

Sustainable Mobility, Development of Integrated Public Transportation Technology 4.0 GIS supports Regional Development: Trend Analysis

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Abstract

Sustainable transportation is a new idea in solving problems that exist in big cities. Commuting activity is a form of non-permanent mobility that has developed in big cities and its surroundings. Commuters or people who do commuting play a role in this development. The existence of commuters leads to development in the commuter's origin and destination areas. Among the developments that have occurred are related to the provision of adequate transportation and overcoming congestion problems. Sustainable mobility research, the development of integrated public transportation with GIS 4.0 technology to support regional development, was carried out to increase the competitiveness of regional development in East Java. This research was carried out to see the weakness in the development of integrated public transportation 4.0 technology. The research objective is to make integrated public transportation research products, based on geographic information technology 4.0. Research methods, secondary data collection, data analysis, continued with the preparation of digital data and the preparation of geographic information

technology 4.0 in the form of web GIS and mobile GIS (Android or iOS). A Geographic Information System (GIS) is a special information system that manages data that has spatial (spatial reference) information. Or in a narrower sense, is a computer system that has the ability to build, store, manage and display geographically efficient information, for example data identified by location, in a database. In general, the notion of a Geographical Information System is a component consisting of hardware, software, geographic data and human resources that work together effectively to enter, store, repair, update, manage, manipulate, integrate, analyze and display data in information.

Keywords

Sustainable Transportation, Sustainable Mobility, Trend Analysis, Regional Development

1. Introduction

Sustainable transportation is a new idea in solving problems that exist in big cities. Commuting activity is a form of non-permanent mobility that has developed in big cities and its surroundings. Commuters or people who do commuting play a role in this development. The existence of commuters leads to development in the commuter's origin and destination areas. Among the developments that have occurred are related to the provision of adequate transportation and overcoming congestion problems. The results of the 2019 Mebidang Commuter Survey show that, of the nearly 4 million Mebidang residents aged 5 years and over, 9.7 percent are commuters. Deli Serdang district has the highest percentage of commuters in Mebidang with 15.8 percent, followed by Binjai City (11.5 percent). Meanwhile, Medan City has the lowest percentage of commuters with 3.4 percent. The results of the 2019 Jabodetabek Commuter Survey show that of the 29 million Jabodetabek residents aged 5 years and over, around 11 percent are commuters. The highest percentage is in Depok City, namely 19.6 percent, while the district / city with the lowest percentage is Bekasi Regency, which is 7.3 percent. Sustainable mobility research, the development of integrated public transportation with GIS 4.0 technology to support regional development, was carried out to increase the competitiveness of regional development in East Java. This research was carried out to see the weakness in the development of integrated public transportation 4.0 technology. The research objective is to make integrated public transportation research products, based on geographic information technology 4.0. Research methods, secondary data collection, data analysis, continued with the preparation of digital data and the preparation of geographic information technology 4.0 in the form of web GIS and mobile GIS (Android or iOS).

2. Literature Review

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2020) sustainable mobility, maritime, airport, and regional government revenue and expenditure (APBD), describe sustainable transportation of seaport and airport impact on GDP and APBD, covered 296 official airports condition in Indonesia, the results are regional government revenues and expenditures (APBD) connected with passenger departures, passenger arrivals, and baggage. So with integrated public transportation technology 4.0 GIS supports regional development and will increase regional income.

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2020) sustainable cities, transportation, and warehousing GDP, describe sustainable transportation connected with cities and GDP of warehousing, covered 151 official airports condition in Indonesia, the results are transportation and warehousing GDP increase based on airplane arrived and departed, passenger, baggage, and cargo. So with integrated public transportation technology 4.0 GIS supports regional development and will increase transportation and warehousing GDP

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2018) the development of long apung airport as the central of economic in the border region with the support of regional renewable energy, describe sustainable transportation supported by renewable energy, as power energy in rural and border airport area of Indonesia. So with integrated public transportation technology 4.0 GIS supports regional development and will increase regional GDP

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2018) the correlations between airport sustainability and Indonesian economic growth, describe sustainable transportation of airport and airport performance impact to industry such as accommodation and food services activities. So with integrated public transportation technology 4.0 GIS supports regional development and will increase regional industry activities.

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2018) E-Business, airport development, and its impact on the increase of information on communication development in Indonesia, describe correlations of 151 airports performance and regional GDP of Information and Communication. So with integrated public transportation technology 4.0 GIS supports regional development and will increase regional industry of Information and Communication.

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2018) business centre development model of airport area in supporting airport sustainability in Indonesia, describe correlations of 151 airports performance and business centre development surrounding airport area. So with integrated public transportation technology 4.0 GIS supports regional development and will increase business activities

Sustainable mobility, development of integrated public transportation technology 4.0 GIS supports regional development: trend analysis, in Setiawan, MI, et al (2017) the technology of web GIS and mobile GIS for airport business area development, describe correlations of 296 airports performance, local government budget (APBD) and local GDP, surrounding airport area. So with integrated public transportation technology 4.0 GIS supports regional development and will increase local budget and local GDP

3. Methods

In 2030, more than 60% of Indonesia's population are residents who live in urban areas, so Sustainable mobility is a very important need to implement. The aim of the research is to create a sustainable mobility design and model, not only the concept of conventional mobility, but considers environmental impacts, inhabited by people who have an awareness of conserving energy, water and food use and minimizing waste disposal, water pollution and air pollution, based on digital technology. Research methods, secondary data collection, data analysis, continued with the preparation of digital data and the preparation of geographic information technology 4.0 in the form of web GIS and mobile GIS (Android or iOS). A Geographic Information System (GIS) is a special information system that manages data that has spatial (spatial reference) information. Or in a narrower sense, is a computer system that has the ability to build, store, manage and display geographically efficient information, for example data identified by location, in a database. In general, the notion of a Geographical Information System is a component consisting of hardware, software, geographic data and human resources that work together effectively to enter, store, repair, update, manage, manipulate, integrate, analyze and display data in information. geographically based

4. Results and Discussion

The train is a means of mass transportation that is quite attractive to land transportation users. Rail transportation in Indonesia is operated by PT Kereta Api Indonesia (PT KAI), which consists of passenger trains (76.18%) and freight trains (23.82%). Until now, this type of transportation is available only in Java and Sumatra. The functional railway area in Java Island consists of 9 regions. DAOP VII Madiun, DAOP VIII Surabaya, and DAOP IX Jember are directly responsible for East Java railway operations. It was recorded that 19.19 million passengers travelled by train in East Java during 2019. Of these, 9.47 million passengers travelled by main or long-distance trains, while 9.73 million passengers by local trains. It means that the number of passengers traveling on the main and local trains is relatively the same. The table shows that most of the train passengers in East Java started their journey from DAOP VIII Surabaya. A total of 12.28 million passengers travelled from DAOP Surabaya, while in DAOP Madiun and Jember, there were 4.33 million and 2.59 million passengers, respectively. Table 1 shows number of train passengers in east java in 2019

Table 1. Number of Train Passengers in East Java in 2019

Class Description	DAOP VII Madiun	DAOP VIII Surabaya	DAOP IX Jember	East Java
Main Category/Long-Distance				
Executive	504,366	1,776,078	239,156	2,519,600
Business	61,124	302,184	61,514	424,822
Economy	1,487,270	3,670,149	1,364,923	6,522,342
Main Category Total	2,052,760	5,748,411	1,665,593	9,466,764
Local category				
Executive	0	0	0	0
Business	0	0	0	0
Economy	2,273,653	6,533,332	920,787	9,727,772
Local Category Total	2,273,653	6,533,332	920,787	9,727,772
Total Passengers	4,326,413	12,281,743	2,586,380	19,194,536

Source: Department of Statistic Distribution (2020)

In 2019, based on the concessions, there are 22 operating and 30 non-operating seaports in East Java. Commercial airports that were operating in 2019 are Juanda Airport (Sidoarjo), Abdul Rachman Saleh (Malang), Blimbing Sari (Banyuwangi), Notohadinegoro (Jember), Harun Thohir (Gresik), and Trunojoyo (Sumenep). Apart from seaports and airports, East Java also has 59 bus terminals spread across various regencies/cities in East Java. It is expected that all the above facilities can optimally meet the needs of land transportation users, complementing the existing sea and airport facilities. Table 2 shows number of seaports, airports, and bus terminals in east java in 2015-2019

Table 2. Number of Seaports, Airports, and Bus Terminals in East Java in 2015-2019

No	Type of Port	2015	2016	2017	2018	2019
1	Seaports	52	52	52	52	52
1.1	Operating	22	22	22	22	22
1.2	Non-Operating	30	30	30	30	30
2	Airports	3	5	6	6	6
3	Bus Terminals	59	59	59	59	59

Source: Department of Statistic Distribution (2020)

The flow of visits by foreign and domestic shipping vessels in East Java is mainly carried out in four major ports, which are Tanjung Perak in Surabaya, Gresik Port, Tanjung Wangi in Banyuwangi, and Tanjung Tembaga of Probolinggo. In 2019, the number of domestic shipping vessels visits to four main ports in East Java was increased compared to the previous year. It was supplemented by 6.24 percent, from 19,465 units in 2018 to 20,679 units in 2019. In contrast, the visits of international ships were decreased by 10.46 percent, from 2,611 units in 2018 to 2,338 units in 2019. Table 3 shows the flow of ship visits of four main ports in east java in 2017–2019

Table 3. The Flow of Ship Visits of Four Main Ports in East Java in 2017–2019

Year	Domestic	International
2017	21390	4057
2018	19465	2611
2019	20679	2338

Source: Department of Statistic Distribution (2020)

The flow of loading and unloading of goods at operating ports, both from abroad and domestically, will generally be affected by ship visits' ups and downs. The more the visits, the bigger the flow of loading and unloading of goods. In general, total ship visits to the four main ports in East Java in 2019 were increased by 4.26 percent compared to the previous year, from 22,076 vessels to 23,017 vessels. It is in line with the loading and unloading activities at the four main ports. The total goods unloaded at the four ports increased by 46.83 percent compared to the entire goods unloaded in the previous year, from 30.12 million tons to 44.23 million tons.

Meanwhile, the total goods loaded at the four ports also increased, although the increase was not as significant as the value of goods unloaded. The increase in the number of goods loaded was from 9.25 million tons in 2018 to 9.39 million tons or an increase of 1.25 percent. There are two out of four main ports in East Java that experienced an increase in the total value of goods unloaded in more detail. The two ports were Gresik port, which increased by 73.14 percent, and Tanjung Perak increased by 11.61 percent. Meanwhile, Tanjung Tembaga port and Tanjung Wangi port experienced decreases in the total value of unloaded goods by 29.21 percent and 60.88 percent, respectively, compared to the previous year. The same thing also happened to the loading of goods in four main ports of East Java in 2019, namely two ports that experienced an increase and two ports that experienced a decrease in total value than the full value of goods in 2018. Total goods loaded at the Tanjung Perak port in 2019 amounted to 7.48 million tonnes, an increase of 6.14 percent from 2018.

Meanwhile, the total goods loaded reached 20,578 tons at the port of Tanjung Tembaga, a rise of 463.78 percent compared to last year, which only reached 3,650 tons. The total value of goods loaded at Gresik port in 2019 was 1.25 million tons. It is lower than that in 2018, which gained 1.51 million tons, or in other words, there was a decrease of 17.55 percent. Apart from Gresik port, the total value of goods loaded at Tanjung Wangi port also decreased, from 684.000 tons in 2018 to 616.000 tons in 2019, a decrease of 9.96 percent. Table 4 shows loading and unloading activities in 4 ports in east java 2018 - 2019

Table 4. Loading and Unloading Activities in 4 Ports in East Java 2018 - 2019

Ports	2018			2019		
	Vessels (Unit)	Unload (Ton)	Load (Ton)	Vessels (Unit)	Unload (Ton)	Load (Ton)
Gresik	7,898	19,041,801.85	7,050,099.9	8,233	32,968,449.69	7,483,190.91
Tanjung Perak	12,627	9,543,604	1,514,413	13,302	10,651,988	1,248,596
Tanjung Tembaga	220	25,044.25	3,650	238	17,729	20,578
Tanjung Wangi	1,331	1,512,482	683,995	1,244	591,729	615,843
TOTAL	22,076	3,012,2932.1	9,252,157.9	23,017	44,229,895.69	9,368,207.91

Source: Department of Statistic Distribution (2020)

The number of passengers using sea transportation services, both boarding and disembarking passengers at 12 ports in East Java, increased rapidly in 2019. It was recorded that the number of disembarking passengers increased by 40.79 percent compared to 2018. The most significant increase occurred at the Karamean port, which increased by 383.59 percent. The data shows that only Branta's port has experienced a 26.21 percent decrease among 12 ports in East Java. Apart from debarking passengers, the number of embarking passengers also experienced a significant increase, namely 33.32 percent. The most massive increase in the number of passengers departing from 12 ports in East Java occurred at Sapudi port, which increased by 331.39 percent compared to 2018. Meanwhile, the port that experienced the largest decrease in passenger numbers compared to the previous year occurred at the port of Branta, amounting to 27.02 percent. Table 5 shows the number of passengers in 12 ports in east java in 2018 – 2019

Table 5. The Number of Passengers in 12 Ports in East Java in 2018 - 2019

Ports	2018		2019	
	Debarking	Embarking	Debarking	Embarking
Bawean	76,690	70,680	82,550	76,527
Branta	5,060	5,255	3,734	3,835
Brondong	15,637	17,116	17,731	16,874
Gresik	65,098	64,712	68,894	57,894
Kalbut	2,072	8,803	4,672	7,911
Kalianget	93,676	99,393	107,526	125,029
Karamean	725	1,203	3,506	3,281
Masalembu	12,087	7,845	16,094	11,717
Sapudi	10,434	7,554	48,775	32,587
Sepekan	16,896	15,221	21,656	18,800
Tanjung Perak	288,406	327,233	448,527	479,477
Tanjung Wangi	0	10,250	2,483	13,005
TOTAL	586,781	635,265	826,148	846,937

Source: Department of Statistic Distribution (2020)

The number of domestic air transportation arriving in East Java in 2019 was 63,373 aircraft units or a decrease of 20.31 percent from 79,524 units in 2018. Meanwhile, the number of domestic air transports departing from East Java was 63,436 units or decreased by 20.24 percent compared to 2018. There were 7,702 units and 7,710 aircraft that came and left the country from East Java as for international air transport. It means that international air transport arriving at and departing from East Java increased by 3.17 percent and 3.19 percent, respectively, from the previous year, which reached 7,465 aircraft and 7,472 aircraft units. Table 6 shows the domestic air transport passenger flows at 6 airports in east java in 2017 - 2019

Table 6. The Domestic Air Transport Passenger Flows at 6 Airports in East Java in 2017 - 2019

Year	Debarking	Embarking	Transit
2017	10,123,723	8,985,322	1,131,375
2018	10,288,120	9,079,890	1,157,557
2019	7,713,174	6,898,372	819,228

Source: Department of Statistic Distribution (2020)

The number of domestic air transport passengers departing from airports in East Java was 6.90 million people in 2019 or a decrease of 24.03 percent compared to 2018, which reached 9.08 million people. Meanwhile, 7.71 million domestic air passengers arrived in East Java, or a reduction of 25.03 percent compared to 2018, which got 10.29 million people. Meanwhile, transit passengers for domestic flights in 2019 reached 819,228 people or a decrease of 29.23 percent compared to 2018. In contrast to the number of domestic air transport passengers, the number of international air transport passengers increased in 2019 compared to 2018. The number of transportation passengers International air arrivals to East Java recorded an increase of 9.00 percent, or to 1.23 million people, from the previous 1.13 million people. Meanwhile, the number of international air transport passengers departing from East Java also increased from 1.11 million people in 2018 to around 1.19 million people in 2019 or 7.07 percent. Table 7 shows the foreign air transport passenger flow at six airports in east java in 2017 - 2019

Table 7. The Foreign Air Transport Passenger Flow at Six Airports in East Java in 2017 - 2019

Year	Debarking	Embarking
2017	1005984	983777
2018	1130815	1107556
2019	1232594	1185813

Source: Department of Statistic Distribution (2020)

In 2019, domestic air transport's baggage weight had decreased quite drastically for both loading and unloading activities. The weight of unloaded and loaded baggage in 2019 reached around 36.10 thousand tons, respectively, down 45.21 percent compared to 2018, and 50.42 thousand tons, down 47.13 percent compared to 2018. In contrast, the weight of the cargo International air transport baggage has increased compared to 2018. The baggage weight of unloaded international air transport reached 21.09 thousand tons, an increase of 11.31 percent compared to 2018. Meanwhile, international air transport's baggage weight reached 12.55 thousand tons or an increase of 7.07 percent compared to 2018.

Meanwhile, the weight of domestic air freight cargo that was unloaded and loaded reached 23.46 thousand tons and 39.41 thousand tons, respectively, in 2019. It means that the value of domestic air transport cargo has decreased by 43.68 percent and respectively. 32.59 percent compared to 2018. The weight of unloaded international air freight cargo reached 12.38 thousand tons in 2019, or an increase of 23.97 percent compared to 2018. Meanwhile, the value of international air freight cargo that was loaded also increased from 2018, which amounted to 38.04 percent or an increase from 10.30 thousand tons to 14.22 thousand tons.

6. Conclusion

One of the supporting elements for realizing equitable development in the economic sector is the role of transportation infrastructure inroads in good condition. In 2019, the road conditions in the province varied, with most of them in steady-state. It is indicated by the state of national roads' stability reaching 93 percent, provincial roads reaching 93 percent, and district/city roads reaching 77 percent. It is thought that the condition can influence the acceleration of development direction in various economic sectors. The development of land transportation subsector, particularly the number of motorized vehicles, continues to increase. It causes the number of vehicles to be no longer proportional to

the development of the road's length, which can reduce the risk to the level of comfort and safety of motorized vehicle users. The condition of sea transportation in East Java shows a positive picture. It is indicated by the relatively increased number of passengers and the loading and unloading of goods. Based on the value of goods unloaded and loaded, it is known that Gresik port has the largest share in the number of goods entering and leaving the province of East Java. However, for merchant ship traffic flow, the Tanjung Perak Port of Surabaya is still the busiest in East Java. Gresik Port is the port with the largest volume of loading and unloading goods from domestic and foreign shipping. As for the flow of shipping passengers, Tanjung Perak Port is still the largest number of passengers than other East Java ports. From the aspect of air transportation, it can be seen that the development of international air traffic has increased, although it is not very significant. However, domestic air traffic has decreased significantly. In line with the increase in air traffic, the flow of international air transport passengers has increased while passengers' flow on domestic air transport has decreased. The same thing happened to the flow of loading and unloading of goods, both baggage and cargo. For domestic flights, the loading and unloading flows of baggage and cargo have decreased. As for international flights, the flow of loading and unloading luggage and cargo has increased. Land, sea, and air transportation facilities and infrastructure are vital objects that must be available to support the development process and access the development results that lead to community welfare achievement. Thus, the stakeholders' role is very much needed to be able to work together with the central and local governments. The position is primarily in maintaining transportation facilities and infrastructure and services to the public as users of transportation services.

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