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Model of Sustainable Urban Infrastructure at Coastal Reclamation of North Jakarta

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Abstract

High economic growth in the city was not balanced with adequate infrastructure provision. Northern Jakarta has been a tangible example of how the development of the city had ignored the environmental conditions, this region has been developed into a very dense and slums areas, and compounded with a huge problem of the exceeding of environment carrying capacity. A massive development of coastal reclamation at north of Jakarta could be used as a model of development based on ecological approach. This study is aiming to examine the concept of sustainable urban infrastructure at coastal reclamation of North Jakarta, which is an approach that integrates urban development components namely city community capital, the city infrastructure needs and ecological city components. To analyze the relationship between these components, this research was carried out by Structural Equation Model (SEM) which is multivariate analysis that analyzes the relationship between complex and simultaneous variables. The application of sustainable urban infrastructure model was done by Goodness of Fit Index (GOFI) value indicators to see how the data support the model on on total of 147 survey respondents. The indicators for each of these six models showed a good fit to ecological city theory, with chi-square of 3.60, df of 4 p-value of 0.45306, and root mean square error of approximation (RMSEA) below 0.08. Latent variable Confirmatory Factor Analysis (CFA) test showed very good match, model is saturated/perfect fit. Therefore, it can be stated that the data strongly support a model for the latent variables. This model of sustainable urban infrastructure in coastal reclamation can be applied to overcome the problems of urban sustainable development.

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Keywords: Sustainable City, Urban Infrastructure, ecological city component, Coastal Reclamation

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1. Introduction

Progress and development efforts Jakarta as the capital of Indonesia is closely related to the dynamics of the socio-cultural, socio-economic, and political. The implications of these developments materialize in the development and growth of Jakarta was physically shown to the physical growth of the city that continues to run indefinitely kept ongoing from time to time. Jakarta as the capital city is characterized by rapid population growth. In 1980 the population of Jakarta was recorded at 6.5 million and 10 years later from 1990 to 2001 has reached 8.25 million with growth rate of 2.4% on average per annum. Taking into account the population of immigrants to Jakarta and commuters, the number has reached 9.7 million in 2010 [1].

The growth of its economy based on GDP in 1990 was reached 8% and this figure is likely to increase steadily to decline to 6.5% after the financial crisis in the late 1990s decade. In the last three years, income per capita it currently has an average 2 trillion per year. In the era of globalization, the impact of economic developments strengthened the tendency of concentration of various funds in Jakarta. The very real implications of this population growth are the increased demand of urban space. Physically, the developments of Jakarta since last four decades is characterized by the large area of the city development, meanwhile open area which was originally planned as a conservation area of the city is also diminishing, especially in the area of suburbs.

On the other hand, Jakarta which covers the area of 662 km2 since the expansion of the city in 1972, can not enlarge its area because of the law. Approximately 67% of the land area of Jakarta has been developed and 33% area has not been established. Therfore, in the 1990s it had contemplated the possibility of opening new land areas through technology development reclaimed island in the northern coast of Jakarta. In connection with this state of thought, Jakarta was prepared two basic policies which are,

- Increase the intensity of space including urban renewal.
- Possibility to develop the area extensively with due to the principle of sustainable urban development.

Jakarta administration has prepared a plan of the city's infrastructure development in the North Coast Region for both the reclamation and revitalization of the old waterfront that has decreasing its environmental conditions. But, the implementation of this kind of plan is always cause social unrest. As a reference, several reclamation plan that has been carried out in other cities in Indonesia resulted in the emergence of an impact on urban development and social environment because of lack of good planning and implementation [2][3]. On the other hand, it has become the common view that a development good attention to the development of the society, social and environmental needs higher economic cost. Therefore, sometimes they necessitate a development environment in order to achieve higher economic value.

Suzuki et al. [4] explains that the principles of sustainable development must take into account and carefully assess the costs of sustainable development investments by calculating and considering the "operational costs" after construction is completed. In other words, operating and maintenance costs should have continuity so as not to "burden" in the future. The implications of this approach is planning an investment program is determined by the sustainability (sustainability) of the operating and maintenance costs, especially in the utilization of water resources and energy resources.

The spatial planning Strategic Areas of north coast of Jakarta is formulated by Strategic Areas North Coast Region vision itself which is "Sustainable Green City Pantura Jakarta"[5]. Definition of sustainable green city is a friendly environment by utilizing effective and efficient water resources and energy, reduce waste, implement an integrated transport system, ensuring the health of the environment, natural and man-made environmental synergy, based on urban planning and design in favor of the principles of

sustainable development [6].

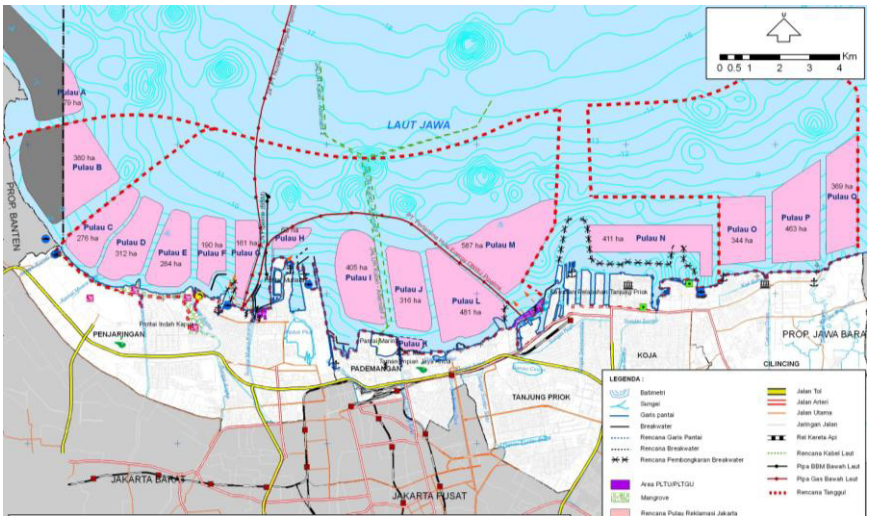

Figure 1. Coastal Reclamation Area of North Jakarta.

Source: Jakarta Spatial Planning 2011-2030[1]

Through these concepts, the development of sustainable coastal development of Jakarta is expected to serve as role models in the development of reclaimed areas in Indonesia. From this vision, the goals formulated spatial Jakarta North Coast Region[5] is:

- Achieve alignment on the reclamation plan and the existing coastal
- Achieve Strategic Areas north coast of Jakarta as an independent city that is not dependent on the land area of Jakarta and is expected to help address the issues contained in Jakarta mainland
- Realizing protection space function and prevention of negative impacts on the environment
- Building a waterfront area that will position the city parallel to other important cities in the world
- Helping to address issues of urban growth orientation that tends to lead to a conservation area in southern Jakarta by creating a more attractive opportunities and provide land for development activities in the area of North Jakarta
- To encourage and accelerate the growth and development of mass transit infrastructure
- It is an important part in the development of program improvement, improvement, and rehabilitation of the quality of the environment, including the conservation and restoration of ecological functions of the area of North Jakarta
- Creating a more efficient urban structure through the integration of land use, transportation infrastructure, and facilities services other cities

2. Method

The concept of urban infrastructure of the city in support of the sustainable city at coastal reclamation of North Jakarta which is proposed in this study is an approach that integrates urban development components namely city community capital, the city infrastructure needs and ecological city components.

Therefore, to support the concept of sustainable urban infrastructure, a comprehensive system should be taken to improve the efficiency of resource use. To obtain the efficient use of resources (especially natural resources), urban development is expected to be integrated into a unified system, especially in the utilization of natural resources. Based on the description, drafted the framework of the research concept that can be seen in Figure 2.

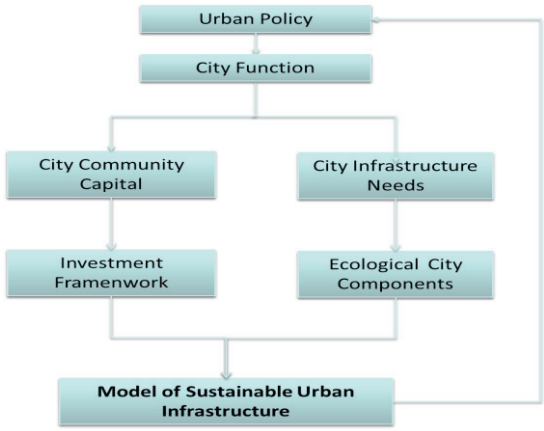

Figure 2. The framework concept of Model of Sustainable Urban Infrastructure

Ministry of Environment[7] states that ecological city can be broken down into components that make up the physical environment of the city. As the diagram below, there are at least eight (8) components of the ecological city:

a. Land use
b. Transportation
c. building
d. open space
e. Network infrastruktur and waste
f. energy system
g. hydrology
h. Air, sunshine

The eight components of ecological cities mentioned above are interrelated and form a synergistic of physical environment of the city. City's physical environment must enables people livable, on the contrary, the bad quality of the physical environment of the city would make the bad quality of life of people who live in the city.

2.1. Research Model

Based on the framework and operationalization of research variables can be formulated path diagram basic research model as described in the Structure of Causal Relationships in Figure 3, using Structural Equation Modelling (SEM). This study used six components of ecological city to design and develop the questionnaire. “Land Use” indicated residents’ views about suitability of land use and density. “Transportation” indicated the views on the availability of public network. “Building” indicated residents’

views about livability. “Infrastructure Network and waste” indicated residents’ views about the quality of city infrastructure and waste. “Energy” indicates the views on energy conservation of influential people which is describe in Table 1.

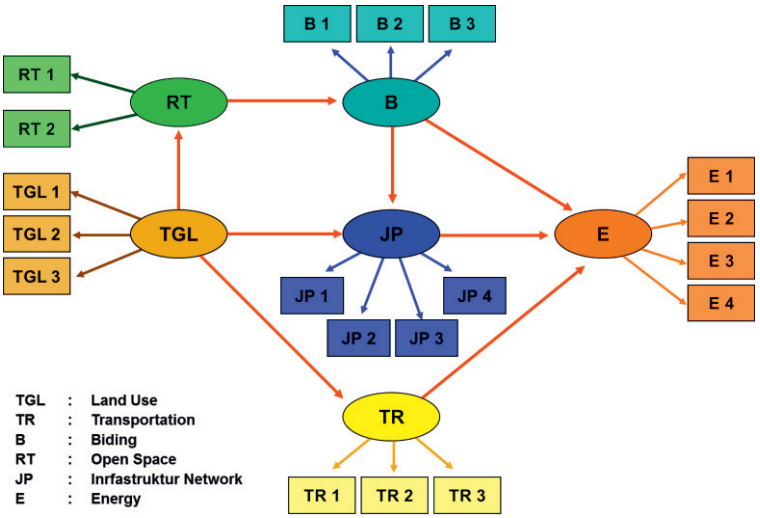

Figure 3. Structural Causal Relationship

Table 1. Variabless and corresponding items in sustainable urban infrastructure analysis of North Jakarta’s residents.

Latent Variables	Item	Observed variables
Land use	TGL1	Suitability of residence with land use
	TGL2	Availability of open space
	TGL3	Density of building in their area
Transportation	TR1	Accesibility of public transport
	TR2	Availability of public transport
	TR3	Preference between public and private transport
Building	B1	Livability of their residensies
	B2	Density of households occupancies
	B3	Maintenance of public building
Open Space	RT1	Availability space for social activity
	RT2	Availability space for water conservation
Infrastructure Network	JP1	Adequate service for transporting solid waste
	JP2	Role of waste segragation in the area
	JP3	Adequate service for waste water
	JP4	Adequate road network
Energy	E1	Adequate service for energy supply
	E2	Suitability of household’s energy using
	E3	Using of energy-efficient appliances
	E4	Using of alternative energy

This research conducted a Confirmatory Factor Analysis (CFA) to examine whether each construct could be explained by its indicators (observed variables); then, Structural Equation Modeling (SEM) was utilized to examine the model fitness and test causal relationships. Path Analysis was used to identify the influence of constructs on the model.

2.2. Sampling and Location of Study

For the determination of the number of samples, the first step is the determination of district based on purposive sampling. District Penjaringan in North of Jakarta region is chosen because it lies in the border of reclamation area and it will effected directly from the impact of reclamation projects. This area is planning to be revitalized along with the reclamation plan. The second step is the determination of the number of the sample. The sample is part of the population that was taken as a source of data and can represent the whole population. Based on the determination of the population, the sampling technique chosen is Probability Sampling with Proportionate Random Sampling [8], by using the formula Slovin :

$$n = N / 1 + N.e2 \quad (1)$$

where: n: Number of samples
N: Number of Population
e: the standard deviation

There fore 147 individual households is selected proportionally from 5 (five) village from the total population of District of Penjaringan in North of Jakarta region. The researchers used questionnaires and face-to-face interviews to collect information.

3. Results Analysis

3.1. Social and economic of the community at the boundary coastal reclamation

Characteristics of the population: The majority of the population is aged over 50 years, with a high school education level and the average number of families 3-4 people. Revenue per month on average-1,000,000 2,000,000-with the main job as self-employed head of household (trade, shop, etc.) and labor (carpenters, taxi drivers, driver, etc.). The average monthly family expenditure was Rp. 1,000,000 - Rp. 2.000.000, -

Characteristics of housing: home ownership status is mostly proprietary to the average building area and wide less than 60 M2 and the form of semi-permanent structures. The average number of occupants is 5-8 people where the use of homes and buildings just as home. On average, each home has installed power of 1300 watts and layout of the building near the main road (less than 30 M).

Water use: The source of water used daily in the home comes from PAM and private wells with hand pumps used for drinking, cooking and bathing, laundry, toilet (MCK). Average water use for domestic purposes is less than 1 M3 and the average cost to get clean water for 50,000 - 70,000 per month. Water obtained from sources / facilities used an average taste fresh, colorless, and odorless.

3.2. *Analysis of model fit*

A confirmatory factor analysis was conducted to see the level of model fit. Wijanto,2008 [9] suggest that a critical ratio (CR) of 0.7 and above indicates good composite reliability; average variance extracted (AVE) value of 0.5 and above indicates a good convergent validity; goodness-of-fit (GFI) and adjusted goodness-of-fit (AGFI) values of 0.8 and above indicate a reasonable fit; comparative fit index (CFI) value of 0.9 and above indicated a well-fitting model; mean–square error of approximation (RMSEA) value below 0.08 indicated a comparatively good fit and x_2/df value below 5 indicates that the model is acceptable.

As for the data which is after the model examination had an excellent match will resulted in the output of SEM test as: Chi-Square value = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the *model is saturated or perfect fit*. Therefore, it can be concluded that the data is strongly support the model for that variables.

After having a good fit for all model the next step is to conduct validity analysis of the model. Wijayanto, 2008 [9] sugest the t-value ≥ 1,96 and *Standardized Loading Factor/* SLF ≥ 0,50 indicates a good convergent validity.

3.3. Model Urban Infrastructure in Land Use

First step to see how data influence the model is using indicator *Goodness Of Fit Index* (GOFI) of latent variable of the construct land use. From the analysis is found out that latent variable land use have Chi-Square = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the *model is saturated or perfect fit*. Therefore, it can be concluded that the data is strongly support the model for that variables.

In the model of urban infrastructur in land use, TGL1 influenced urban infrastructure significantly ($p<.05$). However, the influence of TGL2 and TGL3 was not significant. Based on the model analysis indicate observed variables TGL1 is the most influential variable in the latent variable "land use". This variable is public opinion about the importance of suitability of land use, it shows that people already know and realize the importance of using land properly based on the spatial plan of the city.

3.4. Model Urban Infrastructure in Transportation

From the analysis is found out that latent variable land use have Chi-Square = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the *model is saturated or perfect fit*. Based on the model test measurements indicate observed variables TSP3 is the most influential variable in the latent variable "transportation". This variable is public opinion about the important of using public transport other than private vehicle, so that may be a consideration for the government.

3.5. Model Urban Infrastructure in Building

From the analysis is found out that latent variable land use have Chi-Square = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the *model is saturated or perfect fit*. Based on the model test measurements indicate observed variables BGN3 is the most influential variable in the physical latent variables on "building". This variable is the opinion of the public about maintain public facility must be done together between government and society, it shows that people already know and realize the importance of maintaining public facility. The availability of a public facility to be an important factor and should be a concern for the city government.

3.6. Model Urban Infrastructure in Open Space

From the analysis is found out that latent variable land use have Chi-Square = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the *model is saturated or perfect fit*. Based on the model test measurements indicate observed variables RT1 is the most influential variable in the latent variable "open space". This variable is public opinion about the important of open space to do the social activity of the citizens, so that may be a consideration for the government.

3.7. Model Urban Infrastructure in Infrastructure Network

From the analysis is found out that latent variable land use have Chi-Square = 0, df = 0, P-value = 1, RMSEA = 0.00, which means the model is saturated or perfect fit. Based on the model test measurements, showing three of four observable economic variables influence the latent variables of the "infrastructure network". It is includes the important of waste management, waste water management and road infrastructure that needs to be a concern for the city government.

3.8. Model Urban Infrastructure in Energy

Based on the model test measurements show all variables are influential in the "energy" latent variables. These variables are the opinion of the public about the importance of using alternative and eficient energy, it shows that people already know and realize the importance of energy and should be a concern for the city government.

3.9. Analysis of Structural Model(t-value)

Public understanding of the sustainable urban infrastructure are influenced by land use, transportation, building, open space, infrastructure network and energy. This study revealed that the most influential factor of several observed variables. Unobserved variables that have an influence major concern in planning the strategies to develop new reclamation area along the north coast of Jakarta that will resulted in the better living of the people.

Structural model testing stage simultaneous show that all latent varabel used to support a model based on the theory J.Peaget SEM. The indicators for each of these five models showed a good fit to ecological city, with chi-square of 3.60, df of 4 p-value of 0.45306, and root mean square error of approximation (RMSEA) below 0.08.

The result on the structural analysis 9(t-value) shows in Figure 4 where strong relationship is indicated by t-value $\geq$ 1,96.

a. land use influence infrastructure network significantly (t-value=1.97)
b. land use influence open space strongly (t-value=4.32)
c. infrastructure network influence energy significantly (t-value=2.92)
d. transportation also influence energy strongly (t-valuee=3.71).

The other relationship is not significant or no connection.

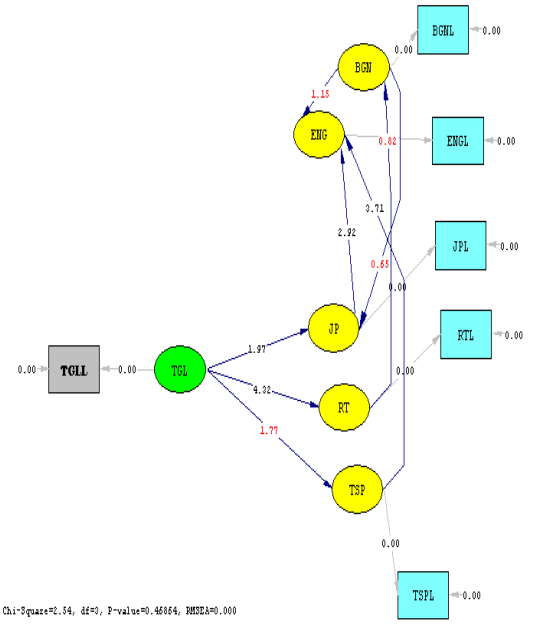

Figure 4: Analysis of Structural Model

4. Results and Discussions

The application of ecological city theory on a model of sustainable urban infrastructure at coastal reclamation of north Jakarta with a total of 147 survey respondents, using data analysis techniques Structural Equation Model (SEM) which is one of the multivariate analysis that analyze the relationship between complex and simultaneous variables. The first step to see how the data support the model used Goodness of Fit Index (GOFI) value indicators. The indicators for each of these five models showed a good fit to ecological city, with chi-square of 3.60, df of 4 p-value of 0.45306, and root mean square error of approximation (RMSEA) below 0.08. Latent variable Confirmatory Factor Analysis (CFA) test showed very good match, model is saturated/perfect fit. Therefore, it can be stated that the data strongly support a model for the latent variables.

The results revealed that people's understanding of ecological city is still lacking, especially the relationship between infrastructure network and transportation for energy use. It is understandable because most of the respondent are low income people with low standard of living. This factor should be major concern of the government planning how to develop the concept of ecological city which must taken into account the carrying capacity of the environment, social and economic components. Development of the land reclamation and integrated revitalization of coastal area must be conducted jointly designated as a regional planning. Implemented in an integrated way through a mutually beneficial business partnership between local government, communities and businesses.

Reclamation area development must be able to generate added value for the revitalization of the old coastal plain through cross-subsidies are realized with the following programs:

- Provision of housing
- Repairing fishing village
- Slum improvement
- Provision of adequate infrastructure
- Providing jobs for the residents of North Jakarta area so as to create an increase in standard of living.

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