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Sustainable Reclamation Model: Study Case of Makassar Waterfront Area

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Abstract: Although, many studies have been done using index sustainability research for developing sustainability index, especially for reclamation area is still lacking. Similarly, a model of sustainable waterfront area has been studied by many scholars, yet a model of sustainable improvement area is also still lacking. The aim of this study is to develop a model of sustainable improvement using Structural Equation Model (SEM). The SEM is used to analyze the relationship between indices which contain three indicators from physical aspects of sustainable development. The indicators are waterfront resource, building and coastal infrastructure. The study provides a novel method for evaluating the sustainability of reclamation using Reclamation Sustainability Index (RSI) by Analysis of Moment Program Structures (AMOS). The research approach is quantitative and the survey is conducted to obtain quantitative data from questionnaires to find information and perceptions of the community about sustainable reclamation. The study area is in Makassar Waterfront City, Indonesia. SEM used with some steps such as model specification, identification, estimation and eligibility test. It found out that the most influential variables in observed are open space, water conservation, protected area, density, the condition of main road and distance from the residential area. The model will be a useful tool to evaluate and monitor the reclamation development. The information generated will be used to predict urban coastal zone scenarios for sustainable development.

Key words: Reclamation, structural equation model, reclamation sustainability index, relationship, influential, infrastructure

INTRODUCTION

Urban sprawl commonly called for the land changes is the rapid expansion of low-density periphery into the city have implication for the sustainability of the environmental and socioeconomic (Yuan *et al*., 2005). The human activities in the coastal zone change the land use of the coastal area (Lo and Gunasiri, 2014; Pernetta and Elder, 1993). Reclamation is one of the phenomena of urban sprawl in the coastal zone (Surya, 2015). The changing is from non-urban to urban area by the process of recovery. Land reclamation is one of the solutions to ease the pressure of insufficient land because of population increase (Peng *et al*., 2013).

Reclamation has many impacts. Although, coastal restoration can create useful space for commercial use, it usually comes losses of the environment (Peng *et al*., 2013). The environmental damage that occurred in urban areas caused by mismanagement of urban land use (Lal *et al*., 2017). Environment and human systems are including the process of land use changes at the peri-urban area (Deep and Saklani, 2014). The settlements in the fast-growing public need to be monitored to design a sustainable urban environment (Deep and Saklani, 2014). The varied and vital information of sustainable urban management viz., urban infrastructure and different socio-economic parameters are being used in urban topics (Lal *et al*., 2017). There is a need to provide urban sustainable parameters to manage the coastal land use.

Changes in urban shape can correlate with the developmental stages in conceptual models of coastal resort evolution (Xie *et al*., 2013). Models used as a tool in the decision-making process is already known for a long time (Widodo, 2011). The models have been growing on rapidly starting from a simple model to a relatively complicated using a computer (Widodo, 2011). In addition to predicting the symptoms of a system, a model can also improve the understanding of the area. While the concept of reclamation will be made through the research of for example the growth of the urban area, a real urban nature, more efficient transportation systems and land suitability (Leung, 1991).

Reclamation has widely performed in many cities in the world. Improvements are carried out in China, South Korea, Holland, Singapore and Japan (Peng *et al*., 2013). All of the reclamations are the great work that has already been through the process of planning and supported by the accurate and thorough study (Djakapermana and Eng, 2010). The reclamation has also been carried out in Indonesia, for example, the recovery in

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Benoa Bali which is a type of land reclamation because of genetic damage which occurred in the region and in Jakarta's North Beach in which there will be 17 islands to reclaim. Another reclamation is on the beach of Losari Makassar, namely Centre Point of Indonesia (CPI).

The immense growth of the population then combined with the thought and technology that develops in creating the needs associated with modern urban development ideas. In its evolution, the mass media became a source in the process of setting up the latest global architectural concept. The architectural concept which was discussed by the international community has been incorporated in the literature and has become the basis for the development of a new architectural trend. The difference of this concept because it focused on the optimization of functional and social aspects of the environment (Petrovich and Victorovna, 2016).

From many types of research about reclaiming or reclamation, there is still lacking research which discusses recovery models based on sustainability index. In Makassar City, the rule and the method of recovery have not been sufficient to produce sustainable regeneration area. This research will help government and stakeholders to manage and plan recovery development. Hence, this study aims to provide a model which is expected to be a novelty in science that is developing a sustainable recovery index.

MATERIALS AND METHODS

The study area located in Makassar City, i.e., in the West-South coast of South Sulawesi in coordinate point between 119°18'27.97" 119°32'31.03" East longitude and 5°3'30.81" 5°14'6.49" South latitude. Makassar City is the capital city of South Sulawesi Province and the fourth largest town in Indonesia with a total area of 175.79 km^2 and with coastal line 52.8 km, consisting of the main coastal land of 36.1 km and the small island of 16.7 km. This research conducted in the Southern coastal zone of Makassar, South Sulawesi Selatan which was delineated based on Regulation of Governor of South Sulawesi No. 17 of 2008 concerning detailed spatial plan of integrated business global area as shown in Fig. 1.

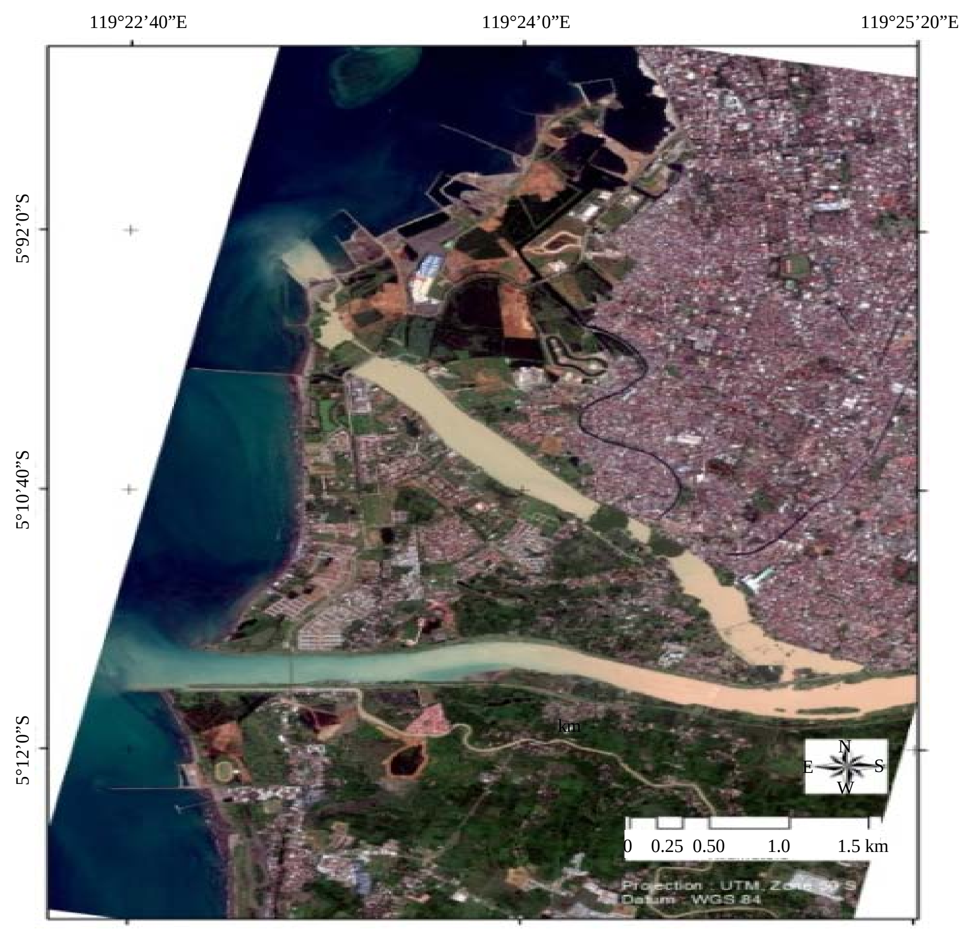

Fig. 1: Research location through satellite image of 2014

Table 1: Elements of questionnaire survey

Items	Community perception	Variable symbol
Green open spaces	Facilities (sports, children's games, children's), green open space area of occupancy	RT1
	The frequency of conducting activities in the area of green open spaces	RT2
	Conditions of green open space in residential/dwelling area	RT3
Water conservation	The availability of space/water conservation lands (reservoirs/lakes) in the reclamation area	KA1
	The condition of conservation of water (lake) in the reclamation area as a water catchment	KA2
	The is the availability of flood conditions or inundated water	KA3
Needs of land	The availability of land/space for social events	KR1
	The availability of space/land for work/seek (economy) in the area	KR2
	The availability of space/land for public buildings (schools, hospitals)	KR3
The river's estuary	Distance from dwelling to river mouth/residence in reclamation area	MS1
	Condition of Estuaries at reclamation area	MS2
	The availability of people's activities that use the estuary as a liaison between the sea and land	MS3
The protected area	The distance from residential/dwelling area to protected areas (mangroves/mangrove)	KL1
	The conditions of the protected area (the mangrove forest/mangrove)	KL2
	Function of nature reserve as it is in the reclamation	KL3
Building coverage	The is conditions of eligibility for residence (housing/home) society	KB1
	The level of density of residential/living area in the surrounding environment	KB2
	Number of people living in one house in surrounding area	KB3
Road infrastructure in residential	Condition of the structure of road in the residential area	IJ1
	The width of the residence road	IJ2
	Street lighting in residential areas	IJ3
Public transportation	The level of ease access to use public transportation	TP1
	The availability of access to public transportation	TP2
	The availability of choice in using public transportation	TP3
Road network	The condition of the surface structure of highway/main road	JJ1
	The ease of the range of environmental street	JJ2
	The distance of the residence/place of residence to highway/main road	JJ3

The sample consisted of permanent residents living in surrounding area of reclamation area of Makassar City. The residents were approached in their neighborhoods and asked to participate in the study. A questionnaire personally administered to the respondents who were approached mainly in around their neighborhoods using a random day/time (Stylidis *et al*., 2017). The data collected between November 2016 and January 2017 using self-administered questionnaires that were distributed by four trained research assistants.

This survey is the media to find out what the public responses are over the implementation of the reclamation. The primary objective of the questionnaire is to obtain information and perceptions of the community concerning sustainable recovery. The information collected will be a reference to analyze in the sustainable recovery model.

A single questionnaire comprising three sections was developed to investigate the proposed model, namely the coastal resource indicator, building indicator and infrastructure indicator. The first part was aimed to measure the resident's perception concerning reclamation area regarding the sustainability of the field from a coastal resource point of view. The second part was designed to measure their understanding about the buildings in the reclamation area whether they were sustainable or not. The last part was to gauge the sustainability of the field from an infrastructure point of view.

To know the size of survey sample using simple random sampling method. It is not surprising that the result showed that the larger sample size, the more accurate the data would be (Zhou *et al*., 2016). The sample used for SEM analysis is about 200 samples (Zhou *et al*., 2016). Therefore, 270 questionnaires handed over from which 250 identified as valid surveys (Table 1).

This study developed an appropriate model to form the sustainable reclamation of the coastal area. The research approach is quantitative in nature and the method of survey was conducted to obtain quantitative data through questionnaires. The purpose of the study to describe the causality relationship between sustainable indices of reclamation (Renald *et al*., 2016).

The analytical method of the research is Structural Equations Model (SEM) to obtain a model of sustainable restoration. Selection of this approach of models using the SEM can explain the relationship between variables that are dynamic in nature. SEM used as a modeling analysis capable of analyzing endogenous and exogenous variables (Zhou *et al*., 2016). It can also model latent variables in particular with the linear combination (Zhou *et al*., 2016). The procedure of SEM (Bollen and Long, 1993) includes the steps of model specification, identification, estimation and test compatibility models. SEM is a covariance structure analysis method consisting of measurement and structural model. It has a great advantage in the analysis of the interaction between the single index and the influence of the unique index to the entirety (Zhou *et al*., 2016). Structural Equation Modeling (SEM) was utilized to examine the model fitness and casual test relationships (Azwar *et al*., 2013).

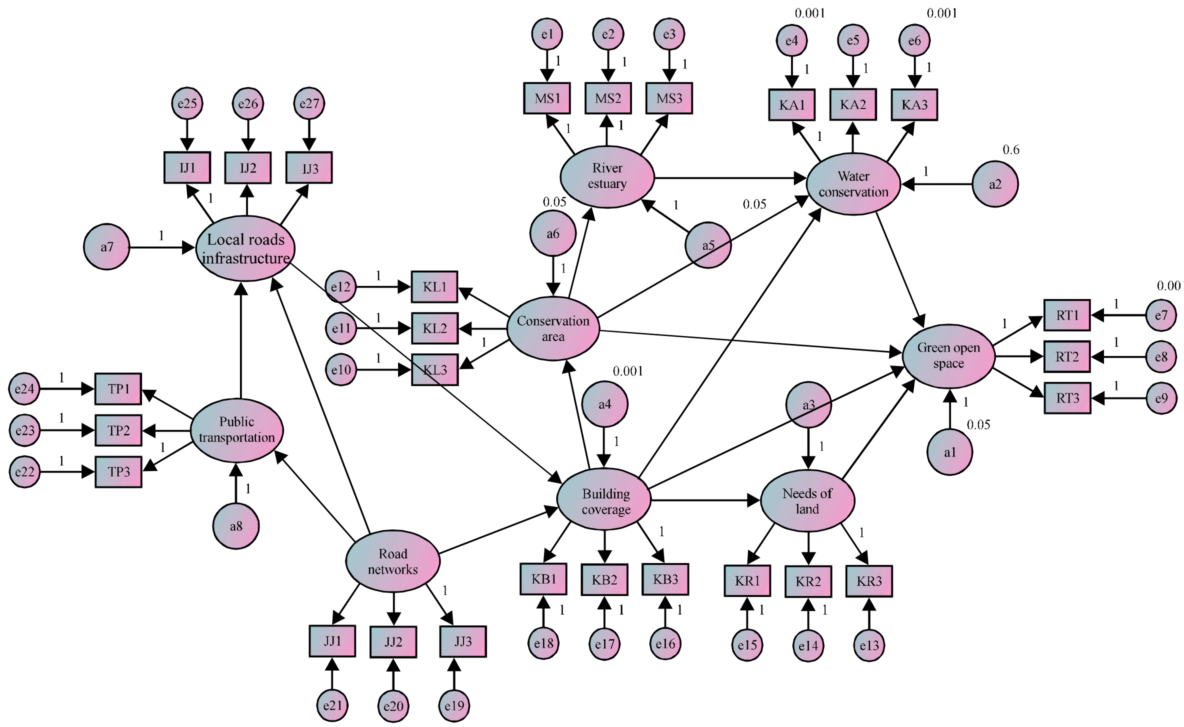

Fig. 2: Research model on Structural Equation Models (SEM)

RESULTS AND DISCUSSION

This study used techniques of Structural Equation Model (SEM) for data analysis which widely used in current empirical research. The program used in data analysis is Analysis of Moment Program Structures (AMOS) Version 10. One of the methods of estimation commonly employed in SEM is Maximum Likelihood (ML). The design of SEM made reference in research as well as the stages in data analysis with SEM program AMOS as in Fig. 2.

Assuming SEM analysis by evaluation of data normality: Assumptions of data normality tested by looking at the values of skewness and kurtosis of the data used (Rose *et al*., 2015).

If the value of the CR is at a range between ±2.58, then data can still be expressed at the level of significance of Gaussian 1%. Results of testing the normality of data shown in Table 2.

The results of the multivariate normality assessment at the column Critical Ratio (CR) shows the calculation result of 2.132 which means far less than the value of the limit ±2.56. Thus, the conclusion that can draw is that the results of the assessment against normality research data used in the model of empirical studies. It is normal in unvaried and multivariate normality which means very viable for use in the next estimation.

Table 2: Normality assessment

Variables	Min.	Max.	Skew	CR	Kurtosis	CR
IJ3	2.000	4.000	-0.143	-0.937	0.383	1.250
IJ2	2.000	4.000	0.020	0.129	0.237	0.775
IJ1	2.000	5.000	1.010	6.596	0.194	0.634
TP1	2.000	5.000	-0.146	-0.951	-0.152	-0.497
TP2	2.000	5.000	0.324	2.115	-0.099	-0.323
TP3	2.000	5.000	0.440	2.874	-0.031	-0.102
JJ1	3.000	5.000	-0.091	-0.592	-0.691	-2.256
JJ2	2.000	5.000	-0.601	-3.926	0.472	1.540
JJ3	3.000	5.000	-0.088	-0.574	-0.401	-1.311
KB1	2.000	4.000	0.792	5.172	-1.047	-3.418
KB2	2.000	4.000	-0.549	-3.583	-0.473	-1.546
KB3	2.000	5.000	0.362	2.363	-0.151	-0.492
KR1	1.000	4.000	-0.133	-0.866	-0.732	-2.390
KR2	2.000	5.000	0.012	0.078	-0.357	-1.165
KR3	1.000	4.000	-0.229	-1.498	-0.244	-0.798
KL1	2.000	5.000	-0.905	-5.911	0.554	1.809
KL2	2.000	5.000	-0.253	-1.653	-0.540	-1.762
KL3	1.000	5.000	-0.348	-2.275	-0.011	-0.037
RT3	1.000	4.000	-0.303	-1.981	0.013	0.043
RT2	1.000	3.000	0.646	4.218	0.627	2.048
RT1	1.000	5.000	0.489	3.195	0.515	1.681
KA3	1.000	3.000	1.426	9.316	0.458	1.496
KA2	2.000	4.000	-0.051	-0.330	-0.553	-1.805
KA1	2.000	4.000	-0.016	-0.108	0.118	0.385
MS3	1.000	5.000	-0.430	-2.806	-0.485	-1.585
MS2	2.000	5.000	-0.417	-2.723	-0.262	-0.855
MS1	1.000	5.000	-0.848	-5.537	-0.551	-1.798
Multivariate					10.545	2.132

The goodness of fit is an indication of a comparison between the model specified by the matrix covariance between indicator or observed variables. If the goodness of fit of the resulting model was fit, then the model can be recommended and vice versa, if the goodness of fit of the resulting model was bad (does not fit), then the model should be rejected or a modified model should perform. Altogether, three types of measure of goodness of fit used which are summed up in Table 3.

The eligibility criteria of the model of perfect appropriate measure consist of five, namely Chi-square, test probability, normal Chi-square, the goodness of fit indices and root mean error of approximation squared. All show the value that provides as shown in Table 4, so, it concluded that the model fit model formulated.

Hypothesis testing research: The first thing to be considered is to do test the hypotheses of causality that developed in this model. It needs to test for zero hypothesis which states that the regression coefficient between relationships is equal to zero through the observation of the value of the component regression weights at the column Critical Ratio (CR) produced by AMOS Programs 22.

The value of CR compared to its meltdown value, i.e., ±0.05 significance level 2.56. If the value of the Critical Ratio (CR) on the relationship of causality variables showed greater than the value of key value that is ±2.56 or probability value $p<0.05$, then H_0 is rejected and the H_1 is accepted.

Table 3: Eligibility criteria models (goodness of fit)

Goodness of fit	Cut-off value	Values	Results
Probability (p)	≥0.050	0.367	Fit
Normal Chi-square (CMIN/df)	<2.000	1.490	Fit
Goodness of Fit Indices (GFI)	≥0.900	0.963	Fit
Root Mean Squard Error of	≤0.080	0.018	Fit
Adjusted Goodness of Fit (AGFI)	≥0.900	0.936	Fit
Tucker Lewis Index (TLI)	≥0.900	0.977	Fit
Normed Fit Index (NFI)	≥0.900	0.916	Fit
Comparative Fit Index (CFI)	≥0.900	0.850	Fit
Incremental Fit Index (IFI)	≥0.900	0.986	Fit
Parsimony Normed Fit Indices (PNFI)	≥0.500	0.544	Fit
Parsimony Compaeative Fit Indices (PCFI)	≥0.500	0.671	Fit
Parsimony Compaeative Fit Indices (PGFI)	≥0.500	0.555	Fit

From the analysis as described the following hypothesis, there is a variable that gets the influence of other sustainability variables but there is also a variable that is not found to affect other variables as shown in Table 4. Variables that have an influence are among others the existence of the public transport infrastructure road occupancy as well as the density of buildings that have an impact on the existence of a protected area that is the fact that the protected area can reduce when the higher building density occurs. The other variables also have the influence, i.e., road infrastructure in the residential area with a population density of buildings as well as the density of road network with the variable building. Based on analysis results, there is a significant influence on both of these variables. The next variable is the protected area and its relation to the estuary of the river. Based on the results of the analysis the influences are significant. The last variable that has influence is the road network with public transportation in which there is significant influence towards a public transit system of highways.

Furthermore, based on the results of the analysis, variables that have no impact on the variables tested are the magnitude of the effect of the road network against a private road infrastructure of the positive value of 0801 probability (p) of 0.052. With the value of the probability $p>0.05$, so, stated that the hypothesis H_0 rejected. It means that there is no influence between the road networks and road infrastructure. While in density test, building density variable to the space requirement in reclamation zone, SEM analysis result obtained probability value $p>0.05$ hence no significant influence from these variables, among others, room for economic and social. Furthermore, other variables that do not have any control tested can see in Table 4.

Based on results of SEM analysis, it found out that Sustainable Reclamation Model forms two connected tracks. In the first track, indirect influence from a variable

Table 4: Test results relationship between variables

Variables	Estimate	p-values
Residential road infrastructure<---Public transport	-0.993	0.026
Residential road infrastructure<---The road network	0.801	0.052
The protected area<---The density of buildings	0.901	0.000
The density of buildings<---The density of buildings	0.422	0.507
The density of buildings<---Residential road Infrastructure	0.774	0.004
The density of buildings<---The road network	0.614	0.000
Water conservation<---Estuary	-0.175	0.453
Water conservation<---The density of buildings	0.370	0.070
Water conservation<---The protected area	-0.006	0.983
Estuary<---The protected area	0.941	0.000
Open green space<---Water conservation	0.094	0.394
Open green space<---Space requirements	0.993	0.512
Open green space<---The density of buildings	0.303	0.554
Open green space<---The protected area	-0.765	0.080
Public transport<---The road network	0.798	0.000

of residential road infrastructure to the variable of green open space through building density has a small impact, in which the influence is much affected by other factors outside the model. Meanwhile, indirect influence of road network variable to the green open space variable through building density is also minimal, mostly influenced by other factors outside the model.

In the second track, in the two direct influences from protected area to green open space, the value of correlation is obtained, despite quite small whereas the rest much influenced by other factors outside of the model. There is an indirect influence of protected area variable to the green open space variable through water conservation and also there are some influenced by other factors outside the model. Total influence of protected area variable to the green open space variable through water conservation is small due to the existence of influences of other factors outside the model.

Furthermore, based on results of analysis using research instrument Structural Equation Model (SEM) towards sustainable reclamation model which has a latent variable of coastal resources, building and infrastructure, it is found out that the most significant influential variables observed are:

- The condition of water conservation in the form of lake/swamp in a reclamation area provides a guarantee of sustainability of recovery area in a coastal zone
- Availability of open space facilities in regeneration area in settlement zone in the form of a sports facility, children's games or parks provides a guarantee of sustainability of recovery area in a coastal region
- Functions of protected area as the protection of environment preservation in recovery area are considered to provide a security of the viability of recovery area in a coastal zone
- Density level of residence in the surrounding recovery area and the number of people living in one house surrounding the recovery area are considered to provide a guarantee of sustainability of reclamation area in a coastal zone
- Conditions of the surface structure of highway/main road and distance residence in recycling area to the motorway/main road are considered to provide a guarantee of sustainability of restoration area in a coastal zone
- The condition of road structure/hardening in a residential area and the availability of road lightings in the residential area in reclamation area are considered to provide a guarantee of sustainability of recovery area in a coastal zone

Then, there are variables which do not have the influence to other tested variables, for instance, the absence of control between main road network outside the reclamation area and the local road infrastructure in the recovery area. From the examination of building density variable with the need for space in the recovery area, the obtained results suggested that there is no influence of building density and the need for space per capita. For application result, in this research, there is a need to formulate an ideal model by eliminating variables which have no influence so that more simplified but efficient model can obtain to use in the field.

Related to reclamation, Indonesia which is part of the global business world in the business activities undertaken still needs to be improved the criteria of sustainable national environmental performance. Is done achieve a comprehensive policy in Indonesia as an effort to follow the existing international environmental performance standards (Yutu *et al*., 2016).

CONCLUSION

In this study, Structural Equations Model (SEM) analysis used with some steps such as model specification, identification, estimation and eligibility test in the formulation of sustainable reclamation model in which for the time being is still rarely found. The steps to proceed are as follows:

The assumption of data normality to tested by considering the value of skewness and data kurtosis used with the results of the assessment on research data normality utilized in the empiric research model. Is happening on unvaried and multivariable normality which means very capable of using in the next estimation.

The goodness of fit which constitutes an indication of comparison among the models set up by matrix covariant, namely the observed indicators and the variable conducted. If the result goodness of fit model is good (fit), then the model can be recommended. And, all of the obtained results suggested the appropriate value and hence it could be concluded that this model formulated.

Step to test the hypothesis of causal relationship developed in this model was proceeded. It found out that a reclamation area can be said as sustainable if:

- There is sufficient open space
- It has water conservation
- Protected area as the protection of environment preservation of reclamation area is available
- The level of residential density in the surrounding recovery area taken into account
- The condition of the surface structure of highway/main road and distance of residential area in the reclamation area is good
- Condition of road structure/hardening in residential area is good

From all steps performed, its found out that there are variables in this model which do not have a significant influence on other variables, although based on the theory and previous researchers they should have. Possibly happens because the respondents have a moderate level of education whose knowledge on reclamation is limited.

LIMITATION

Like other researchers who have some limitations, this model also has some that is the model is still very complex, so that, some further studies required to simplify by reducing insignificant variables.

RECOMMENDATION

Recommendation for this model is sustainable reclamation in the coastal area should build the index of the most influential and related index.

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