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THE ENVIRONMENTAL MANAGEMENT OF AIRPORT WATER SUPPLY RESILIENCE

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ABSTRACT

In developing airports, one of the operational support facilities that must be fulfilled in order to support its function is provision of clean water facilities. Clean water facilities provided must be able to fulfill the activities of entire airport area. Reliability of clean water facilities in airport includes availability of clean water sources in accordance with airport water demand projection to ultimate condition, having an integrated clean water network, and having a back-up supply that will be used for airport operations or inside emergency state. In conducting a study of resilience of clean water supply to airports, the approach used is a quantitative approach. Descriptive analysis will be carried out to describe clean water supply system including the source and distribution of clean water in airport area. Furthermore, benchmarking will be used as an approach in determining water requirements and water resilience in airport area. The study included selecting a back-up system for clean water supply to maintain continuity of clean water supply. Considerations in determining water resources are based on quantity, quality, and continuity. Whereas, when viewed from considerations related to airport conditions, including location readiness, shelter capacity, readiness in cost aspects, and airport development plans and emergency history.

KEYWORDS: Water Resources Management, Water Supply, Eco Airport.

1. INTRODUCTION

The airport, which is one of the facilities currently used by using airplanes, can save time and energy even though it will be more expensive for transportation costs. Therefore, it is not surprising when hosted airports can serve their visitors without knowing holidays with the principle of service 24,7/365 with the increasing population and the development of economic activity, it will also have an impact on the increasing activities that take place at the airport. Seeing the high activity that occurs, it requires serious attention to meeting visitor satisfaction, including satisfaction with clean water supply facilities. The facilities at the airport at this time certainly require more care and study to ensure that the management of the current clean water supply needs to be improved so that visitors' comfort is guaranteed. Reliability of clean water facilities in the airport includes the availability of clean water sources in accordance with the airport water demand projection to the ultimate condition, having an integrated clean water network, and having a back-up supply that will be used for airport operations or inside emergency state. It is expected that the reliability leads to a resilience of water supply in the airport.

2. METHODS

Data collection is carried out through library studies, compilation of primary data and secondary or supporting data, review and analysis of existing scope components, survey and measurement or field observations representative, followed by simulation models to obtain quality data. Data obtained is then processed, analyzed and synthesized to obtain optimum conditions for managing the resilience of clean water supply at the airport and in synergy with conditions in the field.

In this study, the calculation of the potential for surface water sources, namely rivers and lakes, sources of rainwater, and water sources from recycling used water. To find out the river water potential, a direct check is done to see the river profile (discharge and cross section). Unlike the river that uses river discharge to see its water potential, the potential of the lake is seen in its ability to store water or which can be referred to as the volume of storage. For the analysis of rainwater as a potential for raw water, it is done by calculating effective

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rain. Effective rain is calculated by looking at the rain and land use of the area to be checked. The evaluation of groundwater potential is carried out by analyzing secondary data, namely geohydrological maps. This is considering the limitations of time, tools and human resources. For the potential of used water, the amount of used water in the airport refers to the amount of clean water used in the airport and the completeness of existing sanitation infrastructure, usually around 60-80% of the consumption of clean water. Furthermore, the amount of used water generation is projected to the stage of developing the ultimate airport in proportion to the increase in airport clean water requirements. Thus, the potential for used water in the future will be known. The development of used water reclaimed technology can be one solution in dealing with water scarcity that might be faced by the airports at this time or in the future.

In the benchmarking process, data will be selected based on several factors driving the amount of clean water consumption at the airport. Therefore, the criteria to be used are as follows:

1. The maximum availability of the longest data is 2010
2. Available data on water consumption, number of passengers, and number of flights.
3. The airport was chosen with the criteria for the number of passengers and the number of flights approaching.

The collected data will then be processed and analyzed as follows:

1. Sorted to find the scale of the smallest to the largest water usage.
2. Determination of the mean (average) of clean water use in various airports in the world.
3. Determination of median data to be used in benchmarking calculations.
4. Determination of airport benchmarking ratings of the airport samples obtained
5. Then the output will be obtained in the form of ranks from each airport.
6. Determination of performance categories from existing ranking scores.
7. Furthermore, determine the range of water consumption values for each performance category.

From the performance category, data can be analyzed for estimated water requirements at each stage of airport construction. Then, it can also be determined the recommended number of water needs according to the desired level of performance.

Water balance is the balance of input and output of water in an area for a certain period according to rainfall data, temperature, duration of solar radiation obtained on the period. Water balance can show water availability in a region per month or per year which can later be used to see whether the airport can meet the water needs of its passengers. In this study activity two water balance plans will be prepared, namely the rainwater balance (surface water) and the balance of water supply and demand in the airport area.

In conducting future projections, the level of consumption of clean water refers to the Regulation of the Director General of Air Transportation Number: SKEP/77/VI/2005 about Technical Requirements for Operation of Airport Engineering Facilities, the need for clean water for passengers at the airport is 20 liters/passenger. Water requirements for airport employees are 100 liters/employee/day. The calculation of the number of employees is 1/200 times the number of annual passengers if the data on the number of employees is unknown. Water requirements for hangar are 500-1.000 liters/airplane hangar/day and with a leakage rate of 20%. Water requirements for official homes are 150 liters/day/person with 1 house containing 6 people. Calculation of clean water requirements can also be calculated based on the acquisition of data on the total water consumed by the entire airport based on the existing raw water supply. Next, the calculation is done to get the amount of water usage for each passenger. From the data on total airport water usage, calculated the amount of water usage in several activity units within the airport, among others, are Tenant, toilets, non-commercial offices, parks, and reserves of hydrant supplies. From the water usage data per activity or facility then the percentage of water usage can be calculated in each unit of activity or facility. Meanwhile for non-passenger water needs or airport facilities, projections will be made referring to the growth trend of each activity in each facility in the Airport area by using reference data for existing clean water consumption for each tenant or facility.

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3. RESULTS AND DISCUSSION

In this study, the standard analysis of water requirements in the airport area will be carried out by looking at the records of existing water consumption and benchmarking against other airports. The amount of water consumed will certainly influenced by the number of passengers served by the airport. Refers to the Regulation of the Director General of Air Transportation Number: SKEP/77/VI/2005, the standard for water requirements in the airport area is set for passengers, employees and hangars in the airport area with the amount of 20 liter/day for passengers and 100 liter/day for employees. While the standard water requirements for hangars, set between 500-1.000 liter/aircraft entering the hangar/day.

Table 1: Average Water Consumption at Various Airports in the World

No.	Airport	Average Number of Passengers (Million/Year)	Average Water Consumption (Liters/Passenger)
1	Edmonton International Airport	3.263.053	41,301
2	Nashville International Airport	3.985.620	40,512
3	Kota Kinabalu airport	4.383.622	40,638
4	Hat Yai	4.550.000	97,538
5	Cape Town International Airport	4.566.778	55,454
6	Chiang mai Airport	5.516.047	25,516
7	Bandaranaike	6.310.000	10,179
8	King Shaka	7.270.385	40,952
9	Penang Airport	7.780.724	41,330
10	Kuching International Airport	8.413.894	53,659
Average			44,708

From these data it is known that the average water consumption in various countries in the world is 44,708 liters/passenger. Then, the benchmark range can show that of the 10 samples used, three samples are above the average water consumption rate while the other 7 are below the average water consumption rate. Then from the existing sample data, a benchmarking rating will be recommended. In determining the benchmarking rating, it is necessary to determine the median of the data. The table below illustrates the ranking of values obtained from each data sample.

Table 2: Obtaining Scores for Each Sample of Data

No.	Airport	Average Water Consumption (l/person/day)	Rating
1	Bandaranaike	10,179	7,134
2	Chiang Rai Airport	25,516	5,829
3	Nashville International Airport	40,512	4,552
4	Kota Kinabalu airport	40,638	4,542
5	King Shaka	40,952	4,515
6	Edmonton International Airport	41,301	4,485
7	Penang Airport	41,330	4,483
8	Kuching International Airport	53,659	3,433
9	Cape Town International Airport	55,454	3,281

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IMPACT FACTOR- 3.775

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No.	Airport	Average Water Consumption (l/person/day)	Rating
10	Hat Yai	97,538	-0,301
Average		44,708	4,195
Median		**41,126**	**4,500**

Furthermore, from the assessment score, benchmarking recommendations can be made as follows:

Table 3: Water Consumption Value at Benchmarking Range

Performance Categories (Performance)	Score	Water Consumption Value (liters/passenger)
Bad	< 3,00	> 63,98
Not good	3,00 – 3,50	52,9 – 58,8
Baseline (**average**)	3,51 – 4,00	47,0 – 52,8
Good	4,01 – 4,50	41,1 – 46,9
Benchmark	4,51 – 5,00	35,3 – 41,0
Best Practice	> 5,00	< 35,3

Airport water consumption standards issued by The Office of Drinking Water, Washington State Department of Health, the standard water usage at the airport is 3,0-5,0 gpd, equivalent to 11,35-18,93 l/passenger/day. When compared with the recommended benchmarking range, the standard refers to the best practice score. As for the national standard of airport water requirements listed in the Regulation of the Director General of Air Transportation Number: SKEP/77/VI/2005, the standard of airport clean water requirements is set at 20 l/passenger/day. When compared to the recommended benchmarking range, the standard water requirements for passengers in the Regulation of the Director General of Air Transportation Number: SKEP/77/VI/2005 also refer to the best practice score. Thus, in determining the standard of water requirements for airports it is recommended to review this reference value within a certain period with the following considerations:

- Technological development so that the use of water in sanitary equipment (fixture units) decreases with the presence of innovations from producers.
- Lifestyle developments and business trends that are environmentally friendly so that efforts or water saving programs need to be developed.

Water balance is one of the important instruments, by knowing the condition of the water balance in a development area, then the water balance can later be used to ensure there are no obstacles in the growth of development and existing activities, especially when it has to face the threat of water scarcity. The main problems that often occur at airports are raw water supply and limited water treatment capacity. Thus, it is necessary to develop alternative sources of clean water to support the development of the airport to the ultimate stage. The considerations in determining the water resources to be used are based on quantity, quality, and continuity. The projected water demand at each development stage follows the maximum daily water requirements (referring to the water treatment plant (WTP) planning standards). The water production capacity of WTP is assumed not to increase in accordance with the current capacity of WTP at 6 liters/s. The water balance shows that the clean water supply will experience a deficit upon entering stage 2 development.

Whereas when viewed from considerations related to airport conditions, including location readiness, shelter capacity, readiness in cost aspects, airport development plans and emergency history. Additional alternatives for raw water supply to meet water needs at the airport, among others, the nearest water body or river in the airport area, utilization of used water, rainwater harvesting, and additional supply from water supply companies.

The back-up supply plan is prepared based on two things, namely the source of water supply for backing up and the capacity or amount of water prepared for backing up the supply. To maintain the resilience of water supply in the airport area in the development of the next stage, then several alternative water resources that can be utilized are as follows:

ISSN: 2394-7659
IMPACT FACTOR- 3.775

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1) Rainwater harvesting.
2) Harvesting of rainwater is very potential to be used on the roofs of buildings at the airport. Rainwater is collected and can then be channeled to the pond (retention pond) which can then be processed in WTP into clean water.
3) Utilization of PDAM's water (a local water company)
4) Recycling used water (water reclaimed). The use of used water as an alternative source of raw water requires further studies related to perceptual factors, aesthetics and the ability of existing PAPs to treat water from sewage treatment plant (STP) effluents.

As a concept for planning a back-up plan, several considerations or descriptions can be used as follows, Airports are essential facilities so conditions without clean water supply should not occur. But with the consideration that any repair of damage to one component of the clean water supply system requires time. Referring to the planning of water supply for emergency issued by the Environmental Protection Agency (EPA) USA, it is stipulated that the water supply is available for three days. Thus, three days will be used to determine the availability of clean water in backing up supplies. The proportion of water requirements for passengers is found to be around 76% of total water needs. With this consideration, the amount of water supply to be prepared is set at 80% with an allocation of 100% of supply for passenger clean water needs and 4% for supply of clean water needs of employees. The amount of water allocated prepared to back up will affect the storage capacity needed.

The amount that is too large will certainly affect the investment costs to build a new reservoir.

4. CONCLUSION

In developing airports, provision of clean water facilities must be fulfilled. The reliability of clean water facilities in the airport includes the availability of clean water sources in accordance with the airport water demand projection to the ultimate condition, having an integrated clean water network, and having a back-up supply that will be used for airport operations or inside emergency state. This reliability could lead to a resilience of water supply in the airport. For back-up plan supply, the amount of water allocated will affect the storage capacity needed. Thus, if the amount is too large, it will certainly affect the investment costs to build a new reservoir. Whereas, considerations in determining water resources are not only based on quantity, quality, continuity, but also viewed from considerations related to airport conditions, such as location readiness, shelter capacity, readiness in cost aspects, and airport development plans and emergency history.

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