

## **IMPROVING THE AIRPORT OPERATION AND ENVIRONMENTAL QUALITY AT SMALL AIRPORTS IN INDONESIA**

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### **ABSTRACT**

The study purpose is to strengthen the policy and supervision of airport operation and improve the airport environmental quality to face Green Airport in the near future. The data used are primary and secondary data. The primary data is based on field survey, interview and questionnaires, while secondary data is based on data collected from various agencies. In general, the conclusions are as follows: i) the study results show that the airport operator has given enough attention to the environmental management. With good environmental management, airport operator will find comfort in operating the airport such that airports could improve the operation and environmental quality control system; ii) the concept of green airport can be a reference to the the airport operator such that the airport activities does not negatively impact to the environment; and iii) the implementation of Green Airport concept will improve the quality of environment; and iv) the application of green airport concept will reduce the costs of environmental management. The recommendations are i) improve strategy and airport development in facing the green airport for the future challenges; and ii) airport development plan should noticed since the beginning of airport planned/developed so as to facilitate for the availability airport land expansion, permits, changes in traffic patterns, aircraft technology and implementation of environmental management aspect.

**Keywords:** *Green Airport, Airport Environmental*

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### **1.0 INTRODUCTION**

Airport management will have an impact on the environment. Impact on the environment at the airport should be sought, so that the quality of the environment, especially the environment at and around the airport has not decreased. To improve the quality of environment requires implementation of airport activities in order to effectively and efficiently, consideration is needed technically, economically and environmentally. These considerations are the current conditions and future forecasts for the airport system which is technically and operationally accountable; initial indications and future of environmental impacts that will occur at and around the airport. Based on the explanation above then the airport operation is not only focused on the movement of passengers and goods, but also the environmental quality control system should be given high priority [1, 2, 18, and 20].

During the airport operational it can cause impact on the environment such that the existence of airport should be environmentally friendly. The airport it self could become environmentally friendly if the airport operator could reduce the environmental impacts caused by airport activities [4-6].

To anticipate the environmental impacts at and around the airport then this study will be assessed on Increased the Airport Operation and Environmental Quality Control System. The benefits of this study is to share information by collecting data from 3 (three) small airports in

Indonesia, namely Sentani Airport, Jayapura, Papua Province; Mutiara Airport, Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Province to improve the air transportation system to face Green Airport in the near future. The study purpose is to strengthen the policy and supervision of airport operation and improve the environmental quality at and around the airport [7].

## **2.0 THEORETICAL BACKGROUND**

Application of green airport concept can be done with a change in mindset, behaviour, knowledge, and improve technology in the field of civil aviation and airport management on the basis of environment.

The basic concept or basic philosophy of environmentally friendly airport is airport operation which could follow a global environmental perspective, operates the airports that can exist in harmony with the global environment, organizing the airport capability of its development to suit the needs of sustainable development. While viewed from the environment perspectives, the airport is expected to prevent and reduce the noise level, air pollution, and other impacts by utilizing the use of land at and around airport, develop regional network, and develop the harmony of airports toward its territory [9].

### **2.1 ANALYSIS OF ENVIRONMENTAL POLLUTION AT AIRPORTS**

Negative environmental impacts as described above shows a fairly large impact on the environment at the airports. This should be expressed and calculated in detail in the assessment for the construction, operation and development of airports.

#### **2.1.1 NOISE AND VIBRATION**

Airport noise and vibration as a serious environmental problem caused of increasing number in air traffic, particularly the flight with a big jet plane; increasing urbanization around airports; and increased public awareness to the environmental problems in general, and the problems of noise in particular [19].

Number of aircraft that operated has a strong influence on the degree of impairment experienced by people living near the airports. Aircraft noise more annoying during the afternoon and evening compared to operating aircraft during the day. Aircraft operations at night causing greater disruption in social, recreational activities and interfere the bedtime [10].

The effect of noise from flight operation to the housing area around airport is already a serious problem. Noise is characterized by the sound level. The sound level is measured by sound level meter, usually calibrated in decibels. Decibel scale ranges from 0 - 140 dB [14, 19].

#### **2.1.2 ATMOSPHER/AIR POLLUTION**

Atmospheric pollution in a region is an inseparable case of global pollution cases. The main issue is often raised in atmospheric pollution is the emission of greenhouse gases. At the global level issues relating to the emissions of gases that are exposed to the atmosphere is airport operations.

Operational airport will have an impact on gas emissions into the atmosphere and the efforts of the airport operator to reduce gas emissions into the atmosphere. Convention on the Kyoto protocol article 1 and 2 require that greenhouse gas emissions of civil aviation and shipping activities which are not regulated in the Montreal Protocol must be controlled by the

International Aviation Organization and the International maritime organization without exception. In Indonesia already ratified the Kyoto protocol in Law No. 17, year of 2004 [7].

Contribution of aircraft engines for global warming can be minimized through control of CO<sub>2</sub> (by reducing the burning of fuel) and emissions of NO<sub>x</sub>, CO<sub>2</sub> and H<sub>2</sub>O, which is the main emissions generated by a turbine engine aircraft, while NO<sub>x</sub>, carbon monoxide, and unburned hydrocarbon emissions is the second. Civil aviation sector up to now contribute about three percent of global carbon dioxide emissions, from a total of ten percent derived from air transport. Analysis of atmospheric pollution is always associated with the analysis use of energy sources due to emissions of gases that are exposed either fuel for aircraft engines, vehicle at the airport as well as for energy power plants [7].

The amount of combustion products are distributed into the atmosphere depends on the type of aircrafts and engines, phase or mode of operation, and how long the engine operated in each phase. Operation phase of aircraft includes take-off or silent at place with the engine life; climb (since raised to a height of 3000 feet); dived (from 3000 feet to touch the ground), and landed [10,11,16].

Air pollution is the most serious environmental impacts caused by airport operations. Air pollutants can be caused by particles, carbon monoxide; photochemical oxidants; nitrogen oxide; sulfur dioxide, and hydrocarbons. Air pollution at airports can be sourced on the aircraft exhaust fumes; distribution of aircraft fuel; aircraft refueling systems; passengers vehicle, employees and visitors; ground service equipment; heating plant; evaporation of fuel spilled during refueling, and emissions from combustion gases in the incinerator [8].

### **2.1.3 WATER POLLUTION**

Water pollution is directly caused by the construction and operation of airports that can be grouped into four (4) categories, ie waste water sanitary/domestic; pollution of storm water/fuel and oil spills on the runway and apron; liquid waste from the fuel charging and cleaning of aircraft; liquid waste from the inspection and selection of major aircraft, and industrial liquid waste [8-9].

Several important techniques to reduce the impact of water pollution at airports, including the use of slope to channel to avoid erosion; keep the oil spill did not enter the drainage system; keep the oil not wasted into the drainage system; avoiding flushing froth/foam fell into the channel; use a mild phosphate detergent to wash aircraft; minimize the amount and type of use of chemicals for insects and plants; grease and oil spill cleaned with a cloth or sprinkled with sand so that the rest of the spills on the floor do not mix with water; domestic waste water (from toilets) is processed in Sewerage Treatment Plant (STP) with anaerobic-aerobic so that the energy and maintenance is relatively cheap. STP effluent reused for watering plants and gardens; and rain water used to supply clean water to the airports [7-9].

### **2.1.4 SOIL POLLUTION**

One of the pollution that resulted in negative impacts on the environment is soil pollution. To minimize these effects is by preventing pollution caused by oil spills, chemicals and other materials used in airports [7-9].

### **2.1.5 WASTE MATERIAL**

Waste material at airport sourced from passengers, visitors, crew, airport staff, cleaning plants, commercial activities, aircraft maintenance and house keeping.

Activity at the airport will increase the generation of solid waste. Waste that is mostly domestic and B3 waste. B3 garbage coming from the aircraft maintenance, such as used oil, aircraft

cleaning fluid, and chemicals waste. if exposed to B3 waste will be harmful to health. Management of B3 waste is burned to the incinerator. Domestic waste can be sorted out for recycling [7].

Waste derived from airport activity will have an impact on the value of airport aesthetics. The amount of waste is usually measured in kg/passenger-day. To minimize the impact of waste at the airport needed a waste management from it sources. If the existing waste sorting from the source and there is responsible for managing the waste and the impact of that arise, then the waste can be minimized even can be profitable [7,9].

In the airport waste hierarchy can be classified as follows, 40% of the waste can be recycled (recyclable); 29% can be composted; 12% can be burned, and 19% other waste [7].

Some types of waste can be broken down starting from the source, ie junk food (from restaurant/cafeteria, aircraft, waiting rooms, offices and other public service); waste paper, newspapers, and magazines (from offices, aircraft, waiting rooms); plastic, plastic bottles (from restaurant/cafeteria, aircraft, waiting rooms, offices and other public service); glass/bottle glass (from aircraft maintenance and building maintenance) [7].

### **2.1.6 ENERGY**

In general, almost all public services in Indonesia is quite wasteful energy consumption. The room is often left in a state of light, air conditioning is on. The habits of using electrical appliances and other electronics that tend to be redundant.

Energy used in the airport environment (such as electricity, air conditioning, etc.) and its surroundings must be saved in the short-term and medium-term use, especially for long-term. It is important to look for other new energy alternatives for the continued sustainable management of airports. It is expected energy consumption can be reduced in airport operation in order to prevent the emission of greenhouse gases.

Dependence on energy sources requires a lot of electrical energy consumption; effort is needed for alternative energy sources to replace. Some airports in Japan utilizing solar energy (solar cell) as an alternative energy supply. It is required a deep study of alternative energy sources which is feasible recommended at airports in Indonesia [7-9].

### **2.1.7 NATURAL ENVIRONMENT**

The existence of airport allowing the emergences and disrupt the hydrological situation around airport. Airport operation needs water, it is impossible in current condition, local water companies can meet the water needs of airport. Thus, the airport must meet its water needs by utilizing the underground water by making the ground water wells itself [7-9].

In addition other hydrological problems are caused by the construction of runways, taxiways, aprons, and other buildings which will reduce the absorption of rainwater into the soil. Changes in land use from open land with vegetation become watertight land will increase the run-off water so that it can cause flooding. Often the airport is located in coastal areas where the soil surface soft and unstable, so the need to relocate the water line and fill in the swampy-marshy area. The construction of airport more or less will affect the ecological balance in the area. If there is a negative influence, needs to be done the proper precautions so that the existence of airport does not aggravate the condition of the local ecology [7-9].

### **2.1.8 COMMUNITY HEALTH**

The existence of airports that is close to residential enabling the emergence of disruption to the community health around airports. Public health problems that arise in the form of health

disorders and diseases, such as loss of hearing, respiratory, cardiovascular, stress and other diseases will influence the community health around airports [7].

### **2.1.9 LAND USE**

Based on the size and characteristics, airports can bring a profound effect on the land use. Design techniques and control over the utilization of available area are zoning regulation, building codes and airport access facilities planned to provide environment that is functional, effective and efficient, and planning and designing the parking lots, access roads, fencing and landscaping, and so on [14,15,17,19,20,22].

### **2.1.10 ASSESSMENT OF AIRPORT ENVIRONMENTAL STANDARDS**

To determine the quality of environment at the airport reference to environmental standards as follows [13]:

1. Law No. 24, year of 1992 on Spatial Planning.
2. Law No. 15, year of 1992 on Aviation.
3. Law No. 23, year of 1997 on Environmental Management.
4. Government Regulation No. 70, year of 2001 on Airport.
5. Decree of Minister of Environment No. 08, year of 2006 about the Guidelines for Preparation of Environmental Impact Assessment
6. Decree of Minister of Transportation No. KM 44, year of 2002 about the Order of National Airport
7. Decree of Minister of Transportation No. KM 47, year of 2002 about Airport Operations Certification
8. Decree of Minister of Transportation No. KM 48, year of 2002 about the Operational of General Airport.
9. Regulation of Minister of Environment No. 11, year of 2006 about the Types of Business Plan and/or activities that Compulsory Equipped with the Environmental Impact Assessment.
10. Decision of Director General of Air Transport No. SKEP/110/VI/2000 about Guidelines of Flight Operations Safety Zone at the Airport and Surrounding (KKOP).
11. Decision of Director General of Air Transport No. SKEP/109/VI/2000 about Guidelines of Airport Noise Zone.
12. Decision of Director General of Air Transport No. SKEP/223/XII/2000 about Guidelines of Airport Working Environmental Area (DLKr)
13. Keputusan Kepala BAPEDAL NO. Decree of Head of BAPEDAL NO. 09, year of 2000 about Guidelines for Preparation of Environmental Impact.
14. International Regulations such as ICAO Annex of Land used and Environmental Control, 1995, the Montreal Protocol on Global Climate Change, Kyoto Protocol article 2 and annex 1 of the Greenhouse Gases which have ratified in the Law No. 17, year of 2004, or other rules of the International Convention.

## **3.0 METHODOLOGY**

### **3.1 DATA COLLECTION AND INFORMATION**

Data collection and information with the key indicators on air transport sector at landside and airside area. The collection of data and information basically refers to the literature study, primary and secondary data.

The primary data obtained through field survey, interview and distribution of list of questionnaire to the parties, including passengers, visitors, people around airports, airport managers, operators, cargo companies, and workers at the airport. Additionally, it will be consulting also with several agencies. The secondary data obtained from several agencies, including the Department of Transportation, Directorate General of Air Transport, Angkasa Pura I and II, the Central Statistics Agency (BPS), the administrator and Airport Operator, as well as other related institutions. Data and information to be collected include airport activity data (statistics of air transport and routes), airport facilities, Airport Environmental Impact Analysis Document, social and economic conditions, as well as environmental conditions (including air pollution, water and noise) at and around the airport.

In accordance with the objectives of the study, it is necessary to know the environmental status of 3 (three) small airports in Indonesia represented by Sentani Airport, Jayapura, Papua Province, Mutiara Airport, Palu, Central Sulawesi Province and Juwata Airport, Tarakan, East Kalimantan Province. As a case study toward the environmental management and monitoring such that the field survey is meant to know the airports existing condition, management and monitoring of environmental at each airport. The expected result from this survey will be known what are the constraints/difficulties faced by airports in reporting the results of their environmental management and monitoring system.

### **3.2 AIRPORT OPERATION IMPACT**

The impact of airport operation on the environment can be estimated based on the amount of impact that may arise. The impact of airport operation can pollute the environment which results in humans, flora, fauna, atmosphere, water resources and impact on social and economic aspects of society.

Identification of airport operation impact for each airport can be different. Technical and ecological constraints limit can only distinguish the impact of each airport. In general, based on identifying of airport environmental impact operation can be tabulated in table 1 below.

**Table 1.** Environmental Impact of Airport Operation (*Source: SML Airport, 2005*), [7]

<b>No</b>	<b>Type of Activity</b>	<b>Impact</b>
1	Operational of Runway, Taxiway and Apron	Changes in air quality and noise regions Increased of run-off water Changes in regional spatial and flight operation safety
2	Passenger and good services	Solid and liquid wastes Changes in public health
3	Operation of airport infrastructures and utilities	Increased on run-off water Solid and liquid wastes B3 waste
4	Development of airport environmental and surrounding	Changes in air quality and the region Changes in flight operation Social, cultural and public health

The impact as mentioned in Table 1 as arise as a result of aircraft movement, passenger movement, and flight supporting activities, and also airport infrastructures and utilities. While the generation of waste (liquid, gaseous, and solid) caused by the activities of airport. The generation of waste derived from aircraft, cargo area, passenger terminal and other airport supporting facilities [21]. The source of waste airport activity can be seen in Figure 1.



**Figure 1.** Sources of Airport Solid Waste Activities (Source: Narita Airport Website), [21]

#### 4.0 STUDY RESULTS

##### 4.1 STUDY LOCATION

Airport location surveyed consists of Sentani Airport, Jayapura, Papua Province; Mutiara Airport Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Province. Detailed location and physical data can be seen in Figure 2 and Table 2.



**Figure 2.** Map of Airport Location (Source: UNDP Website)

**Table 2:** Airport Physical Data (Source: Ministry of Transportation, Directorate General of Air Transportation, Republic of Indonesia), [7]

<i>Name</i>	<i>City</i>	<i>Aerodrome Latitude/Longitude</i>	<i>Elevation</i>	<i>Airport Operator</i>	<i>Runway Number</i>	<i>RWY Dimension Lx W</i>	
Sentani	Jayapura	02 34 19.000S/140 30 41.190E	289 FT/4E	DGAC	12/30	2.180	45
Mutiara	Palu	00 55 00.230S/119 54 37.320E	284 FT/2E	DGAC	15/33	2.067	30
Juwata	Tarakan	03 19 36.720N/117 34 10.280E	20FT/1E	DGAC	06/24	1.650	30

## 4.2 DESCRIPTION OF AIRPORT

Various activities are carried out on the stage of post-construction (operational) airports as follows [7]:

1. Operation of Runway, Taxiway and Apron.  
With the operation of runway then there are air traffic that could potentially have an impact on air quality components such as noise and vibration.
2. Passengers, Goods and Aviation Services  
To serve the passengers, goods and aviation services throughout the infrastructure and utilities, requires a number of employees. These activities will potentially impact on the components of noise, air quality, water quality, wastewater and solid waste (garbage).
3. Airport Facilities Management and Utilities Airport  
Airport infrastructures and utilities will potentially have an impact on surface water quality, noise, solid waste (garbage) and liquid waste.

## 4.3 NEIGHBORHOOD DEVELOPMENTS

Along with the population growth followed by an increase in economic activity such that airport must also be equipped with safety fence facilities in compliance with International Civil Aviation Organization (ICAO) regulation and in accordance with aviation safety demands. In general, the environmental impact of the 3 (three) airports (Sentani Airport, Jayapura, Papua Province; Mutiara Airport Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Provincet) and its surrounding have not significantly influence the aviation operation. But the mobile phone network tower expansion will potentially obstruct the airport operation activities.

## 4.4 REGIONAL SPATIAL CHANGE, LAND USE AND AVIATION OPERATION SAFETY ZONE

The sources of impact occurred at landing and take-off activities as well as passenger services at and around the airport [10]. Environmental Management, control of land use and land availability is in conformity with the Spatial Planning [15,17,19,20,22]. The existence of a permanent obstacle at the extension of approach runway 12 Sentani Airport, Jayapura, Papua Province and hills at Mutiara Airport, Palu, Central Sulawesi Province in the direction of runway 33, while at Juwata Airport, Tarakan, East Kalimantan Province relatively no permanent obstacle that interferes with the safety of flight operations.

#### 4.5 AIRPORT ENVIRONMENTAL STATUS AND ENVIRONMENTAL MANAGEMENT AT SMALL AIRPORTS IN INDONESIA.

Based on the survey results at small airports in Indonesia (Sentani Airport, Jayapura, Papua Province; Mutiara Airport, Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Province) can be known the status of each airport environmental management system, which can be seen in Table 3 and Table 4 below.

**Table 3:** Airport Environmental Issues (Source: Survey Results and Analysis), [7]

No	Environmental Component	Name of Airport		
		Sentani, Jayapura	Mutiara, Palu	Juwata, Tarakan
1	Air Pollution	+	+	+
2	Noise	-	+	+
3	Water Pollution	+	+	+
4	Solid Waste	-	-	+
5	Soil Pollution	+	+	+
6	Energy	-	-	-
7	Natural Environment	-	+	+
8	Social-Culture	-	+	+

**Notice:**

- : There is a problem on the environmental components that were reviewed
- + : No problems on the environmental components that were reviewed

In Table 3 illustrates the problems of the airport environment at these airports show that the environmental problems in general have no felt/serious environmental impact. Environment Managemnst of airport is shown in Table 4.

**Table 4.** Airport Environmental Management (Source: Survey Results and Analysis), [7]

No	Environmental Components	Name of Airport		
		Sentani, Jayapura	Mutiara, Palu	Juwata, Tarakan
1	Air Pollution	-	Landscaping	-
2	Noise and Vibration	-	-	-
3	Water Pollution	Septic tanks Cleaning the drainage channel periodically	Septic tanks Cleaning the drainage channel periodically	Septic tanks
4	Solid Waste	Open dumping Disposal	Open dumping disposal	Discharged into local government-owned landfill
5	Soil Pollution	Septic tanks	Septic tanks	Septic tanks
6	Energy	-	-	-
7	Natural Environment	Landscape/ tree Planting	Landscape/ tree planting	Landscape/ tree planting
8	Social-Culture	Installation of a ban across the board Informal workers from the local community	Installation of a ban across the board Informal workers from the local community	Installation of a ban across the board Informal workers from the local community

The management of airports in Table 4 below shows that the intensity of impact is influenced by the movement of aircraft, passenger and cargo activities, operation of facilities and

utilities. The environmental impact is also influenced by the regional development and airport environmental growth at and around airports. At the 3 (three) small airports in Indonesia (Sentani Airport, Jayapura, Papua Province; Mutiara Airport, Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Province), from the survey results and analysis, it can be said that the movement of aircrafts, passengers and goods is still relatively small such that the impact of airport operations are also relatively small. Although the environmental impact of the operation of these airports were still relatively small but still need attention from the Government and the airport planners regarding to the airport environmental regulations and policies. The planning and development of airports should be able to anticipate the future impacts that will occur by applying the Green Airport Concept as effectively and efficiently, by integrating the transport system and regional development area at and around the airport area.

## **5.0 CONCLUSIONS AND RECOMMENDATIONS**

In conclusions, the study results show that the airport operator has paid enough attention to the airport environmental management. With the environmental management at airports, airport operator will find comfort in operating the airport such that airports could improve the operation and environmental quality control system.

The concept of green airport can be a reference to the the airport operator in Indonesia as general and to the small airports (Sentani Airport, Jayapura, Papua Province; Mutiara Airport, Palu, Central Sulawesi Province; and Juwata Airport, Tarakan, East Kalimantan Province) in particular such that the airport activities does not negatively impact to the environment.

Implementation of environmentally friendly airport concept (Green-Airport) will improve the quality of the environment that will ultimately improve the efficiency of airport management and will increase the benefit for the airport.

The application of green airport concept will reduce the costs of environmental management before the impacts arise. With the concept of 3R, Reduce-Reuse-Recycle, airport operator will receive additional benefit in the management and operation of airports. 3 R concept will minimize the impact and thus saving the cost of managing the airport environment.

Based on the results of study there are some recommendations that can be used as a reference, namely:

1. Improve strategy and airport development in facing the green airport for the future challenges. The strategy including a) availability of infrastructures and facilities that can provide air transportation services in a comfortable and safety, b) reliability of human resources, c) airport usefulness, which is reflected by coordination in (between each section or unit in the implementation of airport activities) and coordination out (between government and private sector that reflects a professional partnership), d) provision of information and implementation plan related to green airport target.
2. Airport development plan should noticed since the beginning about the environmental aspects so as to facilitate for the expansion of airport, permits, changes in traffic patterns, aircraft technology and the implementation of the environmental management aspect.

## **REFERENCES**

- [1] Adisasmita, S.A. (2011), "Transportation Planning and Development", Graha Ilmu, Yogyakarta.
- [2] Adisasmita, S.A. (2011), "Transportation and Regional Planning", Graha Ilmu, Yogyakarta.
- [3] Adisasmita, S.A. (2011), "The Transportation Network: Theory and Analysis", Graha Ilmu, Yogyakarta.

- [4] Adisasmita, S.A. (2009), "Study on Management and Monitoring of Environment at Gorontalo and Tarakan Airports" Team Leader, Consultant Report, Ministry of Transportation, Directorate General of Air Transportation, Republic of Indonesia.
- [5] Adisasmita, S.A. (2007), "The Design of Hasanuddin International Airport based on Eco-Airport System", *Tribun Timur Newspaper*, Indonesia.
- [6] Adisasmita, S.A. (2007), "Hasanuddin Airport Management viewed from Environmental Perspective", *Environmental Management Agency Article*, Makassar, Indonesia.
- [7] Adisasmita, S.A. (2007), "AJAT-3 : ASEAN-Japan Airport Study Project", Team Leader, Consultant Report., PT. Konsultasi Pembangunan Atmadasa. Department of Transport, Directorate General of Air Transportation, Republic of Indonesia.
- [8] Ashford, N., & Wright, P.H. (1992), "Airport Engineering" (3rd ed). New York: A Wiley-Interscience Publication.
- [9] Aviation Bureau, Ministry of Land, Infrastructure and Transportation, Japan (2003), "Eco-Airport Guideline".
- [10] Boeing. (2008), "Airport Compatibility".
- [11] David, C. (1995), "The Impact of New Aircraft Development on the Design and Construction of Civil Airports", *Proc. Instn. Civ. Engrs. Transp.*, Vol 111, pages: 59-69.
- [12] De Neufville, R. (1995), "Designing Airport Passenger Buildings for the 21<sup>st</sup> Century", *Proceeding of the Institution of Civil Engineers, Transport*, Vol 111(2), pages: 97-101.
- [13] Directorate General of Air Transport, Transport Department (2005), "Blue Print of Air Transport 2005-2024", Department of transport, Republic of Indonesia.
- [14] Etter, R. (2008), "Management of Land Acquired Under the noise Compatibility Program", *Federal Aviation Administration*.
- [15] Federal Interagency Committee On Noise (FICON). (1992), "Land Use Compatibility", *Federal Agency Review of Selected Airport Noise Analysis Issues*, pages 2.6-2.7.
- [16] Ghobrial, A., and Kanafani, A. (1995), "Future of Airline Hubbed Networks: Some Policy Implications", *Journal of Transportation Engineering*, Vol 121(2).
- [17] Greater Amman Municipality. (2007), "Airport Corridor Concept Plan".
- [18] Kasarda, J.D. (2005), "New urban Development at and around Airports", *The University of North Carolina*.
- [19] Kunkel, B. (2001), "Airports and Compatible Land Uses", *Mead & Hunt*.
- [20] Miami-Dade Aviation Department. (1997), "Strategic Airport Master Planning Study".
- [21] Narita Airport Website (<http://www.narita-airport.jp>).
- [22] Planning and Development Services Department, San Antonio (2009), "Stinson Airport Vicinity Land Use Plan".
- [23] Raguraman, K. (2001), "Key Concepts and Issues in Airport Capacity Planning and Management", *Journal of Aviation Management*, pages: 1-131.