



Sustainable Development: An Overview of Sustainable Transportation Realized in the Special Region of Yogyakarta

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Abstract

One aspect of sustainable development is the transportation sector. The concept of sustainable transportation is being implemented by Yogyakarta as a solution to create a livable city that can enjoy and use transportation comfortably. This paper aims to see the steps and priority programs carried out in the implementation of sustainable transportation by the Yogyakarta government by referring to the indicators themselves. The method used in this paper is descriptive qualitative by using the Interview, Observation, Documentation and Nvivo 12 Plus application methods as a supporter in the analysis. The results of the study indicate that the application of the concept of sustainability in the field of transportation in Special Region Of Yogyakarta is more on the economic aspect. Meanwhile, from the social aspect and natural causes in DIY, it has not been resolved. From the results of the analysis using N-Vivo 12 plus the social aspect only fulfills 16%, the environment 29% and the economy almost 42%. For sustainable development in the field of transportation, it is necessary to know more about policies regarding the application of both regulations and socialization to the community such as the use of public services with effective and efficient services. A deeper study of the transportation needs and mobility in the city of Yogyakarta, both from the road-based public transportation system, still needs to be done.

Keywords: Implementation; Transportation; Sustainable Development

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Introduction

One of the crucial problems faced in development is in how to balance out the fulfillment of development needs while maintaining environmental sustainability to ensure that the resources which are exist now can still enjoyed by the next generation (Leuenberger et al., 2014). According to (Bamwesigye & Hlavackova, 2019; Golub, 2010; Leuenberger et al., 2014), Sustainability has become a global concept so that one of the driving wheels in development is sustainable transportation (Bamwesigye & Hlavackova, 2019). Transportation is an essential means in people's lives as a link to all aspects of life (Thaller et al., 2021). Transportation basically provides many benefits for people's lives and the state

such as Facilitating access connecting people to several places, including work and to resources and trade, education, health, and other centers (Saif et al., 2019). The transportation system is directly related to the welfare of society, the natural environment, and even the development of the world economy also depends on the transportation system (Pietrzak & Pietrzak, 2020). Therefore, unmanaged transportation might lead into several externalities. Unmanaged public transportation will make people tend choose private transportation rather than public transportation (Bentlage et al., 2021). In the other hand, it might have also made the transportations facility un use. Those reasons lead to one of the crucial problems faced inaction is how to balance the fulfillment of development needs and efforts to maintain environmental Sustainability as an effort to protect the earth and the lives of future generations (Leuenberger et al., 2014).

Almost all cities experience problems similar situations due to transportation issues, phenomena such as an increase in population, of the road network, lack of residential/shopping land regulation, and the use of technology that has not been maximized yet (Wey & Huang, 2018). Furthermore, the growth of private transportation in Yogyakarta is quite high, based on Transportation Department, DIY 2019 The city of Yogyakarta is one of the cities experiencing an increase in population; Based on BPS data in 2020, the population of the city of Yogyakarta is 435,936 people. The number of vehicles for the Yogyakarta Special Region can be seen in the Special Region of Yogyakarta Vehicle Growth.

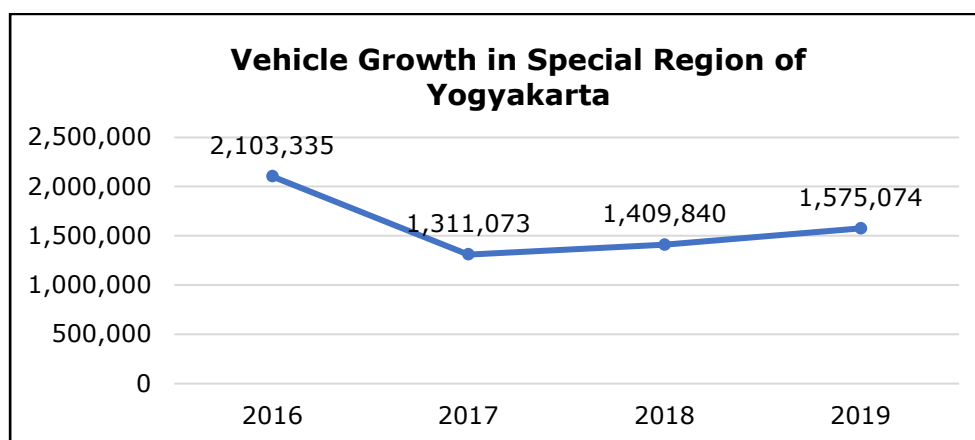


Figure 1 Special Region of Yogyakarta Vehicle Growth

Based on the DIY transportation service, in 2019, the number of cars in Yogyakarta is around 1.8 million units, while the growth of vehicles is estimated at 4% per year and motorcycles at about 6% per year. The same thing was expressed by (Khairina et al., 2022; Nugraha et al., 2020). The high number of vehicles in Yogyakarta is not balanced with the volume of the road causing congestion; besides that, all cars use fuel oil (BBM) which is very limited in number because it comes from nature, so that it does affect not only environmental but also social. In conjunction with the rapid growth of technology and information in urban areas, it enables the government to be imaginative in managing sustainable mobility as a policymaker. According to research conducted by the Center for Regional Development Planning Studies known as (PSPPR UGM, 2016) GU, the most prominent dimensions in Kota Yogyakarta are only a few dimensions such as Smart people, Smart environment, and Smart living, while this research and study have not given attention to the transportation sector. Sustainable development cannot be realized until the community's quality of life is ensured, which includes access to services, feelings of security and tranquility, a healthy environment, and equity, in order to contribute to economic progress.

Various studies and research show that the transportation system so far does not show the existence of the concept of sustainability in it. According to (Sultana et al., 2019) The unsustainability of the urban transportation system can be understood from 3 fundamental aspects, namely environmental, social, and economic quality. Regional issues that can be related to transportation problems include traffic congestion, the increasing proportion of personal use, high accident rates (Nugraha et al., 2020; Pujiati et al., 2020) Inefficient fuel consumption decreased air quality is caused by increased CO₂ emissions produced by transportation which can affect public health and the environment (Arroub et al., 2016). The ratio of road area to city area (Density), which is not followed by the development of the Intelligent Transportation System (ITS) in the use of technology, is still minimal (Rouli et al., 2021; Sutandi, Anastasia Caroline, 2017), a problem that arises in these aspects. The ease of access provided by transportation triggers the effects or impacts caused by vehicle itself, as stated by (Bamwesigye & Hlavackova, 2019) There are equally caused by transportation effects, such as resource depletion, excessive pollution, and congestion. Poor

transportation stable will reduce the negative impact. In general, transportation activities affect the environment, such as air pollution, traffic accidents, and public health (Bamwesigye & Hlavackova, 2019). Based on the exposure of studies that have been carried out from several studies, the terms of sustainable transportation can be seen in the table below.

Table 1
Characteristics/principles of Sustainable Transport

Researcher	Sustainable Transport Indicator
(Bamwesigye & Hlavackova, 2019; Leuenberger et al., 2014)	Sustainable Transport Indicators: <ol style="list-style-type: none"> 1. Enable safe and consistent access to the basic needs of society, human health, and ecosystems to ensure future stability. 2. Sustainable transportation must be efficient in providing alternative means of transportation to be chosen as highways and cycling, public buses, and trains. 3. Utilization of ICT
(Cohen, 2019)	Readiness in sustainable transportation/smart mobility needs to look at five aspects, including <ol style="list-style-type: none"> 1. Local accessibility. 2. Multi-mode access 3. International accessibility. 4. Information & Communication technology infrastructure supporting mobility and sustainable & safe transportation.
(Brotodewo, 2010; Hiremath et al., 2013; Tamin, 2007)	Indicators of sustainable transportation in three aspects, namely: <ol style="list-style-type: none"> a. Environment, vehicle that does not endanger public health and ecosystems, promoting innovative approaches to developing SDGs (Sustainable Development Indicators for decision-making processes in cities b. Economy, the car that can guarantee the fulfillment of costs transportation through the imposition of reasonable fare for the community users of transportation facilities and can realize justice in transportation system; and c. Social, the vehicle that can minimize noise levels, Accidents, traffic jams, improve social justice and health levels in healthy communities, communities that are livable and rich in social capital).
(Penco et al., 2020; Sjafuruddin, 2011)	Sustainable Transport Indicators <ol style="list-style-type: none"> a. Provides access to the fundamental needs of individuals and communities to synchronize human health and ecosystems. b. Operate efficiently, be easily accessible, provide a choice of transportation modes, and support economic development. c. Limiting emissions and waste, minimizing consumption of non-renewable sources, as well as noise production.

A clear relationship between the above indicators must be balanced and not ignore one aspect/indicator to ensure sustainability. This research aims to see the extent to which the application of the Sustainable concept in the DIY transportation sector supports sustainable development and sustainable transportation itself. One example of this solution is looking for an answer from the development of vehicles that are not sustainable but on economic growth. There are several aspects to implementing sustainable development, including institutional readiness, regulatory elements, socio-cultural readiness, human resource readiness, and planning integration.

Research Method

This research uses qualitative narrative methods. The qualitative approach is based on concepts that will involve the exploration and conduct of in-depth, case-oriented studies (Scholtz, 2020). The location of this research was in the city of Yogyakarta, for the reason that this city has an existing condition similar to other cities and has the vision of "Strengthening the City of

Yogyakarta as a City of Comfortable Living" and the mission of "Strengthening Urban Planning and Environmental Sustainability". Besides, the city of Yogyakarta is a tourist city and a student city.

This study's data comprised primary information gathered through interviews with resource persons, particularly affiliated agencies familiar with the problems under investigation. In this study, a triangulation analysis model was used to outline and select data in order to present a clear picture. This model included data reduction, summarizing, picking the major items, and focusing on the important things received through interviews and literature studies. In addition, data is presented in the form of brief descriptions, charts, category correlations, and the like in data presentation. The final step is developing conclusions and verifying them, followed by tracing the results or conclusions from the written data.

This research also uses a data collection application, namely the N-Vivo 12 Plus. Identification of data originating from secondary data sources (research/related studies) is then supported by capturing online media information using the capture feature (Elias, 2022). The data obtained from Scopus, research from accredited journals, the first and second databases, and several articles captured from online media which will then be analyzed using the N-Vivo 12 Plus software.

Results and Discussion

Achieving sustainable transportation must be supported by a sound transportation system. Mobility/transport is one of the dimensions/indicators that exist in the smart city concept, as stated (Brotodewo, 2010; Hiremath et al., 2013; Tamin, 2007) that the indicators of sustainable transportation are in three aspects, namely: Environment, the vehicle that is not endangering public. Health and ecosystems put forward an innovative approach to develop SDGs (Sustainable Development Indicators for decision-making processes in cities. The following is the implementation of the concept of sustainability in each indicator of sustainability in transportation.

Good Area Accessibility

Good accessibility can be a supporting factor for the economy of a region. The simplest economic aspect in the concept of sustainability is seeking services from the transportation system so that it can support urban activities that are able to increase regional accessibility that is efficient and productive area (Brotodewo, 2010; Nugraha et al., 2020; Pratiwi et al., 2015). Good Area Accessibility Well-maintained public roads will support good regional accessibility in Yogyakarta. Based on central statistics agency data and the Yogyakarta Provincial Bappeda from 2016, an assessment of the condition and condition of the roads in Yogyakarta Special Region has been carried out, which then the road conditions in Yogyakarta can be categorized into two types of road conditions, namely steady and unsteady conditions. The state of the road is determined based on the Decree of the Governor of D.I.Y. Number 118/K.E.P./2016 concerning the Determination of the Status of Provincial Roads. Based on this regulation, the change in the length of the D.I.Y. National road section has changed to 760.45 Km. Road conditions in D.I. Yogyakarta can be seen in Table 2 Road Conditions in the Special Region of Yogyakarta.

Table 2
Condition of roads in special in religion of Yogyakarta

Road Condition	Road Length		Road Condition	Road Length	
	Km	%		Km	%
Great	554,53	72,92	Good	333,205	43,82
Not Steady	205,92	27,08	Medium	221,325	29,1
			Light Damage	140,37	18,46
			Heavy Damage	65,55	8,62
Amount	760,45	100,00		760,45	100,00

Source: DIY regional planning agency, 2019

Based on the table 2 it can be seen that the local road network is 554.53 Km with excellent and moderate status, or about (70%) DIY road conditions are in a steady-state, and the rest are in unstable condition with Slightly Damaged. Road conditions with steady and dangerous quality significantly affect accessibility in economic activity, so road conditions with unstable status must be followed up to support sustainable development so that it will affect the financial aspect. Based on the interview, the accessibility of Transjogja services in DIY are areas that are within the content of the Trans Jogja service, which is an area within a radius of 400 meters from the Trans Jogja bus

stop, including regular and portable bus stops, this measure is used based on the criteria for the furthest distance to walk to access the Transjogja Bus.

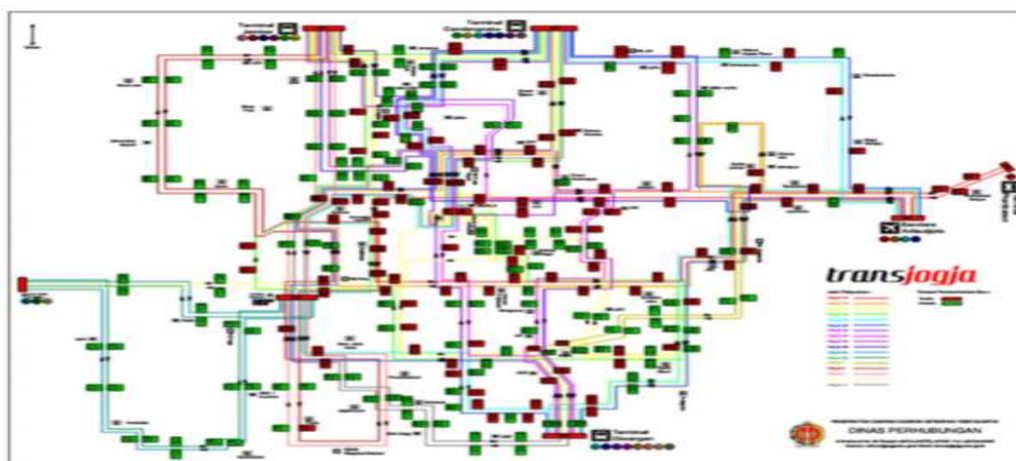


Figure 2 Accessibility of public transportation (Trans Jogja)
Source: Dept TransportationDIY,2020

Based on Figure access the Transjogja Bus, it can be seen that the DIY public transportation mode only reaches the Sleman and Bantul districts, but for the Sleman and Bantul districts, almost all areas are run by public transportation. It can be seen in the drawings that almost all points are spread over the route with a reasonable distance. Not only the ways that are reached by the location of the bus stop as a place to pick up and drop off passengers, this condition certainly causes the affordability of Transjogja services in the Bantul and Sleman areas to be relatively high.

Transportation Services At Affordable Prices And High Capacity

It is important to create a transportation service network to advance the transportation development choice. Some examples of potential road-based public transit systems include Urban Transport and Inter-Provincial Inter-City Transportation Urban Vehicle Transport, or UICT for short (AKDP). To address the many challenges associated with land-based transportation, the DIY government has created a road-based road network system. The evolution of a transportation infrastructure predicated on roads can be broken down into a few distinct subfields. Because of the awful state of affairs in the DIY region, the government has established two distinct modes of urban transportation to cover the Yogyakarta metro area: urban public transportation (bus transportation) known as Trans Jogja (TJ) and implemented with the Buy The Service (BTS) system, and regular urban transit.

Table 3
Urban Transport

Type of Transport	Transport Base	Number Of Fleet
Trans Jogja	Subsidy	110 Fleet
Regular Urban Transport	Deposit	187 Fleet

Source: DIY Transportation Service

The mechanism for assigning or operating the two types of transportation is based on Government Regulation Number 74 of 2014 concerning Road Transportation (Article 110). In 2016 there was a transfer of operations from PT Jogja Tugu Trans to the process of a BUMD named PT Anindya Mitra Internasional (AMI). Urban transportation with the BUY The Service (Trans Jogja) system has 17 routes/feeders with 11 ways actively operating and serving to date (Marwasta & Handoko, 2020). Vehicle transportation in urban areas is transportation from one city to another that passes between districts/cities within 1 (one) provincial area using a public bus bound in a route (Natalia, 2021). Inter-city-in-provincial transportation operation Vehicle transportation in urban areas: Inter-city-in-provincial transportation has 40 public transportation service routes, better known as routes (Gkiotsalitis & Cats, 2021). The management system is implemented with the "Feeder System" system (Wong et al., 2020).

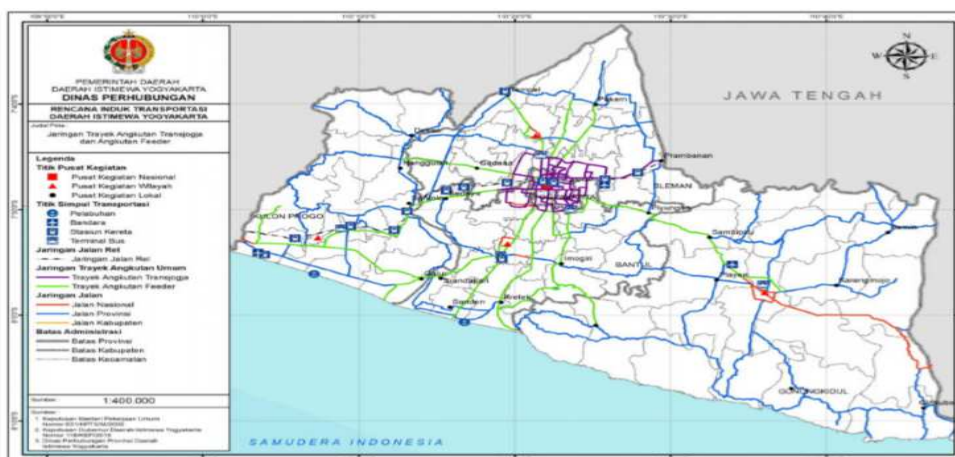


Figure 3 AKDP and Transjogja Urban Route
Source: Dept TransportationDIY,2020

The government's policy on feeder transportation is directed at optimizing public transportation services that support the existing transportation movement patterns in urban Yogyakarta, so that in this case, it must be adjusted to the service time provided by urban transportation to users of public transportation services with services provided to service users who to their subordinate territories. Based on the explanation of each of the indicators above in the economic aspect, it is known that the sustainable characteristics of transportation in the DIY area do not all meet the hands. A clear difference can be seen in the excellent accessibility indicators that not all areas have access to public transportation, although in terms of road accessibility, the status is stable, but for access to affordable public transportation modes, only the Bantul and Sleman districts, while for the Kulon Progo and Gunung Kidul areas only rely on Vehicle transportation in urban areas alone as a mode of transportation.

Public Transportation Services for All Levels of Society/Community Equality

Public transportation services for all levels of society/community equality are part of the social aspect. Coverage The social aspect in the development of sustainable transportation is one aspect that must be considered. Social aspects can be realized by doing several things in transportation development including, public transportation in Special Region Of Yogyakarta is the TransJogja Bus. Trans Jogja must be enjoyed by all levels of society, including those with special needs (disability). Persons with disabilities are protected by Law No. 8 of 2016 concerning disability, namely persons with disabilities have the right to life, freedom from stigma, privacy, justice and legal protection, employment, education, health, entrepreneurship, education, politics, sports, religion, tourism and culture, accessibility, social welfare, and public services. Based on these regulations, it is clear that accessibility and public services are part of the use of public transportation.

The form of services that can be included in sustainable transportation for the public can be seen from several aspects, namely: in terms of service, Drop Point, and the condition of the TransJogja fleet itself. Based on observations, it turns out that in terms of service, some bus stops are not easily accessible by people with disabilities. This can be seen from the condition of the high bus doors so that it is difficult to reach those who are not like the general public. Furthermore, the Drop Point as a place to wait for the arrival of the bus provided by the Department of Transportation is not all accessible to people with disabilities. Can Reduce Accident Rates. The main factor in the occurrence of accidents is caused by humans as road users, both pedestrians and vehicle drivers. Accident data in DIY can be seen in the table below.

Table 4
Number of traffic accidents D.I.Y 2016-2019

Traffic accident	2016	2017	2018	2019
Number of events	3.777	4.011	5.061	5.944
Victim Died	464	442	485	419
Serious Injury Victim	21	29	23	9
Minor Injury Victim	4.910	5.044	6.800	7.259

Based on the table, it can be seen that there is an increase in accidents every year. Most accidents occurred in 2019, with a total of 5944 casualties. The number of deaths in 2019

decreased, as many as 419 people. Meanwhile, accidents involving serious injuries have decreased by nine people. And for the category of minor injuries, there is a reasonably high increase. Sustainable transportation does not seem to have significantly affected the DIY accident rate.

Creating an Efficient Transportation System

To maximize the efficiency level of the transportation system, the DIY government conceptualized a Transport Demand Management (TDM) strategy. Transport Demand Management Is a series of efforts to influence the behavior of travelers to reduce or limit travel demand. Previously, the approach that was often used in transportation development was still manual. The conventional approach consists of prediction and provides which is now replaced by management or transportation management called Transport Demand Management (TMD) which means control of transport needs.

TDM is Implemented by the Department of Transportation as the agency responsible for planning, building, and managing road network transportation services and vehicle regulation. Transport Demand Management is a step chosen by the D.I Yogyakarta government to suppress private vehicles and encourage more effective, healthy, and environmentally friendly modes of transportation and improve the economy. In maximizing the effective implementation of TDM, there are two types of efforts chosen to increase the transportation system, namely, Push and Pull. In the TDM concept, an approach can be used as the most effective way to manage the transportation system. Push is a strategy used by the DIY government to encourage people to use public transportation instead of private vehicles; it is an effort to make personal cars less attractive to use.

Correlation test

The following service to be developed is Park and Ride as a parking facility at public transport nodes specifically for Trans Jogja and AKDP users. Park and Ride is a transportation infrastructure facility serving to raise/unload vehicle passengers (can be in the form of bus transportation or train transportation) combined with vehicle parking facilities (bicycles, motorbikes, or cars) so that passengers can change modes from private vehicles to private vehicles. Public transport to get to the city center (city center). This policy has been in operation since 2008. In 2008 4 locations were designated as Park and Ride facilities serving urban public transportation: Prambanan Terminal, Ngabean Parking Park, Dongkelan Terminal, and Gamping Terminal. The location of Park And Ride can be seen in the image below.

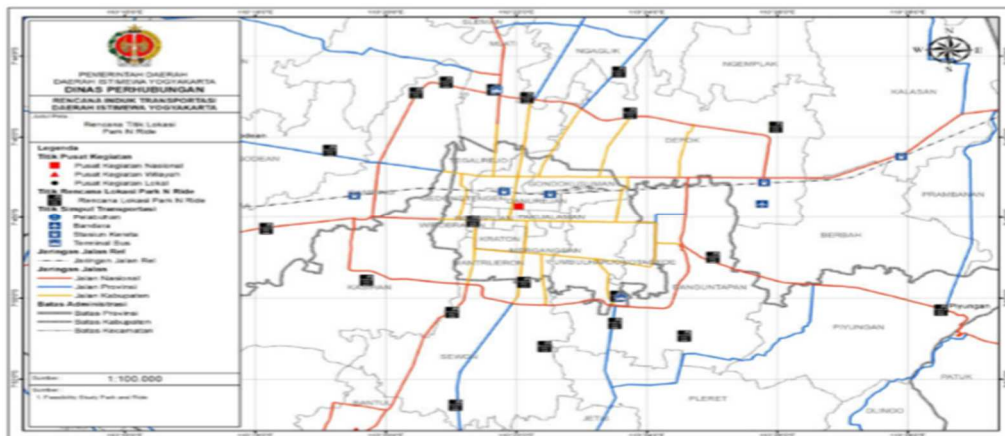


Figure 4 Park and Ride
Source: Dept TransportationDIY,2020

Improving Public Safety and Health

Improving public safety and health is part of the Environmental Aspect indicator. Improving public safety and health as an effort to reduce the negative impact of transportation is a form of sustainable transportation that cares about the future environment. Improving public safety and health can be done by reducing the number of private transportation for the DIY community. However, based on the total number of vehicles, the number of cars in DIY has increased during 2017-2019, which can be seen in the table below.

Table 5
Number of DIY Vichles

Felt Type	2016	2017	2018	2019
Car	284.701	143.689	158.872	168.114
Bus Passenger	10.484	3.448	3.655	5.041
Loard Car	55.083	40.652	43.678	47.372
Motorcycle	1.753.067	1.123.284	1.203.535	1.354.547
Amount	2.103.335	1.311.073	1.409.840	1.575.074

Source: DIY regional planning agency,2019

According to the table of DIY vehicles, the most important vehicle contribution came from the number of private vehicles, specifically motorbikes, which climbed from the previous year to 1,354,547. On the other hand, it can be observed that the number of automobiles has fallen year after year until it reached 1,575,047 in 2019. Although the overall number of cars has decreased, this figure has not yet been included in ecologically friendly vehicles, thus it has a major environmental impact. It is well known that the growing number of cars comes not only from the local population but also from some foreigners who bring or purchase new vehicles in Yogyakarta. Furthermore, in order to promote public health and safety, the DIY Transit Service has developed an ecologically friendly Yogyakarta transportation plan, namely vehicle technology. Some of the activities carried out by the ranks of the DIY Regional Government with the assistance of the Police include emission testing of public transportation (by the DIY Transportation Service as well as private vehicle emission tests by the Police), air quality monitoring, and an electric bus trial by the DIY Regional Government in collaboration with LIPI to produce a bus prototype that will eventually be able to replace the Urban Bus (Trans Jogja).

Providing Transportation Options/Modes

Sustainable transportation must consider environmental aspects. To realize this, it can be done by preparing transportation options. In addition, to reduce the high number of vehicles, it can also be done by providing opportunities or modes of transportation to divert people from dependence on private cars. The Yogyakarta Transportation Department has prepared several modes of transportation that the community can use as transportation, including urban public transit, AKDP, Taxy. The table below will show the number of public transite registered with the DIY Department of Transportation.

Table 6
Number of Special Region Of Yogyakarta Public Transportation

Type of Transport	2016	2017	2018	2019
AKDP	517	484	493	482
Border	8	14	18	14
Regular Town	187	187	187	56
Urban TransJogja	74	128	128	128
Taxi	1025	1025	1025	128
Tourist	805	632	439	619
Special rental transportation	-	16	36	325
	2616	2486	2326	2109

Source: DIY regional planning agency,2019

Based on the table above, it is clear that the public transit options/modes in DIY are quite good. However, the number has been decreasing year after year. According to a field study, the number of automobiles is decreasing year after year since management is not funded. Transportation is still operating to keep functioning. Even though the bus management system is cooperative, the results gained per day are not comparable to bus operations, and income is decreasing year after year.

Availability of Services for Pedestrians (Pedestrians)

A pedestrian groove, sometimes known as a pedestrian route, is a walkway that allows people to walk from one location to another (Sabatini-Marques et al., 2020). According to the research findings, the DIY government has not been entirely successful in adopting pedestrians in DIY.

Pedestrian lanes created at multiple sites cannot function exclusively for pedestrians. Despite the fact that the government has created pedestrian walkways, the lanes are nevertheless utilized as car lanes and trading areas. The development of pedestrian routes revealed a lack of pedestrian implementation in DIY.

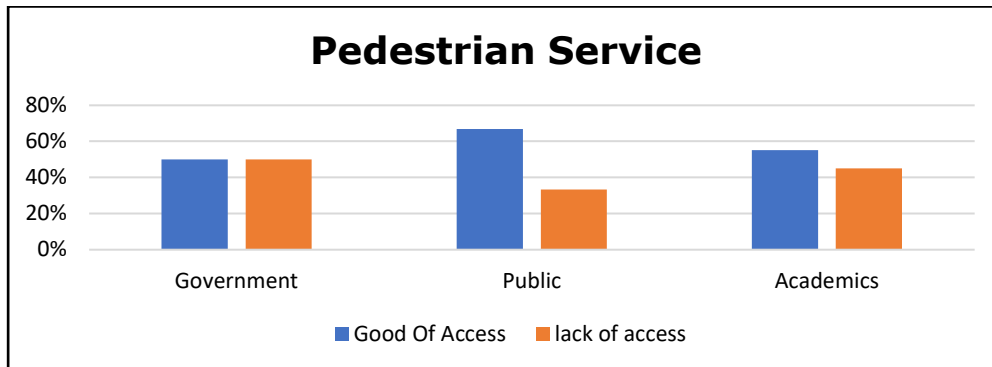


Figure 5 Pedestrian Service
Source: Nvivo 12 Plus

According to Figure Pedestrian Services, pedestrian access in DIY is carried out around 50% of the time; however, based on community satisfaction as users, the lack of pedestrian access is higher, nearing 65%. In comparison, the fulfilled entrance is just about 35%. Meanwhile, experts assess the lack of pedestrian access to be greater, with a value of around 60%, while only 40% of pedestrian access is fulfilled. Based on the graph above, Pedestrian Access is still inadequate in its implementation. The Crosstab Query-Rate results of the N-Vivo 12 plus app show the use of sustainable mobility in the DIY sector. Crosstab run query-rate uses content analysis from online media in DIY to emphasize more on the use of vehicles in DIY in all aspects of sustainability (Economic, Social and Environmental). The following is the result of the Crosstab Query analysis that has been done.

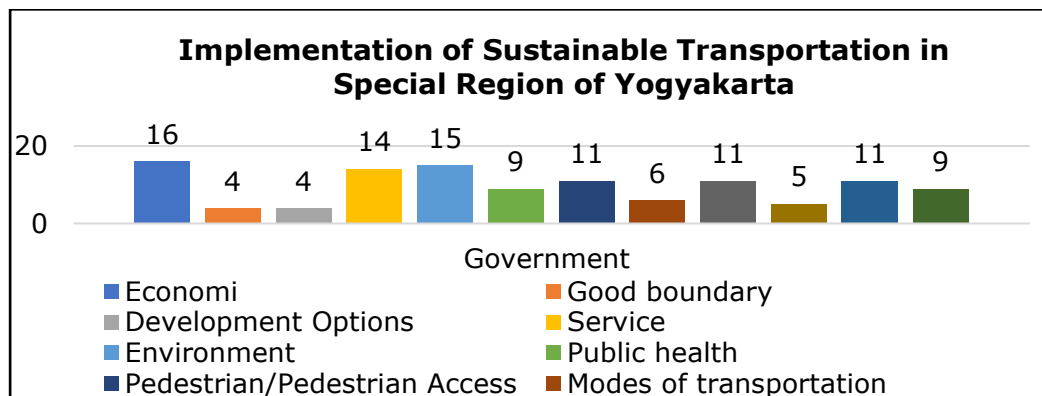


Figure 6 Implementation of Special Region of Yogyakarta Sustainable Transportation from the Government
Source: Nvivo 12 Plus

Based on Figure 5 Sustainable Transportation, indicators are displayed in each aspect of sustainability, so it can be seen that in the economic part, the government is more focused on transportation services. In the environmental aspect, the government is more focused on public health and safety, while in the social part, the government is more focused on implementing efficient transportation. As stated (Sutandi, Anastasia Caroline, 2017), the concept of sustainable transportation does not harm future generations by balancing development in 3 aspects, namely economic, environmental and social.

Conclusions

Smart City realization is carried out through the dimension of sustainable transportation. According to the identification of the features of the vehicle's sustainability aspects in DIY, the idea of sustainability stresses the economic component. Implementing a program that does not promote sustainability results in a failure to meet the sustainability standards in the social realm. Meanwhile, the environmental features of transportation have been better than the social aspects since the ecological aspects of program implementation have matched the sustainability characteristics or needs. The significance of implementing sustainable transportation must be considered, as it necessitates a focus on the sustainability aspect itself. Economic Aspects, Sustainable Transportation in DIY demonstrates that, based on accessibility indices, the transportation system's state has not improved, despite the fact that road conditions are already steady. Increasing accessibility can be accomplished by the use of economic mechanisms to manage transportation activities, such as rising private vehicle taxes, parking charges, and road infrastructure user fees. Furthermore, the employment of electric car technology and ecologically friendly fuels, as well as the reinforcement or optimization of traditional modes of transportation such as Andong, Pedicab, and Bicycle.

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