Impact of Infrastructure Development on Economic Growth (Case Study of Lumajang Regency): A System Dynamics Approach

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Abstract

Infrastructure in Indonesia is currently still considered low, both in terms of quality and quantity when compared to other countries, especially in Southeast Asia, where the availability of infrastructure is a condition for a region to change the potential of the region into economic benefits for its people. Realizing this, the government is currently trying to increase the availability of infrastructure in all sectors needed to leverage the national economy. In fulfilling infrastructure needs to increase the added value of a region's potential to regional income, it is influenced by several important variables that need to be considered by policy makers in developing infrastructure financing strategies. This research aims to see and measure the impact of infrastructure development on economic growth by taking a case study in Lumajang Regency, East Java Province. Lumajang Regency was chosen as the object of research considering the region's GRDP growth is quite high while its economic growth is low. The Dynamic System Method is used in the hope that it can see the issue of infrastructure development as a whole both based on its impact and its linkages with other sectors. With the ability to simulate simultaneously, obtained the role of sectors that contribute to the added value of the construction sector with a proportion of 45.7% followed by the transportation and communication sector at 33.2% in second place, and the agricultural sector ranked 3rd with a score of 15%. Based on the results of various scenarios of infrastructure development policy, it is expected that the best policy is to increase GRDP.

Keywords
Infrastructure, Economic Growth, Dynamic Systems.

1. Introduction
The availability of infrastructure is crucial in economic activity and is one of the drivers of economic growth in a region. With adequate infrastructure, facilities in economic activity can be fulfilled. Infrastructure in Indonesia at this time, is still considered low both in terms of quality and quantity when compared to other countries, especially in Southeast Asia. Recognizing this, the government is currently trying to increase the availability of infrastructure in terms of quality and quantity in all aspects of infrastructure needed to leverage the national economy.

Responding to the efforts of the central government in improving infrastructure facilities, the regional government is the main object as the first step that must be addressed in order to create equalization of development in both the city and regional governments. In this reform then look at the existing situation by comparing the infrastructure budget and national income to see the extent of the impact of infrastructure development in leveraging economic growth as in Figure 1.

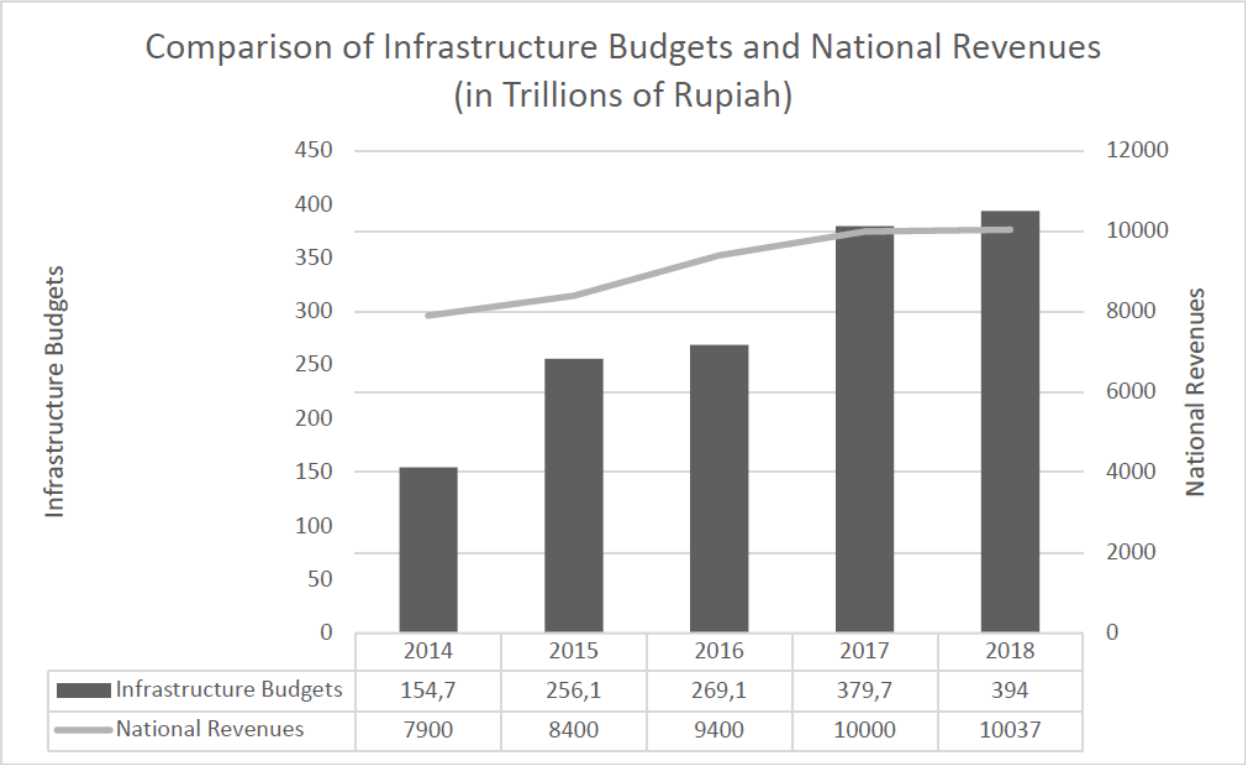

Figure 1. Comparison of infrastructure budgets and national revenues.
(Source: Processed BPS Data 2014-2018)

In this study, the focus is on the development of the island of Java because economic growth and infrastructure development is best centralized in this area, where this area can be a model for other regions. East Java was then chosen as the province with the highest economic growth. More specifically, Lumajang Regency was chosen because this region has proven to have a fairly good income, but has very low economic growth, which indicates the use of resources that cannot be converted to maximum income.

2. Literature Review

2.1. Infrastructure

Based on Presidential Regulation No. 38 of 2015 defines infrastructure as one of the technical, physical, hardware and software systems needed to provide services to the community and support the network to the community and the structure of the network itself, so that economic and social growth can run well.

2.2. Gross Regional Domestic Product (GRDP)

GRDP is the total value added generated by all business units or is the total value of goods and services by all economic units in a region. The higher the GRDP value of an area, this shows the high level of economic growth and illustrates that the region is experiencing rapid progress in the economy.

2.3. Local Government Revenue

Local Government Revenue is the revenue received from the regional tax payments, regional levies from the results of the area, the results of the management of separated regional assets and other legitimate regional original income. As state that Local Government Revenue is a regional revenue originating from various original economic sources of the region, it is expected that each regional government can build economic infrastructure both in their respective regions in order to increase their income (Mardiasmo 2002).

2.4. The Concept of Economic Growth

National economic growth and regional economic growth focuses on the process of increasing the production of goods and services in community economic activities (Djojohadikusumo 1994). Economic growth is defined as an increase in gross domestic product or gross regional domestic product (GDP / GRDP) without regard to the increase being greater or smaller than the rate of population growth, as well as changes in economic structure, community structure and the accompanying institutional progress or not.

2.5. Regional Infrastructure and Economy as a Systemic Linkage

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2.6. Dynamic System Simulation

Dynamic system simulation is a methodology for abstracting a phenomenon in the real world to a more explicit model. Simulation models can be formed that are caused by causal relationships (casual) which then affect the structure contained in the system, both directly between the two structures, as well as the effects of relationships that occur in several structures, until finally forming feedback (Satrio and Suryani 2017).

2.7. Research Gap

This research gap aims to determine the difference between the deeper study of previous studies by this research. All of previous research below focused on increasing economic growth by the scope differentiate in method and the objective sector. Research gap is shown in Table 1 below.

3. Methodology

Data collection in this study uses primary data and secondary data. For primary data the brainstorming method was used with the Lumajang District Development Board (BAPEDA) using Focus Group Discussion (FGD). Whereas for secondary data taken from the constitution of the Republic of Indonesia Constitution, RPJMD of Lumajang Regency, BPS Data of Lumajang Regency.

Forecasting is done as a prediction based on historical data about the uncertainty that will occur in the future. Before doing forecasting, plotting historical time series data in a scatter diagram is first to look at data patterns. Then a correlation test will be performed to test whether there is a strong association between the dependent variable and the independent variable. If the value of R in the correlation test is more than 0.8, then the correlation is declared very strong and can be continued at the Regression Analysis stage. Forecasting at this stage uses the Linear and non-Linear Regression (exponential, logarithmic, and polynomial) approach, which is modeled with a scatter diagram. In the regression model, the independent variable is time.

Table 1. Research gap.

No.	Author	Method	Objective Sector
1	Elhance and Lakshmanan (1988)	Neo-Classic Theory	● Economic
2	Ariyani et al (2015)	System Dynamic	● Industrial ● Electrical, Gas, and Water
3	Sardjono (2013)	System Dynamic	● Economic ● Communication
4	Maddepungeng et al (2017)	System Dynamic	● Industrial ● Economic
5	Keusuma (2015)	Non-Linear Regression	● Economic
6	Egbo (2018)	Ordinary Least Cost Method (OLS), Unit Root Test, Cointegration Test, and Granger Causality Test	● Economic ● Communication ● Electrical, Gas, and Water ● Agriculture
7	Pamudi (2018)	System Dynamic	● Economic ● Communication ● Electrical, Gas, and Water
8	Cigu et al (2018)	Panel Data Method	● Economic ● Communication ● Construction
9	Martin, Paris, and Rogers (1995)	Mathematic Modelling	● Industrial ● Economic
10	Kim et al (2017)	Computable General Equlibrium	● Communication ● Economic
11	Soleh (2012)	Input-Output Model	● Economic
12	This paper	Regression, System Dynamic, Linear Programming	● Economic ● Communication ● Electrical, Gas, and Water ● Agriculture ● Mining ● Hotel and Resto ● Services

In the Dynamic System Simulation stage, the making of Causal Loop Diagrams (CLD) and Stock Flow Diagrams (SFD) based on value-added from 9 sectors studied by the research team, as follows:

1. Agriculture sector
2. Mining & quarrying sector
3. Processing industry sector,
4. The electricity, gas and water supply sector,
5. Building-construction sector,
6. The hotel & restaurant sector,
7. Transportation and communication sector,
8. Financial & rental sector
9. Services sector.

The nine sectors are the main study of the Lumajang BPS, so in this case the research team is easier to model the CLD and SFD based on the results of a joint survey of the District Government Team and the Lumajang BPS. At this stage,

the dynamic system approach is the basis for estimating the value-added values of the nine sectors after the new policy is established. The linkage system between one variable with another regarding the nine sectors will be described using CLD (see Figure 2). Furthermore, CLD will be transformed into SFD with a mathematical model that is appropriate to the workings of adding value added that exists in each sector.

Model verification is a step to ascertain whether the model has been made according to the perception of the model maker by checking the model on the STELLA software. In addition to the model check, the verification process is also done by checking the unit or variable units contained in the model by doing a unit check on the STELLA software. From the results of checking the model, it was found that the model and the overall unit of variables were ok. So, it can be stated that this model can be accepted (verified).

Model validation is the stage of testing the model, whether the model is able to represent or describe the real system and is correct. Validation of the model is done by testing the simulation results with a real system or also called Mean Comparison.

The policy scenario design was obtained from the results of further discussions with the Lumajang Regency Government regarding the value of the variables that affect the overall monitoring system. The value of this variable is the percentage of capital expenditure and non-capital expenditure allocation from the APBD and the percentage of infrastructure and non-infrastructure fund allocation from the capital expenditure fund allocation. Based on the simulation results of the variable value policy that has been tried to run with STELLA 9.1.3 software, the recapitulation of the value-added value of each sector is obtained. The percentage value of the allocation of funds that results in the value-added value of each sector which is the maximum output expected in the simulation results.

After the value added is obtained, the needs of each sector, as well as the annual financing that has been predicted in the dynamic system methodology, the expected final output in the form of PAD will come out in accordance with the results or proportions that follow the needs. PAD that follows this need will continue to change in accordance with the increase in funding incurred. In this Linear Programming approach then determined from the parameters of dynamic system forecasting in the form of value added, the needs of each sector, as well as annual funding spent to obtain high PAD (as a function of purpose) by keeping the financing of infrastructure development as low as possible. The results of the proportions of each sector that have been determined from the Linear Programming methodology will then be input back into the dynamic stock flow system to relax the relationship with other variables that are not the main parameters in building a linear programming model. After that, a sensitivity analysis is done by trying to increase and decrease the proportion of each sector in a dynamic stock flow system before finally getting the best range/ratio that can be combined from the value of all sectors.

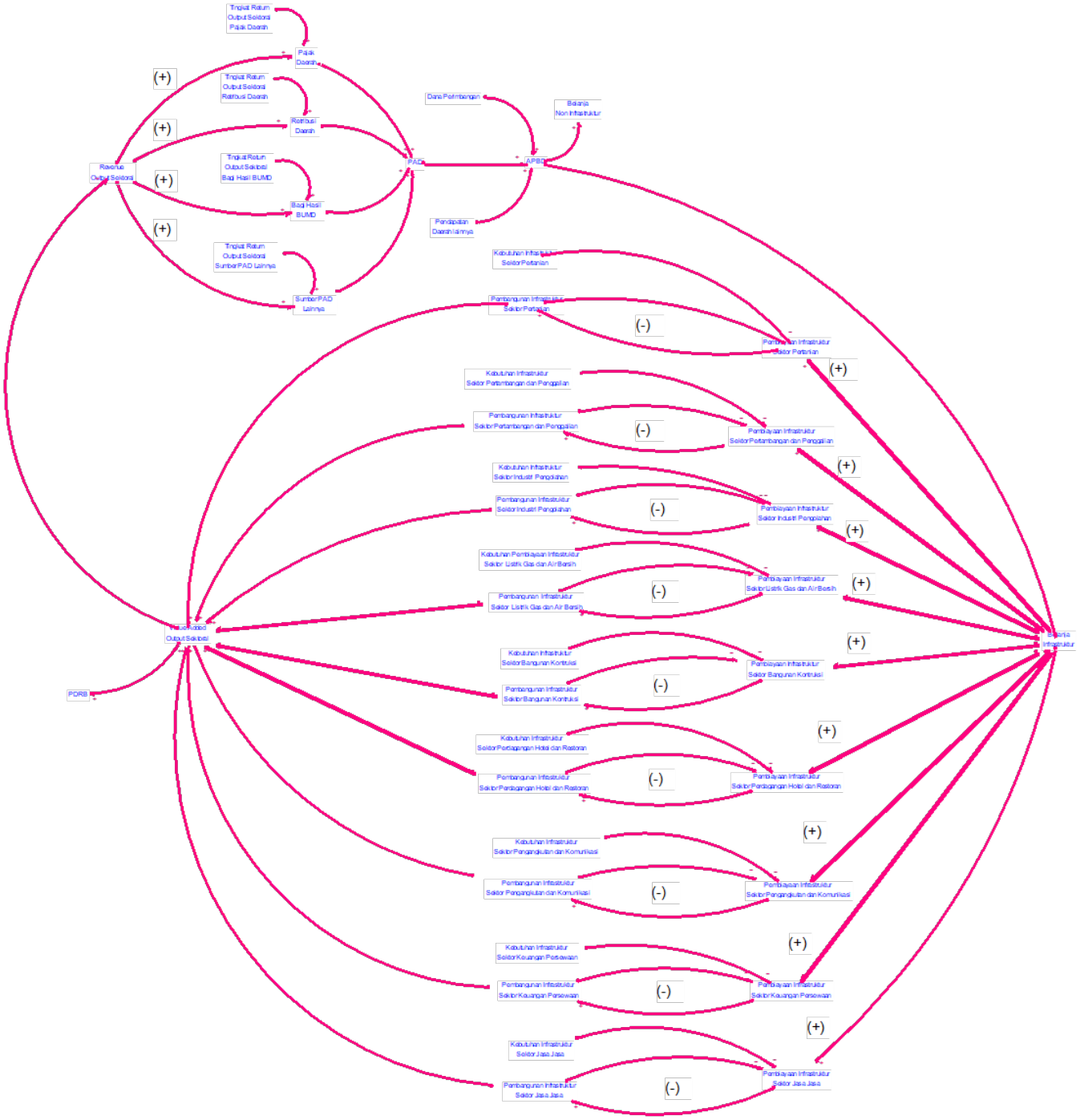

Figure 2. Causal loop diagram.

4. Result

Infrastructure of each sector tends to increase, but exceptions to the budgeted financing for the manufacturing industry sector and the construction sector which continues to fall every year. This is due to the trend of historical data which also tends to go down accompanied by the needs in these two sectors getting lower. In 2020 there will be an increase in PAD of 12.5%. This increase was quite high in previous years. This is because the investment budget is getting bigger and value added in each sector also increases every year. At a cost of 67.9 billion rupiah, the proportion of the construction sector represented by road infrastructure development must be the main focus with a weighting proportion

of 66% or almost ¾ of the overall budget allocation for infrastructure development costs. The financing of the agriculture sector then followed in second place. The sector that emphasizes irrigation infrastructure development gets a proportion of 16% or ¼ of the budgeted allocation for infrastructure development costs. Whereas the most recent proportion is occupied by the Manufacturing Industry sector which processes sanitation infrastructure in Lumajang Regency. In 2021, the increase is not as high as in 2020. Although it has decreased in terms of growth, the value generated in the PAD of Lumajang Regency is still higher than 2020 at the point of 480 billion rupiah. The dominance of the proportion for construction buildings fell by 2% to 64%. On the other hand, the proportion of the services sector which deals with the waste processing infrastructure and the transportation transport sector focusing on drainage infrastructure each rose by 8%. In other words, these 2 sectors are ranked third below the agricultural sector. Furthermore, in 2022 the growth of PAD increases will return to a better rate of 9.19%. Here the largest proportion of financing is dominated by the construction sector again dropping by 2%. Another sector that was later strengthened was the gas electricity and clean water sector. The sector that focuses on infrastructure services that provide electricity and drinking water networks rose 1% to a total proportion in 2020 of 3%. At the end of the regent's term, an increase occurred in the Lumajang Regency's PAD. Although not as drastic as in previous years, the level of infrastructure development in Lumajang regency shows a positive increase from year to year. In other words, the financing for infrastructure development directly or indirectly greatly affects the regional income of Lumajang Regency itself. In 2023, it is estimated that with an increase in the total budgetary cost of infrastructure development in the figure of 69.2 billion, the proportion of development for the construction sector must be reduced again. And the most stagnant sector is seen in the financial and rental sectors, which each year only has a proportion of budgeting for infrastructure development at 2%.

5. Conclusion

Based on the results of the applied scenario, the value-added value in each sector is a manifestation of the profit from each rupiah invested in a sector. The construction sector, the clean water gas electricity sector, and the transportation sector are sequentially a priority sector with an average value of 45.7, 33.2, and 15. The building construction sector itself is involved in road and bridge infrastructure, while clean water gas electricity focuses on infrastructure electricity and drinking water networks as well as the transportation sector are more dominant in building transportation service infrastructure.

An increase in investment in infrastructure development is evidenced by an increase in the development budget at an average rate of 500 million each year. The increase in investment was not accompanied by economic growth represented by fluctuations in the Lumajang Regency's PAD in the forecast year.

By looking at the regional income output from each strategy, 2 main indicators are applied, namely PAD and infrastructure development budget. For the highest PAD it is held by scenario 1 with a scenario of increasing the PAD target at 75% while for the lowest infrastructure development budget is held by scenario
3. The combination of these two indicators is done by looking at the ratio of each parameter, where the best ratio between potential PADs is achieved with the minimum budget expenditure falling in scenario 3 with an average value at the level of 50% while making scenario 3 the best scenario.

Exit scenario 3 as the best scenario, then the input value of this scenario is used as a strategy especially in determining the allocation of financing for infrastructure development in 7 main sectors. The allocation is divided into the agricultural sector 15–17%, the manufacturing industry sector 0.07–0.11%, the gas and water supply sector 2.14–2.42%, the construction sector the construction sector 60.83–65.36%, the transportation and communication sector 7.26–8.34%, the rental finance sector 2.14–2.42%, and the services sector at 7.24–8.3%.

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