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THE EFFECT OF NOISE AND AIR POLLUTION ON THE HEALTH OF EMPLOYEES AND THE COMMUNITY AT THE LARATAMA PLTD - SOUTHWEST SUMBA REGENCY

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Abstract

The introduction highlights the dual impact of technological advancements on production and workplace conditions, particularly focusing on the challenges posed by noise pollution and its effects on health, including hearing loss and decreased productivity. Additionally, it emphasizes the need for eco-friendly practices and innovations to manage these environmental and occupational risks. The study examines the impact of noise and air pollution on hearing loss among employees and the surrounding community at PLTD Laratama, using a quantitative research design with a cross-sectional descriptive observational approach, employing observation sheets, questionnaires, and checklists for data collection. Based on the analysis, it was concluded that noise intensity at PLTD Laratama significantly affects hearing disturbances in both employees and the surrounding community. The correlation coefficient for employees (0.671) indicates a strong relationship, while for the community (0.529), it shows a moderate impact. A majority of employee respondents (79.05%) and a significant portion of the community respondents (37.27%) acknowledged the impact of air pollution on health. The study provides valuable insights into how noise pollution affects health, offering recommendations for noise reduction and further research.

Keywords: Air Pollution, Health Impact, Noise Pollution, PLTD Laratama

Introduction

The rapid advancement of globalization significantly impacts production levels and serves as a marker of technological and communication progress in the workplace. However, technological advancements come with both advantages and drawbacks, including physical factors such as air pollution and noise generated by machinery (Ramdan, 2014). The energy sector faces increasing demand, with electricity now being a fundamental human necessity. Production processes inherently involve risks, including extreme and high-risk scenarios, particularly in technical, plant operation, and maintenance roles. Between 2015 and 2018, workplace accidents at various power plant sites resulted in global fatalities, severe injuries, minor injuries, and asset damage, ultimately reducing electricity output from generators (Cholil et al., 2020).

Industrial activities utilizing machinery often generate noise, raising concerns among the general public and nearby residents, particularly in industrial zones. Sounds such as roars and chirps propagate through airwaves as byproducts of industrial processes. According to the Ministry of Manpower Decree No. Kep-51/MEN/1999, modern equipment can produce noise levels exceeding 85 dBA, posing threats to workers' hearing and the surrounding environment, especially for populations residing within tens of meters from industrial facilities. Noise from power plant machinery has become a significant issue in industrial and technological activities.

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The diesel power plant (PLTD) is widely utilized in Indonesia due to its numerous advantages, including the ability to operate on relatively affordable fuel, flexibility in capacity, adaptability to various load operations, continuous operation capability, and long service life. However, as highlighted by Jayawardana et al. (2014), the noise generated by PLTD activities significantly impacts public health and the comfort of communities surrounding the facilities. This concern is addressed by the Indonesian Ministry of Environment's Decree No. 48 of 1996, which defines noise as unwanted sound from industrial or operational activities occurring at specific times and levels that may harm public health and disrupt local comfort.

Electricity has become a fundamental human necessity, essential not only for daily life but also for offices, industries, and businesses (Sirad, 2019; Joko, 2015; Melany, 2015). Various power plants, including diesel-powered plants (PLTD) and renewable sources such as wind and solar energy, generate electricity. However, PLTD systems, reliant on non-renewable energy sources, incur high operational costs and face eventual resource depletion (Sirad, 2019). Efforts to reduce electricity consumption are underway, with strategies such as improving electrical equipment efficiency potentially lowering energy use by up to 33% (Joko, 2015; Melany, 2015). According to 2012 data from the Ministry of Electricity and Mineral Resources, businesses consumed 51.85% of total energy, while the commercial sector contributed 4.28%, and households accounted for 13.18%.

According to the World Health Organization (WHO), 466 million people worldwide, including 432 million adults and 34 million young individuals, experience hearing impairment. The Institute for Occupational Safety and Health reports that occupational diseases affect 250 million workers globally in noisy environments. By 2050, one in ten people globally may suffer from ear sensitivity (WHO, 2018). In Southeast Asia, 156 million individuals, or 27% of the population, experience hearing loss, with 49 million adults under 65 years old (9.3%) affected by workplace noise. Ristekdikti (2017) warns that hearing loss and deafness will increasingly affect the Indonesian population if not addressed promptly.

According to Jayawardana et al. (2014) highlight that technological advancements in industries have exacerbated noise-related issues, posing serious risks to workers' hearing due to increased noise levels. Noise, particularly from factory equipment operations, impacts both comfort and health. Workers in PLTD power plants are exposed daily to high-noise machinery, which can lead to noise-induced hearing loss (NIHL). Chronic hearing damage, often occurring after 10–15 years of exposure, is a significant occupational hazard (Addina & Keman, 2015). Workplace-related diseases, commonly arising from factors like excessive noise, can severely impact employee well-being (Rimantho & Cahyadi, 2015).

The impact of noise on hearing complaints has been the subject of various studies, emphasizing age as a significant factor influencing susceptibility. Research conducted at PLTD Manado in 2016 by Ramdan et al. categorized respondents into two age groups: 21–29 years and 30–40 years, involving 20 participants, 60% of whom were machine operators and maintenance staff, aligning with the age productivity guidelines of Law No. 13 of 2003 (Rahayu et al., 2016). Noise, particularly from machinery, poses risks such as hearing loss, concentration difficulties, elevated blood pressure, muscle tension, and stress (Harrington et al., 2003). Employees operating diesel-powered generators, especially in industries like PLTD Laratama, face substantial hearing impairment risks (Ardiwantoro et al., 2023). Additionally, population growth drives industrial expansion, which, while economically beneficial, contributes to pollution through emissions from vehicles and industrial activities (Masito, 2018). Air pollution, defined under Law No. 23 of 1997, contains harmful particulates such as PM2.5 and PM10, which penetrate the respiratory and circulatory systems, causing health issues like asthma, chronic obstructive pulmonary disease (COPD), and cardiovascular diseases (Sidabutar et al., 2023; Munfarida, 1999). Addressing these challenges necessitates eco-friendly innovations, reduced

industrial emissions, waste management, and public awareness of environmental sustainability (Zuhri, 2014).

The Waitabula area, located in Tambolaka Subdistrict, Southwest Sumba Regency, East Nusa Tenggara Province, is served by PT PLN (Persero) through the Diesel Power Plant (PLTD) Laratama, which supplies electricity to the region (Doelle et al., 2015). The PLTD operates 24 hours a day, powered by high-speed diesel (HSD) or biodiesel, meeting the electricity needs of local communities while creating significant noise pollution that potentially affects the hearing and productivity of workers and nearby residents. Situated in a residential area, the continuous operation of diesel engines poses health challenges, such as hearing loss among workers and surrounding inhabitants, which may lead to decreased focus and work performance. Diesel generators in the PLTD convert fossil fuel-based chemical energy into electricity, supplying essential power to households in Southwest Sumba, with 100% of households relying on this energy source for cooking and daily activities in recent years. This operational model underscores the critical role of the PLTD in regional energy distribution while highlighting its associated environmental and occupational health risks. This study aims to analyze the relationship between noise and air pollution levels and their impact on hearing health within the specified population. Previous studies have indicated a growing concern regarding occupational and environmental noise exposure, particularly in industrial areas. Additionally, air pollution has been identified as a contributing factor to auditory and systemic health problems, emphasizing the need for comprehensive investigation. This research builds upon existing literature to provide actionable insights for mitigating health risks in affected communities.

Method

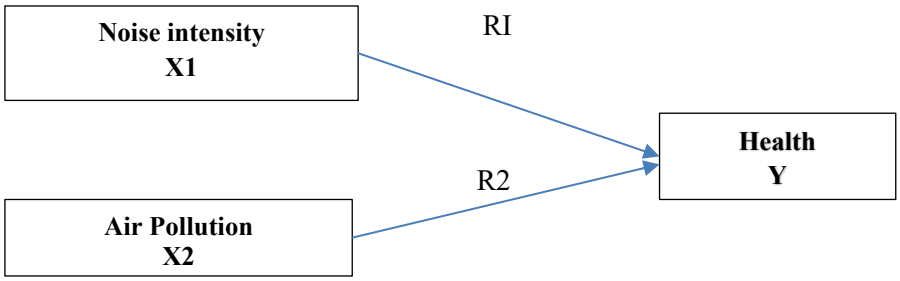

Figure 1. Conceptual Framework

The conceptual framework for studying the impact of noise and air pollution on hearing loss among employees and the surrounding community at PLTD Laratama comprises independent, intervening, and dependent variables. The independent variables include noise levels generated by operational activities and air pollution around the plant. The intervening variables are worker and community exposure, representing the degree of exposure to noise and air pollution experienced by employees and nearby residents, respectively. The dependent variable is hearing loss, hypothesized to be influenced by the level of exposure to noise and air pollution. Demographic and individual characteristics, such as age, gender, duration of exposure, and use of hearing protection, serve as control variables. The relationships between these variables will be measured and analyzed to test hypotheses that noise and air pollution increase exposure levels, which in turn elevate the risk of hearing loss, specifically in the PLTD Laratama context.

This study adopts a quantitative research design, employing a cross-sectional descriptive observational approach using observation sheets, questionnaires, and checklists to collect objective data simultaneously (Sugiyono, 2016). The research was conducted at PT PLN (Persero) NTT UPK

Timor ULPLTD Waingapu, specifically in PLTD Laratama, located in Keretana Sub-district, Waitabula District, Sumba Barat Daya Regency. Data collection sites included key operational areas such as the volleyball field, PLTD Weetobula, rental power plants, transformer step-up areas, and fuel tank facilities, among others. The research activities spanned from February to July 2024, encompassing literature review, proposal preparation, data collection, processing, and thesis report completion within the planned timeline.

The study's population comprised all employees of PLTD Laratama (20 individuals) and 55 community members from 18 households located within 100 meters of the plant, as defined by Sugiyono (2018), who emphasized the population as a collection of elements or individuals with specific characteristics relevant to the research. A saturated sampling technique was employed, involving all employees and nearby residents over 17 years of age who met the inclusion criteria. Primary data were collected using Likert-scale questionnaires (1–5) and direct measurements of noise levels with decibel meters, while secondary data, including PLTD Laratama reports, complemented the analysis (Sirigar, 2013). Data collection methods included structured interviews to gather demographic details and surveys capturing perceptions of noise, air pollution, and their health impacts on workers and residents.

Data processing was carried out with a focus on validation and reliability of the instruments used. The validity and reliability of the questionnaire regarding employee and community complaints about hearing impairments and noise dependence were evaluated. Validity was assessed using Pearson Product Moment, where a higher r value compared to the r table (0.361) indicates stronger validity (Sugiyono, 2016). Reliability was tested using Spearman Brown and Cronbach Alpha coefficients to measure the consistency of the instrument. Spearman Brown focused on the reliability of measurements, ensuring that the calculated r value exceeded the r table value for reliability (Sugiyono, 2016). Additionally, data analysis was conducted through programming and bivariate analysis, presenting findings using graphs, diagrams, and cross-tabulations to explore the relationships between dependent and independent variables. The findings were used to understand the impact of PLTD on air pollution, hearing impairments, health issues, and noise levels within the community, along with discussions on efforts to mitigate these impacts.

Results

1. Overview of Research Location

PT PLN (Persero) Wilayah NTT UPK Timor ULPLTD Waingapu PLTD Waitabula, located at Jl. Komet within the administrative area of Kelurahan Keretana, Kecamatan Kota Waitabula, Kabupaten Sumba Barat Daya, employs a total of 20 male employees at PLTD Laratama, with a surrounding community of 55 individuals. The primary activity at PLTD Laratama is electricity generation, producing the main product, which is electrical energy. The production process at PLTD Waitabula involves operating diesel engines using HSD/Biosolar fuel, supplying electrical energy to Kabupaten Sumba Barat Daya. The following data represents the machinery at PLTD Waitabula. Surrounding activities include residential areas and farmlands. (Source: Author’s Data, 2025).

Figure 2. Location of Waitabula PLTD

2. Respondent Characteristics

The respondents for this study included 20 employees from PLTD Laratama, all of whom submitted complete and analyzable questionnaires. Additionally, 55 individuals living in the vicinity of PLTD Laratama participated in the survey, with all responses deemed valid for analysis. Gender was identified as a key characteristic, revealing that all 20 employee respondents were male (100%), while the surrounding community consisted of 34 male respondents (61%) and 21 female respondents (39%). The majority of responses indicated male dominance among participants. Regarding the frequency of noise intensity and its impact on health, responses were categorized into different criteria such as very strongly agree (SS), strongly agree (S), and so on. The highest frequency for sufficient agreement (criterion 3) was 40% among employee respondents for physiological disturbances, while among community respondents, 48.5% agreed that noise pollution affects their health. For karyawan PLTD Laratama, 79.5% of responses indicated sufficient agreement regarding the adverse effects of air pollution on their health. Similarly, among community members, 37.27% agreed strongly that air pollution affects their health, highlighting concerns about inadequate air quality management and the impact of diesel emissions.

3. Instrument Test

In this exploration, the instrument was tested to assess the validity and reliability of the survey information related to various variables. Analysis of validity aimed to demonstrate the degree of legitimacy and correctness in capturing substantial aspects. Using SPSS 21 for Windows, the analysis showed that an item is valid if the correlation coefficient rr is less than or equal to 0.44. The findings from Table 4.11 revealed that both intensity of noise (IK) and average hearing disturbances (RGP) demonstrated high validity with correlation coefficients of 0.63 and 0.67, respectively, surpassing the threshold of 0.44. Similarly, Table 4.12 shows validity results for these variables in the community, with rr values of 0.53 and 0.613, validating the intensity of noise and hearing disturbances among respondents.

Reliability analysis was conducted to examine how consistent the instrument results are when used repeatedly. Utilizing the Cronbach Alpha strategy, variables with an Alpha value above 0.60 were considered reliable. Table 4.14 and Table 4.15 present reliability coefficients for average intensity of noise and hearing disturbances in the community and among employees, respectively, showing values of 0.687 and 0.618, well exceeding the minimum threshold of 0.60 for reliability. The results indicate that both the independent and dependent variables have a strong level of reliability, ensuring the accuracy and dependability of the research findings.

4. Quantitative Descriptive Results

Table 1. Noise Intensity on Hearing Loss in Employees at PLTD Laratama

Correlations			
		GPK	IK
GPK	Pearson Correlation	1	.671**
	Sig. (2-tailed)		.001
	N	20	20
IK	Pearson Correlation	.671**	1
	Sig. (2-tailed)	.001	
	N	20	20
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation coefficient is determined at 0.671 based on the connection table. Based on the guideline table, the correlation coefficient value of 0.671 indicates that the relationship between NOISE INTENSITY (IK) and HEARING DISORDER (HEAL) in employees is in the HIGH category.

Table 2. Summary Model Results

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.671[a]	.450	.419	1.43426
a. Predictors: (Constant), GPK				

The model summary table can be used to determine the r square value, also known as the coefficient of determination (KD). This value shows how well the interaction between the Employee Hearing Loss variable and the Noise Intensity variable forms a regression model. A KD value of 0.450 or 45% indicates that the GPK variable is influenced by other factors by 55% and the IK variable by 45%.

Table 3. Coefficients Test Results

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	84.226	2.255		37.359	.000
	GPK	.256	.067	.671	3.836	.001

Based on the Coefficients table, it can be seen that employee hearing loss has a significance of 0.01. The significance value is <0.05. So it can be concluded that Noise Intensity affects employee health problems. This study also agrees with Listaningrum's (2011) study which states that noise also has an impact in the form of decreased hearing function which can cause progressive deafness. In addition, research (Sudarmaji 2015) is in line with this study where noise intensity affects hearing loss.

The coefficient table shows the relapse condition model obtained with consistent coefficients and variable coefficients in the Unstandardized Coefficient section B. The resulting regression equation model is Y = 84.226 + 2.255 based on the table. :

a. 84.226 (a), indicating an IK of 84.226 if the GPK value is zero. B. If the IK value changes or increases by

b. 0.256 (b), then the GPK also increases by 0.256. From the results of simple correlation and simple linear regression, it is known that there is a positive relationship. This means that GPK is proportional to the value of the IK variable.

5. t-Test Rsult

bhe results of the t-test calculation show that:

a. GPK is not significantly influenced by Ho = IK.
b. Ha = IK has a small but significant influence on GPK. 0.05, or 5%, is the level of significance used. If the calculated T is greater than the T table, Ho is rejected, but Ha is accepted. The T table shows that Ho is accepted and Ha is rejected if the calculated T is significant. The calculated T obtained is 37.359 based on the T table of 1.72. The calculated T has better performance than the T table (1.72). Because Ha is accepted and Ho is rejected, IK has a large influence on GPK.

6. Simple Correlation Analysis and Simple Linear Regression in Society

Table 4. Ik against gp in SOCIETY in the laratama community

Correlations			
		GPM	IK
GPM	Pearson Correlation	1	.529**
	Sig. (2-tailed)		.000
	N	55	55
IK	Pearson Correlation	.529**	1
	Sig. (2-tailed)	.000	
	N	55	55
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation coefficient is determined at 0.529 based on the connection table. The relationship between NOISE INTENSITY (ik) and HEARING DISORDER (HE) IN THE COMMUNITY is included in the ADEQUATE category as seen in the guideline table above with a correlation coefficient value of 0.529.

Table 5. Model Summary Table

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.529[a]	.279	.266	4.08648
a. Predictors: (Constant), GPM				

The r square value, also known as the coefficient of determination (KD), can be obtained from the model summary table. This value shows how effective the interaction of the IK and GPM variables is in the regression model. The IK variable contributes 27.9% to the GPK variable, and 72.1% is influenced by other factors, according to the KD value of 0.279 or 27.9%.

Table 6. Coefficients Table

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	63.867	5.124		12.464	.000
	GPM	.615	.136	.529	4.534	.000
a. Dependent Variable: IK						

Based on the Coefficients table, it can be seen that community hearing loss has a significance of 0.00. The significance value is <0.05. So it can be concluded that Noise Intensity affects community hearing loss. This study also agrees with the study (Reinhad Hidayat Rahman, et all) Noise disturbances are still widely answered by noise disturbances. This will certainly affect the health conditions of the community living around the Luwuk PLTD. The r square value or so-called guarantee coefficient (KD) can be obtained from the model outline table. This value shows how well the interaction of the regression model between the IK and GPM variables works. The GPK variable is 72.1% influenced by other factors, with a KD value of 0.279 or 27.9% coming from the IK variable.

a. Shows an IK of 63.876 if the GPM value is zero. If the IK value changes or increases.
b. Shows that GPM also increases by 0.615.

From the results of simple correlation and simple linear regression, it is known that there is a positive relationship which shows that GPM also increases in proportion to the value of the IK variable.

7. T-Test Result

The t-test is used to determine whether the dependent variables of hearing loss and public health are significantly influenced by the independent variable of noise intensity. The importance is as follows:

a. GPK is not significantly influenced by Ho = IK.
b. Ha = IK has a small but significant effect on GPK. The t-test is used to see whether the independent variable of noise intensity has a significant effect on the dependent variables of hearing loss and public health.\

Discussion

1. The intensity of noise at the Diesel Power Plant (PLTD) of PT. PLN (Persero) Waingapu at the PLTD Laratama

In the operational process of PLTD, it is useful to produce electrical energy that is greatly needed by the community, besides that this PLTD also has an impact on the surrounding environment. The impacts that may arise include noise impacts, liquid waste impacts, gas waste impacts, solid waste impacts and other impacts. The impact of noise is caused by the operation of generating machines (generators). The noise that exists during the operational process comes from power generating machines, the noise generated not only causes discomfort but can also have serious effects on workers. Hearing loss is a disorder in the form of complaints of feelings when listening to sounds without any sound design or sound from outside, such as complaints in the form of buzzing, hissing, roaring or various other variations of sounds. As a result of noise levels above the NAB, it has a detrimental effect on workers, especially affecting the sense of hearing, namely the risk of experiencing a decrease in hearing that occurs slowly and for a long time and without being realized by the worker (Natalia, et al, 2024).

Noise intensity that exceeds the threshold will cause a serious decline in a person's health condition, especially hearing loss, and if it lasts for a long time can cause temporary hearing loss, which can gradually cause permanent hearing loss (cumulative) (Amalia et al 2015). In Indonesia, one of the industries that is a source of noise is the power generation industry which is caused by the use of machines and equipment in the industrial world. Based on the regulations of the Ministry of Environment, regulations or noise thresholds have been provided which are regulated by the Law of the Ministry of Environment number: KEP-48 / MENLH / 11/1996, concerning noise level standards in the activity environment, especially housing and settlement areas, it is determined that it has a maximum limit value of 55dB.

In general, the impact of noise on health is communication disorders where exposure to noise with high frequency and intensity allows for ongoing communication disorders. the level of noise produced by the PLTD interferes with conversations or concentration of the surrounding community. In addition, noise can also interfere with physiology, which in general high-pitched noise is very disturbing, especially intermittent noise or sudden noise. Physiological disturbances can be in the form of increased heart rate, peripheral blood vessel construction in the hands and feet and can cause paleness and sensory disturbances. In addition to communication and physiological disturbances, noise can also disturb the psychology of the surrounding community in the form of discomfort, lack of concentration and increased emotions, anxiety and fear.

Noise received for a long time can also cause psychosomatic diseases in the form of critical gas, heart, stress and fatigue (Andriani, et al 2017, Münzel et al. 2018 Indonesian labor regulations The Minister of Manpower Regulation is tasked with enforcing noise and health regulations in the workplace in Indonesia. One of the related regulations is Regulation Number 5 of 2018, "Occupational Safety and Health Administration" issued by the Minister of Manpower. The obligation of the business world to protect its workers from health risks due to excessive noise is regulated in this regulation.

It is proven from the results of data processing that respondents at the Laratama PLTD are exposed to noise intensity that can interfere with employee health based on respondent answers. This can be managed well because of the implementation of SOPs in running the PLTD with applicable SOPs and KKK standards correctly. However, based on the answers of respondents who are employees, it is known that ik greatly affects employee hearing loss. The efforts that need to be made to reduce noise are planting large trees to reduce noise in the area around the PLTD, in addition to that, it is necessary to carry out routine and routine maintenance on the PLTD engine.

2. The effect of noise intensity on hearing loss of employees and the community around PLTD Laratama

The results of the analysis show that noise intensity has a correlation coefficient of 0.671 indicating a significant positive effect on employee hearing loss. This covers about 45% of the variation in hearing loss, while 55% is influenced by other factors. Employment regulations in Indonesia require companies to comply with noise threshold limits and implement preventive measures to protect employees from health risks due to excessive noise.

The noise of the generating machine working environment is a fairly serious problem and must be considered, because the use of large-capacity diesel engines is very identical to the presence of noise sources, thus affecting the comfort of the work environment and the residential environment of the surrounding community. Based on the results of field observations that have been carried out previously, the noise of PT PLN (Persero) generating machines comes from the use of diesel engines used to drive electric generators. The relationship between noise and the possibility of health problems is influenced by several factors, namely the intensity of noise and the length of time a

person is in a noisy place or in a place of sound, either from day to day or for a lifetime (Ramdan P. I. Timang, 2016).

Noise with high intensity and for a long time, namely between 10-15 years, will cause tearing of the organ of Corti, resulting in total destruction of the organ of Corti (Permaningtyas, 2011). Noise exposure for more than 10 years will cause an increase in NIPTS (Noise Induce Permanent Threshold Shift), especially at a frequency of 4 KHz. Excessive sound stimulation over a long period of time can cause changes in metabolism and vascular so that damage occurs to the structure of the hair cells of the organ of Corti (Rambe, 2003).

Companies can better reduce the impact of noise on employee hearing health by understanding the findings of the analysis and existing regulations. The impact of diesel power plant noise levels on public hearing interference is positively correlated with a correlation coefficient of 0.529 with a significance level below 0.05 indicating that ik has a 27.9% effect on public hearing loss and 72.1% is determined by other factors. If ik is increased, gpk will also increase by 0.615 percent. 0.529 as a correlation coefficient indicates a positive relationship between the intensity of noise from diesel power plants and public hearing loss, meaning that the higher the noise, the greater the risk of hearing loss. With a significance level below 0.05, this relationship is considered statistically significant, and 27.9% of the variability in hearing loss can be explained by the noise intensity. To prevent and reduce its impact on the community, there are several things that need to be done properly, regularly and continuously, namely by taking steps to prevent and mitigate noise because it is not impossible that in the next 5 or 10 years if there is an increase in the number of buildings in the Laratama area, hearing loss in the community will also increase. For this reason, the following preventive measures need to be taken:

a. Using noise dampers and vibration dampers on PLTD engines to reduce sound emissions and carrying out routine maintenance to prevent damage that can increase noise.
b. Use of Soundproofing Materials: Installing acoustic panels on walls, ceilings, and floors to absorb sound and reduce reflections, and installing insulation around noisy areas to prevent sound from escaping the room.
c. Protection and Awareness: Ear Protection: Providing ear protectors or hearing masks for workers exposed to high noise. Training: Educating workers and the community about the risks of noise and the use of proper protection.
d. Noise Limits: Adopting noise limit standards set by local or international authorities.
e. Routine Monitoring: Conduct regular noise measurements to ensure that noise levels remain within safe limits.
f. Planning and Zoning
g. Planning the location of the PLTD away from residential areas to reduce the impact of noise on the community. Implementing industrial and residential zoning to separate noise sources from densely populated areas.

3. The effect of air pollution on the health of employees and the community around the Laratama PLTD

It is known that the majority of employee respondents stated that Quite Agree (3) is 79 or 39.5% that air pollution causes employee health problems. This can happen because the number of people, the number and volume of residential buildings or other housing in the area around the PLTD is not too dense, so that people think that air pollution has quite an effect on the health of the community around the Laratama PLTD.

Population growth in an area will be followed by the growth of other sectors such as the increasing number of industries and means of transportation. This can have a positive impact on the

economy, but it also has a negative impact on the environment in the form of air pollution due to increased emissions from engines and motor vehicles (Masito, 2018)

In general, air that has been polluted by dust particles can cause various respiratory diseases. Dust particles consist of liquids and solids that are very small and float in the air, these dust particles will be inhaled and enter the lungs. The location of the attachment or deposition of dust particles in the lungs depends on the size of the dust particles. Dust particles measuring 8 to 25 microns will be retained in the upper respiratory tract, namely attached to the nose and throat, while dust particles measuring 2 to 8 microns will be retained in the middle respiratory tract, namely attached to the bronchial tubes. Dust particles measuring 0.5 to 2 microns will enter the lung air sacs and stick to the alveoli. Particles smaller than 0.5 microns will freely enter and exit through breathing (Chandra, 2006). Pollution that occurs around the PLTD is not yet worrying because the amount of green land available around the PLTD is quite a lot so that respondents consider that the air pollution felt is quite affecting health even though the direct impact felt is very small.

Factories and large industries in the southwest Sumba area also do not have large industries in large numbers so that when the Laratama PLTD is managed properly, the by-products of the PLTD engine cannot cause pollution that has a direct impact on the community. In addition to the factors mentioned above, air pollution will be felt to greatly affect public health if there is a strong combination and correlation of various factors and other factors so that the pollution will have a direct impact on public health. It is common knowledge that the majority of public respondents (205 or 37.27 percent) agree that air pollution is detrimental to public health. This is certainly because the public considers that the exhaust from the diesel engine is not completely burned and completely reduced so that the exhaust that can become pollutants will still be spread into the open air. This is felt by the public even though it is not at a dangerous level because generally the public has used PPE according to operational standards. However, if in certain circumstances the public is without PPE, pollutants will be able to enter through the respiratory tract even though the impact that arises will be felt when it has been for a very long time. In addition, employees who are close to diesel engines are at risk of experiencing this

Conclusion

Based on the previous chapters and the analysis using simple regression and correlation formulas, the author concludes that the noise intensity at PLTD Laratama significantly impacts hearing disturbances among both employees and the surrounding community. The correlation coefficient value for employees, 0.671, indicates a strong relationship between noise intensity and hearing disturbances, whereas for the community, the coefficient of 0.529 reflects a moderate impact on hearing disturbances. Furthermore, it was observed that a majority of employee respondents expressed Agree (A) at 79.05%, indicating that air pollution affects employee health. Similarly, a significant proportion of community respondents, 37.27%, indicated that air pollution impacts community health. These findings contribute to a deeper understanding of the relationship between noise and health in industrial areas.

In light of the findings presented in this study, several recommendations are offered. For PLTD Laratama, it is suggested that relevant agencies, particularly PLTD Laratama, implement noise-reducing tree planting efforts to mitigate noise directed toward residential areas, specifically the community of Waitabula. Additionally, the Environment Agency should conduct socialization efforts regarding the impacts and management of noise pollution in residential areas, especially in Waitabula. The surrounding community can also adopt measures to reduce the impact of noise by planting trees around their homes. For future researchers, this study is expected to provide valuable data and references for experts interested in exploring the effects of PLTD noise and air pollution on hearing

disturbances and health in both the community and employees of PLTD Laratama in Sumba Barat Daya.

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