

Impacts of inter-urban transportation railway to regional development (Case study: Sukaraja District - Bogor Regency - West Java Province)

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Abstract. Inter-urban transportation railway becomes the chosen mass transportation mode by the people for daily commuting. The tariff is relatively cheaper and affordable. The travel times are shorter as compared to other modes of transportation. This study aimed to understand the development surrounding Jakarta – Bogor Inter-urban transportation railway station - Cilebut Station located in Sukaraja District. Correlation between passengers and population is 0.99 that shows great impacts to development area surrounding it. Analysis of development aspects are land use, population, and economic change. Using Geographic Information System analysis from the year 2010 to 2015, residential area increased by 18.11% and plantation area decreased by 32.9%. Population was analyzed using average rate of growth from the year 2011 to 2015, the result is 4.6%. Population density increased from 3809 people/sq.km to 4694 people/sq.km. Facilities of industry and grocery store increased, likewise labor structure of business and hotel increased by 11350 persons and services by 3460 persons. But agriculture labor decreased by 894 persons. Based on this research, local government should be alerted. In the case a region has a railway station and is stopped-by inter-urban transportation trains, the area development will take place rapidly, intervention needs to be done.

Keywords: *Inter-urban transportation railway, Regional development, Land use change, Population change, Economic Change.*

1. Introduction

Inter-urban transportation railway becomes one of mass transportation modes preferred by the people for daily commuting. Besides relatively cheaper and affordable, the travel times to destinations are shorter as compared to using other modes of transportation. Republika online newspaper February 1st 2018 [1], according to the report by PT. Kereta Commuter Indonesia as a company which develops inter-urban transportation railway, stated that the passengers of *Commuter Line* trains which serve Jabodetabek routes in 2017 reached 315,849,947, or an average volume of 993.804 passengers per day. The highest record of passengers in a day was 1,076,274. Those numbers are relatively high compared to the users of other mass transportation modes in Jabodetabek. According to Central of Statistic Bureau (BPS), cumulative number of passengers of train in 2017 was 393.3 million or



increased by 11.78% as compared to the same period in 2016. The existence of the Commuter Line trains as mode of inter-urban transportation may elevate the volume of passengers using mass transportation and becomes the most favored transportation mode by the urban people living in Jabodetabek.

The existence of train as one of inter-urban transportation modes save the costs and the travel time urban dweller working in the central of the city. Locations in the vicinity of the stopped by railway stations becomes the chosen alternatives for their dwelling. Although some of the locations may be far away (from the central of the city), since the price of the land is cheaper, easy access to the central of the city and affordable travel cost, they become the deciding factors for choosing those areas for dwelling. In turn, railway inter-urban transportation impacts the development of areas surrounding the stopped by railway stations.

Gordana Stefancic, et al [2] stated that the best location for dwelling is the point where the dwelling location is affordable and having cheap transportation cost, in such that low income family will be less living in the area close to the central of the city. The higher income family will live in area farther away from the central of the city. As a result, the total volume of land use for dwelling will increase and city peripheral will expand.

The high number of higher income family dwelling in locations farther away from the central of the city influences the characteristic of commuters actively using inter-urban transportation for their trip. Mackenbach, et al [3] stated that commuters who actively make trips are individuals having high income where active trip frequency is higher at the end of the commuting (working place) and lower at the start of the commuting. Ministry of Transport New Zealand [4], stated that lower costs and enhanced accessibility, due to better transport links and services, expand markets, create increased opportunities for trade, competition and specialization, which can lead to longer-term productivity gains.

Development of areas surrounding railway stations needs to be paid attention considering their impacts may cause uncontrolled development, as stated by Febri[5] that development of transportation, especially railway, causes the stopped by areas grow more rapidly as identified by the high land use and development of new economic centers which in turn will raise the number of population and resulting in the demand for land increases, it is therefore the area needs to be expanded. If this is not followed by spatial planning from the early stages, it may cause urban sprawl as consequences of uncontrolled expansion of areas surrounding the railway stations. It is therefore involvement is required for the areas surrounding railway stations to avoid problems associated with urban sprawl from arising.

Tony McCall [6] said that in 1950s economics basis used in indicated regional development, towards the end of the 20th century, regional development became far-more multidisciplinary in its approach, and in 21st, the focus of regional development is more on the spatial dynamics of regions. Furthermore Luthfi Muta'ali [7] stated that regional development potential is indicated by population, social – economic characteristics, land-use and infrastructure, and accessibility.

KRL Commuter Line Jakarta – Bogor began the operation in 2011. There are many stations between Jakarta – Bogor stop by the train, one of them is Cilebut Station. Since the existence of KRL Commuter Line Jakarta – Bogor, the area surrounding the station had become more densely populated. It is indicated by data of average population growth in Sukaraja District from 2011 to 2015 which is 4.6% per year. This high population growth has caused growth of residential areas, especially surrounding Cilebut station. This condition showed that the areas surrounding Cilebut station experienced rapid development.

This study is aimed to understand the development of areas surrounding the stations which is inter-urban transportation railway stopped by. Area surrounding Cilebut Station selected, located in Sukaraja District, Bogor Regency, West Java Province - Indonesia, which had rapid development since the station located in this district was stopped by KRL Commuter Line train Jakarta – Bogor as the inter-urban transportation railway. The results can be used for reference in the case of a region

which facilitated station stopped by inter-urban transportation train, the region can be plan earlier to anticipate the bad impact of inter-urban transportation train to the region.

2. Data and methods

This study is limited to Sukaraja District – Bogor Regency as the area surrounding Cilebut Station. Data collection is through collection of primary data and secondary data. Primary data is collected through direct observation and documentation to land use activity in the surrounding Cilebut Station, it is used to obtain description of the existing condition of land use surrounding the station. Secondary data is obtained through institutional survey.

The analysis used for identifying the link between the railway and the regional development is analysis of correlation between the growth of passenger and population from year 2014 through 2017, as available data passengers, the formula in DewiSawitri and Sri Maryati [8] as follows:

$$r_{xy} = \frac{n\sum xy - \sum x \sum y}{\sqrt{n\sum x^2 - (\sum x)^2} \sqrt{n\sum y^2 - (\sum y)^2}} \quad (1)$$

Whereas if r value = ± 1 the correlation of the two variables is perfect, and if r value = 0, there is correlation between the variables.

In identifying regional development, the analysis is done by land use change, the development and density of population, and the availability of economic facilities and the labor changed in each village in the Sukaraja District.

The analysis of land use change used before-after method by utilizing overlay analysis on the land use maps of 2011 and 2015. Variables used in the analysis are acreage and pattern of use variables. Whereas land use change analysis is started by preparing land use maps which covers preparation of area delineation, image cutting, image re-composition, geo-referencing on the images, digitizing on the images in such that it produces land use maps. Subsequently the produced land use maps will be overlaid to obtain data of acreage of change as results of overlaying 2011 map and 2015 map. In identifying population growth, calculation is done on the total population in 2011 through 2014, likewise of economic facilities and labor change. Data used from Potensi Desa 2011 [9] and Potensi Desa 2014 [10].

3. Results and discussion

3.1. Characteristic of Sukaraja District

Sukaraja District is located at 6°34'08.33 South latitude and 106°51'53.27 east longitude, at elevation of between 350-682 meters above sea level. Based on 2016 data, total acreage of Sukaraja District is 4200Ha. The biggest village is Nagrak with area of 800 Ha, the smallest village is East Cilebut with area of 100 Ha. Sukaraja District comprises 13 villages with administrative boundary as follows:

Northward	:	Cibinong District
Westward	:	Bogor City
Southward	:	Ciawi District
Eastward	:	Babakan Madang District

For further clarification see Figure 1.

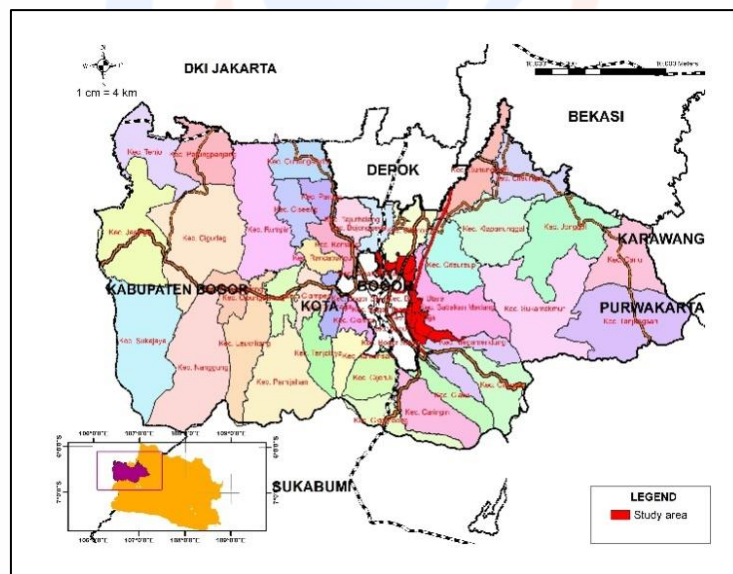


Figure 1. Administrative boundaries map of Sukaraja District

3.2. Correlation between inter-urban transportation railway and regional development

To understand the impacts of the inter-urban railway transportation to the regional development, firstly done is the correlation analysis between the two variables such as population and passengers which start and stop in Sukaraja District. The result strengthen the hypothesis regarding the existence of regional development in areas surrounding Cilebut Railway Station as a result of inter-urban railway transportation. Table 1 show the available data used for correlation analysis.

Table 1. Total passengers and population in Sukaraja District from the year 2014 through 2017.

Year	Passengers	Population
2014	4,724,525	192,820
2015	5,384,099	197,168
2016	5,913,657	201,435
2017	6,466,896	205,599

Source: PT Kereta Commuter Indonesia 2018 and Sukaraja District in Figure year 2014 to 2017

Based on the result of correlation analysis above, the value of r is 0.99 which means the correlation of the growth of population, as one of regional development indicators, is positive with the growth of the number of inter-urban railway passenger. Therefore the impact of inter-urban railway transportation is significant to the regional development.

3.3. Analysis of land use change

In 2015, non built up area of Sukaraja District was 1,827.52 Ha (51%), whereas the built up area was 1,755.194 Ha (49%), mainly for urban residential with acreage of 1.453,7821 Ha or 41% of the total acreage of Sukaraja District. Majority of land use for urban residential is scattered surrounding Cilebut Station which is in the villages of West Cilebut, East Cilebut, Pasir Jambu, Mandala, and Cijunjung, whereas the areas farther away from the station which are the villages of Gunung Geulis, Cibanon, Nagrak and Sukatani are more dominated by non built up area, especially for padi fields, plantation and farming area. For further clarification regarding the land use in Sukaraja District see figure 2 and Table 1 below.

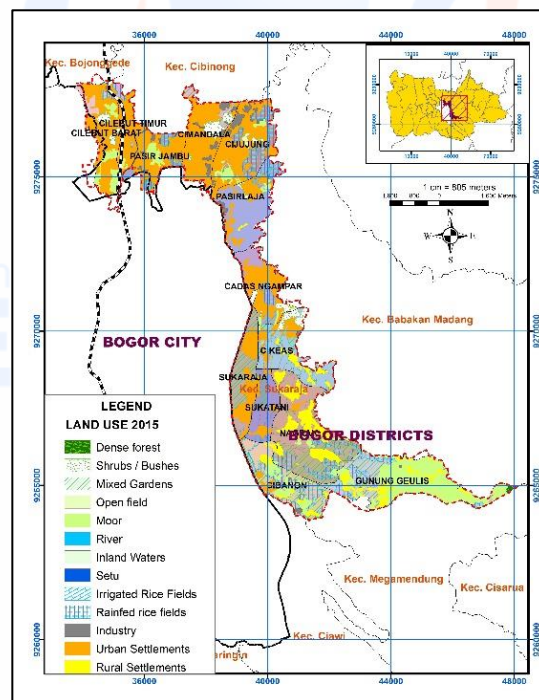


Figure 2. Sukaraja District land use map

Table 2. Percentage acreage of land use in Sukaraja District year 2015

Land Use	Percentage
Rural residential	7.09
Forest	0.11
Plantation	12.47
Mixed Plantation	14.88
River	0.68
Urban Residential	33.11
Rain dependent Padi Field	9.78
Industry	1.66
Land Water	0.01
Irrigated Padi Field	17.54
Bush	2.53
Lake	0.01
Open Area	0.14
Total	100

Source: GIS Analysis, 2015

Based on the results of land use analysis, significant change took place from 2010 through 2015, especially on land use of residential and industry. In 2010, residential area was 22.08% of the total area of the district, whereas in 2015 it was 40.20% of the total. Since the plantation area decreased from 45.37% in 2010 to 12.47% in 2015, it is logical to suspect that the area converted to residential area was from the area used to be plantation area.

3.3. Population analysis

One of the indicators that a region is developing is the increase of population. Villages in Sukaraja District experienced rapid population growth. Population of Sukaraja District in 2011 was 159,988 and in 2015 was 197,164, so annually average growth is 4,6%. Commensurate with this population growth, the population density in Sukaraja District increased from 3,809 people/sq.km to 4,694 people/sq.km.

To prove that this regional development was caused by the increase of population resulted by the existence stopped by Cilebut Station of inter urban-transportation railway KRL Commuter Line Jakarta – Bogor, it may be viewed from the population growth in the period of 2011 to 2015 in the villages located surrounding this railway station which are East Cilebut, West Cilebut, Pasir Jambu and Cimandala compared to population growth of villages farther away from station which are Cijung, Pasir Laja, Cadas Ngampar, Cikeas, Sukaraja, Sukatani, Cibanon, Nagrak and Gunung Geulis. From the results of analysis found that villages surrounding the station tended to have high population density, whereas villages farther away from the station in the average have medium to low population density. For further clarification see Table 3 and Figure 3.

Results of this population analysis show that the existence of inter-urban transportation railway KRL Commuter Line Jakarta – Bogor influenced to the increase of population in Sukaraja District, especially in the area surrounding Cilebut Sation. This increase of population impacted regional development of areas surrounding the station.

Table 3. Population density of each Village in Sukaraja District, year 2011 and year 2015

Village	Population Density 2011 (people/sq.km)	Population Density 2015 (people/sq.km)
Cibanon	1703	1699
Gunung Geulis	1300	1473
Nagrak	1334	1570
Sukatani	2294	2473
Sukaraja	3665	4772
Cikeas	3469	3996
Cadas Ngampar	3113	3786
Pasirlaja	3883	4653
Cijunjung	5594	7526
Cimandala	7938	9120
Pasir Jambu	5185	6694
East Cilebut	18127	21551
West Cilebut	5706	7934
Sukaraja District	3809	4694

Source: Population analysis year 2011 and 2015

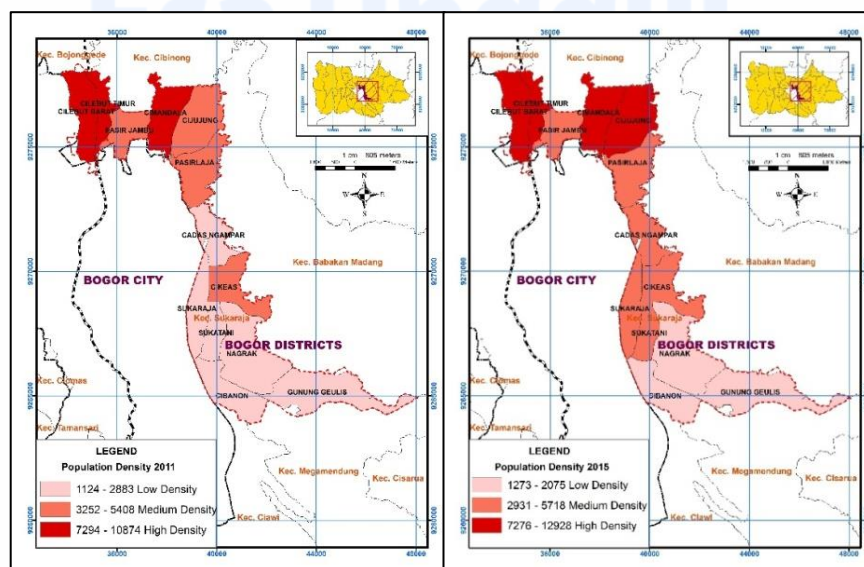


Figure 3. Maps of Population Density in Sukaraja District, 2011 and 2015

3.4. Economic Analysis

Economic analysis Sukaraja District will be approached by the changes of availability of facilities and the change of labor, show in Table 4 and Table 5.

Table 4. The changes of availability of economic facilities in Sukaraja District, 2011 – 2014

Villages	Industry	Grocery Store	Food stalls	Restaurant	Hotel	Mini Market	Bank
Cibanon	-1	29	-2	0	0	0	0
Gunung Geulis	0	0	13	1	0	1	0
Nagrak	5	1	-1	0	0	1	0
Sukatani	-6	-2	-3	0	0	0	0
Sukaraja	0	15	0	1	0	2	0
Cikeas	-3	34	-2	1	2	1	0
Cadas Ngampar	-1	45	2	0	1	0	0
Pasir laja	18	6	5	0	0	0	0
Cijunjung	6	300	11	1	0	1	1
Cimandala	2	8	-2	1	1	2	0
Pasir Jambu	7	137	0	0	0	4	0
East Cilebut	6	-8	-3	0	0	2	0
West Cilebut	1	185	-6	0	0	2	2
TOTAL	34	750	12	5	4	16	3

Source: Result Calculation from Potensi Desa year 2011 and year 2014

Table 5. The Changes of labor structure in Sukaraja District in the year 2011 - 2014

Villages	Agriculture	Industrial	Construction	Business and Hotel	Transportation	Services
Cibanon	-164	81	50	347	59	8
Gunung Geulis	313	46	541	250	-42	-396
Nagrak	-174	171	185	1836	597	1308
Sukatani	-32	19	117	184	1	-12
Sukaraja	-329	141	210	857	240	149
Cikeas	-263	80	235	953	228	438
Cadas Ngampar	-126	10	320	497	44	45
Pasir laja	60	83	249	1145	89	165
Cijunjung	37	454	301	895	213	397
Cimandala	19	501	409	908	166	346
Pasir Jambu	-210	523	149	1676	125	512
East Cilebut	-134	102	185	969	76	82
West Cilebut	109	140	218	833	105	418
TOTAL	-894	2351	3169	11350	1901	3460

Source: Result of Calculation from Potensi Desa year 2011 and year 2014

From Table 4, showed that the availability of facilities in some villages decreased, but the total availability of each facility in the whole district increased. From Table 5, showed that the agriculture labor in some villages decreased, but others are increased.

Based on the above data it is understood that during the period of 2011-2014 economic facilities increase across the board in Sukaraja District especially the grocery stores which increased by 750 units with high increase in Cijujung village e.g by 300 units. And it strengthened by the changes of labor, from agriculture to labor that indicate urban area as industrial, construction, business and hotel, transportation and services. It shows that the existence of the inter-urban railway transportation has

pushed up the economic of the region as indicated by the increase of economic facilities and changes of labor in the surrounding of stop-by railway station.

4. Conclusion

It can be conclude that there is correlation between the existence of inter-urban transportation railway with regional development. The changed of land use, population, labor and economic facility of rural to urban strengthen the prove impact of inter-urban transportation railway to regional development, especially Sukaraja District as area surrounding Cilebut Station.

5. References

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