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Assesment of Enviromentally Friendly Transportation to Achieve Sustainable Transportation in Semarang City

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ABSTRACT

Transportation is the main infrastructure that has a role in driving the economy. The transportation sector can also be a problem if mobility is not accompanied by the availability of adequate infrastructure. Semarang City has the highest number of vehicles compared to other cities or regencies in Central Java Province. Based on data from BPS Semarang City, the number of motorized vehicles in Semarang City in 2021 reached 1,875,781 vehicles with the growth of motorized vehicles increasing by 12% every year. The high number of motorized vehicles in Semarang City causes congestion, air pollution and increases fuel consumption. Semarang City has started to initiate and design an environmentally friendly transportation system that leads to green transportation. The concept of green transportation is an environmentally friendly and sustainable transportation that aims to reduce vehicle emissions and create road space for pedestrians and bicycles. This is in line with the mission of Semarang City in realizing quality infrastructure that is environmentally sound and sustainable. The purpose of this study is to examine the implementation of green transportation that has been carried out in Semarang City in achieving sustainable transportation. This research uses a qualitative approach, This research uses a qualitative approach, while the analysis is carried out by descriptive analysis as well as scoring and weighting analysis so as to obtain the results of the value of the application of environmentally friendly transportation that leads to the concept of green transportation. The results obtained show that Semarang City in implementing environmentally friendly transportation that leads to green transportation has been quite good or quite successful.

Keywords: transportation; environment-friendly transportation; green transportation; sustainable transportation; congestion; air pollution.

INTRODUCTION

Semarang City is the capital of Central Java Province with a population of 1.65 million, making it the 6th most populous city in Indonesia. Semarang City is categorized as a metropolitan city that brings consequences to the high level of urbanization that has an impact on the city's transportation system and patterns as well as its impact on the environment. The current situation is that the growth of vehicles in Semarang City has increased annually by 12 percent and is not matched by road growth which only increases by 0.9 percent each year (Laeis, 2018). The use of private vehicles in Semarang City is also the highest compared to other cities or regencies in Central Java Province. This has led to considerable transportation problems, namely traffic congestion and traffic jams that occur along the roads of Semarang City. Based on the results of a research institute INRIX, Semarang City ranks ninth among major cities in Indonesia with an average congestion level in Semarang City reaching 37 hours a year (Sismanto, 2018). In addition, the excessive use of private vehicles also results in high air pollution. The Meteorology, Climatology, and Geophysics Agency (BMKG) suspects that air quality in Semarang is heavily influenced by air pollution due to motor vehicle exhaust emissions. The trigger for air pollution is a lack of public awareness with the increase in private vehicles, both two and four wheels (Utama, 2019). Semarang City needs to prepare a better transportation system strategy to overcome the current urban transportation problems. Semarang City has a plan to anticipate the current urban transportation problems. This has been stated in the Semarang City RTRW 2011-2031 and the Semarang City RPJMD 2021-2026. The existing transportation has not been able to solve the problem of congestion and high pollution in Semarang City. Green

transportation is one of the attributes of the green city concept that can be used as a solution to the transportation problems faced by Semarang City. Green transportation implements environmentally sound transportation by increasing the development of environmentally friendly public transportation to reduce vehicle emissions and create additional road space for cyclists and pedestrians.This research aims to examine the application of environmentally friendly transportation that has been done in Semarang City in achieving sustainable transportation. So that the results can be known the application of environmentally friendly transportation that has been done by the city of Semarang and leads to the concept of green transportation.

RESEARCH METHODS

Materials

This research aims to address transportation issues, particularly the environmental problems caused by the transportation sector. The resolution of these issues focuses on the concepts of green transportation and sustainable transportation. Sustainable transportation is a system that is safe, healthy, affordable, renewable, operates equitably, and minimizes emissions and the use of new and non-renewable resources (National Academies of Sciences Engineering and Medicine, 2011). Indicators of sustainable transportation encompass three aspects: economic, social, and environmental (Brotodewo, 2010; Litman, 2003).

The concept of green transportation is a transportation approach that aims to reduce transportation and achieve zero transportation greenhouse gas emissions while emphasizing comfort, safety, efficiency, low pollution, humaneness, and the diversification of urban transportation systems (Li, 2016). The implementation of green transportation can be achieved through green fuels, green vehicles, smart infrastructure, mass public transit, and non-motorized options (Abdel Wahed Ahmed & Abd El Monem, 2020; Gusnita, 2010; Saragi, 2015). Essentially, the concepts of sustainable transportation and green transportation are designed to make transportation modes more environmentally friendly by using eco-friendly transportation devices.

The concept of green transportation is considered to support the vision and mission of sustainable transportation. Several attributes of green transportation contribute to the realization of a sustainable transportation system, including focus on access, non-motorized transportation, motorized transportation by current means, motorized transportation by potential means, reduced need for the movement of people, minimal or no impact on the environment and human health, and methods of attaining and sustaining the vision (The Centre for Sustainable Transportation, 2002). The attributes of green transportation are focused on three modes of transportation that have little or no environmental impact: public transit, bicycles, and walking.

This study began with an initial identification of transportation issues in the city of Semarang, including an assessment of BRT facilities, bicycle infrastructure, and pedestrian amenities, as well as the quality of transportation services in the city. Following these identifications, an analysis was conducted to evaluate the implementation of environmentally friendly transportation, focusing on the concept of green transportation. The results of this analysis were then processed and integrated to produce an evaluation of the implementation of green transportation in Semarang. **Figure 1** shows the flowchart of the analysis conducted in this study.

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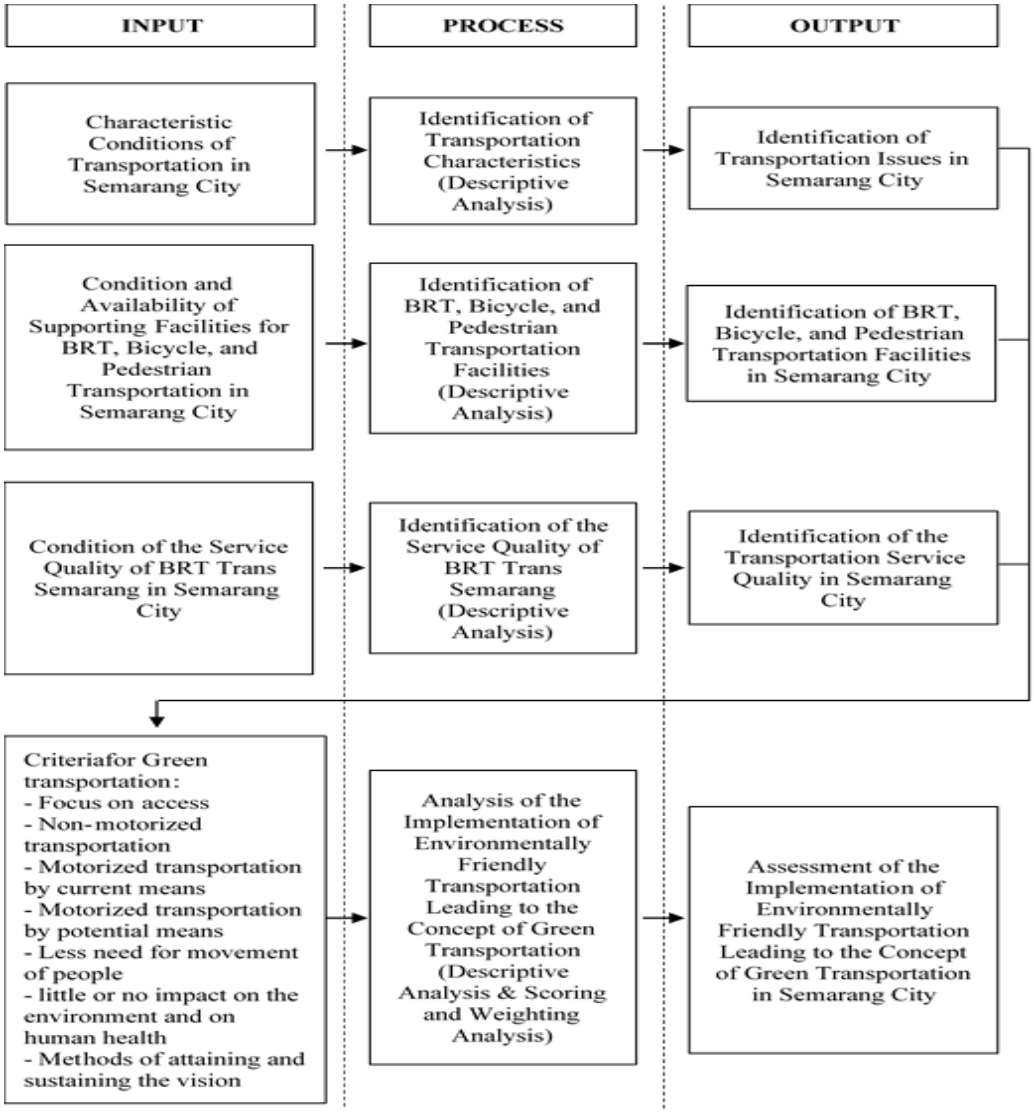

Figure 1. Flow of Analysis

Methods

The method used in this research is a qualitative approach. A qualitative method is employed to study the natural conditions of the object, with the researcher serving as the key instrument. Data collection techniques can be conducted through triangulation (a combination of observation, interviews or questionnaires, and documentation). The data analysis is inductive, and the research results emphasize meaning rather than generalization (Sugiyono, 2014). The questionnaire method uses purposive sampling based on the researcher's needs to obtain maximum information. This questionnaire is aimed at users of the BRT transportation system in Semarang.

The observation method is employed to directly observe and understand the facilities of BRT Trans Semarang, bicycles, and pedestrian infrastructure in Semarang. Field observations are conducted in the Golden Triangle Area of Semarang, which includes Jalan Pandaran, Jalan Pemuda, and Jalan Gajahmada. The results of the observations include images to reinforce existing facts and complement data, particularly regarding BRT, bicycles, and pedestrian facilities. Additionally, a literature review is conducted to gather necessary data from planning documents and statistical data provided by governmental and non-governmental agencies.

Data Analysis

Data analysis was conducted using a descriptive method to identify transportation issues in Semarang, including the identification of BRT facilities, bicycle infrastructure, and pedestrian amenities, as well as the quality of transportation services in the city. The identification process was based on the results of questionnaire data collection and observations, supported by relevant literature studies. Subsequently, data analysis was performed on the implementation of environmentally friendly transportation, focusing on green transportation in Semarang. The analysis utilized a qualitative descriptive method based on the previously conducted identifications. Following this analysis, an evaluation of the implementation of environmentally friendly transportation focusing on green transportation was conducted using scoring and weighting methods, based on the attributes of green transportation as defined by The Centre for Sustainable Transportation (2002).

RESULT AND DISCUSSION

The percentage results of the implementation of environmentally friendly transportation focusing on the concept of green transportation in Semarang can be interpreted by comparing the parameter values defined in the classification instrument list used in **Table 1**. For the analysis and evaluation of the implementation of environmentally friendly transportation focusing on green transportation in Semarang, a qualitative descriptive analysis was conducted. This analysis involved assigning scores to each category, as explained in **Table 2**.

Table 1. Classification of Instrument Terms Used

No	Pronouncing	Parameters
1	Successful	76 - 100 %
2	Fairly succesful	51 - 75 %
3	Less succesful	26 - 50 %
4	Unsuccessful	0 - 25%

Table 2. Assessment of the Implementation of Environmentally Friendly Transportation Leading to the Concept of Green Transportation

Variable	Indicator	Information	Score
Focus on access	**Facilities for disabled individuals on pedestrian paths**	There is already a guide path on the pedestrian paths in the survey area. However, the condition of the guide path is found to be poorly maintained, such as fading or non-contrasting colors. Additionally, some guide paths are found to lack clear spaces on both sides, making it difficult for people with disabilities to access.	3
	Facilities for disabled individuals on mass public transportation	There are already priority seats for disabled individuals inside the BRT that are well-maintained and in good condition.	4
	Cost of mass public transportation	The current fare for BRT Trans Semarang is considered affordable and low, based on the assessment of all respondents who use the BRT.	4
Non-motorized transportation	**Pedestrian paths**	There are already pedestrian paths and supporting facilities in the survey area. The pedestrian paths are in good condition and adequately wide. However, there are still motor vehicles parked and passing through the pedestrian paths, and some other supporting facilities do not perform well.	3

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	Bicycle lanes	There are no bicycle lanes, only bicycle lane signs.	1
Motorized transportation by current means	**Facilities of mass public transportation**	There is already mass public transportation, namely BRT Trans Semarang. BRT Trans Semarang has halte (bus stops) and feeder stops. However, BRT Trans Semarang does not yet have dedicated lanes.	3
Motorized transportation by potential means	**Environmentally friendly modes and fuels**	All modes of BRT already have a hybrid system (BBM and BBG), but only some modes of BRT, particularly those in Corridors 1, 3, 5, and 7, are using the hybrid system.	3
Less need for movement of people	**Accessibility**	The BRT has easily accessible routes, evident from its 8 main corridor routes, 1 special corridor route, and 4 feeder routes. The availability of feeder services near residential areas also facilitates user access to the BRT. Additionally, the majority of BRT Trans Semarang users, about 68%, require less than 30 minutes to reach their destination.	4
	Capability of mass public transportation	A majority of BRT users perceive that the public transport capacity is not met or overcrowded, especially during peak hours, as indicated by 76% of respondents. Furthermore, 64% of BRT users also find the waiting time for BRT to be excessively long (> 10 minutes).	2
little or no impact on the environment and on human health	**Transportation emissions quantity**	Transportation sector emissions have decreased annually from 2015 to 2018. Data from the Semarang City Environmental Agency shows that transportation emissions were 824,129.37 tons in 2018 and 872,838.04 tons in 2017.	4
methods of attaining and sustaining the vision	**Green transportation regulations and policies**	The Semarang City government has regulations and policies supporting green transportation programs, including mass public transportation (BRT), pedestrian paths, and cycling. However, some of these policies lack detailed elaboration and have not been fully implemented yet.	2
		Total Implementation Score	**33**
		Maximum Score	**44**
Percentage of Green Transportation Implementation = Total Implementation Score / Maximum Score x 100			**75%**

The results of the total score and percentage of implementation of green transportation above can be interpreted by comparing the parameter figures specified in the list of classification instruments used. Thus, the evaluation of the implementation of environmentally friendly transportation leading to the concept of green transportation in Semarang City is currently at 75%, indicating that the implementation of environmentally friendly transportation leading to green transportation is considered quite good or fairly successful. The average performance of mass public transportation facilities and pedestrian lanes is currently adequate in accommodating their users. However, attention from the Semarang City government is needed to provide bicycle lanes and supporting facilities.

CONCLUSION

Based on the classification of instrument terms used, the percentage assessment of the implementation of environmentally friendly transportation leading to the concept of green transportation in achieving sustainable transportation in Semarang City is considered fairly successful. Regarding the "focus on access" variable, Semarang City is evaluated as very good for

providing supportive facilities for persons with disabilities on public transportation and pedestrian paths. Additionally, transportation costs are affordable, especially for lower to middle-income groups. In terms of the "non-motorized transportation" variable, Semarang City already has pedestrian paths with supporting facilities and street furniture, but it lacks dedicated bicycle lanes. For the "motorized transportation by current means" variable, Semarang City has mass public transportation in the form of the BRT Trans Semarang and temporary stops (halte/feeder), but it lacks dedicated lanes. Concerning the "motorized transportation by potential means" variable, all modes of BRT Trans Semarang have a hybrid system (BBM and BBG), but only some modes are currently using this hybrid system. Regarding the "less need for movement of people" variable, BRT Trans Semarang provides easy accessibility with 8 main corridor routes, 1 special corridor route, and 4 feeder corridor routes. However, the capacity of BRT Trans Semarang is insufficient or overcrowded at certain times. In terms of the "little or no impact on the environment and on human health" variable, Semarang City is considered good in reducing emissions from the transportation sector annually. For the "methods of attaining and sustaining the vision" variable, Semarang City already has regulations and policies supporting green transportation programs, but some policies lack detailed elaboration and some have not yet been implemented. Overall, the implementation of environmentally friendly transportation leading to green transportation is considered fairly good or fairly successful in achieving sustainable transportation in Semarang City.

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