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Implications of Environmental Noise as an Instrument of Eco-Airport Development

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ABSTRACT

Background: International airports are generally susceptible to various problems. Problems pile up, ranging from non-operational to operational problems. If this is not addressed, the problem will become more complicated due to the accumulation of a greater risk of problems. These conditions will increase the risk of the noise factor, and potential health problems for people who live and move in the airport region. **Objective:**The purpose of this study is to develop a model of environmental noise implications surrounding the airport with the environmental assessment at Soekarno Hatta International Airport. **Results:** The results showed that the noise implications of the model can be built through the factors analysis that can give an idea of the influence of noise to society. **Conclusion:** The conclusion of this study is to obtain a variable noise sensitivity, noise miss-management, noise policy, noise annoyance, noise disturbance, noise areas, noise regularity, and noise standards as indicators of environmental noise implications that can be used as an instrument to evaluate, build, and develop control policies through the implementation of airport noise environment as a part of eco-friendly airport or eco-airport.

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INTRODUCTION

Referring to Law No. 1 of 2009 on Flight (State Gazette of 2009 No. 1, Supplement to Statute Book No. 4956) and the Regulation of the Minister of Transportation No. KM 11 Year 2010 About the National Order of airport affairs, stated that:

The airport is in the area of land and/or water with certain limits are used as a place of aircraft landing and taking off, up and down passengers, loading and unloading of goods, and the intra and inter- transportation movement, which is equipped with the safety and security of flight, as well as basic facilities and other supporting facilities.

While the notion of sustainable development that is environmentally conscious and planned effort, which integrates the environment, including the resources, to the development process to ensure the ability, well-being, and quality of life of the present generation and future generations. Then in 1987 the term sustainable development is defined by the development that can meet the needs of current generations without having to disrupt the ability of future generations to meet their own lives in the future (Peter, 2008).

Noise is unwanted environmental footprint of an airport environment caused by airport operations is the sound of an airplane engine noise that cause noise which affects not only the workers activities at the airport, but it also affects the people who live around the airport area. Increased levels of continuous noise from various activities in the airport environment can lead to interference noise, and other impacts of noise (Sasongko, 2000). Effects of noise emitted by aircraft operating at airports when using the runway was very influential in the community who live or are located around the airport , and gave rise to different perceptions in assessing the level of noise (Ernesto, 2008). Ernesto research conducted at the Ninoy Aquino International Airport - Philippines, showing the variety of respondent communities affected by aircraft noise . length profile of respondents living in the area surrounding the airport, occupation, gender, age and household income gives a different perception of the effects of aircraft noise.

Similar conditions in Indonesia related to airport noise also showed an association between aircraft noise to the disturbance in the community. Increase the frequency of flights and increase aircraft noise will improve the risk factors, which result in potential health risks for workers at the airport

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(Yadnya, 2009). Yadnya research conducted in the area surrounding the Ngurah Rai Airport Bali - Denpasar, suggest a link between the level of noise and ground handling sharp hearing officer. The results showed that the sharp decline in the level of noise affect hearing.

Nelson (2003) conducted a meta-analysis of studies of airport noise and hedonic value of the land. From the research results obtained land prices in areas with noise levels of 55 dB(A) more expensive than the price of land with a noise level of 70 dB(A).

Jarup. et, al. (2008). Aircraft noise is likely to cause hypertension, an important risk factor is not small in the environmental factors that have a major impact on public health, while concerns about the negative impact of aircraft noise on health, is the level of perceived interference and a sensitivity level that has the greatest risk of effects of noise disturbance (Maarten et al, 2008).

Richard (2009). Conduct research related to public transportation as well leave the noise and cause hearing loss, as well as the potential for noise exposure exceeds the quality standards that have been set, so the need for individual hearing protectors.

Daniel et, al., (2010). Relationship between environmental noise and health are poorly understood, but it is important and essential for public health. Each individual may react differently to the aggravation of the same noise, as well as individual differences in response to the noise sensitivity. Research conducted at the Auckland International Airport yielding the conclusion that the noise can degrade the quality of life because of the aggravation and lack of sleep.

Praag. Baarsma, (2000), conducted a study on the effects of noise nuisance around Amsterdam Airport Schiphol is internalized monetary compensation for the disorder, including a compensation scheme depends on, objective noise level, income and the presence of noise insulation.

Methodology:

This research was carried out experimentally to obtain the ideal model of noise environmental capacity region airports, research will be done gradually through direct measurement of the noise level. Factor analysis was performed to see the impact of noise caused by the movement of an aircraft and its implications on society. The research framework is presented in Figure 1.

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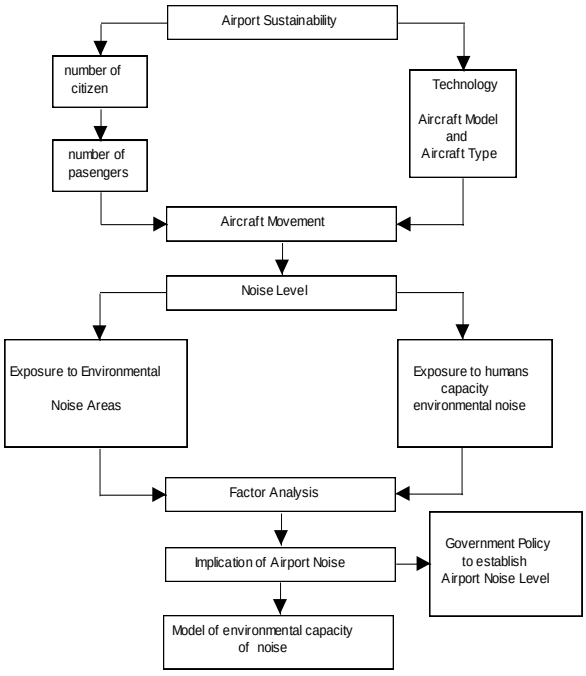

Fig. 1: Research Framework

Data Analysis Techniques:

The process of factor analysis is divided into four stages (Sardjono, 2013), that are:

1. Choosing the appropriate variables included in the factor analysis. Therefore, factor analysis seeks to group a number of variables, then there should be a fairly strong correlation between the variables, so that will happen grouping. If a variable or more weakly correlated with other variables, then these variables will be excluded from the factor analysis.
2. After a number of selected variables, then do 'extraction' variable to be one or several factors.

3. Factors formed, in many cases, less describes the differences between the factors that exist. However, if the content is questionable factors, the process can be carried out to clarify whether rotation form factor is significantly different from the other factors.

4. Once the factor actually been formed, then he process is continued by naming the existing factors.

RESULT AND DISCUSSION

The results of the analysis of secondary data obtained from the noise level monitoring manager International Airport Soekarno-Hatta taken in 2009 and in 2010 (Table 1.), Showed that the average level of noise that occur during this period are: 72,34 dB(A), and if the noise level standard for regional airports is assumed to be 70 dB(A), then the condition of airport Soekarno-Hata actually have passed the standard noise level, which means there has been unsustainable airport. While based on primary data, in March of 2011 to December of 2011, data showed the lowest noise level 60,3 dB(A) occurred in April 2012 and the highest noise level of 76,1 dB(A) occurs also in April 2012. For the data noise level recorded at the time of the interview with the respondent, giving the distribution of noise that occurs with a range of noise by 16,40 dB(A), with the lowest noise level was recorded at 58,70 dB(A) and the highest noise level can be recorded is equal to 75,10 dB(A). Results of univariate analysis showed the level of noise generated following data:

1. Average noise level = 68,55 dB(A).
2. Standard Deviation = 3,55 dB(A).
3. Minimum noise level = 58,70 dB(A).
4. Maximum noise level = 75,10 dB(A).

Analysis of the implications of noise as noise environmental capacity of the natural environment, artificial environment, and the social environment by using the method of analysis - analysis of factors produces an optimal solution with 8 (eight) new factors that is formed from the grouping process output and factor analysis can be interpreted as new variables: Noise Sensitivity, Noise Miss-management, Noise Policy, Noise Annoyance, Noise Disturbance, Noise Area, Noise Regularity, dan Noise Standard. Noise factor is a response of the respondents to the presence of environmental noise that is accepted as the implications of airport noise is perceived, and through factor analysis process continued The next factor that can be obtained if the value associated with the noise level can be used to build the capacity of environmental noise function.

Table 1: Noise Level Region International Airport Soekarno-Hatta Year 2009 and 2010

Location	Period and Time	Sem 1'09	Sem 2'09	Sem 1'10	Sem 2'10	Average
K1 West	L_S dB(A)	72,9	72,9	72,9	68,7	71,85
	L_M dB(A)	74,7	74,7	74,7	67,2	72,83
	L_{SM} dB(A)	73,6	73,6	73,6	68,2	72,25
K2 East	L_S dB(A)	77,2	77,2	77,2	71,2	75,70
	L_M dB(A)	48,1	48,1	48,1	70,0	53,58
	L_{SM} dB(A)	75,4	75,4	75,4	70,9	74,28
K3 North	L_S dB(A)	79,9	79,9	79,9	77,8	79,38
	L_M dB(A)	73,9	73,9	73,9	65,8	71,88
	L_{SM} dB(A)	78,7	78,7	78,7	76,2	78,08
K4 South	L_S dB(A)	73,1	73,1	73,1	74,0	73,33
	L_M dB(A)	74,8	74,8	74,8	60,8	71,30
	L_{SM} dB(A)	74,1	74,1	74,1	72,4	73,68
Average	dB(A)	73,03	73,03	73,03	70,27	72,34

Analysis of the implications of noise as noise environmental capacity of the natural environment, artificial environment, and the social environment by using factor analysis method produces an optimal solution with 8 (eight) new factor that is formed from the grouping process output and factor analysis can be interpreted as a new variable: noise sensitivity, noise miss-management, noise policy, noise annoyance, noise disturbance, noise areas, noise regularity, and noise standards noise sensitivity, noise miss-management, noise policy, noise annoyance, noise disturbance, noise areas, noise regularity, and noise standards. This new form factor is the response of the respondents to the presence of environmental noise that is accepted as the implications of airport noise is perceived, and through the subsequent follow- factor analysis can be obtained if the value of the factors associated with the level of noise can be used to build the capacity of environmental noise function (Y(X)) .

In symbolic models , functions woke generating function form:

Y (X) = Model of Environmental Noise Implication

$Y(X) = 68{,}55 - 0{,}46\ X_1 + 0{,}20\ X_2 - 0{,}95\ X_3 + 0{,}19\ X_4 + 0{,}52\ X_5 - 0.02\ X_6 - 0.43X_7 - 0.13\ X_8$

where,

X_1 : noise sensitivity,
the value of X_1, are : $-3{,}35 \leq X_1 \leq 2{,}49$
X_2 : noise miss-management,
the value of X_2, are : $-2{,}62 \leq X_2 \leq 2{,}88$
X_3 : noise policy,
the value of X_3, are : $-2{,}56 \leq X_3 \leq 2{,}45$
X_4 : noise annoyance,
the value of X_4, are : $-3{,}37 \leq X_4 \leq 2{,}90$
X_5 : noise disturbance,
the value of X_5, are : $-3{,}34 \leq X_5 \leq 2{,}36$
X_6 : noise area,
the value of X_6, are : $-3{,}26 \leq X_6 \leq 2{,}35$
X_7 : noise regularity,
the value of X_7, are : $-2{,}38 \leq X_7 \leq 3{,}10$
X_8 : noise standard ,
the value of X_8, are : $-2{,}55 \leq X_8 \leq 3{,}20$

Implications Noise Sensitivity Factor (X_1) is negative, it indicates that the higher the level of noise that happens it will have implications for the decreased level of sensitivity of human hearing. On the function of noise environmental capacity that is built, Noise Sensitivity factors contribute to changes that occur with the reception noise noise acceptance range of 5,84 dB(A), and the reduction of the maximum noise level of acceptance of 3,35 dB(A) as well as the addition level receipt of the maximum noise of 2,49 dB(A) .

From the results of the investigation of the biological basis of the Noise Sensitivity, noise sensitivity is known to have a heritability of 40% (Heinonen, 2005), and suggests that the sensitivity of the noise sensitive individuals have distinctive patterns of brain activity that distinguish them from individuals who are not sensitive (Pripfl et. Al., 2006) and on the difference in noise sensitivity, most likely reflecting a greater strain differences in cognitive processes. Based on the results of research conducted , this factor is negative, the sensitivity of the noise factor becomes very important to be a concern because it will have a direct impact on individual sensitivity and decrease impact on the health problems caused by noise.

Noise Factor Miss-management implications (X_2) is positive, it indicates that the higher the error in noise management is done it will have implications on the increased level of noise. On the function of noise environmental capacity that is built, Miss Noise-management factors contribute to changes that occur with the reception noise noise acceptance range of 5,50 dB (A), and the reduction of the maximum noise level of acceptance of 2,62 dB(A) and the addition of a maximum noise level of acceptance of 2,88 dB(A).

Based on the research results, Noise factor is Miss-management is positive, then the noise factor management has become very important to be a concern and need to be reduced because it will have a direct impact on the increase in noise levels and result in increased noise at the source of the sound.

Policy implications Noise factor (X_3) is negative, it ndicates that the higher the level of noise that is applied then the policy will have implications for decreasing the noise level . On the function of noise environmental capacity that is built, Noise policy factors contributing to changes in the reception of noise that occurs with noise acceptance range of 5,01 dB(A), and the reduction of the maximum noise level of acceptance by 2,56 dB (A) as well as the addition level receipt of the maximum noise of 2,45 dB(A).

In Noise Policy implications , respondents are clustered at the problem is not the abuse of power in the management of airports , their belief that the government has tried to maintain a balance between environmental factors and economic factors , their belief that the government has tried to enforce environmental norms for issue airport noise, and trust in the government who have known noise problems at airports.

Implications of Noise Annoyance Factor (X_4) is positive, it indicates that the higher the level of noise that happens it will have implications on the increased level of discomfort due to hear the noise. On the function of noise environmental capacity that is built, Noise Annoyance factor contributing to changes that occur with the reception noise noise acceptance range of 6,27 dB(A), and the reduction of the maximum noise level of acceptance of 3,37 dB(A) as well as the addition level receipt of the maximum noise of 2,90 dB(A).

Aircraft noise can be a source of discomfort for disturbing sleep, interrupting conversations , and disrupting human activity, subjective experience aggravation of a general reactions to the noise and each respondent can show different reactions to the same noise level and differences in respondents can be partly ascribed to differences in noise sensitivity.

And a strong emotional response from the direct implications of this noise can affect the health and health deficit will increase due to the emergence of discomfort to the continuous noise (Miedema, 2000), the main cause of the implications of Noise Annoyance is the noise level that it can also affect on psychological factors . Exploration results of previous studies related to the environmental impact of airport operations activities at airports Australasia also showed figures of 17% for the problem Noise Annoyance (Daniel, 2010) and ratings Noise Annoyance aircraft on a study of 12 airports in several European countries also showed the 25% (Kaltenbatch, 2008), while in this study 20% figure obtained for the same factors.

Factors implications Noise Disturbance (X_5) is positive, it indicates that the higher the level of noise that happens it will have implications on the increased level of interference due to hear the noise. On the function of noise environmental capacity that is built , Noise Disturbance factors contributing to changes in the reception of noise that occurs with noise acceptance range of 5,70 dB(A), and the

reduction of the maximum noise level of acceptance of 3,34 dB(A) as well as the addition level receipt of the maximum noise of 2,36 dB(A).

Noise can cause disruption and harm to health, at higher levels can cause deafness or hearing loss due to exposure to noise (Noise Induced Hearing Loss) , noise nuisance factor is the most dominant disturbance variables in the study relationship between noise level with health problems (Fyhri, 2008) and implications of aircraft noise is the appearance of a negative impact on health and the stress of life and can ruin the quality of life (Kaltenbach, 2008). Implications of Noise Disturbance on the mode of transportation, especially air transport more noise due to wind turbine performance reached 25% (Van der Berg, 2009) . This indicates the need to control noise at the source of the soun. Concerns about the adverse health implications of Noise Disturbance as an accumulation together with the emergence of new Noise Annoyance factor which has been obtained previously and the results showed 22,84 % rate.

Factors implications Noise Area (X_6) is negative, indicating that higher levels of neighborhood noise policy is applied it will have implications for the reduced levels of noise . On the function of noise environmental capacity that is built, Area Noise factor contributing to changes that occur with the reception noise noise acceptance range of 5,61 dB (A), and the reduction of the maximum noise level of acceptance of 3,26 dB(A) as well as the addition level receipt of the maximum noise of 2,35 dB(A).

In Noise Area implication, respondents clustered together on issues important to constantly monitor the condition of the aircraft noise is the noise that occurs always in accordance with the quality standards limits the noise that has been determined , the belief that the airport will always grow at the current and future level measurement airport noise to be done continuously, and the situation in the area of airport noise is difficult to control.

Noise implications Regulatity factor (X_7) is negative, it indicates that more clear about the noise regulations are applied it will have implications for the reduced levels of noise . On the function of noise environmental capacity that is built, regularity Noise factor contributing to changes that occur with the reception noise noise acceptance range of 5,48 dB(A), and the reduction of the maximum noise level of acceptance of 2,38 dB(A) as well as the addition level The maximum noise acceptance of 3,10 dB(A).

Noise on the implications of regularity respondents clustered at issue generally considered that the noise of airport noise has exceeded the quality standards required.

Factors implications Noise Standard (X_8) is negative, it indicates that the higher the noise level standards are applied it will have implications for the reduced levels of noise. On the function of noise environmental capacity that is built, Standard Noise factor contributing to changes that occur with the reception noise noise acceptance range of 5,75 dB(A), and the reduction of the maximum noise level of acceptance of 2,55 dB(A) as well as the addition level receipt of the maximum noise of 3,20 dB(A).

In Noise Standard implication, respondents were clustered together on common problems that people can receive the government's policy for the management of the airport area, the feeling of fear came when the crash occurred, and the public can receive airport noise policies issued by the government.

Factors of noise sensitivity, noise miss-management, noise policy, noise annoyance, noise disturbance, noise areas, noise regularity, and the noise standard is an environmental implications of airport noise and a noise environmental capacity to be sustained by the carrying capacity of its environment. In models built noise control, noise environmental capacity is considered as a variable demand because it has direct implications on the social environment, economic environment, and the natural environment.

Conclusion:

Based on the results of the study (analysis) and discussion (synthesis) that have been described in the previous section, then some conclusions can be drawn as follows:

1. The noise level area International Airport Soekarno-Hatta in 2009 and in 2010, the average was 72,34 dB(A). While in the year 2011 is 71,0 dB(A), and in 2013 was 68,55 dB(A).
2. Noise Sensitivity, Miss-management Noise, Noise Policy, Noise Annoyance, Disturbance Noise, Noise Areas, Noise regularity, and Noise Standard is the capacity factors of environmental noise which identifies the implications of noise received by the public. With an average noise level of community acceptance of 68,55 dB(A).
3. the Department of Transportation, to control the aircraft certification which still operates in accordance with the provisions and standards of noise which refers to the office of international civil aviation (ICAO), and establishes criteria for eco-friendly airport refers to the International standards or procedures.
4. For Airline operators and aviation industries, using planes with low noise technology and attention to the environmental impact of business activity or production operations performed.
5. For academics, conduct advanced research related to the pattern of airport noise, airport environmental footprint, and environmentally friendly airports criteria in accordance with the concept of sustainable development.
6. For local government, to control the use of agricultural land and land up in accordance with the function refers to the existing rules and regulations.

7. However, further research needs to be done is:

1. Analysis of components of the criteria for eco-sustainability airport airports.
2. Community involvement in the development of noise compatibility program for eco-sustainability airport airports.
3. Model eco-airport noise exposure for the sustainability of the airport.
4. Model environmental footprint eco-sustainability airport to airport.

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