

# Analysis of Sustainable Transport Implementation in Indonesia

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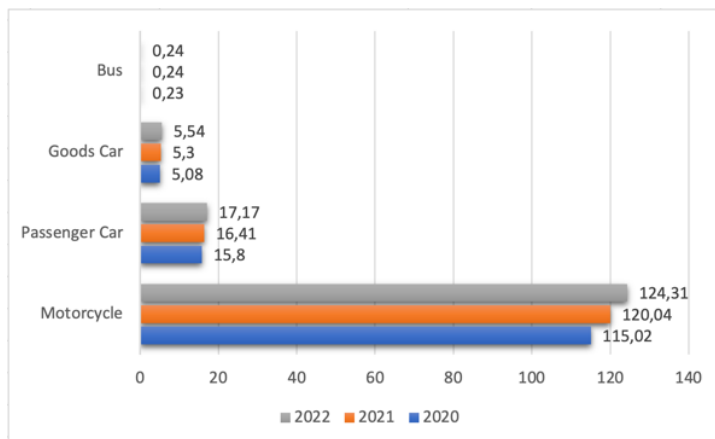
**Abstract.** The study aims to analyze the most significant factors supporting the achievement of sustainable transport in Indonesia using the theory of Transportation System Sustainability. This research uses qualitative methods with a descriptive approach. The data collected came from secondary data from online news portals and journal articles relevant to research topics. Data analysis is assisted by using NVivo 12 Plus software. The results of the research show that there are initiatives and challenges for the Indonesian government in supporting sustainable transport achievements. Reflecting on the natural resources parameters dominated by the transformation of environmentally friendly fuel usage, the System performance parameters are carried out through the optimization of public transport, and the human health parameters through the monitoring and reduction efforts of carbon emissions. However, there are still unoptimal parameters. These are challenges in supporting sustainable transport, such as the still limited safety parameters of facilities supporting sustainability transport in Indonesia, the resilience system parameters restricted by the government on transport technology innovation, and the mobility parameters congestion issues still unresolved in some Indonesian cities.

## 1 Introduction

Indonesia is the fourth most populous country in the world, with a population of 279.04 million in 2024. Rapid population growth raises various demands to meet community activity needs. One is the need for mobility through the transportation system, which is crucial to the meeting. Transportation has become vital in modern society to facilitate various social and economic activities [2] because the large population in Indonesia will increase transport activity and increase the need for mobility.

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**Fig. 1.** Number (Million Units) of Motor Vehicles in Indonesia 2020-2022

The increase in transportation activity is reflected in the picture, which is the type of motorcycle vehicle with the highest intensity used by Indonesian society. With the intensity of the 2022 motorcycles of 124.31 million units. The year-on-year increase in the volume of such transport must raise issues in managing sustainable transport in Indonesia. Sustainability must consider aspects such as fuel consumption, vehicle emissions, safety levels, congestion, and social and economic access that do not harm the environment and human beings and are capable of anticipating the impact on future generations.

The most prevalent issue in Indonesia is due to increased transportation activity, namely air pollution and congestion [3]. Indonesia's air quality is the worst in Southeast Asia. Even Indonesia is ranked 26th globally, with a daily PM 2.5 concentration level reaching 30.4  $\mu$  gram/m<sup>3</sup> by 2022 [4]. In addition, the congestion rate in Indonesia ranks 11th as the world's host country, with an index of 192.9 [5]. According to the 2022 Global Traffic Scorecard report, Indonesia's busiest city is Surabaya, with the duration of time wasted when the congestion reaches 35 hours, Jakarta reaches 30 hours, Denpasar reaches 22 hours, Malang reaches 18 hours, and Bogor reaches 7 hours [6].

Meanwhile, Indonesia is committed to joining the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol [7] in sustainable transport. In reducing greenhouse gas emissions (GRK), Indonesia has committed to signing the Paris Agreement in 2016, targeting zero GRK by 2060 [8]. With the various commitments that have been agreed upon, Indonesia is responsible for implementing the necessary measures for sustainable transport. Based on the transport background in Indonesia in the direction of sustainability, this topic becomes essential for further study.

Previous research has highlighted the increasing attention given to nationally and internationally sustainable transport [9]. Given the transportation challenges in Indonesia, such as severe congestion in Jakarta and Surabaya and high levels of air pollution, efforts in sustainable transport are crucial [10]. According to [11] and [12], building sustainable transport systems not only supports the progress of cities but also protects the environment. This is particularly relevant considering the poor air quality in Indonesia, which is a significant challenge in the region.

The government's role in promoting sustainability through public transport is recognized by [13], which can help address congestion issues in Indonesia. Additionally, [14] emphasizes the need for infrastructure improvements to support sustainable energy transformations, a critical step in reducing greenhouse gas emissions in the transport sector. Emission assessments, as discussed by [15] and [16], are also vital for supporting Indonesia's commitments under international agreements such as the Paris Agreement, which targets

significant emission reductions by 2060. Based on several previous studies, most research examines the importance of sustainable transportation and sustainable transport facilities. Meanwhile, a specific study that analyzes the success rate of sustainable transport in Indonesia has not been the main study by the authors. So, the novelty of this study is to analyze the most significant factors in supporting the achievements of sustainable transport in Indonesia.

## **2 Theoretical Framework**

The author uses the theory of Transportation System Sustainability [17] to look at the most significant factors supporting sustainable transport achievement in Indonesia. There are indicators of transportation system effectiveness reflecting government efforts in facilitating communities through effective modes of transport. This indicator consists of mobility parameters focusing on ease of movement within the transport network. System performance parameters refer to the quality and efficiency of transport infrastructure and services. Then, the environmental sustainability integrity indicator reflects the government's efforts to conduct environmentally friendly transport sustainability efforts. This indicator consists of natural resource parameters referring to environmentally sustainable vehicle fuel use—parameter system resilience vehicle automation capabilities to detect obstacles with artificial intelligence. Finally, the socio-cultural indicator of sustainability social equity reflects government efforts to balance public safety and health. This indicator consists of safety parameters that provide sustainable transport facilities for both users and non-users of vehicles. Human health parameters are government efforts to monitor and evaluate the dynamics of percentage emissions generated by transport activities.

## **3 Method**

This research employs qualitative methods with a descriptive approach to analyze and interpret the facts, phenomena, and events related to sustainable land transport in Indonesia [18]. Secondary data is collected from official online news portals for the period 2017-2024 and relevant previous research. The news portals include Detik, Kompas, and Liputan6 (12 news items), Antara and CNN (10 news items), and Republika (9 news items). These sources were selected due to their relevance and the current information they provide about sustainable transport issues in Indonesia. Descriptive analysis is conducted through three stages: data reduction, where irrelevant data is filtered out to focus on significant information; data presentation, which involves organizing the reduced data into accessible formats such as tables or charts; and conclusion drawing, where the data is interpreted to identify patterns and draw conclusions that support the research objectives. NVivo 12 Plus is used for additional analysis, featuring tools like Word Cloud to visualize the frequency of key terms and themes, and Crosstab to analyze the relationships between different variables.

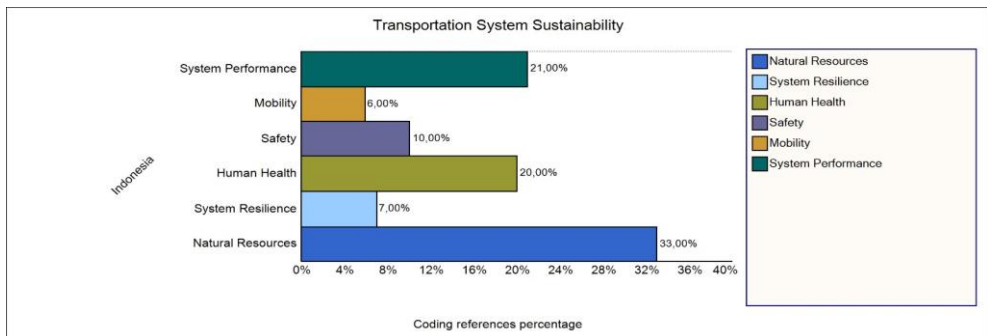
## **4 Result and Discussion**

One of the efforts to create social, environmental, and climate well-being can be achieved through sustainable transport in the context of land transport [19]. This initiative aligns with the Sustainable Development Goals (SDGs) by the alliance of nations. The population growth and the rapid development of cities in Indonesia led to increasing transportation activity. This phenomenon is a significant highlight in Indonesia's achievement of sustainable transport, as shown in the following picture.



**Fig. 2.** Analysis Word Cloud Using by NVivo 12 Plus

The picture is a summary of data acquired from the online news portal. Some words that appear frequently on Cloud visualization reflect a heavily studied topic [20]. High-frequency keywords, namely "transportasi" and "indonesia." Both words indicate the magnitude of the frequency related to transportation issues in Indonesia that are being discussed. Besides, there are keywords "berkelanjutan", "lingkungan", and "masyarakat," whi," are in line with transport-related issues in Indonesia that are closely linked to sustainable transport purposes, taking into account the welfare of the environment and society. In addition th,e Word cloud also displays various keywords related to sustainable transport in Indonesia. Words like "angkutan", "infrastruktur", "teknologi", "emisi", and "energi" point to various aspects that need to be considered in realizing environmentally friendly and sustainable transport in Indonesia.



**Fig. 3.** Analysis Crosstab Using by NVivo 12 Plus

Understanding the dynamics of sustainable transport in Indonesia shows significant potential in several aspects. Based on the picture of the six Transportation System Sustainability theory parameters, the natural resources parameter is the most outstanding, with a 33% presentation. The parameters of natural resources are closely related to transforming environmentally friendly and sustainable vehicle fuel usage. Regarding implementing sustainable transport in Indonesia, this parameter is the aspect that gets the most attention. According to reports from the Life Air Quality Index (AQLI), air quality due to vehicle emissions in Indonesia contributes to global air pollution [21].

Through this problem, the government is trying to reduce the use of fossil fuel vehicles by replacing them with electric vehicles, which do not generate emissions when operated. To encourage the adoption of electric vehicles, the government has issued incentives for people to switch to electric vehicles. Incentives provided by the government, among other things, for imports of electric vehicles at 0%, both in whole form (CBU) and incomplete decomposition (CKD). There is a 100% reduction in the Income Tax (PPh) for enterprises engaged in producing, assembling, and/or importing electric vehicles. In addition, the government bears the Sales of Luxury Goods Tax (PPnBM) of 15% for electric car imports. The government also bears as much as 10% of the Value Added Tax (VPM) for purchasing electric cars [22].

To reduce vehicles using fossil fuels by switching to electric vehicles. Indonesia has successfully increased the number of electric vehicles, with data for 2023 showing 14.993 electric cars, 47.710 electric motors, 312 three-wheeled units, 80 buses, and ten freight cars [23]. Meanwhile, in major cities like Jakarta, Surabaya, and Bandung, efforts to reduce emissions are being made by encouraging people to walk and cycle. The same is true of Yogyakarta, which has a policy restricting motor vehicles in some regions of the city centre at certain hours. Some of these efforts in Yogyakarta have yielded results with a 25% reduction in PM<sub>2.5</sub> particle concentration [24]. The dominance of natural resources parameters shows that various initiatives encouraged to reduce the use of fossil fuels to support sustainable transport have had a positive impact on Indonesia.

Although electric vehicles are a suitable solution to address air pollution, there are downsides. This is due to the fact that Indonesia's ambition to become a major player in the electric vehicle (EV) ecosystem has driven the massive downstream development of nickel, particularly in Halmahera, where PT Indonesia Nikel Weda Bay Industrial Park (IWIP) operates. However, this effort has triggered serious environmental and social issues, including deforestation and human rights violations. Although electric vehicles are seen as a solution to reduce air pollution, ironically, the energy used to produce EV batteries in Halmahera comes from coal-fired power plants (PLTUs), which generate significant air pollution. This case highlights a major dilemma in the clean energy transition, where efforts to reduce vehicle emissions inadvertently increase pollution at the energy source [25].

The system performance parameter prevailed in second place with a presentation of 21%. This parameter refers to the availability of public transportation to encourage people to care about the environment. This effort is carried out by spreading public transportation in various parts of Indonesia. There is a Rapid Transit Bus (BRT) system that is spread across various regions, including Jakarta (Transjakarta), Bandung (Trans Metro Bandung), Solo (Batik Solo Trans), Yogyakarta (Trans Jogja), Medan (Trans MIO), Makassar (Trans Mamminasata), and Palembang. (Trans Sarangan). Also, there are rail-based public transport modes, i.e., KRLs, that have been operating in a few regions only, in Jabodetabek, Surabaya, Yogyakarta, Solo, and Padang. Besides, there is LRT, which only operates in Jabodetabek, and MRT, which is very limited, operating only in Jakarta.

The human health parameter is in third order with a 20% presentation, this parameter relates to emission monitoring on transportation activities. The government has been working on implementing carbon emission monitoring programs in major cities. As in Yogyakarta, emission surveillance programs are carried out using air quality measurements or Air Quality Monitoring System (AQMS) [25]. The central government also carries out emission reduction efforts through the Blue Sky Programme to improve air quality. In addition, the car-free day policy, which aims to reduce carbon emissions, has also been implemented in various cities such as Yogyakarta, Bandung, Semarang, and Surabaya. In Jakarta, restrictions on the use of private vehicles have also been imposed through a strange policy [26]. Most areas in Indonesia have healthy air conditions, although the increase in steam still needs to

be improved, given the air quality in Indonesia by 2024, in Banten, DKI Jakarta, and West Java, which is still unhealthy [27].

Safety becomes the fourth parameter to prevail with a 10% presentation. This parameter relates to the provision of supporting facilities in sustainability efforts. In Bali, the City of Denpasar has provided bicycle lanes at some points spread across the city, such as Sudirman Road [28]. In addition to non-drivers, the government has also provided facilities for environmentally friendly vehicle users by charging electric vehicles in various regions. *Stasiun Penukaran Baterai Kendaraan Listrik Umum* (SPBKLUM) have reached 1,772 units [29]. Unfortunately, SPBKLUM and SPBKLUM facilities are only available in a few large cities, which has caused people to reconsider buying electric cars due to the limitation of charging facilities in many smaller cities.

System resilience becomes the fifth-ordered parameter with a 7% presentation. This parameter relates to vehicle automation through artificial intelligence. One of the efforts that Indonesia has realized is rail-based transportation. LRT Jabodetabek has been operating automatically without a machine, using Communication-Based Train Control (CBTC) Grade of Automation (GoA) level 3 [30]. This parameter still needs to be improved because it has not been massively implemented in Indonesia.

The mobility parameter is in the sixth order with a 6% presentation. This parameter relates to the ease of the vehicle moving freely from congestion. Efforts to overcome the congestion have been widely implemented in Indonesia, one of which is Jakarta, which is the city entering the top 50 congestion cities according to Tomtom's ranking. The Jakarta DKI Provincial Government has undertaken several efforts ranging from the bizarre-complete policy, the closure of the u-turn, the creation of pavement roads, and the Network Operation Centre (NOC) Intelligent Traffic Light System (ITS) to the duplication of artificial intelligence [31]. The congestion in Jakarta is due to several factors, such as the increase in vehicles every year and the lack of willingness of the public to switch to public transportation [33].

## 5 Conclusion

Despite the challenges, Indonesia has demonstrated a significant commitment and effort to achieve sustainable transport. The three parameters that can support the achievement of sustainable transport in Indonesia are natural resources, system performance, and human health. These three parameters influence each other, including natural resources through the transformation of the use of environmentally friendly fuel, in collusion with the system performance done with the promotion of public transportation. In addition, the parameters of natural resources and system performance can influence human health parameters. It is seen in the emission monitoring and reduction program, with the results for most areas in Indonesia regarding quality air conditions. However, there are several areas that still need improvement. Safety, as the fourth parameter with a 10% presentation, requires special attention in providing supporting facilities. System resilience, which is the fifth parameter with a 7% presentation, relates to vehicle automation through artificial intelligence. Mobility, as the sixth parameter with a 6% presentation, concerns the ease of vehicles moving freely from congestion.

To enhance the achievement of sustainable transport, it is recommended that policymakers focus on expanding facilities for electric vehicles to smaller cities, as well as increasing the implementation of automation technology throughout Indonesia. Future research should also consider collecting primary data to provide deeper insights into the factors influencing sustainable transport and to identify more effective solutions. With these measures, it is hoped that the research will significantly contribute to the development of sustainable transport policies in Indonesia.

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