uncomfortable discomfort is 0.000 with a correlation of 0.515, this shows that there is a significant relationship between noise level and discomfort, with a strong level of closeness. The p-value of irritability disorders is 0.405 with a correlation of -0.085 which shows that the relationship between noise level and concentration disturbance is not significant. Also, the disturbance during sleep obtained a p-value of 0.000 with a correlation of -0.368, which indicates that there is a significant relationship between noise level with a disturbance during sleep, with a weak level of closeness.
Table 6. Bivariate test results for communication disorders

| Variable      | Number of respondents | Communication disorders |
|---------------|-----------------------|-------------------------|
|               |                       | Speak loudly            | Difficult to understand the voice when talking | Difficult to interpret the delivery of the other person |
|               | n | %   | p value | Corr. Coef. | p value | Corr. Coef. | p value | Corr. Coef. |
| Noise level   | 30 | 100 | 0.002   | 0.310**    | 0.908    | 0.012     | 0.262    | 0.114     |

Information:
*Spearman correlation test with the level of sig. 1%

Based on the statistical test results in Table 6 using the Spearman rank correlation, with \( \alpha \) of 0.01, the p-value obtained in loud speaking disorders is 0.002 with a correlation of 0.310. This shows that there is a significant relationship between noise level variables with loud speaking disorders and weak relationship closeness. Also, the interference is difficult to understand the voice when talking to the interference is difficult to interpret the delivery of the interlocutor there is no significant relationship. Communication problems can be caused by the masking effect of noise, at first the speech is not heard clearly, so someone needs extra energy to shout with the interlocutor.

3.3. Population Preferences in Dealing with Noise

Preference is divided into several questions. There are the efforts to control the noise, plant arrangement form on the home yard to reduce noise, the function of the desired plant in the home yard, the type of barrier wall, and the comfort of a residential neighborhood. The questions regarding these preference could be a references to reduce noise in residential neighborhood of IPB I Baranangsiang.

![Figure 2. The efforts of noise control in a residential environment](image)

Barriers can be massive walls, fences, earthen mounds, hedges, and other buildings placed between the sound source and the receiver [15]. Based on Figure 2, the results of population preferences to control noise in their environment, they prefer to use vegetation barrier than wall barrier. According to Halim et al (2015), concrete hollow block barrier wall can reduce the noise level by 3.8 – 9.2 dB, precast concrete barrier wall can reduce noise by 7.0 – 8.4 dB, and vegetation barrier can reduce noise by 0.2 – 1.5 dB [16].

The arrangement of plants in the home yard can be grouped into 3 (three), which are clustered (tight and compact), spread, and shaped like a line / path. Each plant has a different function, such as a shade, reducing noise, filtering air pollution, reducing wind speed, enhancing the beauty of the city, aromatic odors, production trees, and as an enhancer of home beauty. According to respondents, the arrangement of plants in the home yard that can reduce noise and what kind of plants function that they want to plant in their home yard are shown in Figure 3.
From figure 3, the respondents choose the arrangement plants in their home yard with spreads pattern. The spread pattern have a high ability to reduce noise, with a combination of plants consisting of ground cover plants, shrubs, and trees have smooth leaf texture will have the ability to drown out the noise of $> 75\%$ [17]. While the kind of plants function that respondents want to plants in their home yard are shade, reducing noise, production tree, and home beauty. The placement of fruit trees and several types of shrubs in home yard can be an example of the function of these plants. In reducing noise, the house can also use a barrier wall. The barrier wall is divided into two types, such as closed (massive) and open (perforated) barrier walls.

From Figure 4, regarding the use of barrier walls, they prefer to use an open type of barrier wall, such as a fence. Some considerations that need to be considered in the barrier for effective noise reduction include the barrier must be high enough, the most effective barrier must be solid and continuous, and placement of barriers near the road [18]. The use of fences can’t completely reduce noise effectively, but if the use of fences is combined with plants (green wall), it can reduce noise by $5 - 15\, \text{dB}$ [19].

The residential environment should provide comfort for its residents. Figure 5 shows the residential environment desired by the respondent.
4. Conclusion
The majority of residents of IPB I Baranangsiang housing experience psychological and communication noise disturbance. Psychological disorders that are felt are feeling uncomfortable, disturbing concentration, and disturbing during sleep, while communication disorders experienced by residents are having to speak loudly. The impact of noise felt physiologically, psychologically, and communication has a significant influence on the population of IPB I Baranangsiang housing. Population preferences for creating audial comfort, including reducing noise in their environment are installing plant barriers, using perforated wall barrier, planting various plants, and arranging planting with spread patterns in home yard.

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