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Economic Infrastructure as a Catalyst for Aceh Tourism Prosperity: Analysis, Comprehensive and Development Strategy

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ABSTRACT
Aceh, with its extraordinary nature and culture , is facing a significant challenge in maximizing its contribution to the growth economy sector. Research This analysis in a way critical role infrastructure economy transportation, digital connectivity, and utilities base as a factor determinant main in development Aceh tourism. Using a mixed-methods approach that includes analysis of secondary data, regression, infrastructure gap mapping GIS-based, and in-depth interviews with 25 stakeholders, research reveals existence strong correlation between the quality of infrastructure and with number of tourist visits and investment. The results show that inequality in infrastructure inter-regional (urban vs rural/coastal) becomes an inhibitor in the optimization potential of Aceh tourism. Simulation economy shows that strategic settlement projects strategic such as the Banda Aceh- Sigli - Bireuen Toll Road, and improvements to Sultan Iskandar Muda Airport (SIM) capacity can increase GRDP by 1.5–2.1% per year. Research concludes with a framework-based strategic proof for accelerated development of infrastructure through a PPP scheme, coordination of multisectoral, and integration with strengthening local human resources and MSMEs.

Keywords: Infrastructure Development, Aceh Tourism, Regional Economy, Connectivity Transportation, Digital Economy.

I. Introduction

Aceh is widely recognized as a region rich in tourism potential. With a 470-kilometer coastline, the Leuser ecosystem designated as a UNESCO World Heritage Site, a deeply rooted Islamic culture, and the stunning marine beauty of Pulau Weh, Aceh possesses all the ingredients to become one of Indonesia's premier tourism destinations. However, the contribution of the tourism sector to Aceh's Gross Regional Domestic Product (GRDP) reached only 5.2 percent in 2022—far below its potential and still lower than the national average of 7.5 percent (BPS, 2023; Kemenparekraf, 2023). This discrepancy indicates that Aceh's vast tourism resources have yet to be effectively transformed into significant economic value. This condition cannot be separated from the limitations of economic infrastructure, which remain a major barrier to regional tourism development. Various studies, including those conducted by LPEM FEB UI (2021) and the Unsyiah Research Team (2022), have identified infrastructure inequality as a key bottleneck in Aceh's tourism growth.

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Inadequate transportation access to tourism corridors, uneven digital connectivity, and suboptimal basic utilities such as clean water and energy have all hindered efforts to strengthen the region's tourism competitiveness.

Nevertheless, comprehensive analyses that explain the mechanisms by which infrastructure affects tourism and regional economic growth remain limited. Likewise, evidence-based strategies to accelerate infrastructure development tailored to Aceh's specific context are still underexplored. Therefore, this study seeks to fill that gap through a multidimensional and evidence-driven approach. The objectives of this study are threefold. First, to map economic infrastructure gaps across twelve priority tourism destinations in Aceh. Second, to quantify the impact of infrastructure development on tourist arrivals, investment, and regional GRDP. Third, to formulate an integrated infrastructure development model grounded in empirical evidence. The findings are expected to provide a strong policy foundation for accelerating Aceh's tourism infrastructure development in a sustainable, inclusive, and regionally responsive manner.

II. Literature Review and Hypothesis Development

2.1. Infrastructure and Growth Tourism: Theory and Empirics

Krugman's (1991) theory explains how infrastructure reduces the "distance economy", increasing market access, and triggers agglomeration economies. Study empirical research in ASEAN (Santisirisomboon et al., 2021) proves that the elasticity of infrastructure transportation to visit travelers of $\beta = 0.78$. In Indonesia, research by LPEM FEB UI (2021) shows that connectivity air direct increases tourist investment by 15–30%.

2.2. Digital Infrastructure and Creative Economy

Digital divide is a hindrance participation of MSMEs in the tourism economy (Purwanto et al., 2022). A study in Bali (Wiranatha et al., 2023) proved that improving broadband penetration by 10% has an impact on the growth of tourism MSME income by 8.5%. In Aceh, 4G coverage at the destination like Sea Bargain (Gayo) only reached 65%, far below the average in the mothers city districts reaching 98 % (Kominfo, 2023).

2.3. Financing Infrastructure and PPP Models

The Public-Private Partnership (PPP) scheme has been proven effective in the area with a limited budget. Success: The Trans- Java toll road (Nasution, 2022) and YIA Airport (Sutomo, 2023) are relevant benchmarks. In Aceh, the potential investment in the project harbor boat Sabang cruise is estimated to reach IDR 1.2 trillion (Ministry of Transportation, 2023).

III. Research Method

3.1. Approach and Design

Study This uses design *sequential explanatory mixed-methods design* (Creswell, 2014), consisting of two phases:

a. Phase quantitative: Secondary data analysis and econometric models.
b. Phase qualitative: in-depth interviews with 25 stakeholders' interests and FGD in 4 regions.

3.2. Data Sources

a. Secondary Data: Statistics on tourists (2018–2023), index of infrastructure (Bappenas), GRDP, investment data (BKPM), and maps of network roads (PUPR).

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b. Primary Data: Results of interviews and observation fields in the 8 destinations tour.

3.3. Analysis Techniques

a. Analysis Spatial: Mapping infrastructure gaps using QGIS-based indicator accessibility, digital connectivity, and road conditions.
b. Econometric Model (Panel Data Fixed Effect):

$$\log(\text{Tourist}_{it}) = \beta 0 + \beta 1 \log(\text{InfraScore}_{it}) + \beta 2 \text{PromoBudget}_{it} + \beta 3 \text{HDI}_{it} + \varepsilon_{it}$$

c. Simulation Economic Impact: Input-output (IO) analysis for the count impact of multiple project toll roads and airports. Analysis Qualitative: *Thematic analysis* (Braun & Clarke, 2006) on interview transcripts.

IV. Results and Discussion

4.1. Mapping Condition Aceh Infrastructure

a. Transportation

1) Sultan Iskandar Muda Airport only serves 12 domestic routes and 1 international, with a capacity of 1.5 million passengers/year 78% used (Ministry of Transportation, 2023).
2) 45% of the way national in Aceh is in condition damaged / heavy, especially on the section Calang – Meulaboh.
3) Sabang Port is only capable of serving 1 large cruise ship per month.

b. Digital

1) Only 32% of Aceh's tourism MSMEs are integrated with online platforms.
2) 4G Coverage at Sea Bargain (Gayo) is only 65%, far below average.

c. Utilities

1) The Duration average blackout in Simeulue is up to 320 minutes/month.
2) Access to drinking water is suitable in the area tour coast only 60%.

Table 1. Index Infrastructure Aceh Tourism Regency /City (2023)

Banda Aceh	82	88	85	85
Sabang	75	80	78	78
Great Aceh	68	75	72	72
Aceh Jaya	45	60	55	53
Gayo Lues	38	52	48	46
Simeulue	30	45	40	38

4.2. Analysis Impact of Infrastructure on Tourism and the Economy

a. Panel Regression Model

1) Infrastructure Transportation: Coefficient $\beta 1 = 0.72$ ($p < 0.01$) → Every 10% increase in index transportation increases tourists by 7.2%.
2) Promotion : $\beta 2 = 0.15$ ($p < 0.05$) → Impact more small compared to infrastructure .
3) HR (HDI): $\beta 3 = 0.38$ ($p < 0.01$).

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b. Simulation Impact Project Strategic

1) Banda Aceh– Bireuen Toll Road: Cut time 50% completion, projected increase in visit travelers to North Aceh by 25% and increase GRDP by 1.5%/ year.
2) Expansion: Addition direct route from Jakarta–Singapore can increase travelers overseas by 40%.

c. Impact Multiple (IO Analysis)

1) Output Multiplier: 2.3 → Every Rp1 billion investment infrastructure generating Rp2.3 billion in additional output .
2) Employment Multiplier: 3.1 → Every 10 workers in construction created 31 jobs in the sector.

4.3. Challenges Financing and Governance

a. Limitations Budget: APBA 2023 only allocates 15% for infrastructure (Rp. 4.2 trillion), far below the need amounting to IDR 12 trillion / year (Bappenas, 2023).
b. Coordination: 70% stakeholders' interest state coordination inter-agency " less than optimal".
c. Maintenance: Budget maintenance road only 30% of ideal standards (Aceh Transportation Agency, 2023).

The strategic framework for Aceh's infrastructure development emphasizes innovation, integration, and sustainability as the core pillars for accelerating regional growth. A key component of this strategy is the adoption of innovative financing models that leverage both public and private sector participation. Priority is given to Public–Private Partnership (PPP) schemes, including the development of the Sabang Cruise Ship Port, which has an estimated investment potential of IDR 1.2 trillion. Another major initiative involves expanding rural broadband infrastructure through collaboration between BAKTI–Kominfo and telecommunication operators to strengthen digital connectivity in remote areas. Additionally, the establishment of eco-resorts in the Leuser ecosystem under a partnership model between local state-owned enterprises (BUMD) and private investors is projected to attract international visitors. To support financial coordination, the Aceh Infrastructure Fund Management Institute (LPDA) will be formed to consolidate resources from APBA, DAU, DAK, and private investment funds, ensuring more efficient and transparent financing mechanisms.

The framework also promotes the integration of infrastructure with Aceh's tourism ecosystem through the development of interconnected economic corridors. The Sabang–Banda Aceh–Meulaboh corridor will focus on strengthening tourism, maritime industries, and historical heritage, while the Central Corridor connecting Takengon and Gayo Lues will emphasize agro-tourism and ecotourism. Supporting these corridors, a "One Data Tourism Platform" will be developed to integrate information on micro, small, and medium enterprises (MSMEs), accommodations, and tourist attractions using a GIS-based system, enabling data-driven decision-making and improved visitor experiences. To ensure long-term sustainability, the plan introduces a strengthened governance mechanism through the creation of the Aceh Infrastructure Governance Board, a cross-sectoral coordinating body led by the Governor. This board will oversee strategic alignment across projects, ensuring consistency and accountability. Furthermore, a Maintenance Fund will be established by allocating 5 percent of regional income specifically for infrastructure upkeep. Environmental sustainability will be embedded across all projects, with the promotion of green ports and solar-powered eco-resorts to protect Aceh's natural assets and reinforce its position as a sustainable tourism destination.

V. Conclusion

This study confirms that economic infrastructure serves as a fundamental prerequisite in transforming Aceh's tourism potential into a prosperous and competitive regional economy. Infrastructure inequality across regions is not merely a technical issue but is deeply rooted in broader economic disparities. The findings reveal several key insights. First, there is a significant correlation between infrastructure quality

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and tourism growth, with infrastructure emerging as the dominant factor influencing visitor expansion (β = 0.72). Second, priority projects such as the completion of the Banda Aceh–Bireuen toll road and the expansion of Sultan Iskandar Muda (SIM) International Airport demonstrate systemic effects in improving accessibility and stimulating local investment. Third, the Public–Private Partnership (PPP) model is identified as a crucial mechanism to bridge the annual infrastructure funding gap, estimated at IDR 8 trillion, offering an effective means of mobilizing both public and private capital for long-term development. The policy implications of this research are multifaceted. It is essential to incorporate the Aceh tourism corridor into the National Tourism Infrastructure Master Plan 2025–2045, ensuring that Aceh's development aligns with broader national strategies. Additionally, the government should provide investment incentives, including tax holidays and streamlined licensing processes, to attract private sector participation in tourism-related PPP infrastructure projects. A place-based policy approach is also recommended, focusing on tailored infrastructure development according to the specific geographic and ecological characteristics of each region—whether coastal, island, or mountainous. Despite these insights, the study acknowledges certain limitations. It has not yet examined the impact of climate change on infrastructure along Aceh's coastal zones, which are increasingly vulnerable to environmental degradation and extreme weather events. Future research should therefore explore climate risk assessment and the design of adaptive infrastructure models to ensure that Aceh's development strategy remains resilient, sustainable, and inclusive in the face of global environmental challenges.

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