THE INFLUENCE OF ROAD NETWORK DEVELOPMENT ON LAND USE (CASE STUDY: KARAWANG REGENCY, INDONESIA)

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ABSTRACT

The aims of this research are to find out the most influencing sector that brings huge impact towards the economic growth of Karawang regency after Jakarta-Cikampek toll road is established, and to generate the mathematical model which enables to serve information about the GDRP (Gross Domestic Regional Product) value of agriculture sector based on the impact of industrial sector GDRP value, trading sector DGRP value, and number of populations in Karawang regency.

Keywords*: Transportation, Road Network, GDRP*

1. PRELIMINARY

In the new global economy, urban growth has become an important issue regarding to the regional development (Lee, 2006). Urban growth provokes the development of economic activities through the construction and expansion of public services to facilitate the human needs, such as residential, school, department centre store, and recreation area. Despite this motive, land use management becomes one of the popular methods to promote the regional economic.

Development of a region is affected by the region's economic activities as proven by its per capita income (Fujita, 1989). Economic activities run and develop properly when they are supported by adequate facilities, among others, goods and service distribution entire the region. Transportation system can be considered as a backbone of the development of particular industries as well as region's economic growth. Infrastructures such as roads that connect areas of economic centres (urban, district, and rural areas) help distribution flow of goods and service so that the economic activities will continuously develop.

Numerous of toll roads had been established in Jakarta, and outer ring road that connect some places around Jakarta is being constructed. Jakarta-Cikampek Toll Road is one of the densely populated districts and the artery of transportation that connect Jakarta to Bekasi area (Jasa Marga, 2012). This area would be the main focus research area, which considers the high number of vehicles that pass the Jakarta-Cikampek toll road among other toll-roads from year to year, and moreover, this toll-road connects Jakarta to the developed area named Karawang Regency.

On the other hand, land use management also raises conflicted problem at the same time. Beinet and Nijkamp (1998) stated that the sustainability of the environment would be decreased in unbalanced land-use case. However, land-use implementation provides significant impact to the citizen if it well-developed and supported by sufficient supporting facilities, such as toll road. Therefore, the aim of this research is to investigate the trade-off of Jakarta–Cikampek toll road between the industrial development, trading area, and agricultural area in Karawang Regency using multiple regression approach.

In this research, the method applied to obtain the result is using linear regression approach. The aim of linear regression is to predict the influence of some sectors that associated with changing in land-use of Karawang Regency because of the development of road network in the area such as Jakarta-Cikampek toll road. The agricultural sector is the original form of land use in Karawang Regency as the dependent variable. There are three sectors that associated with the changing in land use as independent variable which are industrial, trading and population development.

Figure 1 Map of Karawang Regency

This research examines the importance of land use management in Karawang Regency along the corridors of the toll roads by considering the following issues:
1. Fast growing area development along the toll roads, which is beyond the expectation and causing unbalanced between the capacity of road and the traffic demand. This condition has resulted in traffic jam and accident along the road network.
2. Changes in land use at several locations along the road network. This can be evidenced by the changes in spatial utilization from productive or technically irrigated agricultural areas into settlement, industrial sites, and urban areas.

Aim of the research
The aims of the research are:
1. Find out the most influencing sector that brings huge impact towards the economic growth of Karawang regency after Jakarta-Cikampek toll road is established.
2. Generate the mathematical model which enables to serve information about the GDRP value of agriculture sector based on the impact of industrial sector GDRP value, trading sector DGRP value, and number of populations in Karawang regency.

2. LITERATURE REVIEW
Transportation and Economic Sector
The influence of the transportation sector to the economic development comes from the role of transportation facilities in enabling movement and interchange of activities between locations. In the previous research in regional science recognized that both growth and concentration of economic activity at any given location depends on access to markets and the location economies enabled by that access (Bryan et al., 2007).

Economic life of a region may not operate without facilities, such as structures and infrastructures. Infrastructure of particular region or area can be an indicator for area development, adding in income per capita. There is a strong relationship between available infrastructures.

A region's economic growth is possible by the smooth flow of goods and services distribution, which specifically are formed by particular industries, from upstream to

downstream. It results in a transportation system, which plays as the backbone of the industrial and economic growth of the region. Transportation facilities connect areas at the centre of economic activities to the sound peripheral areas.

Urban Development

Major cities have been fast developing and will continue to develop despite unconformity with national policies imply some potential economic reasons behind the growth. Major cities become more productive compared to their minor counterparts because of their ability to provide effective labour markets.

Types of proper urban structure must allow labour mobility in the metropolitan area. Wherever the family live in this area, they must be reached in a reasonable length of time (i.e., less than one hour) from any working location to be offered.

Urban Spatial Structure

A city always experiences development over time, either in political, social, cultural, technological, economic, or physical aspects. Aspect directly related to the urban land use is physical development, in particular the areal change. This condition mainly affected by the higher population growth and urbanization rate. High population growth in urban areas often occurs in developing countries and it shifts urban space to autonomous area that is situated in the hinterland.

The development of new zones along the transportation axis areas will be faster than that of interstitial areas. The development along this axis is limited by competition with the areas closer to the CBD, even though this area is not provided with fast transportation facilities. In other words, areas without fast transportation facilities can compete with other areas with fast transportation facilities in the "time cost" because of its close distance to the city centre.

Industries and Distribution

When an area does not have any transportation network or has very high transportation cost, the area tends to depend itself on production derived from its natural sources. A relatively low transportation cost will enhance large economic scale of a particular area so that the goods and services are produced more economically. One of factors that play an important role in determining industrial location or economic activity is how much the transportation cost is needed.

Transportation cost as one of factors that determine the industrial location depends on weight of the goods to be transported (Von Thunen, 1966). If the raw material is heavier, the location must be placed as close to the raw material site as possible, as he proposes in choosing the factory/company location, as follows:

1) Raw materials are spread anywhere
2) Market for the finished goods is limited to one market
3) Transportation cost per kilometre, the total cost divided by distance covered

Transportation is part of distribution. It plays a very important role for industries because producers have intention to sell and transport their goods to the customers timely, in the right place, and in perfect condition. A distribution system demonstrates the relationship between activities where transportation sector plays a pivotal role. (Woodward, 1980)

3. RESEARCH METHODOLOGY

Research Approach

Case study is defined as one of research strategies that obtain the sources based on the factual life and empirical study (Saunders et al., 2012). Bryman and Bell (2007) stated that the typical of case study is concentrating to the certain occasion within organization and experiencing frequent change. This research applies case study approach and selects Jakarta-Cikampek toll road as the object of case study. Saunders et al., (2012) added that case study bring

advantage which enable the researcher to gain a deep understanding towards the case. A case study approach was chosen in this research since it applies the theoretical term into the real-life event. Moreover, case study considers implementing quantitative method as the data input (Saunders et al., 2012).

Data Collection

This research uses quantitative data from secondary data. Saunders et al., (2012) defined that quantitative data is the kind of research design strategy which computes a numeric data based on the raw data. This study adopts quantitative data as the input because it calculates the data using linear regression to obtain the result.

Gross Domestic Regional Product (GDRP) in Karawang regency from 2000-2012 in various sector,

- Agricultural sector
- Industrial sector
- Trading sector
- Population number

Data Analysis

Saunders et al., (2012) stated that quantitative data is involving some numerical calculation to be processed within the data analysis in order to generate the well-interpreted result. Quantitative data is the most suitable research strategy in this study since it requires raw numerical data to be analysed; moreover, it is related with multiple regression which is relevantly applied in this research.

This research has been developed based on urban design and transportation knowledge. Various kinds of studies have been widely investigated in the previous time using the similar technique. The first step of this research is identifying the problems due to the relevant aspects in order to conduct the research method. This step is required to organise the research contents due to the existing theory and knowledge.

4. RESULT AND ANALYSIS

Toll Road Development

Many cities have changed themselves from small towns to industrial urban areas because they now become accommodated and facilitated by the presence of the toll roads. Such condition accelerates the movement of changes in social, economic, and politic aspects.

The change in value due to industrial development and progress requires high level of accessibility in supporting the development of an area where the highway transportation is situated. The area is fast growing to be cultivated site in which production, service, and/or housing activities significantly contribute to national and local economy as well as regional development. The role of transportation in urban area is very important. Urban traffic problem can be limited to give more opportunities to the citizen to fulfil their needs by combining vary transport-related strategies, i.e., more dense cities connected by free highway to give more access to the production goods delivery, land development for settlement, industry, and shopping/commercial centre (Oglesby and Hicks, 1982).

Jakarta-Cikampek toll road, which is part of Java North Coast traffic networks that plays an important role in economic development and distribution, is used as a case study. This toll road has frequently suffered from traffic jam and burden overloads. Prior to the construction of Jakarta-Cikampek toll road, Karawang Regency was known as a rice producer. After the toll road has been operated, it becomes the site for factories that lie at the right- and left-side of the road. There is a change in land use from agricultural area to industrial site. Local people also change their living from being farmers to factory labours.

The above statistics suggest that industrial sector has changed, even more productively, agricultural sector. However, a question arises whether this positivity is also followed by its negative impact and consequence.

The toll road construction will be followed-up by new activities along the road, such as, industries and settlements. Land-use and accessibility management is necessary, accordingly. Frequently the toll road construction has been related to change in land-use and mobility rate of the community structure.

Result of Linear Regression
Frequently the toll road construction has been related to change in land-use and mobility rate of the community structure. One can identify development of particular area by the increase of Gross Domestic Regional Product (GDRP) at any given time span. The standpoints for this progress in this research were agriculture, industry (other than oil and gas), trade, and population density. The secondary data that obtained is processed by the SPSS version 22 application software which is giving the following results as described.

Correlation between agricultural sector, industrial sector, trading sector, and population density
The aim of generating the correlation among agricultural sector, industrial sector, trading sector, and population is to obtain the most influenced aspect within Jakarta-Cikampek toll road development. The calculation method is using multiple linear regression analysis with the data below:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3$$

Denotation:
a = constant
b_1 = Industrial coefficient
b_2 = Trading coefficient
b_3 = Population coefficient
Y = Agricultural variable
X_1 = Industrial variable
X_2 = Trading variable
X_3 = Population variable

Agriculture is the dependent factor; meanwhile industrial sector, trading sector, and population are independent factor. Hypothesis that used are:

- H0: Independent variable does not bring any impacts to the dependent variable, which means industrial sector, trading sector, or population development does not correlate with the development of agriculture sector.
- Ha: Dependent variable brings any impacts to the dependent variable, which means industrial sector, trading sector, or population development correlates with the development of agriculture sector

Table 1: Correlations between Agriculture and Population

Correlations

		AGRICULTURE	INDUSTRY	TRADE	POPULATION
Pearson Correlation	AGRICULTURE	1,000	,978	,924	,960
	INDUSTRY	,978	1,000	,955	,982
	TRADE	,924	,955	1,000	,940
	POPULATION	,960	,982	,940	1,000
Sig. (1-tailed)	AGRICULTURE	.	,000	,000	,000
	INDUSTRY	,000	.	,000	,000
	TRADE	,000	,000	.	,000
	POPULATION	,000	,000	,000	.
N	AGRICULTURE	13	13	13	13
	INDUSTRY	13	13	13	13
	TRADE	13	13	13	13
	POPULATION	13	13	13	13

The above table is a matrix of the variable correlation between agricultural, industrial, trade, and population density sectors. The N rate of each sector was 13 and the technique of analysis used was Pearson correlation. The above output led to the interpretation of the correlation that whether correlation existed, it followed the below requirements:

- If probability rate was less than 0.05, H0 was rejected, and a significant correlation existed.
- If correlation was marked negative, a positive (one-direction) correlation existed; the higher the score of the first variable, the higher the score of the second variable, vice versa.
- If correlation coefficient was marked negative, a negative direction (opposed direction) correlation existed; the higher the score of the first variable, the lower the score of the second variable, vice versa.

Based on the above requirements one could enter the correlation interpretation. From the significance aspect, the below correlation might follow:

- The correlation between agricultural and industrial sectors had the correlation of 0.978 and significance rate of 0.000 less than 0.05, showing a significant correlation.
- The correlation between agricultural and trading sectors had the correlation of 0.924 and significance rate of 0.000 less than 0.05, showing a significant correlation.
- The correlation between agricultural and population sectors had the correlation of 0.960 and significance rate of 0.000 less than 0.05, showing a significant correlation

Table 2: Coefficients of Agriculture as dependent variable

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1160052,879	881630,704		1,316	,221
	INDUSTRY	,091	,036	1,092	2,566	,030
	TRADE	-,019	,039	-,112	-,479	,643
	POPULATION	-,011	,558	-,007	-,019	,985

a. Dependent Variable: AGRICULTURE

Furthermore, the regression coefficient resulted in the following model:

$$Y = 1160052.879 + 0,091X_1 - 0,019X_2 - 0,011X_3$$

Based on series of tests, it was found that the dominant effect of the land-use management went to industrial sector. When the agricultural area was replaced by industrial site, then the agricultural value changed along with the change in industrial value. In other words, the change in industrial sector would affect the value of agricultural sector.

Furthermore, trade sector did not always use agricultural area for trade or commercial activities because it dealt with vary products and population density did not have any direct correlation to the increasing value of the agricultural sector.

Industrial fast growth needed more accessibility to leverage the service and goods distribution. Facilities were significantly required. To overcome the problems that potentially arose, roads were built to enable distributional trips and commodity delivery. However, arterial roads were not always capable of accommodating the traffic volume. Emerging activities alongside the toll roads were also under strict consideration. Authorities had responsibility to manage the land-use and accessibility of the toll roads operation.

5. CONCLUSION

Based on the result of the data analysis, it is indicated that the dominant factor which influence on land-use is industrial sector. If the agricultural area which produce high value to the economic growth replaced by the number of new industries, then the economic growth value of the industry will be increased proportionally as well as the incremental of the agriculture value. This conclusion is obtained by the result of interpretation from SPSS calculation that indicates the highest coefficient value of industrial sector among others.

In other words, industrial sector brings the most impact after Jakarta-Cikampek toll road has been established. Therefore, attention is required toward the development of industrial sector in Karawang regency in order to obtain the maximum economic growth value.

In every land use management activity, such as toll road establishment, it is required to do the research related to the substituent sectors that give the hugest impact. The objective of the research is to obtain the information about the most influencing sectors, so that the government could focus to the development on those substituent sectors.

The planning of land use should therefore be to design by local government for the long-term care of the area. Industry area, agriculture, trading, and real estate are supposed to be well-managed. Moreover, those areas should be equipped by the access road which connected to them. Well-planned of land use in the toll road could avoid the negative impacts in the future.

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