Analysis of the Implementation of Eco-Airport Concept Using Willingness to Pay Method at Soekarno-Hatta Airport

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Abstract

Airport management needs to balance various aspects of operations such as security, safety, space availability and schedule of airplane movement, local economy growth, and environmental sustainability. Soekarno-Hatta Airport in Jakarta, Indonesia, committed to adopt the Eco-Airport concept to transform itself into an eco-friendly airport. This article analyzed management needs to balance its efforts in environmental sustainability with the commercial aspect of the airport by being sensitive towards the preference of customers' willingness to pay for the implementation of eco-friendly airport. This research was conducted from August to November 2020 to identify the current condition of the airport in the implementation of concept of eco-friendly airport, the customers' willingness to pay, and analyze the contributing factors. Data was collected using Purposive Sampling Method by questionnaires. Majority of the respondents think that Soekarno-Hatta Airport still needs improvement in comfort, aesthetic, hygiene, and noise control. The 97 respondents interviewed expressed their willingness to pay additional IDR 13.865,98 to the Passenger Service Charge per person per flight in return for a better eco-friendly and more comfortable airport. Education level, income level, flight frequency, and comfort dummy, are defined at 10% significance on the value of willingness to pay.

Keywords
Eco-airport, Eco-Friendly, Willingness-To-Pay, Soekarno-Hatta Airport, Environment Management

1. Introduction
The airport is a strategic infrastructure in air transportation supporting economic activities and the development of surrounding area. Various aspects of the airport must be managed in an integrated manner to realize the provision of airport services according to the standard and level of requirement. The airport management needs to consider the aspects of security, aviation safety, spatial planning, local economic growth, and environmental sustainability (Angkasa Pura II 2012).

The operation of airport has an impact on environmental degradation. This degradation is due to pollution generated by air transportation as well as energy and waste management, which are not environmentally-friendly in the airport area. Environmental degradation at airports can and should be prevented. The quality of the airport environment needs to be preserved by implementing operational activities effectively and efficiently (Adisasmita and Hadipramana 2012). Environmental aspects need to be an important consideration in addition to economic and technical aspects (Adiati and Rahardyan 2012).

Increasing public awareness of the importance of environment preservation poses a challenge to airport management. Several concepts have been implemented to realize environmentally-friendly airports which are planned, developed, and operated to create environmentally-friendly facilities and operation. Implementation of the concept brings about changes in mindset, behavior, application of knowledge, and technological improvements in civil aviation and environmental-based airport management (Rachman 2007).

The Eco-Airport was first introduced in Japan as a response the global environmental agenda. It was subsequently introduced to other countries especially ASEAN and was formalised in the form of Eco-Airport guideline initiative document, i.e., the ASEAN-Japan-Eco-Airport Guideline. This concept also corresponds with Indonesia's Law No.1 of 2009 about Aviation, which stipulates the obligation for all airports in Indonesia to implement environmental management programs addressing factors such as air pollution, efficiency in clean water use, electrical energy saving plans, and waste management. The implementation of the Eco-Airport concept is expected to deal with various issues in the airport environment's quality, such as noise, vibration, waste, biodiversity degradation, groundwater quality degradation, and river water. These issues should be monitored and reviewed by managers and all stakeholders associated with the airport (Angkasa Pura II 2013).

Among the first airports to implement the Eco-Airport concept is Narita International Airport in Japan. On April 21, 2005 Narita International Airport management announced the construction of an environmentally friendly airport. The Eco-Airport concept has also been implemented at numerous airports in other countries (Agustini 2011, NAA Corporation 2010).

Soekarno-Hatta Airport is one of the airports that adopts the Eco-Airport concept. The success of the implementation is determined by the commitment of all relevant stakeholders, adequate infrastructure and facilities, the use of appropriate and environmentally-friendly technology, a work culture that cares for the environment, and support from airport service users so that the community can be involved in the development process and maintenance of eco-airport at the airport (Gujarati 2007). Therefore, research on community preferences by assessing willingness to pay for the implementation of Eco-Airport concept at Soekarno-Hatta Airport can be a beneficial reference to both the airport management as well as the regulator/ government (Firdaus 2004).

2. Methodology

2.1 Research Location

The research was conducted at Soekarno-Hatta Airport, Cengkareng, Tangerang, Banten Province the largest airport in Indonesia. The primary data collection research was conducted for approximately three months, from August to November 2020.

2.2 Types and Sources of Data

The type of data used in this research is cross-sectional data. Primary data were obtained by interview using a questionnaires. The primary data required in this study include the respondent's characteristics, willingness or unwillingness to pay, the amount that the respondent is willing to pay, and the factors that affect willingness to pay. The data is also complemented by interviews with PT Angkasa Pura II.

Secondary data were obtained from PT Angkasa Pura II and literature studies related to research. The secondary data required is an overview of Soekarno-Hatta Airport, statistical data on the number of passengers, aircraft and cargo, the eco-airport concept, and the master plan for airport development and other data required in the research.

2.3 Data Collection Methods

The sample selection was designed to target respondents who were passengers of flight services at Soekarno-Hatta Airport. Specifically, those who have flown at least twice to and/ or from Soekarno-Hatta Airport. The sampling method used in this research is the purposive sampling method. Respondents selected in the study were aged seventeen and over, willing to participate in the interview process and fill out questionnaires. Researchers consider that those over seventeen years of age can understand and answer accountably in the interview process and questionnaire filling.

2.4 Data Analysis

The data obtained were analyzed qualitatively and quantitatively. Qualitative aspects include identifying airport conditions, while quantitative aspects include estimating the the amount that the respondent is willing to pay (WTP) and analyzing the factors that influence it. The descriptive statistics in this study describe the condition of the airport. In this study, the WTP value of the airport community uses the Contingent Valuation Method using the (Hanley and Spash 1993) approach, namely:

1. First, setting up the Hypothetical Market. In building a hypothetical market, literature studies and field observations were performed. All respondents were informed that to improve the airport environment's quality and reduce the negative effects of the airport, PT Angkasa Pura II plans to create an eco-friendly airport. Through this system that is being piloted, all shortcomings or negative aspects of airports such as noise, air pollution, water pollution, and energy use can be minimized as much as possible (Sintorini 2007).

2. Second, obtaining the value of WTP (Obtaining Bids/Payment Card). The technique used in this research is the game bidding method, a method that offers several suggested numbers to respondents. Respondents can choose the offer provided according to their respective perceptions. In obtaining the bid numbers, there are estimates of investment costs in several scenarios to implement the Eco-Airport concept. To find cost estimates and scenarios, this study consulted with PT Angkasa Pura II and related parties.

3. Calculating the estimated mean value of the WTP. In this study, the WTP value is estimated using the average value of the sum of the total values and divided by the number of respondents. The estimated mean WTP value is calculated as show in equation (1).

$$EWTP = \frac{\sum_{t=0}^{n} WTPxi}{n} \tag{1}$$

Where,
EWTP : Estimated mean value of WTP (IDR)
xi : The amount of each data
n : Total respondents (120 people)
i : The i-respondent willing to pay (i : 1,2,...,120)

4. Estimating the WTP Demand Curve (Aggregating Data)
At this stage, the aggregating data is a process where the average value of WTP is converted to the total population. After estimating the mean value of WTP, it can be estimated that the total value of WTP from the population as show in equation (2).

$$WTP = f \text{ (number of respondents, value of WTP)} \tag{2}$$

Where,
Number of Respondents : number of respondents who are willing to pay.
WTP value : maximum value that is willing to be paid

5. Determining the Total WTP
Aggregating data is the process of converting the mean bid value to the total population as show in equation (3).

$$TWTP = \sum_{t=0}^{n} WTPini \tag{3}$$

Where,
TWTP : Total WTP (IDR)
WTP : The i-individual WTP (IDR)
Ni : The i-number of samples willing to pay
i : The i-respondent willing to pay (i = 1, 2, ..., 120)

2.5 Multiple Linear Regression Analysis

Analysis of the factors that influence the WTP value using multiple regression show in equation (4).The WTP function is obtained by entering the dependent variable, namely the amount of value willing to be paid, which is presumed to affect the independent variable. The independent variable consists of the education (X1), occupation (X2), income (X3), convenience (D4), cleanliness (D5), noise (D6), water (clarity) (D7), and air (coolness) variables (D8).

$$\textit{"WTP} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_2 D_3 + \beta_4 D_4 + \beta_5 D_5 + \beta_6 D_6 + \beta_7 D_7 + \beta_8 D_8 + e_i\textit{"} \qquad (4)$$

3. Results and Discussion

3.1 Identification of the Eco-Aiport Concept

An eco-airport is an airport that has made measurable measurements of several components that can impact the environment to create a healthy environment at the airport and its surroundings. Eco-Airport is implemented to minimize the environmental impact that occurs due to airport operational activities. The implementation of Eco-Airport at Soekarno-Hatta Airport is motivated by PT Angkasa Pura II's awareness to protect the environment and comply with the Government Regulation SKEP/124/VI/2009 issued by the Ministry of Transportation, Directorate General of Civil Aviation. This regulation is based on the global issues regarding airport environmental problems so that guidelines for implementing environmentally-friendly airports (eco-airport) are required (Direktur Jenderal Perhubungan Udara 2009)

Currently, part of the Eco-Airport concept had been implemented at Terminal 3 of Soekarno-Hatta Airport, namely by using materials that minimize the use of lights during the day and minimize air conditioner energy use. In addition, terminal 3 uses soundproof ceilings to reduce noise and increase greening. However, at terminal 1 and terminal 2, the concept has not been implemented.

This implementation is not only done by reducing the pollution and waste generated, but also to create an environmentally-friendly culture for all staff and the community at Soekarno-Hatta Airport. PT Angkasa Pura II had produced Eco-Airport master plan and roadmap, and the installation of Eco-Airport publication media such as an appeal to protect the airport environment (Ramanathan 1997)

The Regulation of the Directorate General of Civil Aviation SKEP/124/VI/2009, listed of eight components in the Eco-Airport concept, namely air quality, energy, noise or vibration, water quality, soil pollution, waste, natural environment (flora or fauna), as well as social, cultural economy, and public health. However, PT Angkasa Pura II identified nine components: air quality, energy, surface water quality, noise and vibration, soil pollution, liquid waste, solid waste, flora and fauna, as well as the social, economic, cultural and public health. PT Angkasa Pura II elaborated the waste components in more detail, namely solid waste and liquid waste. Thus, the Eco-Airport components of PT Angkasa Pura II is more than components listed in the Government Regulation. These components have a target to reduce negative impacts on the environment from 2013 to 2022. The target for the each component at Soekarno-Hatta Airport can be seen in Table 1.

Table 1. The target plan for the eco-airport component program at Soekarno-Hatta Airport

No.	Components	Target
1.	Air quality	- Greening program and planting shade trees in the airport area - Collaborating with the Environment Agency to test the emission content of airport operational vehicles
2.	Energy	- Applying *Building Automatic System*(BAS) - Utilizing alternative energy such as biodiesel or vegetable oil - Arrangement of utility systems (water, lighting, ventilation) - Selection of the use of building materials at the airport - Regulating the use of air conditioning and electricity according to the dimensions and shape of the room
3.	Surface water quality	- Utilization of rainwater by making a water reservoir - Drainage cleanliness management - Wastewater Treatment Plant management - Sanitary sewer maintenance

4.	Noise and vibration	- Planting trees around administrative buildings, offices, and airport operational sites - Replanting of dead plants and adjusted to the field conditions - Planting cover crops by considering the type of plants that are fitted with the maximum plant height - Planting noise-reduction plants with hard-trunked plants and lush leaves that do not attract birds around the airport buildings - Making embankments - Plant preservation
5.	Soil pollution	- Construction of waste storage
6.	Liquid waste	- Wastewater Treatment Plant Management - Maintenance of sanitary sewers
7.	Solid waste	- Separation of dry and wet waste - Working with colleagues who are assigned to manage the cleanliness throughout the airport environment, including outdoor areas, landside, airside, office building, and passenger terminal building
8.	Flora and fauna	- Selection of plants type according to its purpose - Create or maintain ornamental plants for airport aesthetics - Collecting data on protected animals (mammals, vertebrates, reptiles)
9.	Social, economic, cultural, and public health	- Empowerment of communities around airports, development of the environment (provision of public facilities and social facilities) around airports, corporate social responsibility - Improvement of economic infrastructure and facilities - Improve environmental conditions - Assisting health facilities and medical personnel

3.2 Analysis of Respondents' Willingness to Pay

In connection with PT Angkasa Pura's plan for eco-airport implementation, a willingness to pay (WTP) analysis that can approach the amount the users are willing to pay for environmental improvements at the airport is required. Respondents in this study were 120 people. Most of the respondents, namely as many as 97 people (80.83%), were willing to pay for improvements to the airport environment. The remaining 23 people (19.17%) were unwilling to pay for improvements to the airport environment. The distribution of respondents' willingness to pay can be seen in Table 2.

Table 2. Distribution of respondents' willingness to pay

Respondents' willingness to pay	Respondents	
	Total (person)	Frequency
Yes	97	80,83
No	23	19,17
Total	120	100

Twenty-three Respondents were not willing to pay mentioned several reasons, namely the they were satisfied with the current condition of the airport, did not trust the airport management, did not have the financial ability, thought that they had been paid through taxes, and did not feel responsible for protecting the airport environment. Twelve people (52.17%), were unwilling to pay because they did not feel responsible for preserving the airport environment. Only one respondent (4.35%) was unwilling to pay because the respondent is satisfied with the airport's current condition. Two other respondents (8.70%) were unwilling to pay because they did not have the financial capacity. Three people (13.04%) were unwilling to pay because they thought they had been paid through taxes. Five respondents (21.74%) were unwilling to pay because they did not trust the airport management. The distribution of reasons for the respondents' unwillingness to pay can be seen in Table 3.

Table 3. The distribution of reasons for the respondents' unwillingness to pay

The reasons for the respondents' unwillingness to pay	Respondents	
	Total (person)	Frequency
Satisfied with the airport's current condition	1	4,35
Do not trust the management	5	21,74
Do not have the financial capacity	2	8,71
Assume that it has been paid through taxes	3	13,04
Do not feel responsible for preserving the airport environment	12	52,17
Total	23	100

3.3 Estimation of Willingness to Pay Value

This study determines the respondent's willingness to pay (WTP) value for improving airport environmental quality through the implementation of Eco-Airport concept at Soekarno-Hatta Airport. The method used is the contingent valuation method (CVM). The results of implementing work steps in the CVM method are as follows:

1. Build a hypothetical market

   Respondents were given information about the implementation of an eco-airport at Soekarno-Hatta Airport, which can improve environmental sustainability so that respondents have an idea of the hypothetical market situation in question. This method is done so that respondents can determine the amount of money they are willing to pay.

2. Obtain the WTP offer value

   The amount of the respondent's WTP value is obtained using the payment card method. This method offers the respondent a card that consists of various values of the ability to pay where the respondent can choose the maximum value according to his preference. The value of WTP obtained varies from IDR 5,000 to IDR 30,000.

3. Calculating the estimated mean value of the WTP

   The estimated mean value of the respondent's WTP is calculated based on the respondent's WTP data. The results of the calculation of the mean WTP obtained are IDR 13,865.98 per person per flight. This value reflects the respondent's considerable willingness to pay for the implementation of eco-airport at Soekarno-Hatta Airport. The average distribution of respondents' WTP can be seen in Table 4.

Table 4. Total WTP of Respondents

No.	WTP value (IDR/month/flight)	Respondents		Mean WTP (IDR)
		Total (person)	Percentage (%)	
1	5.000	21	21,65	1.082,47
2	10.000	28	28,87	2.866,60
3	15.000	19	19,59	2938,14
4	20.000	15	15,46	3.092,78
5	25.000	9	9,28	2.319,59
6	30.000	5	5,15	1.546,39
Total		97	100	13.865,98

3.4 Estimating the WTP demand curve

The respondent's WTP curve is formed based on the respondent's WTP value on the implementation of Eco-Airport concept at Soekarno-Hatta Airport. This curve is formed using the cumulative number of individuals who have a WTP value. This curve relationship illustrates the level of WTP that is willing to be paid with the number of respondents who are willing to pay at that WTP level. The WTP curve in this study has a negative slope. It is estimated that the higher the WTP value offered, the fewer the number of people willing to pay for improving the airport's environmental sustainability. The respondent's WTP curve can be seen in Figure 1.
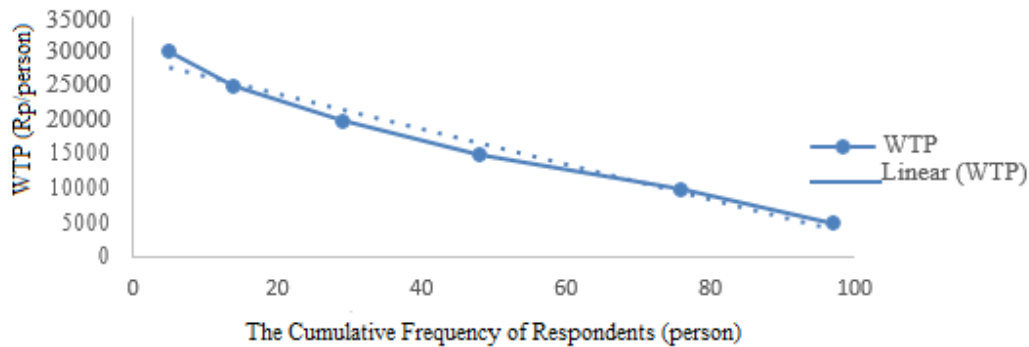
Figure 1. WTP demand curve

3.5 Determining the Total WTP

The total value of WTP can be obtained by multiplying the mean WTP of the respondent with the total passenger population at Soekarno-Hatta Airport in 2012 of 57,772,864. Based on the calculation results, the total WTP value of Soekarno-Hatta Airport passengers is IDR 8.01 x 1011. The total WTP value of the respondents is estimated to be IDR 1,345,000. The total WTP of respondents can be seen in Table 5.

Table 5. Total WTP of respondents

No.	WTP value (IDR/person/flight)	Respondents		Total WTP (IDR)
		Total (person)	Percentage (%)	
1	5.000	21	21,65	105.000
2	10.000	28	28,87	280.000
3	15.000	19	19,59	285.000
4	20.000	15	15,46	300.000
5	25.000	9	9,28	225.000
6	30.000	5	5,15	150.000
	Total	97	100	1.345.000

3.6 Multiple Linear Regression Analysis

The results of multiple linear regression analysis of the WTP model are obtained by entering the dependent variable, namely the number of funds willing to be paid, which is estimated to affect the independent variable. The independent variable consists of the variables of education (X1), occupation (X2), income (X3), convenience (D4), cleanliness (D5), noise (D6), water (clarity) (D7), and air (coolness) (D8).

$$WTP = -0.835 + 0.180X1 + 0.022X2 + 0.155D3 - 0.282D4 + 0.281D5 + 0.210D6 + 0.233D7 + 0.120D8$$

Based on the equations above, the data is analyzed to get the final result of the decision-making. Multiple linear regression using the F-test as a statistical tool for the initial decision-maker. F-test for users to compare the value of Fcount obtained from the statistical analysis results with the value of the distribution of Ftable data. Based on the number of variables and samples used, the value of Ftable (0.05; 53) = 2.16.

The results of the performed F-test (attachment) showed that the value of Fcount = 3.780 > Ftable (0.05; 53) = 2.16 (sig.α = 0.002 < 0.05). It can be deduced that H1 is accepted and H0 is rejected. Therefore, it can be stated that the independent variable has at least one independent variable (x) which has a significant effect on the WTP value obtained.

After obtaining results that have a real effect, it is necessary to carry out advanced tests in the multiple linear regression tool. This advanced test is required to examine which variable has the most influence on the dependent variable, namely WTP. In addition, variables that do not directly affect the dependent variable can also be identified through this advanced test (Ridwan and Sunarto 2009).

An advanced test in multiple linear regression is the t-test. As with the F-test, the t-test requires a decision-making analysis tool in the form of a t-value distribution table to determine the ttable value as the value for decision-making. The value of ttable for the data of this research is ttable (0.1;53) = 1.30; ttable (0.05;53) = 1.68; ttable (0.01;53) = 2.41. The results of the t-test (attachment) showed that the education variable has tcount = 1.733 > ttable (0.1;53) = 1.30, so that H1 is accepted and therefore education has a significant effect on WTP (Setyosari 2012).

Income variable has a value of tcount = 0.165 < ttable (0.1;53) = 1.30, so that H1 is rejected and thus income has no significant effect on WTP. Convenience has a value of tcount = 1.112 < ttable (0.1;53) = 1.30, so that H1 is rejected and thus convenience has no significant effect on WTP. Cleanliness has a value of tcount = 1.531 > ttable (0.1;53) = 1.30, so that H0 is rejected and therefore cleanliness has a significant effect on WTP. Beauty has a value of tcount = 1.696 > ttable (0.05;53) = 1.68, so that H0 is rejected and therefore beauty has a significant effect on WTP. Noise has a value of tcount = 1.977 > ttable (0.05;53) = 1.68, so that H0 is rejected and therefore noise has a significant effect on WTP. Clarity has a value of tcount = 2.014 > ttable (0.05;53) = 1.68, so that H1 is accepted and thus clarity has a significant effect on WTP.

The coolness variable has a value of tcount = 1.531 > ttable (0.1;53) = 1.31, so that H1 is accepted and therefore coolness has a significant effect on WTP. The test results showed that some of the variables do not directly affect but have a significant effect if there is an interaction between each of the existing independent variables. Therefore, it can be stated that the existence of these variables essentially has an important role in the fluctuation of the WTP value but through interactions with other independent variables.

4. Conclusion

Soekarno-Hatta Airport Management's efforts to implement Eco-Airport concept faces numerous challenges such as lack of capacity, lack of human resources, and no real efforts from stakeholders. A vast majority of the respondents, 97 people, were willing to pay for the airport environment improvement, whereas the remaining 23 people were unwilling to pay. The average value of the respondents' willingness to pay (WTP) to improve the airport environment is IDR 13,865.98 per person per flight.

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