Built Environment Innovations (BEI)
Vol. 1, No. 1, pp. 1-15

Research Article

Assessment of Infrastructure Performance in Banda Aceh City Using the City Prosperity Index (CPI)

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Abstract

Urban infrastructure performance is a critical determinant of sustainable urban development, particularly in post-disaster cities such as Banda Aceh. This study aims to evaluate the existing infrastructure conditions in Banda Aceh City by applying the City Prosperity Index framework, emphasizing housing, social services, information and communication technology, and urban mobility dimensions. The research employed a quantitative descriptive analysis approach, utilizing secondary data from official government sources. Infrastructure performance was measured based on CPI indicators, with specific focus on housing quality, access to clean water and sanitation, electricity provision, healthcare services, digital connectivity, and public transportation utilization. The findings reveal that Banda Aceh has achieved significant progress in several areas. Housing infrastructure is generally durable, with widespread access to electricity, clean water, and improved sanitation. Social infrastructure is robust, reflected in a favorable doctor-to-population ratio and an adequate number of public libraries, although spatial disparities remain. High levels of internet access indicate strong digital connectivity. However, a significant digital divide persists due to moderate levels of home computer ownership. The most pressing issue identified is the extremely low utilization of public transportation, indicating heavy reliance on private vehicles and pointing to systemic urban mobility challenges. In summary, while Banda Aceh has demonstrated substantial achievements in post-disaster infrastructure rebuilding, critical gaps remain that need urgent attention. This study contributes to the existing literature by providing a holistic, measurable evaluation of urban infrastructure performance in a post-reconstruction setting and offers evidence-based insights for future policy interventions to foster resilient, inclusive urban development.

Keywords: City Prosperity Index; Urban Infrastructure; Urban Mobility; Public Services; Sustainable Urban Development.

Introduction

Urbanization is a fundamental phenomenon shaping contemporary cities worldwide. Rapid demographic growth and land-use changes increasingly challenge cities, especially in developing countries like Indonesia, to meet the basic needs of their populations while promoting

Article History
Received: 16 April 2025; Revised: 2 May 2025;
Accepted: 10 May 2025; Published: 14 May 2025

sustainable urban environments. The city of Banda Aceh is no exception. In the aftermath of the 2004 Indian Ocean tsunami, Banda Aceh underwent an intense phase of reconstruction and recovery that profoundly affected its urban fabric, population distribution, and infrastructure development [1]. Urban growth, while bringing economic and social opportunities, often exacerbates complex social, economic, and environmental issues if not properly managed. Therefore, assessing and understanding the status of urban infrastructure becomes vital to maintaining the quality of life and environmental sustainability [2].

Recent studies have emphasized that urban expansion, particularly after disasters, creates new vulnerabilities if infrastructure planning does not accompany population growth (Brown et al., 2015). Moreover, the reconstruction phase following disasters like the tsunami in Banda Aceh led to significant shifts in land use patterns and urban density, necessitating a strategic approach to infrastructure planning and management [1]. Infrastructure, both physical and social, is a core determinant of urban prosperity. As Garcia and Lee [3] argue, adequate provision of infrastructure such as water supply, sanitation, electricity, road networks, and information technology is crucial to supporting urban economic and population growth. In addition, UN-Habitat [4] introduced the City Prosperity Index (CPI) as a holistic tool for evaluating urban sustainability, providing a comprehensive approach to measure the performance of cities across critical dimensions including infrastructure development.

Despite its importance, many Indonesian cities, including Banda Aceh, lack comprehensive and structured assessments of their infrastructure performance. The problem is twofold: First, post-disaster recovery often focuses on immediate needs, neglecting the long-term sustainability and quality of infrastructure systems [5]. Second, rapid demographic changes increase pressure on existing urban infrastructure, potentially degrading service quality if not monitored effectively [6]. Without a systematic evaluation, urban managers may struggle to identify weaknesses, allocate resources effectively, or prioritize sustainable interventions. Addressing this problem is vital to ensuring that cities can sustain growth while maintaining or enhancing the well-being of their inhabitants.

While general approaches to urban development planning exist, they often lack the integrative perspective necessary to capture the multi-dimensional aspects of urban prosperity. Traditional urban management strategies sometimes narrowly focus on economic development or physical expansion without a balanced view of social inclusion, environmental sustainability, and infrastructure resilience [2]. Furthermore, basic urban indicators—such as population growth rates or GDP—fail to capture the qualitative dimensions of urban life that infrastructure systems directly impact, such as access to clean water, mobility, or healthcare [4]. Consequently, a comprehensive, structured, and measurable approach like the CPI becomes indispensable to diagnosing and guiding urban development processes.

In this context, the City Prosperity Index (CPI) offers a valuable framework for systematically measuring various critical dimensions of urban prosperity. Developed by UN-Habitat, CPI integrates several sub-indices related to productivity, infrastructure, quality of life, social equity and inclusion, and urban governance [7]. By consolidating indicators across these dimensions, CPI produces a consolidated score representing the overall prosperity of a city. The infrastructure dimension, in particular, measures key aspects such as housing quality, access to clean water, sanitation, electricity, transportation, and information and communication technology [3]. These metrics are essential not only for evaluating current performance but also for informing strategic urban development plans. Previous studies, such as Kembaren et al. [7], demonstrated the utility of CPI in diagnosing infrastructure strengths and weaknesses in Indonesian cities, highlighting its relevance as an analytical tool.

Several empirical studies underline the role of specific infrastructure components in supporting urban prosperity. For example, Asaolu et al. [8] found that access to improved water

and sanitation significantly reduces disease prevalence among children in low- and middle-income countries. Similarly, Alley et al. [9] highlighted the crucial impact of reliable electricity access on industrialization and economic growth. Moreover, access to information and communication technology (ICT) is increasingly recognized as a catalyst for economic inclusion and educational advancement [10,11]. Public transportation availability also plays a vital role in promoting urban mobility, reducing pollution, and enhancing access to employment opportunities [12,13]. These findings underscore that urban infrastructure must be multidimensional, connecting physical development with social and economic outcomes.

Despite the growing body of literature supporting the use of CPI and the critical role of infrastructure in urban prosperity, few studies specifically apply the CPI framework to post-disaster urban settings such as Banda Aceh. Existing research tends to focus either on immediate post-disaster reconstruction [1] or general urban management challenges [2,6], without a holistic, data-driven evaluation of how infrastructure systems have evolved and performed over time. Moreover, most available studies either use isolated indicators (such as GDP growth or housing provision) or qualitative case study methods without rigorous quantitative assessments like CPI. Thus, a significant research gap remains in systematically applying the CPI framework to evaluate Banda Aceh's current infrastructure performance and identify priority areas for sustainable urban development.

Given this background, the present study aims to assess the existing availability and performance of Banda Aceh's infrastructure using the City Prosperity Index framework. This study provides a comprehensive evaluation across key infrastructure components, including housing quality, social infrastructure (healthcare and libraries), information and communication technology access, and urban mobility. By doing so, the study contributes to filling the empirical gap in the application of CPI to post-disaster cities and offers evidence-based insights to policymakers for future urban planning. The novelty of this research lies in its systematic use of CPI metrics in a post-reconstruction, rapidly urbanizing context, thus enriching both academic understanding and practical policymaking. The scope of the study is limited to Banda Aceh's urban area and uses secondary data collected from government sources and statistical agencies. The findings will be instrumental in informing sustainable urban management strategies aimed at enhancing the prosperity and resilience of Banda Aceh.

Materials and Methods

Study Area

The study was conducted in Banda Aceh City, the capital of Aceh Province, located at the northern tip of Sumatra Island, Indonesia (**Figure 1**). Banda Aceh covers an area of approximately 6,136 hectares and had a population of 257,635 residents as of 2022, with a population density of 4,156 people per square kilometer and a population growth rate of 1.2% (BPS Kota Banda Aceh, 2023). The city is geographically bounded by the Malacca Strait to the north, Aceh Besar District to the south and east, and the Indian Ocean to the west. Banda Aceh's strategic coastal location and its history of significant urban reconstruction post-2004 tsunami make it a critical case study for evaluating urban infrastructure performance.

Research Variables

This study evaluated the infrastructure performance of Banda Aceh using the City Prosperity Index (CPI) framework developed by UN-Habitat [4]. Variables were selected based on their relevance to the CPI's infrastructure dimension, which integrates both physical and social infrastructure aspects necessary for urban prosperity [3,7]. The variables are classified into two main groups.

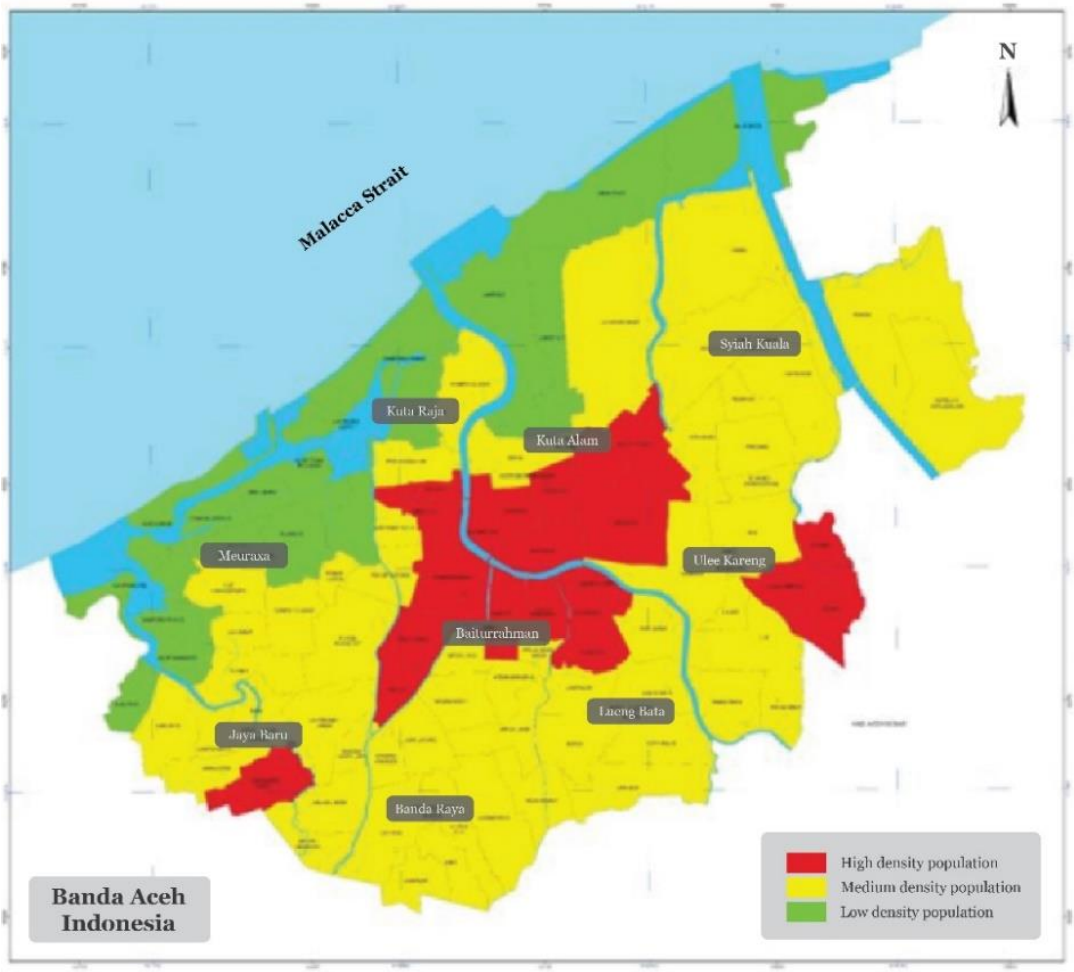

Figure 1. Study area of assessment of infrastructure performance of Banda Aceh city

Existing Infrastructure Availability Variables

The study identified the current availability of infrastructure based on indicators in **Table 1**.

Table 1. Existing infrastructure availability variables

No	Infrastructure Aspect	Indicators
1	Housing Infrastructure	Durability of housing materials and household protection.
2	Access to Clean Water	Connection to piped water, boreholes, or protected wells.
3	Access to Improved Sanitation	Availability of flushing toilets, drainage systems, and septic tanks.
4	Access to Electricity	Household connection to the electricity network.
5	Population Density	Total population divided by the urban land area.
6	Doctor Density	Number of doctors relative to population size.
7	Number of Public Libraries	Availability of public libraries within the city.
8	Internet Access	Percentage of households or individuals accessing the internet.
9	Home Computer Access	Household ownership of computers or digital devices.
10	Public Transportation Use	Utilization rate of public transportation systems.

Infrastructure Performance Variables

Infrastructure performance was assessed across four sub-dimensions as in **Table 2**.

Table 2 Infrastructure performance variable

Infrastructure Development Indicators		
No	Sub-Dimension	Indicators
1	Housing Infrastructure	Quality of housing, access to basic services, and population density.
2	Social Infrastructure	Doctor density and availability of public libraries.
3	Information and Communication Technology Infrastructure	Access to internet services and home computers.
4	Urban Mobility	Usage levels of public transportation.

Data Collection Methods

The research primarily employed secondary data collection techniques. Data sources included statistical reports from BPS Kota Banda Aceh (2023), municipal government publications, and other relevant public datasets. Secondary surveys were conducted to gather information regarding the existing condition of infrastructure indicators. This approach ensured consistency and reliability by using officially recognized data, minimizing subjectivity. As noted by Johnson [14], secondary data analysis enables systematic and factual representations of phenomena, providing a robust foundation for quantitative descriptive analysis.

Analytical Framework

City Prosperity Index (CPI) Calculation

The primary analytical method was based on the CPI framework developed by UN-Habitat [4]. Each infrastructure indicator was computed using specific standardized formulas to ensure comparability and reproducibility. The calculations for each indicator are outlined as in **Table 3**. This analytical approach aligns with the CPI methodology, ensuring the integration of various indicators into a comprehensive evaluation of urban infrastructure performance [7].

Quantitative Descriptive Analysis

Quantitative descriptive analysis was employed to systematically and factually describe the state of infrastructure and its performance in Banda Aceh. As suggested by Johnson [14], this method allows the clear depiction of variable characteristics through statistical data aggregation, analysis, and interpretation. The process included data aggregation, which involved collecting all relevant numerical data for each indicator; statistical computation, where percentages, densities, and other metrics were calculated following the City Prosperity Index (CPI) standards; and graphical representation, through which the findings were presented using tables, graphs, and spider charts to visualize infrastructure performance across multiple dimensions. The combined CPI and descriptive analysis approaches ensured a rigorous and comprehensive understanding of Banda Aceh's infrastructure conditions and performance levels.

Research Limitations

This study relies on secondary data, which, although reliable, may not fully capture informal or unregistered aspects of infrastructure usage—particularly in areas like informal transportation services (e.g., motorcycle taxis and non-registered ride-sharing services). As noted by Soesilo [15], modes like traditional ojek and informal rickshaws are often excluded from official public transportation statistics, even though they play a significant role in daily urban mobility. Thus, while CPI-based analysis provides valuable insights, future research may need to incorporate

primary data collection to validate and expand on secondary findings. Moreover, while CPI offers a standardized global measurement tool, local context variables specific to post-disaster cities like Banda Aceh could influence outcomes differently compared to typical urban environments. It is necessary to interpret CPI results with sensitivity to these local dynamics.

Table 3. City Prosperity Index (CPI) calculation method

Infrastructure Type	Sub-Infrastructure	Calculation Method
Housing Infrastructure	Housing Durability	$100\left(\frac{\text{Number of durable houses}}{\text{Total number of households}}\right)$
	Access to Clean Water	$100\left(\frac{\text{Households with access to piped or protected water sources}}{\text{Total number of households}}\right)$
	Access to Improved Sanitation	$100\left(\frac{\text{Households with improved sanitation facilities}}{\text{Total number of households}}\right)$
	Access to Electricity	$100\left(\frac{\text{Households with electricity access}}{\text{Total number of households}}\right)$
	Population Density	$100\left(\frac{\text{Total population}}{\text{Urban area in square kilometers}}\right)$
Social Infrastructure	Doctor Density	$1{,}000\left(\frac{\text{Number of doctors}}{\text{City population}}\right)$
	Number of Public Libraries	$100{,}000\left(\frac{\text{Number of public libraries}}{\text{City population}}\right)$
Information and Communication Technology	Internet Access	$100\left(\frac{\text{Internet users}}{\text{Total population}}\right)$
	Home Computer Access	$100\left(\frac{\text{Households with computers}}{\text{Total households}}\right)$
Urban Mobility	Public Transport Utilization	$100\left(\frac{\text{Number of public transport vehicles}}{\text{Total number of motor vehicles}}\right)$

Results and Discussions

Overview of Existing Infrastructure Availability in Banda Aceh

This section presents an analysis of the existing availability of urban infrastructure in Banda Aceh based on secondary data collected from official sources, following the indicators defined within the City Prosperity Index (CPI) framework. The findings are organized into four key areas: housing infrastructure, social infrastructure, information and communication technology (ICT) infrastructure, and urban mobility.

Table 4. The quality of housing infrastructure in Banda Aceh

Households based on building materials	Total Households
House with durable materials (wall)	56,511
House with less durable materials (wood)	6,936
Total	63,447

Housing Infrastructure

Housing Quality

The quality of housing in Banda Aceh was assessed based on the durability of building materials (**Table 4**). According to available data, the majority of households (approximately 89%) reside

in houses constructed with durable materials such as brick or concrete walls (BPS Kota Banda Aceh, 2023). Only a small fraction, around 11%, live in houses with less durable structures such as wood. This finding is consistent with Grady et al. [16], who noted that the use of durable construction materials significantly contributes to improving residential safety and reducing long-term maintenance costs. As can be seen in **Table 5**, in terms of floor space, most households occupy dwellings between 20–49 square meters, indicating a predominance of small to medium-sized housing. Although this reflects efficient land use, it also highlights potential overcrowding concerns in certain urban sectors, an issue closely tied to urban density problems discussed by Mustika et al. [17].

Table 5. Households based on floor space in Banda Aceh

Households based on floor space	Total Households
Floor space below 19 square meters	1,959
Floor space between 20–49 square meters	24,491
Floor space between 50–99 square meters	15,877
Floor space between 100–149 square meters	10,047
Floor space above 150 square meters	11,447
Total	63,447

Access to Clean Water

The analysis shows that approximately 96% of households have access to improved sources of clean water, predominantly through piped water systems and protected wells (**Table 6**). Access to clean water is a crucial determinant of public health, reducing the prevalence of waterborne diseases [8]. Nevertheless, some reliance on less protected water sources remains, indicating the need for ongoing improvements to ensure universal safe water access.

Table 6. Clean water access of housing infrastructure in Banda Aceh

Clean Water Sources	Total Households
Piped water systems	32,992
Drilled wells / pump	5,628
Protected/unprotected wells	24,276
Protected/unprotected water springs	551

Access to Improved Sanitation

Around 92% of households in Banda Aceh benefit from improved sanitation facilities, such as flush toilets connected to sewer systems or septic tanks as in **Table 7**. However, approximately 8% still lack access to adequate sanitation, presenting potential public health risks. WHO [18] emphasizes that inadequate sanitation is strongly correlated with increased rates of waterborne diseases and child mortality, stressing the urgency of universal sanitation coverage.

Table 7. Sanitary access of housing infrastructure in Banda Aceh

Access to Sanitation	Total Households
Access to improved sanitation	58,246
Lack access to adequate sanitation	5,201

Access to Electricity

Electricity access in Banda Aceh is exceptionally high, with 100% of households connected to the national electricity grid provided by PLN (**Table 8**). This widespread access supports the city's economic and social activities and aligns with findings by Alley et al. [9] and Best and Burke [19], who demonstrated that reliable electricity supply is a key enabler of urban and industrial growth.

Table 8. Electricity access of housing infrastructure in Banda Aceh

Source of Electricity	Total Households
Provided by PLN	63,447

Population Density

Banda Aceh exhibits an uneven distribution of population density across its districts as can be seen in **Table 9**. The highest density was recorded in Baiturrahman district at 7,239 people per square kilometer, while the lowest was in Syiah Kuala district at 2,328 people per square kilometer (BPS Kota Banda Aceh, 2023). Overall, the city's population density stands at 4,156 people per square kilometer. High population densities, if unmanaged, can strain urban infrastructure and degrade living conditions [6, 17].

Table 9. Population Density per Districts

Districts	Population Density per km²
Meuraxa	3,821
Jaya Baru	7,044
Banda Raya	5,435
Baiturrahman	7,239
Lueng Bata	4,572
Kuta Alam	4,250
Kuta Raja	3,031
Syiah Kuala	2,328
Ulee Kareng	4,573

Social Infrastructure

Healthcare Services: Doctor Density

The doctor-to-population ratio in Banda Aceh is relatively favorable (**Table 10**), with a doctor density of 4.261 per 1,000 inhabitants. This relatively high density suggests satisfactory access to healthcare services, crucial for maintaining urban health standards. Improved healthcare access aligns with broader goals of sustainable urban development and supports the notion, discussed by HR et al. [20], that smart healthcare innovations enhance urban quality of life.

Table 10. Healthcare services of doctor density in Banda Aceh

Healthcare Services	Specialist Doctor	Doctor	Dentist	Specialist Dentist	Total
Health Center	62	-	15	-	77
Hospital	308	675	31	7	1,021
Total					1,098

Educational Services: Public Libraries

Banda Aceh hosts 50 public libraries distributed across its nine districts as in **Table 11**. However, their distribution is uneven, with Kuta Alam district having the highest number (nine libraries) and Meuraxa the lowest (three libraries). Public libraries are critical infrastructure elements that support lifelong learning and social inclusion, as highlighted by Johnson and Griffis [21] and Gordon et al. [22], suggesting that better spatial equity in library services could enhance communal educational outcomes.

Table 11. Public Libraries per Districts

Districts	Total Library
Meuraxa	3
Jaya Baru	5
Banda Raya	7
Baiturrahman	7
Lueng Bata	4
Kuta Alam	9
Kuta Raja	5
Syiah Kuala	5
Ulee Kareng	5
Total	50

Information and Communication Technology (ICT) Infrastructure

Internet Access

Internet penetration in Banda Aceh is remarkably high, with 236,841 individuals, representing over 90% of the city's population, reported as internet users based on **Table 12**. This extensive access demonstrates Banda Aceh's strong positioning in terms of digital connectivity. Hilbert [10] asserts that high internet accessibility stimulates urban economic development by facilitating e-commerce, remote work, and digital education opportunities.

Table 12. Internet access in Banda Aceh

Remarks	Total
Internet users	236,841

Home Computer Access

Despite widespread internet access, home computer ownership remains moderate, with only 47.84% of households having access to a computer or similar digital device (**Table 13**). This digital divide may hinder full participation in digital economic opportunities, as emphasized by Waverman et al. [23] and Vicente and Lopez [24], who found that limited access to information technology perpetuates social and economic inequalities.

Table 13. Home computer access in Banda Aceh

Remarks	Total
Home computer access	30,346

Table 14. Urban mobility of public transport in Banda Aceh

Public Transport	Total
Trans Koetaradja	59

Urban Mobility

The use of public transportation in Banda Aceh is critically low as can be seen in **Table 14**. Only 59 registered Trans Koetaradja buses serve the entire city, resulting in a minuscule public transport utilization rate of approximately 0.01901% relative to the total number of motorized vehicles (BPS Kota Banda Aceh, 2023). From **Table 15**, motorcycles dominate urban mobility, comprising the majority of registered vehicles. This overreliance on private transportation not only strains urban infrastructure but also contributes to traffic congestion and increased carbon emissions, contrary to sustainable urban mobility goals. Agarwal et al. [12] stressed that efficient

public transport systems significantly reduce urban air pollution and enhance urban livability. The current scenario reflects an urgent need for policy interventions aimed at expanding and improving public transportation options in Banda Aceh.

Table 15. Urban mobility of private transport in Banda Aceh

Remarks	Total
Motorcycles	233,594
Sedan and Jeep	12,187
Minibus and microbus	41,558
Bus, pick up and truck	15,754
Heavy equipment and special vehicles	555
Total	303,648

Table 16. Calculation results obtained from infrastructure performance data analysis of Banda Aceh City based on CPI

No	Infrastructure Type	Sub- Infrastructure	Benchmark	Result
1	Housing Infrastructure	Housing Durability	Minimum = 84.80% Maximum = 98.40%	89.00%
		Access to Clean Water	Minimum = 50% Maximum = 100%	96.00%
		Access to Improved Sanitation	Minimum = 15% Maximum = 100%	92.00%
		Access to Electricity	Minimum = 7% Maximum = 100%	100%
		Population Density	Minimum = 0% Maximum = 100%	27.99%
2	Social Infrastructure	Doctor Density	Minimum = 0.01 Maximum = 7.74	4.261
		Number of Public Libraries	Minimum = 1 Maximum = 7	106
3	Information and Communication Technology	Internet Access	Minimum = 0% Maximum = 100%	92.00%
		Home Computer Access	Minimum = 0% Maximum = 100%	47.84%
4	Urban Mobility	Public Transport Utilization	Minimum = 5.95% Maximum = 62.16%	0.01901%

Summary of CPI Scores

Table 16 summary consolidates the performance results across each infrastructure component based on CPI computations. For housing infrastructure, the quality of housing scored 89%, access to clean water was at 96%, access to sanitation reached 92%, electricity access achieved 100%, and the population density score, relative to optimal standards, was 27.99%. In terms of social infrastructure, the doctor density was 4.261 per 1,000 people, and public library availability stood at 106 libraries per 100,000 people. Regarding ICT infrastructure, internet access reached 92%, while home computer access was recorded at 47.84%. Finally, urban mobility was identified as a major weakness, with public transport utilization recorded at only 0.01901%. The spider chart analysis as in **Figure 2** visually demonstrates the sharp contrast between strong performance in housing and ICT access and very weak performance in urban mobility.

Interpretative Observations

Overall, Banda Aceh's infrastructure performance reveals mixed outcomes. Housing, access to basic services (water, sanitation, electricity), healthcare services, and internet connectivity exhibit commendable achievements. These strengths position Banda Aceh favorably compared to many other post-disaster urban environments [1,5]. Nonetheless, key challenges remain, notably in equitable access to home computing technology and, most critically, in urban mobility infrastructure. The limited public transport system undermines urban accessibility and inclusivity, as discussed by Salon and Gulyani [13]. Addressing these issues is fundamental to achieving a balanced, resilient, and prosperous urban future for Banda Aceh.

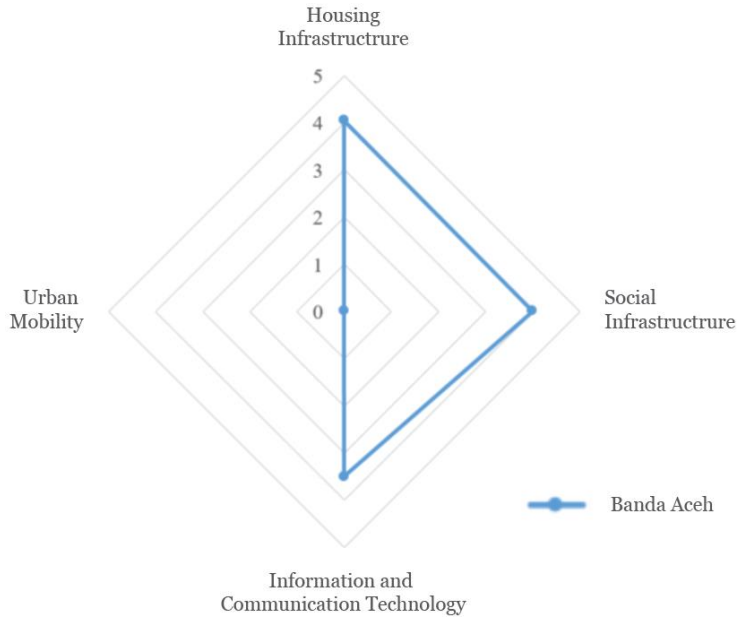

Figure 2. The spider chart analysis from infrastructure performance data analysis of Banda Aceh City

Discussion

The assessment of infrastructure performance in Banda Aceh using the City Prosperity Index (CPI) framework reveals a nuanced landscape of achievements and challenges in the city's post-reconstruction urban development. A critical analysis of the results indicates that while certain infrastructure sectors have demonstrated substantial progress, others exhibit significant deficiencies that must be addressed to support sustainable urban prosperity.

The housing infrastructure in Banda Aceh is generally of high quality, with the majority of households residing in durable structures and enjoying full access to the electricity network. This outcome reflects the success of post-tsunami reconstruction efforts and highlights the city's commitment to improving living standards [1]. Furthermore, the widespread access to clean water (96%) and improved sanitation facilities (92%) underscores effective urban service delivery in essential sectors. As emphasized by Asaolu et al. [8] and WHO [17], these achievements are critical to enhancing public health outcomes and reducing the prevalence of waterborne diseases, thereby directly impacting the quality of life.

Nevertheless, housing-related challenges persist, particularly concerning population density and floor space adequacy. High population concentrations in certain districts, such as Baiturrahman, suggest potential stress on available housing stock and urban services. As

discussed by Mustika et al. [17], uneven population distribution and high residential density can strain infrastructure, diminish service quality, and exacerbate urban inequalities. Although the CPI results indicate strong basic housing quality, these findings highlight the need for more equitable housing policies and spatial planning initiatives to manage urban growth sustainably.

The evaluation of social infrastructure reveals relatively favorable conditions in Banda Aceh, particularly regarding healthcare access. The doctor density of 4.261 per 1,000 residents compares well to urban standards, indicating a robust healthcare network that aligns with the arguments of HR et al. [20] regarding the central role of health services in promoting urban well-being. The availability of 50 public libraries further supports educational opportunities and lifelong learning, reinforcing social inclusion as outlined by Johnson and Griffis [21] and Gordon et al. [22]. However, the uneven distribution of libraries across districts signals the necessity for more strategic investments to ensure equitable access to educational resources for all urban residents.

The information and communication technology (ICT) infrastructure in Banda Aceh presents a mixed picture. Internet access is impressively high, with over 90% of the population connected, positioning Banda Aceh favorably in the context of digital inclusion. As Hilbert [10] (2014) and Warschauer and Matuchniak [11] have asserted, high internet penetration stimulates economic development and broadens educational access, providing significant opportunities for Banda Aceh's socio-economic growth. However, the relatively low rate of home computer ownership, at 47.84%, exposes a critical digital divide. This limitation may hinder the city's ability to fully leverage digital technologies for economic and social advancement. Waverman et al. [23] and Vicente and Lopez [24] highlighted the negative impacts of digital inequality on urban growth and social inclusion, suggesting that targeted policies are required to increase access to home computing technologies, particularly for disadvantaged groups.

Urban mobility emerges as the most problematic aspect of Banda Aceh's infrastructure. The extraordinarily low rate of public transportation use (0.01901%) reflects a heavy dependence on private motorized vehicles, primarily motorcycles. Such a transportation model is unsustainable in the long term, contributing to urban congestion, pollution, and reduced accessibility for non-vehicle-owning residents. Agarwal et al. [12] emphasized that efficient public transportation systems are vital for reducing urban air pollution and supporting health and environmental sustainability. Furthermore, as Salon and Gulyani [13] argued, accessible public transport is essential for promoting equitable urban development by linking residents to employment opportunities and essential services. The current state of Banda Aceh's mobility infrastructure indicates an urgent need for significant investments and reforms to expand and modernize the public transport system, making it a more attractive and viable option for the city's population.

The spider chart analysis further illustrates the pronounced imbalance in Banda Aceh's infrastructure performance. While housing, sanitation, electricity, and internet access achieve high scores, the severe deficiency in urban mobility pulls down the overall infrastructure prosperity. This imbalance highlights the complexity of urban development, where success in one domain does not automatically translate into comprehensive urban prosperity. A multi-sectoral approach is necessary to address interconnected challenges and create a more resilient and inclusive urban environment.

The findings of this study are consistent with broader observations in the literature regarding post-disaster urban development. As Brown et al. [5] noted, cities recovering from major disasters often succeed in rebuilding basic infrastructure but face difficulties in achieving integrated and sustainable urban systems. The results also reaffirm the importance of the City Prosperity Index as an effective tool for diagnosing urban infrastructure strengths and weaknesses, as advocated by UN-Habitat [4] and demonstrated in prior applications such as Kembaren et al. [7].

Despite the valuable insights gained, it is important to recognize the limitations inherent in the study. The reliance on secondary data may overlook informal infrastructure developments and unregistered urban dynamics, particularly in the domain of informal transportation services, as noted by Soesilo [15]. Therefore, future research incorporating primary data collection and qualitative field studies could offer a more comprehensive understanding of Banda Aceh's infrastructure landscape.

In conclusion, the discussion of the results highlights that Banda Aceh has made significant strides in post-disaster urban reconstruction, achieving strong performance in housing, sanitation, electricity, healthcare, and digital connectivity. However, the city faces considerable challenges in achieving more equitable housing distribution, closing the digital divide, and, most critically, improving its public transportation system. Addressing these gaps is essential to enhancing urban resilience, inclusivity, and prosperity. Strategic, evidence-based policymaking, informed by CPI evaluations, will be crucial in guiding Banda Aceh towards a more sustainable and prosperous urban future.

Conclusion

This study assessed the infrastructure performance of Banda Aceh City using the City Prosperity Index (CPI) framework, focusing on key sectors including housing, social infrastructure, information and communication technology (ICT), and urban mobility. The findings reveal that while Banda Aceh demonstrates significant achievements in basic infrastructure provisions—such as durable housing, near-universal access to clean water, sanitation, electricity, healthcare services, and internet connectivity—critical challenges persist in achieving balanced urban development.

The city's housing infrastructure is generally robust, supported by durable construction and full electricity access, reflecting the success of post-tsunami reconstruction efforts. Social infrastructure is similarly strong, with favorable doctor-to-population ratios and adequate public library availability, although disparities in spatial distribution remain. ICT infrastructure shows high levels of internet penetration, fostering economic and educational opportunities, but the relatively low ownership of home computers indicates a persistent digital divide that requires targeted interventions.

The most critical shortcoming lies in Banda Aceh's urban mobility system. Public transportation use is exceptionally low, indicating a severe reliance on private vehicles that contributes to congestion, environmental degradation, and limited accessibility. This imbalance underscores the need for integrated urban planning strategies that prioritize the development of an efficient, inclusive, and sustainable public transport network.

The study's findings contribute to the existing body of knowledge by applying the CPI framework to a post-disaster urban context, providing a holistic and measurable evaluation of urban infrastructure performance. It offers a data-driven basis for policy recommendations aimed at fostering sustainable urban prosperity. Importantly, the study highlights the necessity of addressing infrastructural inequalities to achieve more balanced urban growth.

Future research could build upon this work by incorporating primary data collection to capture informal sector dynamics, particularly in transportation and housing. Comparative studies with other post-disaster or rapidly urbanizing cities would also deepen understanding of how different urban contexts affect infrastructure resilience and sustainability.

Overall, this research underscores that while Banda Aceh has made commendable progress in rebuilding and developing its infrastructure, continuous efforts are needed to close existing gaps and promote an urban environment that is equitable, resilient, and prosperous for all its residents.

Acknowledgments

The authors would like to thank the staff of the Department of Architecture and Planning, Faculty of Engineering, Universitas Syiah Kuala, Indonesia, for their opportunity, guidance, and knowledge in completing this research.

Conflict of Interest

The authors declare no conflicts of interest.

Author Contribution Statement

Naufal Khalil: Methodology, Software, Writing-Original draft preparation. **Ashfa Achmad:** Conceptualization, Data curation, Validation, Supervision, Writing-Reviewing and Editing. **Fahmi Aulia:** Data curation, Visualization, Investigation, Writing- Reviewing and Editing.

Data Availability Statement

The data used to support the findings of this study are included within the article.

Ethics Approval

Not required.

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