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Unified Perspectives in Urban Transport Sustainability: An AHP-Based Comparative Analysis of National and Local Indicator Weights

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ABSTRACT

This study investigates the differences in urban transport sustainability indicators from national and local perspectives using Amman, Jordan as a case study. Employing the Analytic Hierarchy Process (AHP) method, we aim to understand the weighted importance of various sustainability indicators as viewed by experts at different administrative levels. A structured survey was conducted with 30 national and 30 local experts gathering their insights through pairwise comparisons of indicators. The results reveal significant disparities between national and local priorities, highlighting the need for integrated approaches in urban transport planning. National experts prioritize public transport coverage and air quality, reflecting broader strategic goals, while local experts emphasize pedestrian infrastructure and accessibility to green spaces, focusing on community-specific needs. This comparative analysis underscores the importance of balancing both perspectives to enhance urban transport sustainability effectively. The findings suggest that integrating national and local views can lead to more comprehensive and inclusive transport policies. This research contributes to the existing literature by addressing the often-overlooked social dimension of sustainability and providing a practical framework for evaluating and balancing national and local priorities in urban transport planning.

1. Introduction

Urban transport sustainability is an essential aspect of urban planning, significantly impacting the environmental, economic, and social well-being of cities. As urban populations grow and cities expand, the need for sustainable transport systems that address these dimensions becomes increasingly critical (Litman, 2021). Sustainable urban transport systems are designed to reduce environmental impacts, promote economic efficiency, and enhance social equity. This multifaceted approach ensures that urban transport meets present needs without compromising the ability of future generations to meet theirs (Banister, 2012).

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Despite the comprehensive nature of urban transport sustainability, much of the existing research has predominantly focused on its environmental and economic dimensions (Shirazi & Keivani, 2017). Environmental sustainability in urban transport often emphasizes reducing greenhouse gas emissions, improving air quality, and mitigating climate change impacts (Dimitriou & Gakenheimer, 2012). Economic sustainability, on the other hand, focuses on cost-effectiveness, infrastructure investments, and the economic benefits of efficient transport systems (Litman, 2009).

However, the social dimension of urban transport sustainability is equally important but less frequently addressed in scholarly literature. Social sustainability in transport involves ensuring equitable access to transport services, improving safety for all road users, and enhancing the overall liveability of urban environments (Lucas 2012). These aspects are critical for fostering inclusive and resilient communities, particularly in developing countries where disparities in transport access and safety are often more pronounced (United Nations Department for Economic and Social Affairs, 2021).

The concept of social sustainability in urban transport is multifaceted, encompassing accessibility, safety, and liveability (Ghahramanpouri et al., 2013). Accessibility refers to the ease with which urban residents can reach essential services and opportunities such as employment, education, healthcare, and recreation (Banister, 2012). Safety involves reducing the risk of accidents and ensuring the security of all transport users, including pedestrians, cyclists, and motorists (Dimitriou & Gakenheimer 2012). Liveability relates to the overall quality of life in urban areas, influenced by factors such as air quality, noise levels, and the availability of green spaces (Shirazi & Keivani, 2017).

Research Question: This study aims to bridge the gap between national and local perspectives on urban transport sustainability by addressing the following research question: *How do national and local experts prioritize different urban transport sustainability indicators, and what implications do these priorities have for urban transport planning and policy in Amman, Jordan?*

Using Amman, Jordan as a case study, we apply the Analytic Hierarchy Process (AHP) to evaluate the relative importance of different indicators. By comparing the insights from national and local experts, this research seeks to provide a comprehensive understanding of how different administrative levels perceive urban transport sustainability, thereby facilitating more effective policy and planning decisions.

The choice of Amman as the case study is particularly relevant due to the city's rapid urbanization and diverse population, which present unique challenges and opportunities for sustainable urban transport development. Amman has been experiencing significant growth with increasing demand for efficient and sustainable transport systems to support its expanding urban population (Greater Amman Municipality, 2020). This context provides a valuable setting for exploring the differences in priorities between national and local stakeholders and identifying strategies for integrating these perspectives into urban transport planning.

2. Literature Review

2.1. Urban Transport Sustainability

Urban transport sustainability involves a holistic approach to addressing the environmental, economic, and social impacts of transport systems (Litman, 2021). Environmental sustainability focuses on reducing emissions, minimizing resource use, and mitigating climate

change impacts. Economic sustainability involves cost-effectiveness, economic growth, and the equitable distribution of economic benefits. Social sustainability, which is the focus of this study, includes accessibility, safety, and liveability, aiming to improve the quality of life for urban residents (Banister, 2012).

The concept of sustainability in urban transport has evolved over time, reflecting changes in societal values and priorities. Early approaches to urban transport planning often prioritized economic growth and efficiency with limited consideration of environmental and social impacts (Dimitriou & Gakenheimer, 2012). However, the recognition of the interconnectedness of environmental, economic, and social factors has led to a more integrated approach to urban transport sustainability (United Nations Department for Economic and Social Affairs, 2021).

Environmental sustainability in urban transport emphasizes the need to reduce greenhouse gas emissions and other pollutants that contribute to climate change and degrade air quality (Litman, 2009). Strategies for achieving environmental sustainability include promoting public transport, non-motorized transport modes (such as walking and cycling), and the use of cleaner technologies and fuels (Shirazi & Keivani, 2017). These measures help to minimize the environmental footprint of urban transport systems and enhance the resilience of cities to environmental challenges.

Economic sustainability in urban transport focuses on ensuring that transport systems are financially viable and contribute to economic development (Banister, 2012). This involves optimizing the efficiency of transport networks, reducing congestion, and improving connectivity to support economic activities and enhance the competitiveness of cities (Dimitriou & Gakenheimer, 2012). Economic sustainability also encompasses the equitable distribution of economic benefits, ensuring that all segments of society have access to affordable and efficient transport services (United Nations Department for Economic and Social Affairs, 2021).

Social sustainability in urban transport addresses the need to create inclusive and equitable transport systems that improve the quality of life for all urban residents (Lucas, 2012). This dimension of sustainability is particularly important for vulnerable and marginalized populations who often face barriers to accessing transport services (Ghahramanpouri et al., 2013). Social sustainability includes measures to enhance accessibility, safety, and liveability, ensuring that urban transport systems meet the diverse needs of urban communities (Banister, 2012).

2.2. Importance of Social Sustainability in Urban Transport

Social sustainability ensures equitable access to transportation services, improves safety, and enhances the liveability of urban areas (Dimitriou & Gakenheimer, 2012). It is crucial for reducing social inequalities and fostering inclusive urban development. In developing countries, the challenges of achieving social sustainability are particularly pronounced due to resource constraints and inadequate infrastructure (United Nations Department for Economic and Social Affairs, 2021). This study emphasizes the need to integrate social sustainability into urban transport planning to address these challenges effectively.

Accessibility is a key aspect of social sustainability in urban transport as it determines the ability of urban residents to reach essential services and opportunities (Banister, 2012). Accessible transport systems enable people to participate fully in economic, social, and cultural activities, enhancing their quality of life and promoting social inclusion (Lucas, 2012). Inadequate accessibility can lead to social exclusion, particularly for vulnerable

groups such as low-income households, people with disabilities, and the elderly (Ghahramanpouri et al., 2013).

Safety is another critical component of social sustainability in urban transport, involving measures to reduce the risk of accidents and ensure the security of all transport users (Dimitriou & Gakenheimer, 2012). Unsafe transport systems can have severe consequences for public health and well-being, particularly in urban areas where traffic congestion and high vehicle speeds increase the likelihood of accidents (Litman, 2009). Improving safety in urban transport requires a combination of infrastructure improvements, enforcement of traffic regulations, and public awareness campaigns (Shirazi & Keivani, 2017).

Liveability refers to the overall quality of life in urban areas influenced by transport systems (Banister, 2012). Transport systems play a significant role in shaping the liveability of cities as they affect the physical environment and the experiences of urban residents (Ghahramanpouri et al., 2013). Enhancing liveability involves creating transport systems that are not only efficient and safe but also contribute to the well-being and enjoyment of urban life (Lucas, 2012).

2.3. Indicators of Urban Transport Sustainability

Indicators are essential tools for measuring and monitoring the sustainability of urban transport systems (Gasparatos et al., 2008). They provide quantifiable data that can inform policy decisions and track progress towards sustainability goals. Common indicators include measures of accessibility, safety, and liveability (Litman, 2021). These indicators help to transform complex sustainability concepts into actionable insights, facilitating more effective planning and management of urban transport systems.

Accessibility indicators measure the ease with which urban residents can reach essential services and destinations such as employment, education, healthcare, and recreation (Banister, 2012). Common accessibility indicators include public transport coverage, average distance to transport services, and the availability of pedestrian and cycling infrastructure (Litman, 2009). These indicators provide insights into the inclusiveness and equity of urban transport systems, highlighting areas where improvements are needed to enhance accessibility for all residents (Lucas, 2012).

Safety indicators measure the risk of accidents and the overall security of transport users (Dimitriou & Gakenheimer, 2012). Common safety indicators include accident rates, enforcement of traffic laws, and the presence of safety features such as pedestrian crossings and traffic calming measures (Litman, 2009). These indicators help to identify safety issues and inform interventions to reduce the risk of accidents and improve the security of urban transport systems (Shirazi & Keivani, 2017).

Liveability indicators measure the overall quality of life in urban areas influenced by transport systems (Banister, 2012). Common liveability indicators include air quality, noise pollution, accessibility to green spaces, and the comfort of public transport services (Ghahramanpouri et al., 2013). These indicators provide insights into the environmental and social impacts of transport systems, highlighting areas where improvements are needed to enhance the liveability of urban environments (Lucas, 2012).

3. Methodology

The AHP, developed by Thomas L. Saaty (1980), is a structured technique for analysing complex decisions based on mathematics and psychology. The process involves the following steps:

1. **Define the Problem and Objective**: The problem is to determine the relative importance of various urban transport sustainability indicators from national and local perspectives. The objective is to establish a hierarchy of indicators to facilitate decision-making in urban transport planning.
2. **Structure the Hierarchy**: The decision problem is decomposed into a hierarchy of more comprehensible sub-problems. Each level represents a set of criteria or factors considered when making the decision. In this study, the hierarchy includes three main categories of indicators: accessibility, safety, and liveability (Figure 1).

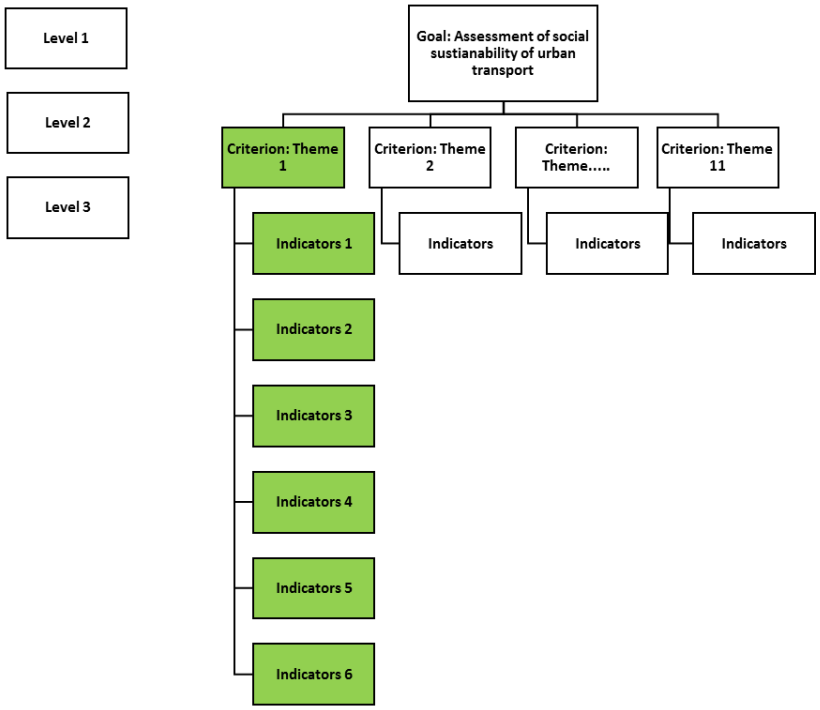

Figure 1. Hierarchical Structure of Urban Transport Sustainability Indicators

3. **Construct Pairwise Comparison Matrices**: Experts compare pairs of indicators at each hierarchy level to establish priorities. The comparisons are made using a scale of relative importance ranging from 1 (equal importance) to 9 (extreme importance). Each decision-maker assigns their preferred values to individual elements, transforming these judgments into group judgments using the geometrical average (Table 1).

Table 1.
Scale of Relative Importance

Value	Explanation
1	Equal importance
3	Moderate importance of one over another
5	Strong importance
7	Very strong importance
9	Extreme importance
2, 4, 6, 8	Intermediate values

4. **Calculate Consistency Ratio**: The consistency ratio (CR) is calculated to ensure the logical consistency of the pairwise comparisons. A CR below 0.10 is generally considered acceptable. The consistency index (CI) is determined using the formula:

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{1}$$

The consistency ratio is then computed using:

$$CR = \frac{CI}{RI} \tag{2}$$

where λmax is the maximum eigenvalue of the comparison matrix and RI is the random consistency index based on matrix size (Table 2).

Table 2.
Random Consistency Index (RI) Values Adapted from Saaty (1980)

n	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.52	0.89	1.11	1.25	1.35	1.40	1.45	1.49	1.51	1.54	1.56	1.57	1.58

5. **Derive Priority Weights**: The normalized weights from the pairwise comparison matrices are used to derive the overall priority weights for each indicator. These weights represent the relative importance of each indicator in achieving the overall objective.
6. **Aggregate the Results**: Combine the priority weights to establish a ranking of the indicators according to their importance. This step synthesizes the weights from different hierarchy levels to obtain a final ranking.

3.1. Sampling Strategy and Expertise Criteria

Experts were selected based on their extensive knowledge and experience in urban transport planning and sustainability. The selection process involved:

- **National Experts**: 30 experts from national government agencies, academic institutions, and national research organizations.
- **Local Experts**: 30 experts from local government bodies, community organizations, and local academic institutions.

3.1.1. Criteria for Expert Selection

To ensure the validity of the expert opinions, the following criteria were applied:

- A minimum of five years of relevant experience in urban transport planning or sustainability.
- Recognized contributions to urban transport planning, either through publications, projects, or professional activities.

3.1.2. Mitigation of Potential Biases

To mitigate potential biases, the following strategies were employed:

- **Diverse Expertise**: Experts were selected from a range of backgrounds, including academia, government, and community organizations, to capture a broad spectrum of perspectives.
- **Anonymity**: Experts completed the surveys anonymously to reduce the potential for bias related to peer influence or reputational concerns.
- **Structured Questionnaire**: The use of a structured questionnaire ensured that all experts evaluated the indicators using the same criteria, reducing variability in responses due to differing interpretations of the questions.
- **Consistency Check**: The AHP method includes a consistency check (consistency ratio) to ensure the logical coherence of the pairwise comparisons, thereby enhancing the reliability of the results.

3.2. Data Collection and Analysis

Data were collected through structured questionnaires distributed to 30 national and 30 local experts. The questionnaires included pairwise comparison matrices for each indicator category, allowing experts to compare the relative importance of different indicators. The responses were used to create pairwise comparison matrices, analysed using the AHP method to calculate weights. The consistency of the pairwise comparisons was checked to ensure reliable results. AHP analysis was conducted using specialized software to facilitate calculations and ensure accuracy.

3.3. Case Study: Amman, Jordan

Amman was selected as the case study due to its unique urban transport challenges and ongoing efforts towards sustainable development. The city's rapid urbanization and diverse population make it an ideal case for studying the differences in perspectives on urban transport sustainability. The selection of Amman provides a relevant context for exploring how national and local priorities can be balanced to enhance urban transport systems.

Amman has been experiencing significant growth, with increasing demand for efficient and sustainable transport systems to support its expanding urban population (Greater Amman Municipality 2020). The city's transport system faces challenges such as traffic congestion, inadequate public transport infrastructure, and environmental pollution. These challenges make Amman an important case for examining the differences in priorities between national and local stakeholders and identifying strategies for integrating these perspectives into urban transport planning.

4. Results and Discussion

4.1. Accessibility Indicators

Accessibility indicators focus on the ease of access to transport services and the convenience of travel within the urban area. National experts emphasized public transport coverage and the average distance to the nearest public transport station, while local experts placed more weight on pedestrian infrastructure and the availability of cycling paths.

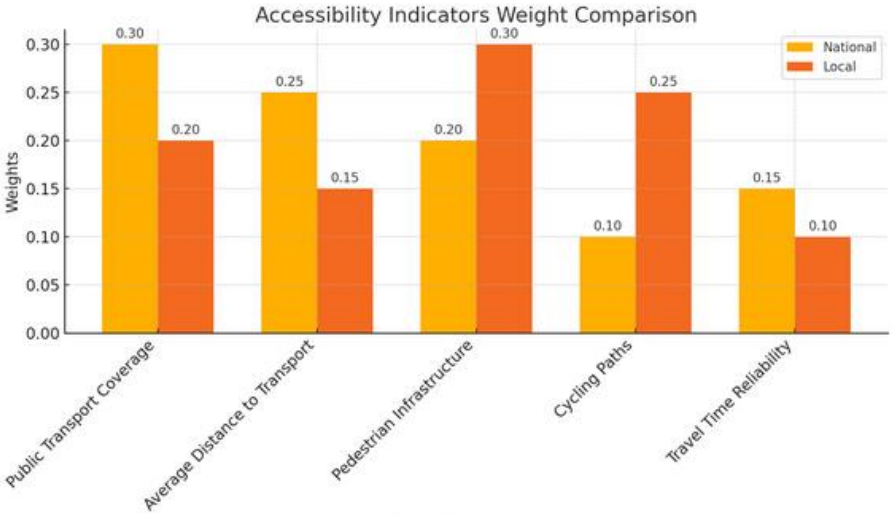

Figure 2. Accessibility Indicators Weight Comparison

National experts assigned the highest weight to public transport coverage (0.30), reflecting a strategic focus on enhancing the reach of the public transport network. This priority aligns with broader national objectives of reducing traffic congestion and minimizing environmental impacts, as highlighted in the literature on environmental sustainability (Litman, 2021). Average distance to public transport stations also received significant attention (0.25), emphasizing the importance of reducing physical barriers to accessing public transport, which corresponds with national policies aimed at long-term environmental and economic benefits (Banister, 2012).

Conversely, local experts placed the highest weight on pedestrian infrastructure (0.30), emphasizing the immediate benefits of improving walkability within urban areas. The availability of cycling paths (0.25) was another key focus, reflecting a grassroots demand for safer and more convenient non-motorized transport options. This focus on pedestrian and cycling infrastructure underscores the importance of creating safe and accessible environments, crucial for promoting active transport modes and improving public health (Dimitriou & Gakenheimer, 2012). These local priorities align with the literature on social sustainability, which emphasizes equitable access and liveability (Lucas, 2012; Ghahramanpouri et al., 2013).

4.2. Safety Indicators

Safety indicators concern the reduction of accidents and the overall security of transport users. National experts prioritized measures such as accident rates and traffic law enforcement, whereas local experts highlighted the importance of safe pedestrian crossings and traffic calming measures.

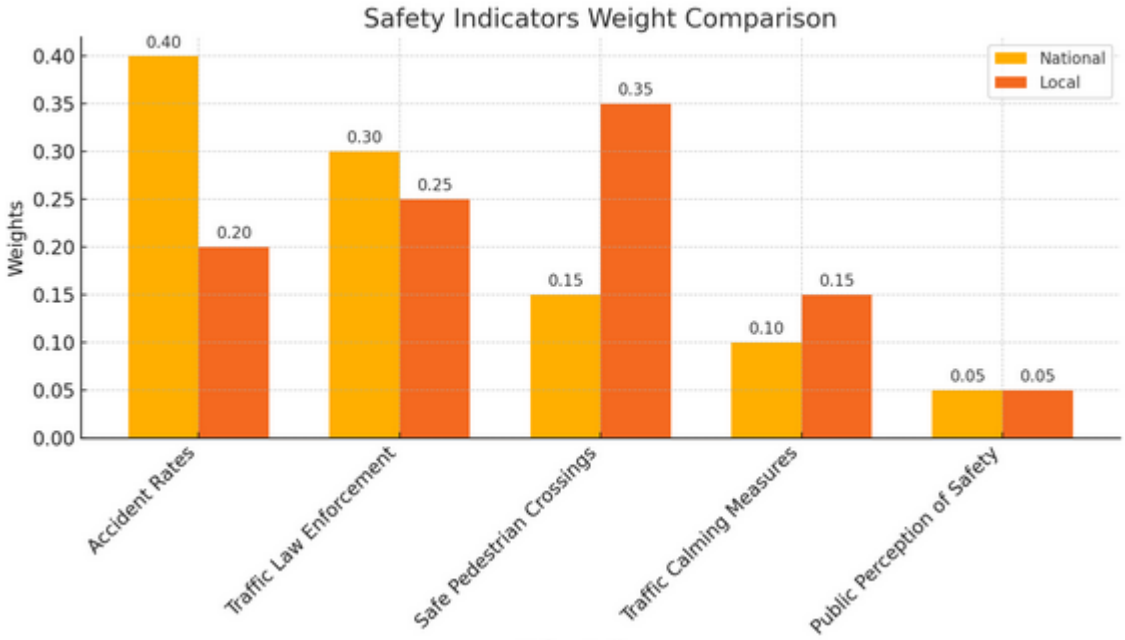

Figure 3. Safety Indicators Weight Comparison

The emphasis on accident rates (0.40) and traffic law enforcement (0.30) by national experts indicates a policy-driven approach focused on measurable safety outcomes and regulatory compliance. These indicators reflect broader public health and safety goals at the national level, aiming to create safer road environments through stringent enforcement of traffic laws and reduction of traffic-related incidents. This approach is consistent with national-level strategies discussed in the literature (Litman, 2009).

Local experts, on the other hand, highlighted the importance of safe pedestrian crossings (0.35) and traffic calming measures (0.25). These indicators address the immediate safety concerns of urban residents, emphasizing the need for infrastructure that protects pedestrians and mitigates the risks posed by vehicular traffic. The focus on pedestrian safety by local experts aligns with the literature on social sustainability, which underscores the need for targeted interventions to protect vulnerable road users and promote road safety (Dimitriou & Gakenheimer, 2012; Shirazi & Keivani, 2017).

4.3. Liveability Indicators

Liveability indicators address the overall quality of life related to urban transport, including air quality, noise pollution, and accessibility to green spaces. National experts emphasized air quality and noise pollution reduction, while local experts placed higher importance on the accessibility of parks and recreational areas.

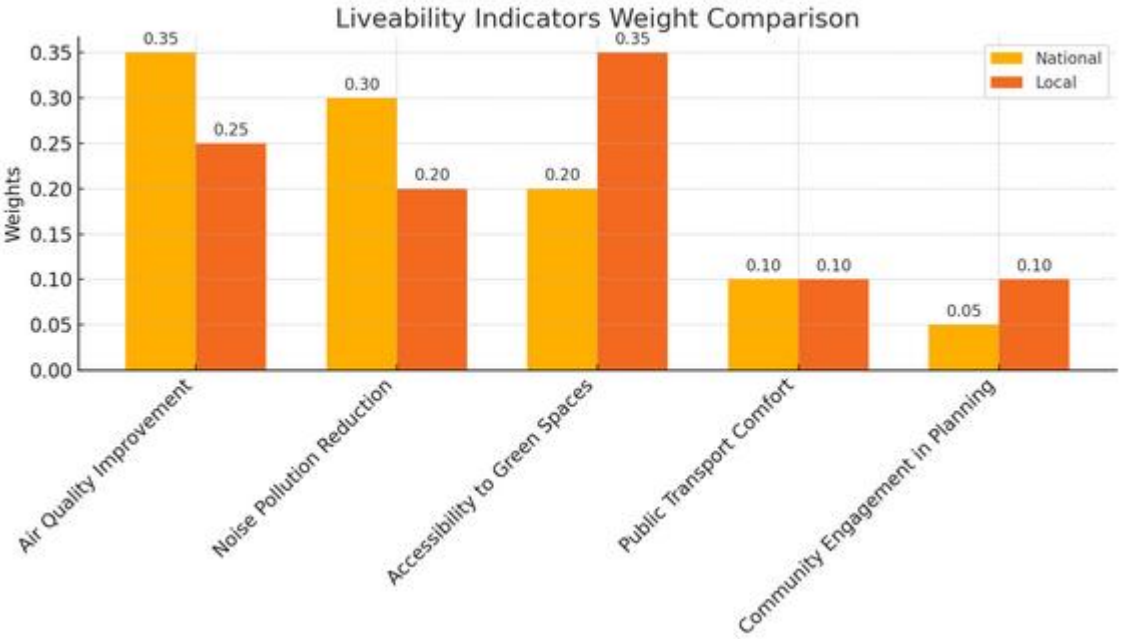

Figure 4. Liveability Indicators Weight Comparison

National experts assigned the highest weight to air quality improvement (0.35) and noise pollution reduction (0.30), reflecting a focus on mitigating environmental impacts and enhancing public health through improved air quality and reduced noise levels. These priorities align with national environmental policies aimed at reducing pollution and creating healthier urban environments (Banister, 2012; Litman, 2021).

Local experts, however, placed a higher weight on accessibility to green spaces (0.35), highlighting the importance of recreational areas for urban dwellers. This priority underscores the need for urban transport systems that not only facilitate mobility but also contribute to the overall well-being and quality of life of urban residents. The availability of green spaces is crucial for promoting physical activity, mental well-being, and social interaction (Ghahramanpouri et al., 2013). The emphasis on community engagement in planning (0.10) by local experts highlights the importance of involving residents in the decision-making process, ensuring that transport systems are responsive to the needs and preferences of urban residents (Lucas, 2012).

4.4. Comparative Analysis

The comparative analysis reveals distinct differences between national and local perspectives on urban transport sustainability. National experts tend to prioritize indicators that address broader, more systemic issues such as coverage, enforcement, and pollution reduction. In contrast, local experts focus on indicators that directly impact the daily experiences of urban residents, such as pedestrian infrastructure, safe crossings, and green space accessibility.

These disparities underscore the necessity of integrating both perspectives into urban transport planning. The literature suggests that national strategies should consider local insights to ensure policies are comprehensive and effective (Banister, 2012). This alignment can address the immediate concerns of urban residents while achieving long-term sustainability goals (Shirazi & Keivani, 2017). For instance, while national experts emphasize broader environmental and regulatory measures, local experts focus on the practical aspects of daily urban living. This dual focus ensures that both strategic and operational needs are met, leading to a more balanced and effective approach to urban transport sustainability.

4.5. Practical Implications for Urban Planners and Policymakers

The findings of this study provide several practical implications for urban planners and policymakers aiming to enhance urban transport sustainability:

1. **Balanced Planning Approach:** Urban planners should integrate both national and local perspectives in their planning processes. National strategies should set broad sustainability goals, while local strategies should focus on specific community needs and priorities. This balanced approach ensures comprehensive and effective urban transport policies.
2. **Focus on Social Sustainability:** Policies should prioritize social sustainability indicators such as accessibility, safety, and liveability. Emphasizing these indicators can improve the quality of life for urban residents and address social inequalities, particularly in rapidly urbanizing areas like Amman.
3. **Adaptive and Inclusive Policy Frameworks:** Develop adaptive policies that can be adjusted based on local feedback and changing urban dynamics. Inclusive frameworks that involve community participation in the planning process can lead to more responsive and effective transport solutions.
4. **Capacity Building:** Invest in capacity building for local governments and communities to enhance their ability to participate effectively in urban transport planning. Training programs and resource allocation can empower local stakeholders to contribute meaningfully to sustainability efforts.
5. **Data-Driven Decision Making:** Utilize advanced analytical tools, such as the AHP, for informed decision making. Improved data collection and analysis can provide valuable insights into the relative importance of different sustainability indicators, guiding more precise and impactful planning and policy interventions.
6. **Integrated Transport Policies:** Promote integrated transport policies that consider the interconnections between different dimensions of sustainability. For example, measures aimed at reducing emissions should also address accessibility and safety to ensure a holistic approach to urban transport sustainability.
7. **Public Engagement:** Enhance public engagement in the planning process to ensure that transport policies reflect the needs and preferences of the community. Engaging residents in discussions about transport priorities can lead to more inclusive and acceptable solutions.

By implementing these practical recommendations, urban planners and policymakers can develop more effective and resilient urban transport systems that meet both strategic and community-specific sustainability goals.

4.6. Future Research Directions

Future research should explore the integration of additional dimensions, such as economic and technological factors, in the comparative analysis of urban transport sustainability indicators. Specifically:

1. Economic Factors: Investigate how economic indicators, such as cost-effectiveness, investment in infrastructure, and economic benefits, influence urban transport sustainability. Understanding the economic trade-offs and benefits can provide a more holistic view of sustainability.
2. Technological Advancements: Examine the impact of emerging technologies, such as smart transportation systems, electric vehicles, and digital mobility platforms, on urban transport sustainability. These technologies can significantly alter the priorities and effectiveness of sustainability strategies.

3. Longitudinal Studies: Conduct longitudinal studies to track how priorities and indicator weights evolve over time, especially in response to policy interventions, technological advancements, and changing urban dynamics. Such studies can provide valuable insights into the long-term effectiveness and adaptability of sustainability strategies.
4. Cross-Cultural Comparisons: Expand the research to include cross-cultural comparisons of urban transport sustainability priorities in different cities and countries. This can help identify universal principles and context-specific strategies that can be adapted to diverse urban environments.
5. Community Engagement: Investigate the role of community engagement and participatory planning in shaping sustainable urban transport policies. Understanding how local communities perceive and prioritize sustainability indicators can enhance the inclusiveness and effectiveness of transport planning.

5. Conclusion

This study bridges the gap between national and local perspectives on urban transport sustainability using the AHP method. By comparing expert opinions in Amman, Jordan, it highlights significant disparities in priorities, emphasizing the need for a balanced approach that incorporates both perspectives. This research makes an original contribution to the field by focusing on the often-overlooked social dimension of sustainability, particularly in the context of urban transport.

The study's original contribution lies in its detailed comparative analysis of national and local priorities using the AHP method, providing a nuanced understanding of how different administrative levels perceive urban transport sustainability. This approach not only adds to the existing literature but also offers a practical framework for evaluating and balancing these priorities in urban transport planning.

5.1. Advancement of the Field

1. Highlighting Social Sustainability: The findings underscore the importance of social sustainability in urban transport, which has often been overshadowed by environmental and economic considerations. By emphasizing indicators such as accessibility, safety, and liveability, this study provides a comprehensive framework that urban planners can use to ensure equitable and inclusive transport systems.
2. Balancing National and Local Perspectives: The study demonstrates the significant differences between national and local priorities, advocating for an integrated planning approach. This dual focus ensures that strategic and operational needs are met, leading to more holistic and effective urban transport policies.
3. Practical Implications for Policymakers: The results offer actionable insights for urban planners and policymakers, highlighting the need for regular consultations and collaborations between national and local stakeholders. This multi-level engagement is crucial for developing sustainable transport strategies that are both comprehensive and adaptable to local contexts.

By addressing both immediate and long-term sustainability goals, this study provides a comprehensive evaluation framework that can be used by urban planners and policymakers. This research not only contributes to the academic literature but also offers practical insights for enhancing urban transport sustainability in diverse urban contexts.

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