Optimizing Sustainable Transportation Policies and Mobility Technologies to Reduce Air Pollution and Traffic Congestion in Jakarta

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ABSTRACT

Air pollution and traffic congestion continue to pose significant challenges to sustainable urban development in Jakarta. Rapid population growth, increasing vehicle ownership, and expanding mobility demands have intensified environmental degradation and transportation inefficiencies throughout the metropolitan area. This study aims to analyze the influence of sustainable transportation policies and mobility technologies on reducing air pollution and traffic congestion in Jakarta. A quantitative research approach was employed using data collected from 175 respondents representing public perceptions of urban transportation conditions. Data were gathered through a structured questionnaire utilizing a five-point Likert scale and analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS 3). The findings reveal that sustainable transportation policy has a positive and significant effect on air pollution reduction and traffic congestion reduction. Furthermore, mobility technology significantly influences air pollution reduction and demonstrates the strongest effect on traffic congestion reduction. The model explains 66.4% of the variance in air pollution reduction and 70.1% of the variance in traffic congestion reduction, indicating substantial explanatory power. The results suggest that the integration of sustainable transportation policies and smart mobility technologies can effectively improve environmental quality and transportation efficiency in Jakarta. This study contributes to the sustainable urban mobility literature by providing empirical evidence that policy interventions and technological innovations function as complementary mechanisms for addressing complex transportation challenges in rapidly urbanizing cities.

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1. INTRODUCTION

Rapid urbanization and population growth have fundamentally transformed transportation systems in major metropolitan regions across the world. While urban development serves as a catalyst for economic growth, social interaction, and regional competitiveness, it simultaneously generates substantial environmental and mobility-related challenges [1], [2]. Among these challenges, air pollution and traffic congestion have emerged as critical issues threatening urban sustainability. The increasing reliance on private vehicles, coupled with inadequate public transportation capacity and rising travel demand, has intensified transportation-related externalities in many cities [2], [3]. Transportation systems have become major contributors to greenhouse gas emissions, energy consumption, and deteriorating air quality, while persistent congestion imposes significant economic costs through productivity losses, increased fuel consumption, and inefficient mobility patterns [4], [5]. Consequently, the pursuit of sustainable urban transportation has become a strategic priority for governments and policymakers seeking to balance mobility needs with environmental protection and long-term urban resilience.

Jakarta, the capital city of Indonesia, exemplifies the complexity of transportation challenges faced by rapidly growing megacities. As the nation's economic, political, and administrative center [6], [7], Jakarta accommodates millions of daily trips generated by residents, commuters, and business activities. Over the past several decades, population growth and urban expansion have significantly increased transportation demand, while road infrastructure development has struggled to keep pace with rising vehicle ownership. This imbalance has resulted in chronic traffic congestion and severe air pollution problems that affect economic efficiency, environmental sustainability, and public health. Transportation-related emissions, including carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM2.5 and PM10), and carbon dioxide (CO_2), have become major contributors to declining air quality in the metropolitan area. Furthermore, prolonged exposure to these pollutants has been associated with respiratory diseases, cardiovascular disorders, and reduced quality of life among urban residents. These conditions highlight the urgent need for innovative and sustainable approaches capable of addressing both environmental and mobility challenges simultaneously [8], [9].

In response to these concerns, sustainable transportation policies have gained increasing attention within both academic and policy discussions. Sustainable transportation policies encompass a broad range of initiatives aimed at reducing environmental impacts while enhancing accessibility, affordability, and transportation efficiency [6], [10]. Such policies typically include investments in public transportation infrastructure, promotion of non-motorized transportation, implementation of vehicle emission regulations, transit-oriented development, and transportation demand management strategies. Theoretical perspectives on sustainable mobility suggest that transportation systems should not only facilitate movement but also support environmental stewardship and social well-being [10], [11]. Accordingly, effective transportation policies can influence travel behavior, reduce dependence on private vehicles, and promote the adoption of more environmentally friendly mobility options. Nevertheless, the effectiveness of these policies often depends on public acceptance, implementation quality, institutional capacity, and their ability to adapt to rapidly changing urban mobility demands.

Alongside policy interventions, technological innovation has emerged as a transformative force in modern transportation systems. Advances in mobility technologies, including intelligent transportation systems, artificial intelligence-based traffic management, real-time navigation platforms, digital mobility applications, and integrated transportation information systems, have significantly altered how transportation networks are managed and utilized [12], [13]. These technologies provide opportunities to optimize traffic flows, reduce travel delays, improve route efficiency, and enhance the overall performance of transportation systems. Smart mobility solutions are increasingly recognized as essential components of sustainable urban development because they enable data-driven decision-making and more efficient utilization of existing transportation infrastructure. By improving operational efficiency and reducing unnecessary vehicle movements, mobility technologies can contribute to both congestion mitigation and emission reduction [11], [13]. Consequently, the integration of technological innovation into transportation planning has become a key strategy for achieving sustainable mobility objectives in rapidly urbanizing cities.

Although previous studies have extensively examined sustainable transportation initiatives and smart mobility solutions, the existing literature remains fragmented. Many studies have focused primarily on the environmental impacts of transportation policies, while others have investigated the operational benefits of mobility technologies independently. Research has shown that public transportation improvements can reduce vehicle dependence and lower emissions, whereas intelligent transportation systems can enhance traffic management and mobility efficiency. However, limited empirical evidence exists regarding the combined influence of sustainable transportation policies and mobility technologies on both air pollution reduction and traffic congestion mitigation, particularly within the context of emerging megacities. Moreover, relatively few studies have incorporated public perception as a critical dimension for evaluating transportation sustainability, despite the fact that public acceptance and behavioral adaptation are fundamental determinants of policy and technology effectiveness. This gap indicates the need for a more integrated analytical framework capable of simultaneously examining the contributions of policy interventions and technological innovations to sustainable transportation outcomes.

This study addresses these gaps by investigating the influence of sustainable transportation policies and mobility technologies on reducing air pollution and traffic congestion in Jakarta. The novelty of this research lies in its integrated examination of policy and technological dimensions as complementary determinants of urban transportation sustainability. Unlike previous studies that typically analyze these factors separately, this study develops a comprehensive framework that evaluates their simultaneous effects on environmental and mobility outcomes, the research provides empirical evidence from one of Southeast Asia's most complex urban transportation environments. The findings are expected to contribute to the growing body of knowledge on sustainable urban mobility while offering practical insights for policymakers, transportation planners, and technology developers seeking to create cleaner, more efficient, and more resilient transportation systems. Therefore, the primary objective of this study is to analyze the direct effects of sustainable transportation policies and mobility technologies on air pollution reduction and traffic congestion reduction in Jakarta and to provide evidence-based recommendations for future urban transportation development.

2. LITERATURE REVIEW

2.1 Sustainable Transportation Policy

Sustainable transportation policy refers to strategic regulations and planning initiatives aimed at meeting mobility needs while maintaining environmental quality, social equity, and economic sustainability. Based on sustainable mobility theory, such policies seek to reduce the negative impacts of transportation activities, including air pollution, greenhouse gas emissions, traffic congestion, and excessive energy consumption, through measures such as public transportation development, promotion of active mobility, vehicle emission standards, and transportation demand management [6], [14]. Previous studies have shown that sustainable transportation policies can improve urban environmental performance by reducing traffic volumes and emissions while encouraging more sustainable travel behavior. In Jakarta, initiatives such as mass transit expansion, bus rapid transit improvements, transit-oriented development, and vehicle emission regulations have become increasingly important in addressing urban mobility and environmental challenges [14]–[16]. Therefore, sustainable transportation policy is expected to play a significant role in reducing air pollution and traffic congestion. In this study, the construct is measured through transportation infrastructure development, public transportation improvement, environmental transportation regulations, accessibility enhancement, and sustainable mobility promotion.

2.2 *Mobility Technology*

Mobility technology refers to the application of advanced digital innovations that enhance the efficiency, accessibility, safety, and sustainability of transportation systems. The development of smart mobility has transformed transportation management through the integration of information and communication technologies, artificial intelligence, big data analytics, and Intelligent Transportation Systems (ITS), enabling real-time traffic monitoring, route optimization, and improved transportation services [17], [18]. Technologies such as smart traffic management systems, digital navigation platforms, mobility-as-a-service (MaaS), ride-sharing applications, and real-time transportation information systems have been widely adopted to reduce travel time, improve traffic flow, and minimize fuel consumption. Supported by the Technology Acceptance Model (TAM), the adoption of mobility technologies depends on users' perceptions of usefulness and ease of use. Previous studies have demonstrated that mobility technologies contribute significantly to transportation sustainability by reducing congestion, improving transportation efficiency, and supporting informed travel decisions [19], [20]. In this study, mobility technology is measured through intelligent transportation systems, digital mobility platforms, real-time transportation information, smart traffic management, and transportation technology integration.

2.3 *Air Pollution Reduction*

Air pollution reduction refers to efforts to decrease the concentration of harmful pollutants generated by transportation and other human activities, particularly in urban areas where vehicle emissions are a major source of environmental degradation [21], [22]. Transportation-related pollutants such as carbon monoxide (CO), nitrogen oxides (NOx), particulate matter (PM2.5 and PM10), and carbon dioxide (CO_2) significantly affect air quality and public health. According to environmental sustainability theory, reducing pollution requires integrated approaches involving policy interventions, technological innovation, and behavioral change. Previous studies have shown that sustainable transportation initiatives, including public transportation development, stricter emission standards, and smart mobility technologies, can effectively reduce emissions and improve air quality. Beyond environmental benefits, air pollution reduction also contributes to public health by lowering the risks of respiratory and cardiovascular diseases [23], [24]. In this study, air pollution reduction is measured through decreased vehicle emissions, improved air quality, reduced fuel consumption, enhanced environmental sustainability, and mitigation of transportation-related pollution.

2.4 *Traffic Congestion Reduction*

Traffic congestion reduction refers to efforts to improve traffic flow by minimizing delays, travel times, and inefficiencies caused when transportation demand exceeds road capacity. According to transportation systems theory, congestion occurs when road networks operate beyond their optimal limits, resulting in economic losses, increased fuel consumption, environmental pollution, and reduced mobility efficiency [25], [26]. To address this issue, sustainable transportation policies and mobility technologies have been widely implemented through public transportation improvements, transportation demand management, intelligent traffic control systems, predictive analytics, and real-time traffic monitoring. Previous studies indicate that integrated transportation strategies combining policy interventions and technological innovations are more effective in reducing congestion than isolated measures [27], [28]. In Jakarta, where congestion remains a major urban challenge, understanding the factors that contribute to congestion reduction is essential for improving transportation sustainability. In this study, traffic congestion reduction is measured through improved traffic flow, shorter travel times, enhanced transportation efficiency, reduced road overcrowding, and increased transportation system effectiveness.

2.5 Conceptual Framework

This study develops a conceptual framework in which Sustainable Transportation Policy and Mobility Technology act as exogenous variables, while Air Pollution Reduction and Traffic Congestion Reduction function as endogenous variables. The model proposes that Sustainable Transportation Policy positively influences Air Pollution Reduction and Traffic Congestion Reduction, while Mobility Technology positively affects both Air Pollution Reduction and Traffic Congestion Reduction. The framework assumes that policy interventions and technological innovations play complementary roles in enhancing environmental quality and transportation efficiency. Therefore, the integration of sustainable transportation policies and mobility technologies is expected to provide a comprehensive approach to achieving sustainable urban mobility and addressing environmental and transportation challenges in Jakarta.

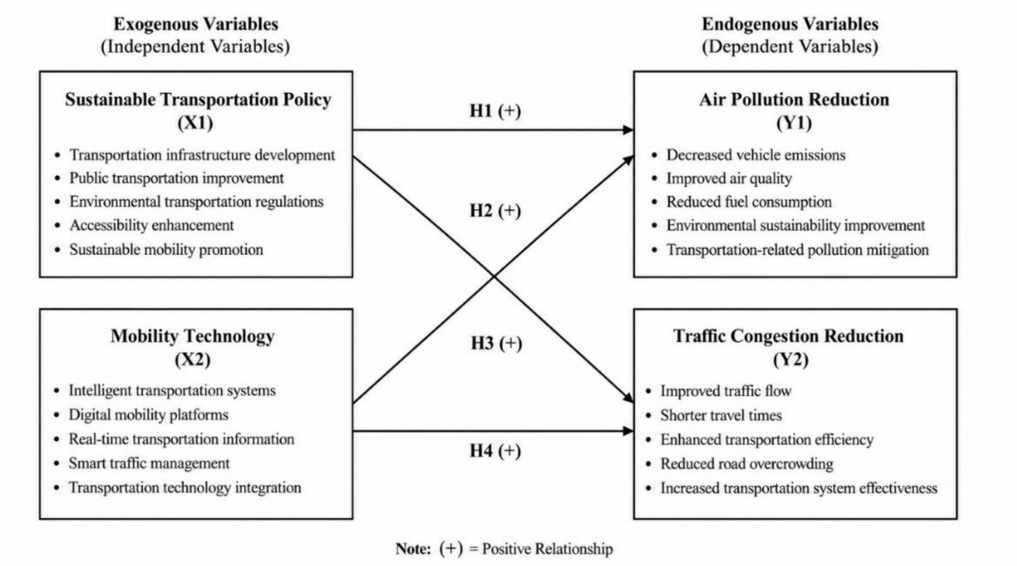

Figure 1. Conceptual Framework

3. METHODS

This study employed a quantitative research approach with an explanatory research design to investigate the influence of sustainable transportation policies and mobility technologies on air pollution reduction and traffic congestion reduction in Jakarta. The study focused on public perceptions regarding the effectiveness of transportation policies and technological innovations in addressing urban environmental and mobility challenges. Jakarta was selected as the study area due to its severe traffic congestion, high levels of air pollution, rapid urbanization, and increasing transportation demand, making it an appropriate context for examining sustainable transportation solutions. The target population consisted of Jakarta residents who regularly utilize transportation services for commuting, education, business, and other daily activities. A total of 175 respondents participated in the study using a purposive sampling technique. Respondents were selected based on the following criteria: being at least 18 years old, residing in Jakarta, regularly using transportation services within the city, having experience with public transportation, private vehicles, or digital mobility applications, and being willing to participate in the survey.

Primary data were collected through a structured questionnaire distributed both online and offline. The questionnaire was developed based on previous literature related to sustainable transportation, mobility technologies, environmental sustainability, and traffic management. All items were measured using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The study included four latent variables: Sustainable Transportation Policy (STP), Mobility Technology (MT), Air Pollution Reduction (APR), and Traffic Congestion Reduction (TCR). Sustainable Transportation Policy was measured through transportation infrastructure development, public transportation improvement, environmental transportation regulations, accessibility enhancement, and sustainable mobility promotion. Mobility Technology was measured through intelligent transportation systems, digital mobility platforms, real-time transportation information, smart traffic management, and transportation technology integration. Air Pollution Reduction was measured through decreased vehicle emissions, improved air quality, reduced transportation-related pollution, decreased fuel consumption, and enhanced environmental sustainability. Traffic Congestion Reduction was measured through improved traffic flow, reduced travel time, decreased congestion levels, improved transportation efficiency, and enhanced urban mobility effectiveness. The proposed research model hypothesized that Sustainable Transportation Policy and Mobility Technology positively influence both Air Pollution Reduction and Traffic Congestion Reduction.

Data analysis was performed using Structural Equation Modeling–Partial Least Squares (SEM-PLS) with SmartPLS 3 software. The analysis consisted of measurement model (outer model) and structural model (inner model) evaluations. Convergent validity was assessed through outer loadings (>0.70) and Average Variance Extracted (AVE >0.50), while discriminant validity was evaluated using the Fornell-Larcker Criterion, cross-loadings, and Heterotrait-Monotrait Ratio (HTMT). Reliability was examined through Cronbach's Alpha and Composite Reliability values exceeding 0.70. The structural model was evaluated using the coefficient of determination (R^2), effect size (f^2), predictive relevance (Q^2), and model fit indices including Standardized Root Mean Square Residual (SRMR) and Normed Fit Index (NFI). Hypothesis testing was conducted using the bootstrapping procedure with 5,000 subsamples. Hypotheses were accepted when the path coefficient was positive, the t-statistic exceeded 1.96, and the p-value was below 0.05, indicating statistically significant relationships among the study variables.

4. RESULTS AND DISCUSSION

4.1 Respondent Characteristics

A total of 175 valid responses were collected and analyzed. The respondents represented Jakarta residents who regularly use transportation services for commuting, education, business, and other daily activities.

Table 1. Demographic Profile of Respondents

Characteristics	Category	Frequency	Percentage (%)
Gender	Male	96	54.9
	Female	79	45.1
Age	18–25 years	42	24.0
	26–35 years	71	40.6
	36–45 years	39	22.3
	>45 years	23	13.1
Occupation	Employee	78	44.6
	Student	36	20.6
	Entrepreneur	32	18.3
	Government Officer	15	8.6
	Others	14	8.0
Main Transportation Mode	Private Vehicle	85	48.6
	Public Transportation	62	35.4
	Ride-Hailing Services	28	16.0

Table 1 presents the demographic profile of the 175 respondents involved in this study. Based on gender, male respondents accounted for 54.9% (96 respondents), while female respondents represented 45.1% (79 respondents). Regarding age distribution, the majority of respondents were between 26–35 years old (40.6%), followed by those aged 18–25 years (24.0%), 36–45 years (22.3%), and over 45 years (13.1%). In terms of occupation, employees constituted the largest group at 44.6%, followed by students (20.6%), entrepreneurs (18.3%), government officers (8.6%), and others (8.0%). Concerning transportation usage, private vehicles were the most frequently used mode of transportation among respondents (48.6%), followed by public transportation (35.4%) and ride-hailing services (16.0%). These findings indicate that the sample was dominated by economically active individuals who regularly experience Jakarta's transportation conditions and therefore provide relevant insights regarding sustainable transportation policies and mobility technologies.

4.2 Measurement Model Assessment (Outer Model)

4.2.1 Convergent Validity

Convergent validity was evaluated through outer loading values and Average Variance Extracted (AVE). All indicators exceeded the recommended threshold of 0.70.

Table 2. Outer Loadings

Construct	Indicator	Loading
Sustainable Transportation Policy	STP1	0.821
	STP2	0.854
	STP3	0.791
	STP4	0.873
	STP5	0.839
Mobility Technology	MT1	0.846
	MT2	0.871
	MT3	0.825
	MT4	0.887
	MT5	0.842
Air Pollution Reduction	APR1	0.832
	APR2	0.876
	APR3	0.861
	APR4	0.804
	APR5	0.845
Traffic Congestion Reduction	TCR1	0.857
	TCR2	0.881
	TCR3	0.842
	TCR4	0.866
	TCR5	0.851

Table 2 presents the outer loading values used to assess the convergent validity of the measurement model. The results indicate that all indicators exhibit loading values above the recommended threshold of 0.70, ranging from 0.791 to 0.887. For the Sustainable Transportation Policy construct, the loading values range from 0.791 (STP3) to 0.873 (STP4). Mobility Technology demonstrates loading values between 0.825 (MT3) and 0.887 (MT4). Air Pollution Reduction records loading values ranging from 0.804 (APR4) to 0.876 (APR2), while Traffic Congestion Reduction shows loading values between 0.842 (TCR3) and 0.881 (TCR2). These findings confirm that all indicators possess satisfactory convergent validity and adequately represent their respective latent constructs, indicating that the measurement model is suitable for further reliability and structural model analysis.

Table 3. Reliability and Convergent Validity

Variable	Cronbach's Alpha	Composite Reliability	AVE
Sustainable Transportation Policy	0.884	0.915	0.683
Mobility Technology	0.899	0.925	0.711
Air Pollution Reduction	0.887	0.917	0.689
Traffic Congestion Reduction	0.902	0.928	0.721

Table 3 presents the results of reliability and convergent validity testing for all constructs in the model. The findings show that the Cronbach's Alpha values range from

0.884 to 0.902, while Composite Reliability values range from 0.915 to 0.928, exceeding the recommended threshold of 0.70 and indicating strong internal consistency among the measurement items. Furthermore, the Average Variance Extracted (AVE) values range from 0.683 to 0.721, which are above the minimum requirement of 0.50, confirming adequate convergent validity. Among the constructs, Traffic Congestion Reduction demonstrates the highest reliability with a Cronbach's Alpha of 0.902, Composite Reliability of 0.928, and AVE of 0.721.

4.2.2 Discriminant Validity

Table 4. Fornell-Larcker Criterion

Variable	STP	MT	APR	TCR
STP	0.826			
MT	0.647	0.843		
APR	0.712	0.695	0.830	
TCR	0.684	0.739	0.703	0.849

Table 4 presents the Fornell-Larcker Criterion results used to assess discriminant validity among the constructs. The diagonal values, representing the square root of the Average Variance Extracted (AVE), are 0.826 for Sustainable Transportation Policy (STP), 0.843 for Mobility Technology (MT), 0.830 for Air Pollution Reduction (APR), and 0.849 for Traffic Congestion Reduction (TCR). These values are higher than the corresponding inter-construct correlations, indicating that each construct shares more variance with its own indicators than with other constructs in the model. For example, the square root of AVE for Mobility Technology (0.843) exceeds its correlations with STP (0.647), APR (0.695), and TCR (0.739). Similarly, the square root of AVE for Traffic Congestion Reduction (0.849) is greater than its correlations with STP (0.684), MT (0.739), and APR (0.703). Therefore, the results confirm satisfactory discriminant validity, demonstrating that all constructs are empirically distinct and adequately measure different theoretical concepts.

4.3 Structural Model Assessment (Inner Model)

4.3.1 Coefficient of Determination (R^2)

The coefficient of determination (R^2) values for the endogenous variables in the structural model. The results show that Sustainable Transportation Policy and Mobility Technology jointly explain 66.4% of the variance in Air Pollution Reduction (R^2 = 0.664) and 70.1% of the variance in Traffic Congestion Reduction (R^2 = 0.701). According to commonly accepted SEM-PLS guidelines, these values indicate moderate-to-substantial explanatory power, suggesting that the proposed model has a strong capability to explain variations in both environmental and transportation outcomes. Furthermore, the higher R^2 value for Traffic Congestion Reduction indicates that the independent variables provide slightly greater explanatory power for congestion mitigation than for air pollution reduction.

4.3.2 Predictive Relevance (Q^2)

The predictive relevance (Q^2) values obtained from the blindfolding procedure. The results show that Air Pollution Reduction has a Q^2 value of 0.451, while Traffic Congestion Reduction records a Q^2 value of 0.512. Since both values are greater than zero, the model demonstrates satisfactory predictive relevance, indicating that the exogenous variables possess substantial predictive capability for the endogenous constructs. Moreover, the higher Q^2 value for Traffic Congestion Reduction suggests that the model has slightly stronger predictive power in explaining congestion reduction compared to air pollution reduction.

4.3.3 Model Fit

Table 5. Model Fit Indices

Indicator	Value
SRMR	0.071
NFI	0.892

Table 5 presents the model fit indices used to evaluate the overall adequacy of the structural model. The results show an SRMR value of 0.071, which is below the recommended threshold of 0.10, indicating a good level of model fit and suggesting that the discrepancy between the observed and predicted correlations is relatively small. In addition, the Normed Fit Index (NFI) value of 0.892 approaches the recommended benchmark of 0.90, reflecting an acceptable model fit. Collectively, these results indicate that the proposed model adequately represents the relationships among Sustainable Transportation Policy, Mobility Technology, Air Pollution Reduction, and Traffic Congestion Reduction, supporting the suitability of the model for hypothesis testing and further interpretation.

4.4 Hypothesis Testing

Bootstrapping analysis with 5,000 subsamples was performed to test the proposed hypotheses.

Table 6. Path Coefficients and Hypothesis Testing

Relationship	Path Coefficient	T-Statistic	P-Value	Result
STP → APR	0.432	5.863	0.000	Supported
STP → TCR	0.351	4.479	0.000	Supported
MT → APR	0.417	5.224	0.000	Supported
MT → TCR	0.501	6.712	0.000	Supported

Table 6 presents the results of hypothesis testing, revealing that all proposed relationships are positive and statistically significant. Sustainable Transportation Policy has a significant positive effect on Air Pollution Reduction ($\beta = 0.432$, $t = 5.863$, $p < 0.001$), indicating that policies related to public transportation development, environmental regulations, and sustainable mobility promotion contribute substantially to improving air quality in Jakarta. Similarly, Sustainable Transportation Policy positively influences Traffic Congestion Reduction ($\beta = 0.351$, $t = 4.479$, $p < 0.001$), suggesting that transportation policy interventions can effectively reduce traffic density and improve mobility efficiency. Mobility Technology also demonstrates a significant positive effect on Air Pollution Reduction ($\beta = 0.417$, $t = 5.224$, $p < 0.001$), implying that intelligent transportation systems, digital mobility platforms, and real-time transportation information help reduce emissions through more efficient transportation operations. Furthermore, Mobility Technology exhibits the strongest influence on Traffic Congestion Reduction ($\beta = 0.501$, $t = 6.712$, $p < 0.001$), highlighting the critical role of smart traffic management and digital transportation solutions in mitigating congestion and optimizing traffic flow.

Discussion

The findings show that Sustainable Transportation Policy significantly influences Air Pollution Reduction, indicating that respondents perceive transportation policies as an important mechanism for improving environmental quality in Jakarta. Policies that promote public transportation systems, stricter vehicle emission standards, and environmentally friendly transportation modes can reduce dependence on private vehicles and lower transportation-related emissions. This result supports sustainable mobility theory, which argues that policy interventions can shape travel behavior and environmental outcomes by encouraging shifts toward cleaner and more efficient transportation alternatives [6], [29].

The results also indicate that Sustainable Transportation Policy has a positive effect on Traffic Congestion Reduction. This finding suggests that policy measures such as public transportation expansion, transit-oriented development, congestion management, and transportation demand management can improve mobility efficiency by reducing traffic density and encouraging more sustainable travel choices. As more residents use public transportation or alternative mobility modes, pressure on Jakarta's road networks can be reduced, leading to smoother traffic flow and shorter travel times [25], [26]. Therefore, transportation policy remains a critical foundation for achieving sustainable urban mobility.

Mobility Technology was also found to significantly influence Air Pollution Reduction. This result implies that technological innovations can support environmental sustainability by improving transportation efficiency and reducing unnecessary fuel consumption. Intelligent transportation systems, smart traffic signal management, real-time traffic monitoring, and digital navigation applications allow vehicles to move more efficiently and reduce idle time. Lower idle time and more efficient routing can reduce emissions, thereby contributing to improved air quality. This finding confirms the role of digital transformation and smart mobility in supporting cleaner transportation systems [17], [18], [20].

The strongest relationship in the model was found between Mobility Technology and Traffic Congestion Reduction. This result indicates that respondents perceive mobility technologies as highly effective in addressing congestion problems in Jakarta. Smart transportation technologies can improve traffic flow through real-time traffic management, route optimization, predictive traffic analytics, and rapid incident response. Compared with policy interventions, mobility technologies may provide more immediate operational benefits because they directly improve traffic monitoring, decision-making, and network efficiency.

Overall, the findings demonstrate that Sustainable Transportation Policy and Mobility Technology both contribute significantly to reducing air pollution and traffic congestion. However, Mobility Technology shows a stronger influence on congestion reduction, while Sustainable Transportation Policy provides a slightly stronger contribution toward environmental improvement. These results suggest that neither policy nor technology should be implemented separately. An integrated approach that combines regulatory frameworks, public transportation development, sustainable urban planning, and smart mobility technologies is necessary to create cleaner air, reduce congestion, improve public health, and strengthen urban sustainability in Jakarta.

5. CONCLUSION

This study examined the influence of sustainable transportation policies and mobility technologies on reducing air pollution and traffic congestion in Jakarta. The findings reveal that all proposed relationships are positive and statistically significant, indicating that both sustainable transportation policy and mobility technology play important roles in enhancing urban transportation sustainability. Sustainable transportation policies contribute significantly to reducing air pollution and mitigating traffic congestion through public transportation improvements, environmental regulations, and sustainable mobility initiatives, while mobility technology demonstrates a significant influence on both environmental and mobility outcomes, with the strongest effect observed on traffic congestion reduction. These results highlight the effectiveness of intelligent transportation systems, smart traffic management solutions, and digital mobility platforms in improving transportation efficiency and optimizing traffic flow. Furthermore, the findings suggest that integrating policy interventions with technological innovations provides a comprehensive approach to addressing Jakarta's transportation challenges, as policies establish the regulatory and infrastructural foundation for long-term sustainability, whereas mobility technologies deliver real-time operational improvements. Therefore, policymakers should continue investing in public transportation infrastructure, strengthening emission-control regulations, and accelerating the implementation of smart mobility technologies to support a more efficient, environmentally sustainable, and resilient transportation system. Nevertheless, this study is limited by its reliance on public perception data and its focus on a single metropolitan area. Future studies are encouraged to incorporate objective environmental and transportation indicators, expand the geographical scope of analysis, and examine additional variables such as public transportation satisfaction, environmental awareness, smart city readiness, and behavioral intentions toward sustainable mobility to provide a more comprehensive understanding of sustainable transportation development in emerging urban environments.

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