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Research Article

The design study for the development of sea wall construction on mangrove ecosystems : A case study of Tambak Lorok and Genuk district

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Abstract. The Design Study of the Semarang Sea Wall Development Plan will result in a change in environmental conditions in the eastern coastal area. Changes in environmental conditions that will occur in the area include changes in sea currents which originally flowed eastward moving to the Tambak Lorok area on the west coast and the Java Sea. The method uses Descriptive Qualitative with the help of SEM analysis. Based on the results of the analysis of the SEM model, it is known that the indicator that will be affected based on the Design Study of the Sea Wall Development Plan is the Mangrove Ecosystem of 0.477. To maintain the sustainability of the mangrove ecosystem, a coastal area management system needs to pay attention to the principle of the continuity of the function of existing mangrove forests. Mangrove ecosystems in coastal areas that are maintained, and supported by awareness and common perceptions of various parties about the importance of the existence of mangrove ecosystems will have an impact on the sustainability of coastal areas.

Keywords: Mangrove Ecosystem, Management Strategy, Sea Wall Contruction

1. Introduction

The Ministry of Public Works and Public Housing (PUPR) continues to push for the completion of the construction of the Semarang-Demak Toll Road using the Business Entity Cooperation with the Government (PPP) scheme. This project has high traffic volume. Semarang as the capital city of Central Java Province is well developed with industrial and trading goods. This toll road will be integrated with the construction of a sea wall to overcome sea flooding and land subsidence. The presence of the toll road that is integrated with the Semarang City Sea Wall is expected to support the growth of a new Economic Center in Central Java Province (Ministry of Public Works RI, 2022).

The Design Study of the Sea Wall Development Plan in Semarang aims to protect coastal areas from the threat of tidal flooding and coastal erosion. Design studies like this are carried out by a team of experts consisting of civil engineers, marine architects, and experts in hydrology and oceanography. They will analyze the local geographic and weather conditions to plan the proper shape and size of the dike. Design studies also consider factors such as long-term climate change, sea level rise, and potential environmental damage from development. The goal is to create a structure that is strong and sustainable over the long term.

Mangroves are natural coastal habitats that buffer coastlines from erosion and inundation, providing an important protection service. Other benefits, including nurseries for species of commercial and recreational value, landing points for migratory birds, screening of sediments, nutrients and pollutants, enhancing coastal fisheries. To maintain the sustainability of the mangrove ecosystem, a coastal area management system needs to pay attention to the principle of the continuity of the function of existing mangrove forests. Mangrove ecosystems in coastal areas that are maintained, and are supported by awareness and common perceptions of various parties about the importance of the existence of mangrove ecosystems will have an impact on the sustainability of coastal areas (Martuti*et al.*,2018).

Environmental impacts: An environmental impact study should be carried out to understand how the construction of a levee may affect the coastal ecosystem as well as the survival of local flora and fauna. Materials of construction : The choice of material such as concrete, stone, or gabion will affect the durability and stability of the embankment against coastal erosion and other environmental influences.

Design StudiesThe Semarang Sea Wall Development Plan can have a significant impact on the Mangrove Ecosystem. One of the real impacts that will occur from the construction of the sea wall on mangroves is the loss of

natural habitat for wild animals and fish that live in it. The construction of a sea wall can also trigger beach erosion due to changes in the flow of currents and beach sand. In fact, the mangrove ecosystem has an important function as a sediment binder so that it can prevent abrasion or coastal erosion. Can result in decreased production of marine products such as fish and shrimp due to disruption of their habitat due to damage to the mangrove ecosystem.

2. Method

This study uses a qualitative descriptive method, which is a research method used to describe and explain a phenomenon or event in detail by describing data obtained through observation, interviews, or document study. This method focuses more on narrative analysis than statistical analysis, so it is more suitable for use in exploratory studies. Researchers will make direct observations of the object of research and record all things that are considered relevant for further detailed and in-depth analysis. This study uses a SEM quantitative analysis (*Structural equation modelling*) : The term structural equation modeling (SEM) does not refer to a single statistic, but rather refers to a primary group consisting of two or more related procedures. Structural equation modeling can be defined in its most basic sense as the use of two or more structural equations to model multivariate relationships.

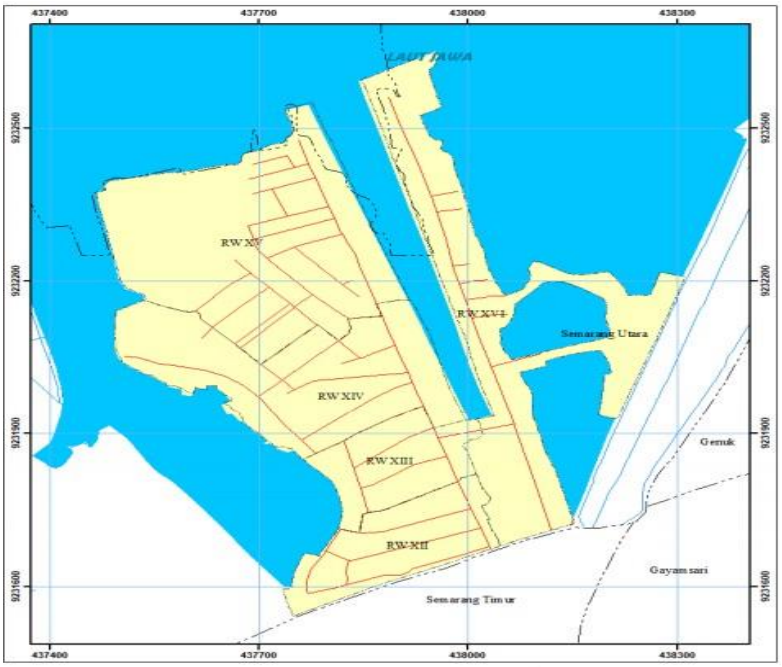

Figure 1. The Research Location Map

The research subjects in this study are called informants/respondents, namely people who provide information about the data the researcher wants related to the research being carried out. This information can be in the form of circumstances and background research conditions. The use of informants in this research is to capture a lot of information needed in depth in a short time. By utilizing informants, researchers can also exchange ideas or compare events found from other subjects. Informants/Respondents are key in this research, where Informants/Respondents are people who live in coastal areas, occupying the area for at least 5 years, such as: fishermen, fishermen's wives, mangrove farmers, village officials, and village youth. This study uses qualitative research methods, where qualitative data is data that is not in the form of numbers or numbers so that it is only in the form of statements or sentences in the form of a questionnaire. The questionnaire is a data collection technique that is carried out by giving a set of written statements to the respondents to answer. Assessment on the questionnaire technique using a scale of *Linkert*. According to Sugiyono (2011) scale of *Linkert* namely the scale used to measure attitudes, respondents' opinions about social phenomena. The alternative answer is by using a scale of *Linkert*, namely by giving a score to each alternative answer as follows:

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Table 1. Research Instruments

Alternative Answers	Value Weight
SS (Strongly Agree)	5
S (Agree)	4
RR (Doubtful)	3
TS (Disagree)	2
STS (Strongly Disagree)	1

3. Result and Discussion

Research results when interviewing respondents, namely the chairman of KNTI (Indonesian Traditional Fishermen Community) there has been logging of Mangrove in the Northeastern part of Java, namely in the coastal area of Tambak Rejo, Sayung and Demak areas, in order to build a Sea Wall (Toll Road).Mangroves in this area are dominated by *Rhizophora mucronata*and*Avicennia marina.*According to the local community who is also the head of the traditional fishing community in the Tambak Rejo area, mangrove damage in the coastal area is also caused by industrial waste, apart from that land clearing for pond areas that are not good adds to the existing damage, over-exploitation and an increase in pollution load is one of the activities that contribute to the destruction of mangrove ecosystems, this will spur habitat degradation and biodiversity on the coast.

Table 2. Results of the Direct Effect Hypothesis Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Mangrove -> Impact of sea wall construction	0.477	0.473	0.022	22.103	0.000
Ecogy -> Efforts to control and prevent the impact of the construction of the sea wall	0.281	0.281	0.011	25.189	0.000
Planning Management -> Efforts to control and prevent the impact of the construction of the sea wall	0.544	0.544	0.014	39.862	0.000
Institutional-Social -> Efforts to control and prevent the impact of the construction of the sea wall	0.283	0.283	0.011	25.229	0.000
Preservation and improvement of the economy on the impact of the construction of the sea wall -> Community monitoring	0.774	0.773	0.032	23.905	0.000
Preservation and improvement the economy on the impact of the construction of the sea wall -> Provision of local economy in the tourism sector	0.889	0.890	0.011	84.131	0.000

Based on the results of the analysis on testing the direct effect hypothesis, it shows that the results of the SEM model analysis show that pond value is one of the core indicators that has experienced a reduction in pond area and fishermen's fishing area, has a coefficient value of 0.508 or higher compared to the mangrove aspect of 0.477, and community aspect of 0.219. The study of the construction of sea walls and toll roads has an impact on changes in mangrove vegetation. The Semarang Sea Wall Development Plan can have a significant impact on the Mangrove Ecosystem. One of the real impacts of the construction of the sea wall on mangroves is the loss of natural habitats for wild animals and fish that live in them. In addition, the construction of a sea wall also has the potential to damage

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biodiversity because it changes environmental conditions such as rising water temperatures, changes in salt levels, and decreasing water quality. This can affect the growth and reproduction of plants and animals in the mangrove ecosystem.

Not only that, the construction of a sea wall can also trigger beach erosion due to changes in the flow of currents and beach sand. In fact, the mangrove ecosystem has an important function as a sediment binder so that it can prevent abrasion or coastal erosion. Can result in decreased production of marine products such as fish and shrimp due to disruption of their habitat due to damage to the mangrove ecosystem. In addition, it also increases the risk of flooding due to the loss of mangrove tree vegetation which functions as a water store when tides occur. In order to avoid these things, it is best if the parties in charge of carrying out the development are given proper consideration so as not to harm the sustainability of the surrounding environment.

In assessing the inner model testing with PLS begins by looking at the R-Square for each dependent latent variable. Changes in the R-Square value can be used to assess the effect of certain independent latent variables on the dependent variable whether they have a substantive effect. The following is the formula for F Square, which is as follows:

$$q^2 = \frac{Q2\ Included - Q2\ Excluded}{1 - Q2\ Excluded}$$

Testing the outer model aims uTo evaluate discriminant validity it can be seen by the average variance extracted (AVE) method for each construct or latent variable. The model has better discriminant validity if the AVE squared for each construct is greater than the correlation between the two constructs in the model. The AVE value describes the magnitude of the variance or diversity of manifest variables that can be owned by latent constructs. According to Ghozali (2014) and Yamin and Kurniawan (2011:18) recommend using AVE as a criterion in assessing Convergent Validity. A minimum AVE value of 0.5 indicates a good measure of Convergent Validity. That is, latent variables can explain on average more than half of the variance of the indicators. The AVE (Average Variance Extrated) formula is:

$$\text{AVE} = \frac{\sum \lambda i^2}{\sum \lambda i^2 + \sum \varepsilon i}$$

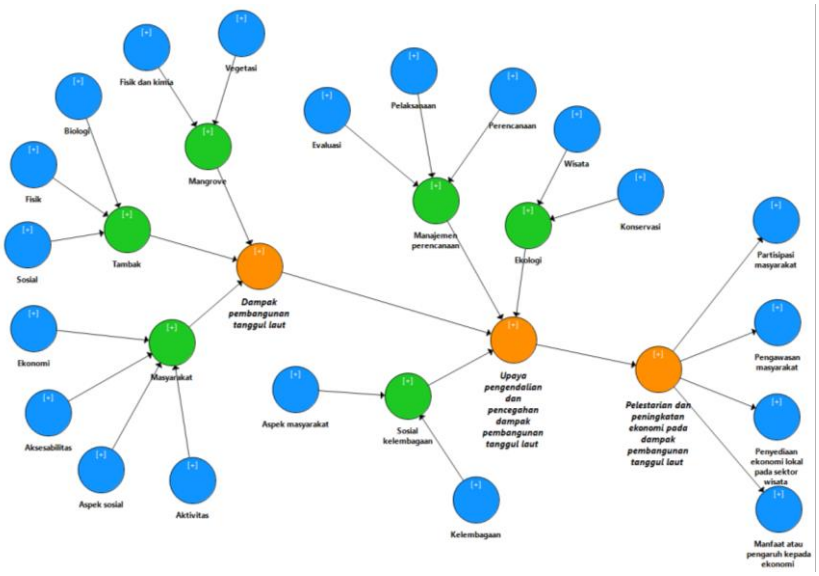

Figure 4. Inner Model Planning

The following figure the design of the inner model resulting from SmartPLS software processing where the blue circle describes the model dimensions, the green circle describes the sub-variables, while the orange circle describes latent variables.

The design of this model is the design of a model that describes how the relationship between the indicators and the constituent dimensions. Each variable has an indicator that the arrow points to is represented by a yellow box. The picture below shows the impact of the construction of the embankment which is arranged from the mangrove aspect.

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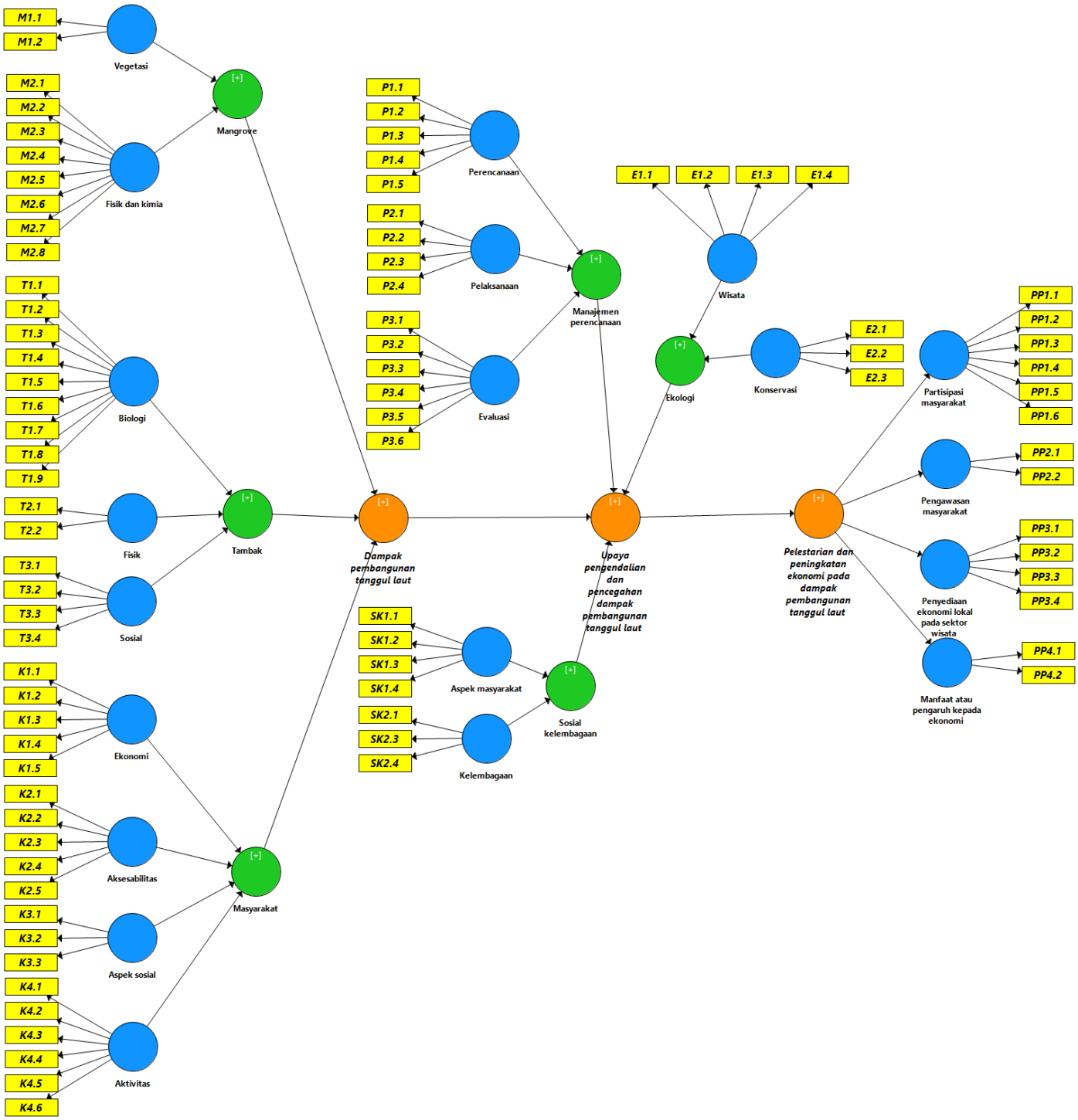

Figure 5. Outer Model Planning

4. Conclusion

The Design Study of the Semarang Sea Wall Development Plan will be impact of the construction of the sea wall on the mangrove ecosystem: a case study in the Tambak Lorok and Genuk sub-district resulted in positive and negative impacts. The positive impact is the efforts made by stakeholders with the construction of this sea wall. Efforts from the planning management aspect such as preparing control and prevention plans if unwanted things occur when the sea wall construction is in progress, carrying out periodic inspections to the work location, stakeholder efforts to use efficient and effective principles when working on the construction of the sea wall; conduct an evaluation of the activities that have been carried out, make decisions that must be coordinated, conduct management analysis, be able to account

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for all activities. While the negative impacts are the reduction of land and coastal vegetation around mangroves, changes in air, noise and vibration when working on the sea wall so that it disrupts community activities.

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