



# Understanding Airport Leakage at Multi Airport in West Java through Accessibility Characteristics to the Airport

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**Abstract.** Airport development must pay attention to the catchment area of the surrounding airport so that there is no overlap, which leads to airport leakage problems. Airport leakage is a phenomenon where passengers avoid local airports in their area of residence and choose airports outside their territory. The scope of study in this research is West Java Multi-airport, which consists of Kertajati Airport and Husein Sastranegara Airport, as well as Soekarno-Hatta Airport and Halim Perdanakusuma Airport as airports around West Java. The purpose of this study was to determine whether the phenomenon of airport leakage occurred at the Multi-airport of West Java Province. The study findings concluded that the addition of Kertajati Airport in West Java Province improved air connectivity in terms of flight routes but was not accompanied by an increase in the number of passengers. This phenomenon can be attributed to airport leakage, whereby passengers in West Java tend to favor Soekarno-Hatta Airport and Halim Perdana Kusuma Airport. These airports provide more flight options, offering greater time flexibility and enhanced accessibility.

**Keywords:** Airport Leakage, Accessibility, Passengers

## INTRODUCTION

The movement of people and goods from one place to another facilitates mobilization. Sufficient transportation infrastructure can support the movement of people and goods in an area. Transportation serves as a measure of spatial interaction between regions. It plays a significant role in supporting the regional development process [1]. The development of transportation allows for spatial interactions between regions, extending beyond areas that are directly adjacent to administrative zones. It allows interactions to occur with areas that are not spatially located. Air transportation is one of the modes that can support the interaction of these areas because this mode can connect areas that are not spatially close together by streamlining the user's time.

Air transportation can significantly encourage regional development. Because, air transportation has a positive correlation with regional economic development [2]. Airports, as air transportation hubs, can increase the number of outside visitors to cities, leading to an increase in the regional economy and direct development of local potential. Therefore, airports can trigger regional productivity due to positive externalities from the economic agglomerations that are developing around these locations. Airport construction must consider the estimate of its own catchment area and that of other airports. Overlapping catchment areas can occur at airports between regions. This has the potential to cause airport leakage problems.

Airport leakage is a phenomenon where people who use air transportation choose to drive longer distances to access other than those in their local area, referred to as airport/passenger traffic leaks [3]. This condition occurs when passengers residing in proximity to multiple airports choose airports outside their immediate region as their departure points [4]. Airport traffic leaks is often observed when airports are in close proximity to each other, motivating passengers to drive longer distances, sometimes significant, to initiate their journeys from more distant airports due to factors such as lower ticket prices or improved connectivity [5], [6].

Airport leakage is closely related to the passenger's decision when choosing their departure airports, a phenomenon known as passenger airport choice. There are several main factors that influence passenger decisions, including accessibility to the airport and the frequency of flights related to the route offered by an airport [7]. Airport access time plays the most important role in airport choice, and the effect is more pronounced for business than for other types of travelers [8]. Furthermore, airport leakage also occurs due to the frequency of flights or direct destination routes of an airport more than the local airports in the region. Flight time and frequency are two factors that are often found together. Flexibility in choosing time will determine the choice of the passenger airport, especially for business passengers with direct flights from the airport [9]. Overlapping catchment areas can occur at airports between regions leading to airport leakage problems. Airport Leakage can occur at airports located less than 240 km from other airports where passengers are motivated by better benefits such as better connectivity. The connection sees this connectivity of access to the highway or toll road network, train access and a travel time of 3-4 hours overland travel [7], [8], [10].

In West Java Province, Husein Sastranegara Airport is the 5 best airports that have the highest number of foreign tourist visits in Indonesia [11]. In addition, Husein Sastranegara Airport has increased by 6 percent for the number of passengers, 40 percent for cargo, and 11 percent for aircraft traffic [12]. However, the capacity of Husein Sastranegara Airport is estimated to be unable to accommodate the demand for air transportation in West Java in the future due to the increase that occurs every year. In addition, Husein Sastranegara Airport has constraints in the form of limitations in airport development, for example an unfavorable runway extension to increase the Maximum Take-Off Weight of the aircraft so that the aircraft can carry more loads. This is due to the geographical location of Husein Sastranegara Airport where there is Mount Tangkuban Perahu which becomes an obstacle during taking off and landing. This has led West Java Province to build West Java Kertajati International Airport to support increased visitor numbers and economic development.

The construction of Kertajati West Java International Airport is expected to become the main airport of West Java Province, which can expand the coverage of the airport catchment area. West Java Kertajati International Airport began operating in June 2018, but it has not yet been effective. This is because the new commercial flights opened in December with routes to Balikpapan and Bandar Lampung. To maximize the function of West Java Kertajati International Airport and to accommodate the increase in passengers who could not be accommodated at Husein Sastranegara Airport, several flight routes were transferred from Husein Airport to Kertajati Airport in July 2019. However, the flight route diversion received negative responses from various parties because the number of tourist arrivals decreased, especially domestic tourists. This is evidenced by the decline in hotel occupancy by 20 percent.

**TABLE 1.** Nearest Airport Location at Multi Airport West Java

Airports	Distance from Multi-Airport, West Java Province (Kilometers)		Status
	BDO	KJT	
	Soekarno-Hatta Airport (CGK)	176,7	
Halim Perdanakusuma Airport (HLP)	144,7	176	International/round-trip
Wiriadinata Tasikmalaya Airport (TSY)	199	114	Domestic/round-trip
Cijulang Nusawiru Airport (CJN)	206	199	Domestic/round-trip

Accelerating the development of accessibility to and from West Java Kertajati International Airport is a solution to improving the airport's performance. So, the factors that influence the size of the airport catchment area are effective intermodal connections and accessibility to airports such as roads, expressways/toll roads, and railways to the airport [13]. In the context of accessibility to the airport, ease of accessibility is important to meet flights on time and avoid financial losses, so the travel time to the airport must be reliable. Airport accessibility is an important consideration for air passengers in choosing an airport [14]. Travelers often choose an airport because it is close in terms of access

to travel time and with low access costs [14], [15]. Thus, increasing airport accessibility can be one of the possible strategic actions for the airport to improve its market position. Accessibility greatly affects the increase in airport profits, where passenger traffic can be increased by 2% with a 1% increase in airport accessibility [16]. Suppose it is related to the airport leakage phenomenon. In that case, this phenomenon occurs between airports located less than 240 kilometers from other airports and are connected to road or toll road network access with 3-4 hours road trip to the replacement airport [4], [10]. Accessibility can affect the size of the airport catchment area where the effective intermodal connection factors to the airport, namely trains, buses, toll roads, and road access, can expand the airport catchment area [13]. It is feared that the diversion of logging routes will cause consumers or passengers to move to Soekarno-Hatta or Halim Perdana Kusuma Airport because the location of Kertajati West Java International Airport is 177 kilometers from Husein Sastranegara Airport. West Java Kertajati International Airport, located 175 km from Bandung City Center, is connected to the Cikopo-Palimanan toll road with a travel time of 2,5 to 3 hours. In addition, there is no alternative transportation through other modes of transportation, such as trains. The service route offered by Kertajati Airport is the same route offered by the surrounding airports, namely Soekarno-Hatta Airport and Halim Perdana Kusuma Airport. Meanwhile, the distance between Bandung City Center and Soekarno-Hatta Airport, which reaches 173 kilometers, and Halim Perdana Kusuma Airport, which reaches 141 kilometers, allows for overlapping airport catchment areas.



**FIGURE 1.** Location of West Java Multi-Airport

This overlap can lead to airport leakage problems in which passengers tend to choose a departure airport outside their area with the characteristics of a departure airport that is larger than the closest airport in their area. This phenomenon can occur due to airports being near each other, where passengers can be motivated by better connectivity in terms of road accessibility and the variety of modes offered or more flight frequency due to the airport being a larger hub [5], [8]. In addition to connectivity, passengers have different priorities depending on the purpose of their travel, so there are different assessments for choosing the departure airport. The results of his research show that the purpose of passengers traveling affects the choice of airport to use [17]. Passengers traveling for business tend to be time-sensitive and do not prioritize service prices, so they will choose time-efficient flights and easy to access [18]. Frequent and flexible services allow passengers to change flights to a more comfortable time quickly; it can be seen from the frequency of services and the number of direct routes available coupled with good accessibility in terms of travel time, distance to the city center, these factors that can affect the airport have higher business connectivity [19].

The phenomenon of airport leakage can harm an area due to its impact on the economy of a region. Airport leakage causes a reduction in passengers at the local airport. Thus, an airport leakage phenomenon can reduce regional revenue that should be received due to the reduced number of passengers passing through the airport. Therefore, sustainable Airport leakage can cause inefficiency in infrastructure provision. Efficiency can be defined as the ratio between output and input. The input referred to the investment that has been spent on the construction of a new airport in West Java Province (West Java Kertajati International Airport). Based on the conditions of these problems, the purpose of this study was to determine whether the phenomenon of airport leakage occurred at the Multi-airport of West Java Province. This research is expected to be useful for the development of regional infrastructure science, especially

airport transportation, and as a consideration in making decisions or developing policies in the management of local airports to be able to compete with surrounding airports, especially aspects of the catchment area for passengers, so that the management and airlines are not harmed.

## RESEARCH METHODOLOGY

This research uses quantitative methods. The use of quantitative methods is carried out to compare the accessibility to the departure airport in quantity and does not see the quality of the access. This study also uses spatial analysis methods and descriptive analysis methods with a quantitative approach. The spatial analysis carried out is network analysis. Network analysis analyzes network-based ArcGIS applications, including the routing, direction of travel, nearby facilities, and service areas. The assumption used in this study is that it needs to consider the road capacity and the level of congestion. The following are the speed assumptions used in the study.

**TABLE 2.** Maximum Speed Assumption for Each Road Classification

<b>Road Classification</b>	<b>Maximum Speed</b>
Arterial Road	80 Km/Hour
Collector Road	80 Km/Hour
Another Road	50 Km/Hour
Flyover	50 Km/Hour
Local Road	30 Km/Hour
Toll Road	80 Km/Hour

Furthermore, the descriptive analysis method through a quantitative approach is carried out by measuring the indicators of the research variables to obtain a description of these variables. The indicators of this research are indicators for selecting a departure airport based on the results of the literature review. The departure airport selection factor will be used as an indicator for measuring the presence or absence of the airport leakage phenomenon at Multi-Airport West Java. Based on the results of the literature review, the following are indicators for selecting a departure airport.

**TABLE 3.** Indicators of Airport Leakage

<b>Factors Affecting the Selection of Departure Airports</b>	<b>Previous Research</b>						
	<b>Fuellhart (2007)</b>	<b>Basar &amp; Bhat (2004)</b>	<b>Hess &amp; Polak (2006)</b>	<b>E. Pels et al. (2003)</b>	<b>Harvey (1986)</b>	<b>Ishii et al. (2003)</b>	<b>Suzuki et al. (2003)</b>
Time to Departure Airport	v	v	v	v	v	v	v
Cost to The Departure Airport	v	-	v	v	-	v	v
Flight Frequency	-	v	v	v	v	-	v
Flight Ticket Prices	v						
Flight Schedule	-	-	v	-	-	-	-
Airline and Aircraft Type							
Direct Flight Availability	-	-	v	-	-	-	v
Airport Service Quality	v	-	-	-	-	-	-
Reliability	-	-	v	-	-	v	v

Based on the results of previous research, the main indicators that will determine the occurrence of airport leakage are the frequency of flights provided by an airport, the time to the departure airport, and the cost to the departure airport. The times and costs to the departure airport will be classified into accessibility to the airport.

## RESULT AND DISCUSSION

Based on the results of the spatial analysis that has been carried out, Kertajati Airport can only cover 78% of the total area of West Java Province. Soekarno-Hatta Airport can cover 65% of the total area of West Java Province, and Halim Airport can cover 70% of the total area of West Java Province. This allows for overlapping catchment areas between the three airports. This impacts passengers who can choose another airport as their departure airport. This is because the main factors that influence the choice of the departure airport include the frequency of direct flights offered by the airport and accessibility to the airport [7].

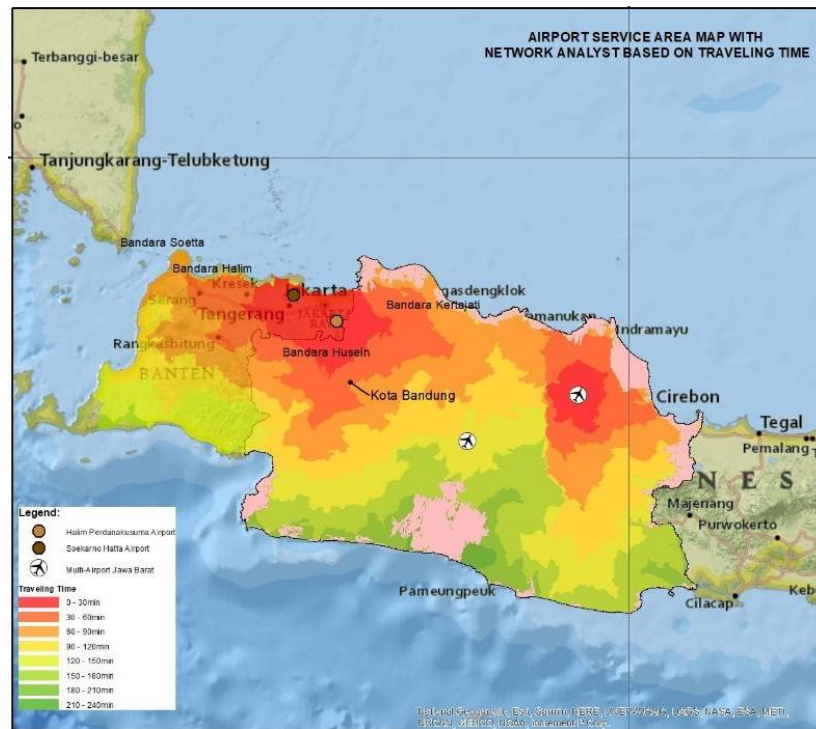


FIGURE 2. Coverage of Airport Service Determined by Travel Time

Airport leakage or air traffic leakage can occur when their catchment areas overlap or when they effectively work as alternative transfer hubs [20]. In addition, the frequency of direct flights at an airport greater than the local airport causes the flexibility to choose a higher departure time [9]. This factor is the main factor influencing the passenger's decision to choose the departure airport. They are seen in **Figure 2**. It is known that there are sixteen direct flights served by Multi-airport West Java, Soekarno-Hatta Airport, and Halim Perdana Kusuma Airport, and seven flights that are only served by Multi-airport West Java and Soekarno-Hatta Airport.

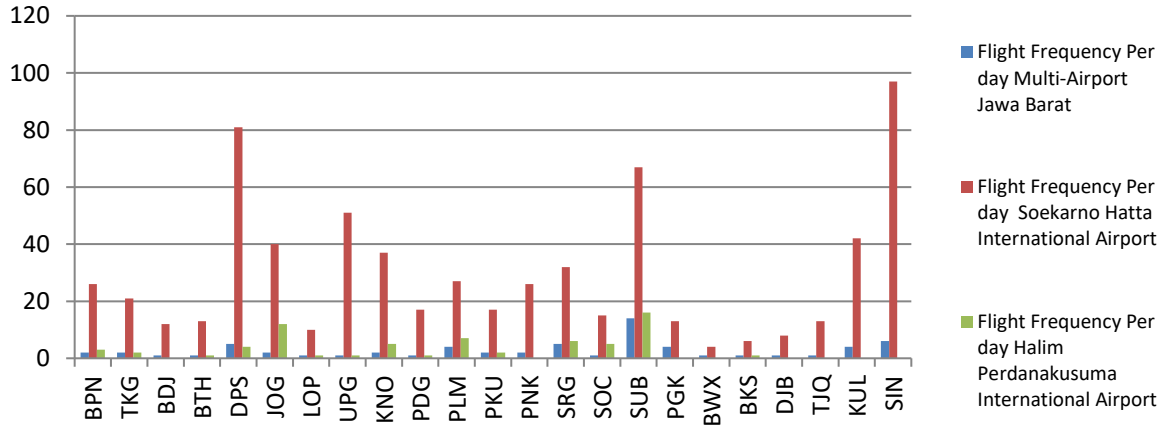


FIGURE 3. Number of Daily Flight Frequencies of The Same Route in 2019

Based on **Figure 3**, Soekarno-Hatta Airport has the highest flight route frequency compared to the other two airports. As for Halim Airport, there are routes that Halim Airport does not serve, such as routes to Banjarmasin, Pontianak, Pangkalpinang, Banyuwangi, Jambi, Tanjung Pandan, Kuala Lumpur and Singapore. This is because the position of Halim Airport is indeed a supporter of Soekarno-Hatta Airport, so not all routes are opened at Halim Airport, such as Husein Airport, which supports Kertajati Airport. However, Halim Airport has more daily flight frequencies than West Java Multi-airport for routes to Balikpapan, Jogjakarta, Medan, Palembang, Semarang, Surakarta, and Surabaya. This has triggered the people of West Java to choose airports outside their territory with their main competitors. The airport is Soekarno-Hatta Airport because it has more direct flight frequencies than West Java Multi-Airport.

TABLE 4. Number of West Java Multi-airport direct routes 2015-2019

Year	Total	Gain	Lost
2015	18	0	0
2016	17	0	-1
2017	15	0	-2
2018	20	5	0
2019	23	4	-1

After the construction of Kertajati Airport in West Java Province, there were the opening of four direct flight routes at the West Java Multi-airport to Banyuwangi, Bengkulu, Jambi, and Tanjung Pandan. Based on **Table 4**, it is known that 2019 has the largest number of routes compared to the last five years, which served 23 direct flight routes. However, after analyzing the load factor of each new route opened, load factor reached less than 50% on the new route, which shows the level of passenger occupancy (**Table 5**). This indicates that the flight routes that were opened were not of interest to the public, so several flights were canceled by the airlines to minimize departures due to the insufficient number of passengers. The passenger load factor measures the airline's efficiency to determine the profit value and margin between revenue and expenses (revenue-cost). This has an impact on efforts to increase the number of passengers by adding direct flights that could be more successful because the routes offered are not in demand by the people of West Java Province.

TABLE 5. Load Factor on the New Routes of West Java Multi-Airport

Route	Load Factor
Tanjung Pandan	13%
Bengkulu	29%
Jambi	32%
Route	Load Factor

Another major factor that influences passengers to choose the departure airport is accessibility to the airport. When viewed from travel time, passengers sacrifice travel time, which is relatively the same when viewed from Bandung City to Soekarno Hatta Airport, Halim Perdana Kusuma Airport, or West Java Multi-Airport. The distance from Bandung City to Kertajati Airport is 178 km via toll roads, which is twice the distance due to the unavailability of road access. Meanwhile, the distance between Bandung City and Soekarno-Hatta Airport is 175 Km, and Halim Airport is 143 Km. This allows the overlapping of the catchment area between the three airports as a result of passengers being able to choose another airport to become the departure airport because they sacrifice relatively the same travel time. The access time to the airport is a significant factor influencing the choice of airport to use [21].

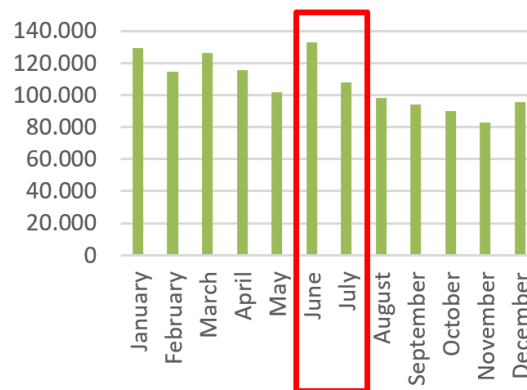
Furthermore, the comparison of accessibility will be reviewed through the components of the types of modes offered, the capacity of each mode, the frequency of mode trips per day, and the average cost that must be paid to the departure airport. The following is a matrix for comparing accessibility between the three airports.

**TABLE 6.** Comparison of Accessibility

Component	Kertajati Airport	Soekarno Hatta Airport	Halim Perdanakusuma Airport
Type of Transportation	Travel & Bus	Travel, Bus, dan Train - Bus, Train-Airport Train	Travel
Number of Capacity	114	148	85
Frequency of Departure per day	38	128	46
Average Cost	Rp 95.556	Rp 132.796	Rp 184.286

Based on the easy access component viewed from Bandung City to Kertajati Airport and the surrounding airports, it can be seen that Kertajati Airport is superior in terms of travel costs. Travel costs can attract passengers, especially passengers with tourist destinations who are more concerned with fares. Cost-effectiveness will be an important factor in making decisions about travel activities. This shows that the purpose of the passenger traveling affects the choice of airport to use [17].

Business passengers are more sensitive to the time and flexibility of travel hours than travel costs [18]. In addition, convenience in terms of the airport's location to the downtown and the frequency of service is taken into account by business passengers to choose the departure airport [22]. Meanwhile, passengers with tourist destinations are more concerned about tariffs. So, cost-effectiveness will be an important factor in traveling. This makes passengers from Bandung to travel for tourism prefer to use the Kertajati departure airport. However, when viewed from other factors, Kertajati Airport is still inferior to the surrounding airports (Soekarno-Hatta Airport and Halim Perdanakusuma Airport). The main competitor of Kertajati Airport is Soekarno-Hatta Airport, the largest airport in Indonesia. Meanwhile, Halim Perdanakusuma Airport is a supporting airport for Soekarno-Hatta Airport, which has an equal position with Husein Sastranegara Airport, which supports Kertajati Airport. Passengers interested in using the Soekarno-Hatta departure airport are passengers for business purposes.



**FIGURE 4.** Number of Passengers Departing from Multi-Airport Jawa Barat In 2019

Intermodal transportation can be defined as a system that connects different modes of transportation, such as land, sea, and rail transportation. So, intermodal transportation can facilitate passengers to complete their entire journey by using more than one mode [23]. Intermodal planning around the airport needs to be done to meet the demands of passenger needs [24]. Intermodal integration in the Kertajati Airport area can be realized by accelerating the construction of the Cileunyi-Sumedang-Dawuan Toll Road, which can shorten the travel time to Kertajati Airport from Bandung City. In addition, the acceleration of development can be carried out with the Jakarta-Bandung-Kertajati-Cirebon fast train plan, as well as other transportation plans that can support accessibility to Kertajati Airport. Integrating transportation modes around the Kertajati Airport area can increase passenger interest in choosing Kertajati Airport as their departure airport. This is the impact of accessibility to the airport, which is easy and anticipates the phenomenon of airport leakage.

## CONCLUSION

The phenomenon of overlapping catchment areas between West Java Multi-airport, Halim Perdanakusuma Airport, and Soekarno-Hatta Airport has triggered airport leakage. Based on the analysis of the frequency of direct flights offered, Soekarno-Hatta Airport has the most flight route frequencies compared to the other two airports (Halim Perdanakusuma Airport and Kertajati Airport). Furthermore, the accessibility from Bandung City to Kertajati Airport is only superior in the average cost that must be paid by passengers. The average cost can attract passengers to tourist travel destinations that are more sensitive to the costs incurred. Meanwhile, an airport that can become a major competitor to trigger the airport leakage phenomenon is Soekarno-Hatta Airport. Soekarno-Hatta Airport is a major competitor because it is a bigger hub that offers more flight frequencies and the flexibility to choose travel hours and other components that are superior to Kertajati Airport. Apart from that, this airport also offers good intermodal integration using trains. This has led to a decrease in the number of passengers in 2019 following the policy of rerouting to Kertajati Airport, which was caused by airport leakage or passenger leakage. To anticipate the decreasing number of passengers due to airport leakage at West Java Multi-Airport, it is necessary to accelerate the development of transportation to the airport from the aspect of availability of toll road access and adequate transportation.

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