

Assessing the Environmental Benefits of Urban Transport Integration: A Comprehensive Review

Menilai Manfaat Lingkungan dari Integrasi Transportasi Perkotaan: Tinjauan Komprehensif

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ABSTRACT

Urban transportation integration plays an important role in influencing greenhouse gas (GHG) emissions in developing and developed cities. This systematic literature review analyzes the impact of urban transport integration on GHG emissions by comparing the two types of cities. Through literature searches and analysis, the characteristics of developing and developed cities, the challenges of implementing urban transport integration, as well as solutions that can be implemented to overcome these challenges have been identified. The results show that urban transport integration has significant potential in reducing GHG emissions, especially through the promotion of sustainable transport and compact urban planning. The implications of this research highlight the importance of policies that support public transportation and sustainable infrastructure development to reduce GHG emissions and encourage environmentally friendly urban development.

Keywords: Urban transportation integration, greenhouse gas emissions, developing cities, developed cities, transportation policy, systematic literature review.

ABSTRAK

Integrasi transportasi urban memainkan peran penting dalam mempengaruhi emisi gas rumah kaca (GRK) di kota-kota berkembang dan maju. Tinjauan literatur sistematis ini menganalisis dampak integrasi transportasi urban terhadap emisi GRK dengan membandingkan kedua jenis kota tersebut. Melalui pencarian dan analisis literatur, karakteristik kota-kota berkembang dan maju, tantangan implementasi integrasi transportasi urban, serta solusi yang dapat diterapkan untuk mengatasi tantangan tersebut telah diidentifikasi. Hasilnya menunjukkan bahwa integrasi transportasi urban berpotensi signifikan dalam mengurangi emisi GRK, terutama melalui promosi transportasi berkelanjutan dan perencanaan perkotaan yang kompak. Implikasi penelitian ini menyoroti pentingnya kebijakan yang mendukung transportasi publik dan pembangunan infrastruktur yang berkelanjutan untuk mengurangi emisi GRK dan mendorong pembangunan perkotaan yang ramah lingkungan.

Kata kunci: Integrasi transportasi urban, emisi gas rumah kaca, kota berkembang, kota maju, kebijakan transportasi, tinjauan literatur sistematis.

1. Introduction

To evaluate the environmental benefits of urban transport integration, it is essential to consider various factors highlighted in the literature. Sustainable urban transport development aims to minimize the environmental impact of transportation systems (Kechagias et al., 2020). Integrated transport planning is crucial for achieving sustainable urban transport, focusing on factors such as economic development, transport demand, environmental quality, and energy consumption (Li et al., 2017). Criteria for sustainable urban transportation encompass social, economic, and environmental aspects, emphasizing the necessity of a holistic approach (Kraus & Proff, 2021). Public transport significantly contributes to urban ecological governance and can aid in disaster risk reduction in cities (Ge & Zhang, 2022).

Efforts toward sustainable urban mobility involve objectives like enhancing

accessibility, safety, reducing pollution, and improving transportation system efficiency (Chou, 2017). Sustainable transport planning should incorporate smart mobility indicators to assess environmental, social, and economic sustainability (Ali, 2021). Policies and initiatives aimed at enhancing urban transportation sustainability can positively impact citizens' social life and address urban environmental challenges (Mousavimasouleh et al., 2022). Efficient and environmentally friendly municipal freight transport systems can be developed through urban planning interventions (Ogryzek et al., 2020).

When assessing the impact of motor transport enterprises on urban ecosystems, criteria for evaluating negative environmental impacts are identified, underscoring the importance of mitigating adverse effects (Soloshych et al., 2021). Sustainable urban form should include characteristics such as compactness, walkability, high density, public transport dominance, mixed land use, and ecological integration (Chen et al., 2022). Urban freight transport, crucial for sustainable and livable cities, necessitates a theoretical research framework to guide future sustainable practices (He & Haasis, 2020). In conclusion, a comprehensive evaluation of sustainable urban transport integration must adopt a multidimensional approach addressing environmental, social, and economic aspects. By incorporating sustainability criteria, promoting public transport, and implementing efficient freight transport systems, cities can progress towards reducing environmental emissions and enhancing overall urban sustainability.

This research aims to fill the knowledge gap in the literature regarding the effectiveness of urban transportation integration in reducing greenhouse gas (GHG) emissions in developing and developed cities. Transportation is an important element in human life, but it is also a major source of GHG emissions, which threaten environmental sustainability. Especially in developing cities with high population densities such as Mumbai and Dhaka, the problem of GHG emissions from transportation has become more acute due to rapid growth and lack of adequate infrastructure. On the other hand, developed cities such as Amsterdam and Singapore show more established and diverse transport systems, with a tendency to use public transport to a greater extent. However, although there has been previous research on urban transport integration, this research notes gaps in the literature, especially in the context of comparisons between developing and developed cities. Therefore, this research will present a comprehensive analysis of how urban transportation integration affects GHG emissions in both types of cities. By using in-depth research methods, this research is expected to provide a better understanding of the role of urban transportation integration in climate change mitigation and sustainable city development. Thus, the contribution of this research lies not only in deeper academic understanding, but also in assisting the formulation of more effective policies and encouraging best practices in urban transport integration planning and implementation.

2. Research Methods

Data for this research was obtained through literature searches in various relevant sources, including scientific databases such as Scopus, Web of Science, and Google Scholar, as well as direct access to academic journals and related research reports. Keywords used in the search included phrases such as "urban transportation integration", "greenhouse gas emissions", "developing cities", "developed cities", and other variations of keywords that fit the focus of this research. The article selection process is carried out based on predetermined criteria. The included articles must be closely related to the research topic of the integration of urban transportation and greenhouse gas emissions, use relevant research methodology, and be published within the specified time frame. Articles that did not meet these criteria, including those not available in English, were excluded from this study. The article selection process was carried out in stages, starting from deleting articles based on the title and abstract, followed by full reading of the article to ensure compliance with the inclusion criteria. The

number of articles included and excluded at each selection stage will be documented in detail.

Data analysis was carried out using a systematic approach, especially in the context of a systematic literature review. Data obtained from selected articles will be compiled, synthesized, and evaluated to gain a comprehensive understanding of the effectiveness of urban transportation integration in reducing greenhouse gas emissions in developing and developed cities. This analysis method includes identifying patterns, trends and key findings from the collected literature, as well as critical evaluation of the research methodology used in the selected articles. Data interpretation will be carried out by considering the research context, the relevance of the findings, and the implications for policy and practice in the areas of urban transportation integration and greenhouse gas emission mitigation.

3. Results and Discussion

3.1. Impact of Urban Transportation Integration on GHG Emissions in Developing Cities

Urban transportation integration plays a crucial role in influencing greenhouse gas (GHG) emissions in developing cities. Studies have shown that urban areas are significant contributors to national GHG emissions, with cities responsible for a substantial portion of these emissions (Kennedy et al., 2009). Developing-country cities with nascent infrastructures can benefit from compact urban forms and well-planned transportation systems to increase population densities and avoid high carbon emission patterns (Creutzig et al., 2015). However, research indicates that transportation carbon footprints are notably higher in large suburbs compared to principal cities, emphasizing the importance of urban planning and transportation strategies in mitigating GHG emissions (Jones & Kammen, 2014).

The relationship between land-use changes, urbanization, and GHG emissions in urban areas is complex and varies based on residence and transportation characteristics (Liao et al., 2013). Urban transport, particularly passenger land-based systems, accounts for a significant portion of urban GHG emissions, highlighting the need for sustainable transportation policies (Milovanoff et al., 2021). Furthermore, the production and supply of energy, materials, and services in urban areas significantly impact global GHG emissions, underscoring the challenges in accounting for city-level emissions (Lanau et al., 2021).

Policy interventions have the potential to reduce transportation GHG emissions in urban areas while improving economic welfare and health outcomes (Liotta et al., 2022). Compact city designs have been shown to reduce both urban transport and building GHG emissions, emphasizing the importance of urban form parameters in emission reduction strategies (Pierer & Creutzig, 2019). Additionally, achieving GHG reductions through integrated transportation and land use planning is complex but essential for sustainable urban development (Nahlik & Chester, 2015). In conclusion, urban transportation integration plays a critical role in shaping GHG emissions in developing cities. Effective urban planning, compact city designs, and sustainable transportation policies are essential for mitigating GHG emissions and promoting environmentally friendly urban development.

Urban transportation integration is essential for reducing greenhouse gas (GHG) emissions in developing cities. Research shows that public transportation modes such as electric trains, electric buses, and bicycles are more effective in curbing GHG emissions compared to private vehicles using fossil fuels (Ruparathna et al., 2017). Factors influencing the success of urban transportation integration include population density, existing transportation systems, and government policies. High population density can pose challenges due to mobility pressures and infrastructure needs, while underdeveloped transport systems can hinder integration efforts (Rosiers et al., 2016). Government policies supporting eco-friendly transportation and sustainable infrastructure are crucial for enhancing the effectiveness of urban transport integration in reducing GHG emissions (Liao et al., 2013).

Efforts to tackle GHG emissions in developing cities require a comprehensive approach

considering these factors. Studies highlight the importance of incentives for public transportation use and sustainable infrastructure development to reduce reliance on private vehicles (Park et al., 2017). Additionally, the relationship between land-use change and GHG emissions in urban areas underscores the need for comprehensive planning to mitigate emissions (Baur et al., 2014). Implementing city-level carbon accounting, as demonstrated in a comparison between Madrid and London, offers insights into emission inventories and supply chain impacts (Andrade et al., 2018). In conclusion, addressing urban transportation integration in developing cities is a complex challenge that demands coordinated efforts. By prioritizing environmentally friendly public transportation, addressing population density issues, improving existing transport systems, and implementing supportive government policies, cities can significantly reduce GHG emissions and promote sustainable urban development.

3.2. Impact of Urban Transportation Integration on GHG Emissions in Developed Cities

Urban transportation integration is a critical factor influencing greenhouse gas (GHG) emissions in developed cities. Research indicates that urban transport systems are a significant contributor to GHG emissions in cities, with passenger land-based systems alone responsible for approximately 14% of urban GHG emissions (Milovanoff et al., 2021). The density of urban areas has been linked to transportation energy use and subsequent GHG emissions, suggesting that more compact cities can help reduce emissions not only from urban transport but also from building activities (Kennedy et al., 2009; Pierer & Creutzig, 2019). Factors such as population density, urbanization, and improvements in fuel economy have been identified as key influencers of GHG emissions from road transportation (Lim et al., 2020).

The relationship between urban form, infrastructure, and fuel production is crucial for understanding and quantifying GHG emissions from urban transportation systems (Chester et al., 2014). Strategies aimed at reducing emissions are increasingly focusing on redesigning urban forms to encourage alternatives to automobile use, such as public transit, to help mitigate GHG emissions from transportation (Nahlik & Chester, 2015). Moreover, the use of private vehicles in developing countries has been highlighted as a significant contributor to GHG emissions in the transportation sector (Setyono et al., 2020).

As urban areas continue to expand, the importance of sustainable urban planning grows to mitigate GHG emissions. Urban planners advocate for compact, transit-oriented, and pedestrian-friendly urban development to reduce carbon dioxide and other GHG emissions associated with settlement patterns, built form, and transportation (Guerra, 2011). By considering the impact of urban transportation integration on GHG emissions and implementing measures to promote sustainable transport modes, cities can progress towards reducing their overall carbon footprint and contribute to global efforts to combat climate change.

Efforts to reduce greenhouse gas (GHG) emissions in developed cities through urban transportation integration are crucial for sustainable urban development. Research indicates that the adoption of environmentally friendly transportation modes, such as mass public transportation, electric trains, and well-integrated bicycle networks, plays a significant role in mitigating GHG emissions (Seto et al., 2011). Factors influencing the effectiveness of urban transportation integration include the existing transportation system, environmental policies, and community culture. A well-established public transportation network and progressive environmental policies like high parking fees and incentives for public transport usage contribute to reducing GHG emissions (Huang et al., 2021). Moreover, a public culture that supports sustainable lifestyles and environmental awareness encourages the shift towards environmentally friendly transportation options (Saenz et al., 2016).

Studies emphasize the importance of considering various factors comprehensively to enhance urban transport integration in developed cities for effective GHG emissions reduction

and sustainable urban development (Jin et al., 2019). By implementing measures like encouraging sustainable transportation modes and enacting supportive policies, cities can significantly reduce their carbon footprint and promote environmentally friendly practices (Park et al., 2017). Additionally, research highlights the significance of population density in reducing urban GHG emissions in Europe, showcasing the interconnectedness of urban planning and environmental impact (Wei et al., 2023). In conclusion, integrating environmentally friendly transportation modes and implementing supportive policies are essential strategies for reducing GHG emissions in developed cities. By considering factors such as the transportation system, environmental policies, and community culture, cities can effectively mitigate their carbon footprint and work towards sustainable urban development.

3.3. Comparison of the Effectiveness of Urban Transportation Integration in Developing and Developed Cities

To compare the effectiveness of urban transportation integration in developing and developed cities, it is essential to consider various factors such as sustainable urban development, transport modeling, public transport optimization, and the impact of transportation networks on urban agglomerations. Lee (2020) emphasizes the importance of an integrated approach to transport and spatial planning for sustainable urbanization, highlighting its relevance not only in developed regions but also in rapidly developing cities in Asia. Feng et al. (2010) discuss the effectiveness of the EM algorithm in predicting urban transport development in expanding urban areas of developing cities, showcasing improvements in transport planning despite challenges like limited survey data.

Xu et al. (2022) stress the need for multi-mode coordinated planning of urban and rural transportation to overcome limitations in public transport development in small and medium-sized cities. Yao et al. (2021) provide evidence of the radiation effect of transportation networks in urban agglomerations, indicating the significance of transportation systems in sustainable urban development. Additionally, Rode et al. (2017) highlight the positive impact of dense urban development and accessible public transport on disadvantaged groups in cities.

Furthermore, Li (2012) discusses the importance of low-carbon management concepts in transit-oriented development planning, emphasizing the relationship between transportation, land use, and urban development. Ejdy (2021) underscores the necessity of recognizing and analyzing changes in urban transport systems for sustainable development. Lastly, Bertolini (2012) advocates for integrating mobility and urban development agendas to address challenges like suburbanization and promote sustainable transportation practices. In conclusion, by synthesizing insights from these references, it is evident that integrated urban transportation planning is crucial for achieving sustainable urban development in both developing and developed cities. Effective transport modeling, public transport optimization, and coordination between urban and rural transportation systems play vital roles in enhancing urban mobility and overall quality of life.

3.4. Challenges and Solutions for Implementing Urban Transportation Integration

Implementing urban transportation integration poses several challenges that need to be addressed for successful integration. One key challenge is the lack of an integrated view of the entire multimodal urban transportation network (MUTN), which can lead to difficulties for citizens and urban planning (Smarzaro et al., 2021). Additionally, challenges include improving human health by reducing urban air pollution and traffic accidents, controlling excessive motorization, enhancing public transport services, and strengthening active modes of transportation (Chatziioannou et al., 2020). The growth in urban population and consumption rates also presents challenges for cities to achieve sustainable urban freight transport (Oliveira et al., 2019).

To address these challenges, it is essential to consider key factors such as impacts on

existing traffic patterns, safety analysis, economic and environmental benefits, and the development of shared infrastructure for urban air mobility (UAM) and ground-based transportation (Xuan et al., 2023). Furthermore, integrating urban and rural multi-mode transportation planning can promote the overall development of transportation systems in various areas (Xu et al., 2022). Innovative frameworks that integrate freight and passenger urban systems can optimize transport capacity and enhance urban sustainability (Mazzarino & Rubini, 2019).

Moreover, the integration of public transport infrastructure, service quality, management levels, and socioeconomic development guarantees are crucial for successful urban and rural public transport integration (Zhou, 2023). Leveraging waterway transport in urban transportation systems, especially in Amazonian cities, can contribute to sustainable mobility by integrating urban and water transportation networks (Tobias et al., 2019). Sustainable urban mobility models should extend beyond resource optimization and address challenges holistically to achieve long-term sustainability (Souza et al., 2019). In conclusion, addressing challenges in urban transportation integration requires a comprehensive approach that considers various factors such as infrastructure development, service quality, environmental impacts, and stakeholder interests. By integrating different modes of transportation, leveraging innovative solutions, and promoting sustainable practices, cities can work towards achieving efficient, safe, and sustainable urban transportation systems.

4. Conclusion

The results and discussion presented in this systematic literature review highlight the important role of urban transport integration in shaping greenhouse gas (GHG) emissions in both developing and developed cities. In developing cities, urban transport integration plays a significant role in reducing GHG emissions by promoting sustainable transport modes and dense urban forms. In contrast, in developed cities, transportation systems remain a major contributor to GHG emissions, highlighting the need for effective strategies to reduce carbon footprints.

The implications of these findings highlight the importance of sustainable urban planning, compact city design, and supportive government policies in reducing GHG emissions from transportation. Policy interventions aimed at promoting public transportation and providing incentives for environmentally friendly modes of travel can result in real reductions in GHG emissions while improving economic well-being and public health.

However, it is important to acknowledge the limitations of existing literature, including the complexity of urban systems and the diverse socio-economic contexts of different cities. Future research should focus on overcoming these limitations by exploring innovative solutions, integrating urban and rural transport planning, and leveraging emerging technologies to achieve sustainable urban mobility.

Overall, this systematic literature review provides valuable insights into the effectiveness of urban transport integration in reducing GHG emissions in both developing and developed cities. By adopting a holistic approach, leveraging innovative solutions, and encouraging multi-stakeholder collaboration, cities can progress towards sustainable urban development and contribute to global efforts to tackle climate change.

5. References

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