Noise Level Analysis in the Education Sector which Located close to the Runway of Sultan Babullah Airport

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Abstract. Aircraft noise pollution is an annoying sound effect produced by airplane in flight. For instance, some aviation activities; landing and takeoff could produce a harmful noise that would become some distractions for a learning process. Specifically, for those particular education buildings located in a line across the runway service of Babullah airport. Thus, it is necessary to identify the level of noise produced by airplane passing and flying around the area of campus and schools during teaching and learning activities. This research, therefore, aims to discover how much the noise level likely to disturb the learning process then compare with applicable regulations based on Noise Quality Standards. Additionally, the method of this study using a survey of a sound level meter and conducting an equivalent noise level analysis (LEQ) in accordance with SNI 7231: 2009 at each point of the research location. The results of the 5 largest noise level research sites occurred at point L1 with a distance of 125 m in the location of Khairun University which is 65.7 dBA transpired on Monday when Batik Air A320 landed at 13:00 p.m CEST, and at point L5 with a distance of 166 m at SDN 57 location, namely 75.6 dBA, it figured out on Monday during the takeoff with Sriwijaya Air B737-800 at 15:10 p.m. As a result, the noise level had exceeded 55 dBA thresholds for schools or campus either.

Keywords: aircraft type noise, sound level meter, quality standard

1. Introduction

Noise caused by a few aviation activities during landing or take off will cause annoying sounds and would be impacted to the education sector located in the same area near by the runway of Sultan Babullah Airport. In fact, the noise pollution produced by aircrafts has a detrimental effect on learning process and it exceeds the noise quality standard of 55 dBA for education settlements. In consequence, it is necessary to conduct a research for revealing how damaging the effects of the aircraft noise pollution to schools and universities that are close to the runway and whether the location has met the noise quality standards based on the decision of the Minister of environment No.48 / MENLH / 11/1996 about noise quality standards. On this basis, research was made on "Noise Level Analysis in the Education Sector which Located close to Sultan Babullah Airport Runway". The main purpose of this research is to discover how much the noise level occurs when aircrafts passing and flying around the campus and
workshop located near the runway. Furthermore, the reasons and data will compare with applicable regulations.

2. Fundamental Theory

2.1. Noise Pollution
Noise pollution is a harmful noise effect produced by aircraft in flight. In other words, that particular noise is an unwanted sound because it is not in accordance with the context of space and time. Hence, it can cause disturbances for people comfort and health [1].

2.2. Types of Noise
Types of noise as follows:
- Continuous noise with a wide frequency spectrum (wide band noise). e.g. engines, fans, and others.
- Noise is continuous with a narrow frequency spectrum (narrow band noise). e.g. silkuler saws, gas valves and others.
- Noise intermittent. For instance, traffic, aircraft noise at the airport and others.
- Impulsive noise, such as rifle or cannon fire and explosion.
- Repeated impulsive noise, for example forging machines in companies.

2.3 Noise Impacts
The effects can cause various disorders such as physiological disorders, communication disorders and deafness. There are classifying disorders such as Auditory disorders, for instance, hearing and non-auditory disorders. e.g. safety hazards, decreased work performance, stress, and fatigue [2].

2.4 Noise Control
In general, noise control efforts are carried out through the reduction and control of noise levels into 3 parts, namely:
- Control at Source
  - Control at source
- Control at Propagation Media
  - Control on propagation media is carried out between the source and receiver of noise.
- Noise control in humans is done to reduce the level of noise received every day. This control is mainly aimed for those certain people who work as aircraft operators.

2.5 Noise Quality Standards
Noise quality standard is the maximum limits of noise allowed to be discharged to the environment from business or daily activities that would not become problems for people around that areas. [3].
Table 1. Noise Level Standards Based on Decree No.48 of 1996

| Allocation Area / Environmental Health | Noise Level dB (A) |
|---------------------------------------|--------------------|
| a. Provision of                       |                    |
| 1. Housing and Settlements            | 55                 |
| 2. Trade and Services                 | 70                 |
| 3. Office and Trade                   | 65                 |
| 4. Green Open Space                   | 50                 |
| 5. Industry                           | 60                 |
| 6. Government and Public Facilities   | 70                 |
| 7. Recreation                         |                    |
| 8. Special:                           |                    |
|   - Airport                           | 55                 |
|   - Railway Station                   | 60                 |
|   - Port Sea                          | 70                 |
|   - Heritage                          |                    |
| b. Environmental Activities           |                    |
| 1. Hospital or the like               | 55                 |
| 2. schools or similar                 | 55                 |
| 3. Places of Worship or the like      | 55                 |

2.6. Noise Zone

Minister of Health Regulation, number 718 of 1987 concerning noise in health is divided into four regional zones [4]
- Zone A: Intensity 35 - 45 dB. The zone is intended for research sites, hospitals, health / social care centers & the like.
- Zone B: Intensity 45 - 55 dB. The zone is intended for housing, education and recreation.
- Zone C: Intensity 50 - 60 dB. The zone is designated for offices, trade and markets.
- Zone D: Intensity 60 - 70 dB. The zone is intended for industry, factories, AC stations, bus terminals and the like.

2.7. The noise

Noise level at the airport is determined by the equivalent value of the noise level in an area that can be received continuously for a period of time with a certain weighting [5]. Because SLM is not equipped with lack of facility and the noise value obtained in each measurement fluctuates so it is calculated manually by using the formula in accordance with SNI 7231: 2009 regarding the method of measuring Noise Intensity at Work as follows:

$$Leq = 10 \log \left( \frac{\sum ( t \times 100 \times L_i)}{T} \right)$$  \hspace{1cm} (1)

3. Methodology of Research

3.1. Types of Methods

Methods used in this study is the descriptive methods. Descriptive research is carried out with the main objective, which is systematically describes the facts and characteristics of the object or subject under study.
3.2. Research Sites
The study was conducted at the point of the research sites below:

![Research locations](image)

**Figure 1.** Its research locations

| Point | Distance | Area           |
|-------|----------|----------------|
| L1    | 125m     | Khairun University |
| L2    | 285m     | Elementary School48 |
| L3    | 369m     | High School 5    |
| L4    | 170m     | Junior High School 5 |
| L5    | 166m     | Elementary School57 |

3.3. Data Analysis Techniques
Based on the data retrieval, 1 minute when the aircraft takeoff and landing, readings are carried out every 10 seconds, so we get 6 times data retrieval, then the data obtained are analyzed in the form of:
- Measurements made for about 10 hours of each point of the study location using a sound level meter and with measurement times that have been determined then analyzed according to SNI 7231: 2009 regarding the method of measuring Noise Intensity at Work.
- Make a graph of the noise level from the results of noise measurements for each point.
- Determine the value of the maximum equivalent noise level for each observation location.

4. Results and discussions
Based on the results of the study, the greatest noise level occurred at each study location as below:

| No | Type of Aircraft | Time | Campus | ES 48 | HS 5  | JHS 5 | ES 57 |
|----|------------------|------|--------|-------|-------|-------|-------|
| 1  | SRIWIJAYA        | 07.10| 60.2   | 54.2  | 58.6  | 58.4  | 57.2  |
| 2  | GARUDA           | 07.25| 65.6   | 56.4  | 58.2  | 59.7  | 55.3  |
LANDING

| No | Type of Aircraft | Time   | Campus  | ES 48 | HS 5  | JHS 5 | ES 57 |
|----|------------------|--------|---------|-------|-------|-------|-------|
| 3  | WINGS            | 07.59  | 54.2    | 42.2  | 48.5  | 54.2  | 55.2  |
| 4  | LION             | 07.50  | 60.1    | 47.4  | 56.4  | 58.5  | 53.5  |
| 5  | SRIWIJAYA        | 10.20  | 65.3    | 53.6  | 57.3  | 58.9  | 56.3  |
| 6  | WINGS            | 11.30  | 57.2    | 46.7  | 52.5  | 51.6  | 57.2  |
| 7  | BATIK AIR        | 13.0   | 65.7    | 51.1  | 57.9  | 57.5  | 61.4  |
| 8  | TRIGANA AIR      | 14.00  | 55.2    | 45.2  | 44.7  | 49.7  | 46.2  |
| 9  | WINGS            | 13.45  | 55.7    | 47.1  | 48.6  | 56.8  | 54.6  |
| 10 | SRIWIJAYA        | 14.05  | 60.2    | 57.4  | 57.6  | 59.6  | 61.2  |
| 11 | BATIK AIR        | 15.35  | 64.6    | 52.2  | 57.2  | 59.3  | 59.4  |
| 12 | WINGS            | 16.35  | 59.8    | 47.6  | 47.5  | 49.6  | 52.4  |

From table 3, the greatest noise level at landing exceeds the Threshold Value Set by the Ministry of Environment for Environmental Activities in Education, which is 55 dB (A). of the 5 research locations when landing the largest noise level occurred on Monday in Khairun University, with a distance from Babullah airport for about 125 m which is 65.7 dBA when landing with Batik Air A320 aircraft at 13:00 CEST. and the lowest noise level occurred at the location of HS 5 with a number of 44.7 dBA with Trigana Air ATR-42 aircraft at 14:00 CET.

![Figure 2. Equivalent Noise (Leq) at five locations with Noise level at landing Monday July 1, 2019](image)

Table 4. Noise level when takeoff in five different research locations on July, 1

| No  | Type of Airplane | Time | Campus  | ES 48 | HS 5  | JHS 5 | ES 57 |
|-----|------------------|------|---------|-------|-------|-------|-------|
| 1   | SRIWIJAYA        | 07.55| 60.3    | 53.5  | 57.4  | 58.2  | 75.3  |
| 2   | GARUDA           | 08.15| 65.9    | 56.2  | 57.6  | 58.5  | 75.2  |
| 3   | WINGS            | 08.20| 52.1    | 47.1  | 47.8  | 53.8  | 72.3  |
| 4   | LION             | 08.30| 60.2    | 50.1  | 55.8  | 57.9  | 73.6  |
| 5   | SRIWIJAYA        | 11.05| 65.2    | 54.2  | 56.4  | 58.4  | 71.3  |
| 6   | WINGS            | 11.55| 59.7    | 48.7  | 51.1  | 50.8  | 71.2  |
| 7   | BATIK WATER      | 14.35| 65.2    | 50.2  | 56.3  | 57.4  | 75.1  |
| 8   | TRIGANA          | 14.25| 52.5    | 44.6  | 44.1  | 48.5  | 47.8  |
| 9   | WINGS            | 14.15| 58.9    | 48.2  | 47.3  | 55.9  | 72.1  |
| 10  | SRIWIJAYA        | 15.10| 60.1    | 55.1  | 56.4  | 58.7  | 75.6  |
From table 4. the greatest noise produced by aircraft when take off is the noise level that exceeded the Threshold Value set by the Ministry of Environment for Education Activities, which is 55 dB (A). From 5 locations when aircraft was taking off, the biggest noise level occurred at ES 57 with a distance of 166 m, the biggest noise occurred on Monday during take off which was 75.6 dBA with Sriwijaya Air B737-800 at 15:10CET, where the noise level has exceeded 55 dBA thresholds for schools or the like. Meanwhile, the lowest noise level occurred at the location of HS 5 with a distance of 368 m, reaching 44.1 dBA with the type of Trigana Air ATR-42 aircraft at 14:25 CET.

![Figure 3](image.png)

**Figure 3.** Equivalent Noise (Leq) at five locations with noise level during take off Monday, July 1, 2019

5. Conclusions
Based on the results of this research and discussion, it can be concluded that from 5 different locations, the largest noise level occurred on Monday in the first location, Khairun university, with a distance of 125 m which is 65.7 dBA when landing with Batik Air A320 at 13:00 CEST. Meanwhile, the distance of 166 m at Elementary School 57 was the biggest noise level occurred on Monday during take off which is 75.6 dBA with Sriwijaya Air B737-800 at 15: 10WIT, where the noise level has exceeded the 55dBA threshold for schools or either.

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