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Analysis of Sustainable Infrastructure Development in Sorong Regency Based on Environmentally Technology Criteria

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Abstract: Sorong Regency is inhabited by around 188,6779 people in West Papua Province. At this time, Sorong Regency is starting to develop infrastructure to support economic activities in Sorong actively. It has become one of the districts focused on development in the eastern part of Indonesia, with examples of infrastructure projects including the improvement and creation of several roads, bridges, irrigation and the construction of Sorong Special Economic Zones (SES). This research aims to determine the sustainable infrastructure development of Sorong Regency, especially in the Aimas, Mariat, Mayamuk, and Salawati Districts based on environmental and technological criteria. The research method used is Multidimensional Scaling (MDS) with the Rapinfra (Rapid Appraisal of Infrastructure) method. The results of the research regarding the status of infrastructure development in the Aimas District area with an index value of 48.74% and Mariyat District with an index value of 58.92% in terms of environmental criteria are considered less sustainable. In comparison Mayamuk District with an index value of 68.56% and Salawati District with an index value of 60.00% are considered sufficient. Meanwhile, in terms of technological criteria, the Aimas District with an index value of 65.07% and the Mariyat District with an index value of 60.22% are considered not or not yet sustainable; meanwhile, the Mayamuk District area with an index value of 84.64% and the Salawati District with an index value of 91.55 are considered to be quite sustainable.

Keywords: Development, Infrastructure, Technology, Environment

INTRODUCTION

Infrastructure is one of the most important things in development efforts. The availability of adequate infrastructure will certainly help the implementation of development goals. Good infrastructure development will encourage economic growth (Sukwika, 2018). On the other hand, if infrastructure is not provided properly then economic development and growth will not be able to develop (Azizah et al., 2021). Therefore currently, Sorong Regency is starting to actively build infrastructure to support economic activities and has become one of the districts focused on its development in eastern Indonesia (Fitria, 2022). Examples of infrastructure projects are the improvement and construction of several roads, bridges, irrigation, and the construction of the Sorong Special Economic Zone (SES) (Awom et al., 2017; Mlik et al., 2022; Palilu & Suripatty, 2018;

Puriningsih, 2022). The Sorong Special Economic Zone is located in the Mayamuk District and its surroundings which is very strategic for the development of the logistics, agro-industry, and mining industries (Madaul & Ibal, 2023). The infrastructure is being prepared in the Sorong SEZ includes a 50 MW PLN power plant, a main canal, a clean water network, and so on (Pribadia et al., 2021; Yoenoes, 2023).

As infrastructure develops in Sorong Regency, the sustainability aspect of infrastructure must be given great attention (Sjafruddin, 2013). Sustainable infrastructure is the concept of infrastructure development by paying attention to the balance between meeting current and future infrastructure needs (Rini et al., 2024). In this research, the author focuses on environmental and technological aspects, namely looking at the importance of implementing environmentally friendly infrastructure (green infrastructure) and the technologies applied to infrastructure development (Imran, 2018; Nainggolan et al., 2023; RAMAH, n.d.). If these aspects are not implemented, this infrastructure development could endanger the environment in the future, such as environmental pollution.

LITERATURE REVIEWS

According to (Karta et al., 2019), the definition of infrastructure is a system that supports social and economic systems which is also a link to environmental systems, it can be used as a basis for making policies. The rapid progress of technology has also encouraged the emergence of many innovations, one of which is the concept of sustainable infrastructure (Sistek, 2020). Sustainable infrastructure is a concept of infrastructure development by paying attention to the balance between meeting current and future infrastructure needs (Cahyani, 2020). Thus, in sustainable infrastructure development, it is necessary to pay attention to and integrate 3 aspects of sustainability including economic, environmental, and resource sustainability (Aufa Azizah et al., 2021).

The Green City Development Program (P2KH) is a program that is pioneering sustainable infrastructure development in cities in Indonesia. This program has 8 attributes, namely green planning and design, green community, green open space, green transportation, green waste, green water, green energy. and green building (Demak et al., 2022).

RESEARCH METHODS

1) Research Location

The research was carried out in Aimas District, Mariat District, Mayamuk District, and Salawati District, Sorong Regency, West Papua as seen in the map below with detailed geographic data based on the Central District Statistics Agency. Sorong 2022 as follows:

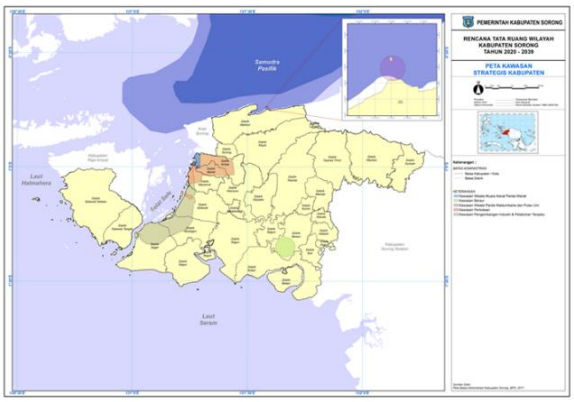

Figure 1. Research Location Map

2) Research data

a. Primary data

The data taken in this research can be in the form of interviews and questionnaires with informants who are parties/ stakeholders related to Sorong Regency infrastructure development. The following are the criteria for informants to obtain primary data: (1) Have competent experience in the field studied; (2) Have a position within their competence in the field being studied; (3) Willing, and/or located at the location studied

b. Secondary Data

The secondary data comes from documents/reports related to research studies, in the form of the Sorong Regency Regional Medium Term Development Plan (RPJMD), Sorong Regency Regional Spatial Planning Map (RTRW), Sorong Regency Environmental Status Report, and Sorong Regency Regional Statistics for 2023-2026.

3) Data processing

The assessment of the level of sustainability of infrastructure development in Sorong Regency was analyzed using Multidimensional Scaling (MDS) with the Rapinfra (Rapid Appraisal of Infrastructure) method. Rapinfra is an adaptation of Rapfish or Rapid Appraisal of Fisheries which is a tool for analyzing the sustainability status of resources and in this research is used as an analysis tool for evaluating the level of sustainability of urban areas (Persada, 2014).

4) Data analysis

The stages and flow of analysis can be seen in the following list: (a) Multidimensional Scaling (MDS) Analysis; (b) Monte Carlo Analysis; (c) Leverage Analysis; (d) Pareto Analysis; and (e) Stress Value and Determination Coefficient Value (R2)

The object of this study is about the verses of the Qur'an and the environment, so, the approaches used are the science of interpretation and the science of geography.

RESULTS AND DISCUSSION

Sorong Regency is located in the western part of Southwest Papua Province with an area after the formation of Tambrauw district of 13,075.28 km² which is divided into a land area of 8,457 km² and a sea area of 4,618.28 km². The following are the results of an analysis of the sustainability status of the Sorong district urban area based on environmental and technological criteria.

1) Sorong Regency Urban Area Sustainability Status Based on Environmental Criteria

Based on the table above, it is known that the MDS results using Rapinfra show that the sustainability index value in the Aimas District based on environmental criteria is 48.74%, which is classified as less sustainable. The MDS results using the Mariyat District Rapinfra show the environmental criteria sustainability index value of 58.92% which is classified as less sustainable. MDS results using the Mayamuk District Rapinfra show an environmental criteria sustainability index value of 68.56% which is classified as quite sustainable. MDS results using Rapinfra in the Salawati District show a sustainability index value for environmental criteria of 60.0% which is classified as quite sustainable.

Table 1. Sustainability index for Aimas, Mariyat, Mayamuk, Salawati Districts based on environmental criteria

No	Regional Criteria	Index Value	Information
1	Aimas District	48.74 %	Less Sustainable

2	Mariyat District	58.92 %	Less Sustainable
3	Mayamuk District	68.56 %	Quite Sustainable
4	Salawati District	60.0 %	Quite Sustainable

Source: Analysis Results, 2023

2) Sorong Regency Urban Area Sustainability Status Based on Technology Criteria

Based on the table above, it is known that the MDS results using Rapindra show that the sustainability index value for technology criteria in the Aimas district is 65.07%, which is classified as less sustainable. The MDS results using the Mariyat District Rapinfra show that the sustainability index value for Technology criteria is 60.22%, which is classified as less sustainable. MDS results using the Mayamuk District Rapinfra show a sustainability index value for the technology criteria of 84.69% which is classified as very sustainable. MDS results using Rapinfra in Salawati District show a sustainability index value for Technology criteria of 91.55% which is classified as very Sustainable.

Table 2. Sustainability index for Aimas, Mariyat, Mayamuk, Salawati Districts based on environmental criteria

No	Regional Criteria	Index Value	Information
1	Aimas District	65.07 %	Quite Sustainable
2	Mariyat District	60.22 %	Quite Sustainable
3	Mayamuk District	84.69 %	Very Sustainable
4	Salawati District	91.55 %	Very Sustainable

Source: Analysis Results, 2023.

3) The Impact of Infrastructure Development on the Environment and Ecology in Sorong Regency

In sustainable infrastructure development in Sorong Regency, three stages that are important to pay attention to. These stages include planning, implementation, and monitoring. The following is a discussion of each of these stages:

a. Planning Stage

- According to the Brundtland Report in (Lasaiba, 2023), the planning stage must pay attention to long-term sustainability aspects, including economic, social and environmental needs, and involve community participation.
- According to Jeffrey Sachs, a leading economist and academic, planning must consider sustainable development priorities, such as access to clean water resources, renewable energy, and environmentally friendly transportation infrastructure.

b. Implementation Stage

- According to Michael Porter, a business strategy theorist, implementing sustainable infrastructure requires a partnership between the public and private sectors, to create sustainable economic profits and achieve environmental goals.
- According to Mark Swilling, a sustainable development expert, the implementation requires the adoption of green technologies and environmentally friendly construction practices, as well as the involvement of a skilled workforce in building and operating the infrastructure.

c. Monitoring Stage

- According to the World Commission on Environment and Development (1987), monitoring must be carried out continuously to ensure that the environmental and social impacts of infrastructure remain under control and can be corrected if there are problems.
- According to Ian Davis, a management consultant, monitoring must also involve evaluating the sustainability of the project, including economic, social, and environmental aspects, as well as the role of stakeholders in decision-making.

In the sustainability of infrastructure development carried out in Sorong Regency, development is carried out using approvals and permits from the local government. Construction is also carried out with planning and field inspections by regulations to minimize damage or impact on the environment. However, in the efforts that have been made to minimize the impact on the environment, the impact also occurs outside the limits of control, this is as stated by Mr. Simon from the Environmental Service:

> *"As you can see Sorong Regency is currently carrying out a lot of development, as can be seen in the hill area. This certainly affects the surrounding environment, especially if extreme weather occurs such as heavy rain, the effect of evictions being carried out in the development area will be affected by soil deposition or sedimentation and affect the surrounding area. This is one example of what happened."*

4) The Impact of Infrastructure Development on Technology in Sorong Regency

Infrastructure development is carried out to create a comfortable area that can improve the welfare of the people living nearby. However, on the other hand, Indonesia is famous for its rainy season and frequent flooding also occurs at several points in the Sorong Regency area.

In this case, the construction of channels that are appropriate to the volume of water received, whether in rainy weather or not, must be able to accommodate it so that flooding does not occur. Sorong Regency has also built appropriate drainage as it can be seen that there is a reduction in the volume of water when it rains. This was also conveyed by Mr. Semuel BAPPEDA that:

> *"Regarding drainage, this area has several locations where flooding is disturbing and drainage itself has been carried out to reduce flooding itself."*

In several locations where construction is underway, there are certainly obstacles both in terms of traffic regulations and others. Although sometimes obstacles like this can be predicted and mitigated so that they do not occur, in some conditions this cannot be avoided. Such as traffic jams that occur at several points under construction.

In the Sorong Regency area, it is also seen that there will be traffic jams at several points due to infrastructure development. This can be seen from the results of the interview conducted with Mr. Khodim said that:

"The reduction in traffic jams is more visible only during peak hours. Such as in school areas and other public gathering places. However, there are several points where traffic jams occur due to infrastructure development."

Cleanliness in the environment also needs to be considered even in the existing development conditions in several locations. The cleanliness of an area shows that there is concern from both the local government and the community in the surrounding environment. In maintaining cleanliness, Sorong Regency also provides disposal and has maintained local cleanliness. This can be seen from the results of the interview conducted with Mr. Tongan:

"If the waste is a large volume, there is a landfill at KM 38. However, if there is not too much, it is usually handled in the local area."

Many of the facilities provided meet community needs, such as transportation or public transportation. This also has an impact on the environment by reducing pollution levels and avoiding air pollution due to reducing the number of vehicles in traffic by replacing them with public transportation. This transportation also has special routes and areas that are handled respectively. Evidence of this can be seen from the results of the interview conducted with Mrs. Endang said:

"Transportation is quite good, there are special routes and transportation that handle every area around it. And of course, the public facilities that are built can help the surrounding community, so that many people will find this facility easier. The only drawback is that the quantity of facilities is insufficient for the community."

In the infrastructure development carried out in Sorong Regency, the technological criteria show that the impact has been quite good. Even though several locations that still have bad impacts such as traffic jams, this does not affect conditions and has fatal consequences. Overall, sustainable development in Sorong Regency is considered to be quite good.

CONCLUSION

In the analysis of sustainable infrastructure development in Sorong Regency based on environmental technology criteria, several important factors have been discussed. The following conclusions can be drawn: (1) The Importance of Sustainable Infrastructure: Sustainable infrastructure development in Sorong Regency is very important to achieve sustainable economic growth and protect the environment. By considering environmental technology criteria, infrastructure can be developed by minimizing its negative impact on the environment. (2) The status of infrastructure development in the Aimas District area with an index value of 48.74% and Mariyat District with an index value of 58.92% in terms of environmental criteria is considered less sustainable. In comparison, the Mayamuk District with an index value of 68.56% and the Salawati District with a value of an index of 60.00% are considered sufficient. (3) The Aimas District area with an index value of 65.07% and the Mariyat

District with an index value of 60.22% in terms of technology criteria are considered not yet sustainable; Meanwhile, the Mayamuk District area with an index value of 84.64% and the Salawati District with an index value of 91.55 are considered to be quite sustainable. So, sustainable infrastructure development in Sorong Regency must consider environmental technology criteria. By adopting renewable energy, energy efficiency, good water and waste management, sustainable transportation, utilizing green technology, and reducing environmental impacts, infrastructure can be developed sustainably and provide long-term benefits for society and the environment.

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