

SUSTAINABILITY OF NUSA PENIDA TOURISM AMIDST LIMITED AND UNREADY INFRASTRUCTURE

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Abstract

Tourism in Nusa Penida has grown rapidly over the past two decades, establishing the area as one of the leading destinations in the Province of Bali. However, the surge in tourist visits has not been matched by adequate readiness of basic infrastructure such as roads, clean water, electricity, public transportation, and waste management. This study aims to analyze the impact of infrastructure limitations and insufficiencies on the sustainability of tourism in Nusa Penida. The research employs a descriptive qualitative approach through field observations, interviews with stakeholders, and literature review. The findings indicate that inadequate infrastructure has put pressure on the environment, reduced the quality of visitor experiences, and threatened the well-being of local communities. Nevertheless, initiatives from local communities and regional governments to develop community-based sustainable tourism demonstrate a positive direction. This study recommends integrated planning among government, private sectors, and communities to strengthen infrastructure and ensure sustainable destination governance.

Keywords: Destination Management, Infrastructure, Nusa Penida Sustainability, Tourism.

A. INTRODUCTION

Nusa Penida is one of the tourist destinations experiencing the fastest growth in Bali Province over the past decade. This growth is inextricably linked to massive digital promotion through social media, destination marketing platforms, and exposure from content creators, which has significantly increased the island's visibility both nationally and internationally. The viral phenomenon of tourist attractions like Kelingking Beach, known for its unique "T-Rex"-shaped cliff panorama; Broken Beach with its natural arch-shaped rock formations; Angel's Billabong, a natural pool with crystal-clear water; and Crystal Bay, which offers stunning sunsets and world-class snorkeling, have made Nusa Penida an increasingly respected marine tourism icon. These attractions have driven a surge in domestic and international tourist visits, which in turn has fueled local economic growth through the accommodation, transportation, and micro-tourism sectors.

This rapid tourism development has not been fully matched by the readiness and adequacy of basic infrastructure. The imbalance between growing tourist demand and available infrastructure capacity is a structural issue that is increasingly prominent. In several areas, road access remains narrow, riddled with potholes, and unable to accommodate the increasing volume of vehicles, especially during peak tourist seasons. Public transportation on the island is also limited, so most tourists rely on rental vehicles, which exacerbates traffic congestion and increases environmental pressure. Furthermore, clean water management is suboptimal due to limited local water resources and uneven distribution infrastructure across

the region. Solid and liquid waste issues have also not been comprehensively addressed, impacting the cleanliness of destinations and potentially polluting the coastal environment.

These conditions create a development paradox, where rapid tourism economic growth is accompanied by environmental degradation and reduced tourist comfort. This phenomenon reflects an imbalance often referred to in tourism development literature as the tourism growth paradox, a situation where increasing tourist numbers actually weaken the quality of destinations due to exceeding their carrying capacity. This imbalance becomes even more complex when linked to the institutional structure of tourism management at the village and sub-district levels, which is not yet fully capable of managing the impacts of tourism growth effectively and in an integrated manner.

In the context of sustainability, the United Nations World Tourism Organization (UNWTO) emphasizes that tourism development must take place while considering the balance between economic, social, and environmental dimensions. Tourism that relies solely on economic growth without ensuring the sustainability of natural resources and the well-being of local communities will lose its appeal in the long term (Irawati & Prasetyo, 2025). The lack of basic infrastructure in Nusa Penida has the potential to hinder the realization of sustainable tourism development by creating ecological pressures, reducing the quality of the tourist experience, and threatening the preservation of the natural attractions that are the destination's primary assets.

In this context, this research is urgently needed. This study seeks to systematically identify and analyze various infrastructure limitations that remain major obstacles to tourism development in Nusa Penida. The research focuses on three key aspects: (1) the condition of land and sea transportation infrastructure, (2) the availability and management of clean water and sanitation, and (3) the management systems for solid and liquid waste. The analysis examines the extent to which these infrastructure limitations affect the quality of tourism services, tourist comfort, environmental carrying capacity, and the socio-economic sustainability of the local community.

This research is also expected to provide a deeper understanding of the strategic implications of infrastructure unpreparedness for tourism sustainability in Nusa Penida. By combining theoretical approaches to sustainable tourism with empirical findings in the field, the results of this study are expected to form the basis for formulating more targeted, measurable policy recommendations based on real needs on the ground. Through comprehensive mapping, this research contributes to efforts to strengthen tourism governance that is responsive to contemporary challenges, while maintaining a balance between economic growth and environmental sustainability as the main foundation for the sustainability of the Nusa Penida tourism destination.

B. LITERATURE REVIEW

Sustainable Tourism Theory

Sustainable tourism theory essentially emphasizes that a destination can only survive and thrive if it maintains harmony between environmental, social, and economic aspects in the long term (UNWTO, 2023). Interestingly, this theory goes beyond simply conserving natural resources, emphasizing the moral and operational responsibility of managing ecosystems, the primary foundation of tourist attractions. Furthermore, a more equitable distribution of economic benefits to local communities is considered crucial, as sustainable tourism is difficult to achieve without strong social support. It is noteworthy that destinations that fail to safeguard the well-being of local communities typically face greater vulnerability to market pressures and fluctuations in tourist arrivals. Therefore, this theory serves not only as a normative guideline but also as an analytical framework that allows researchers to assess

whether tourism practices truly reflect the principles of multidimensional sustainability. Indicators:

- Environmental sustainability
- Social sustainability
- Economic sustainability
- Resource efficiency
- Protection of local culture

Carrying Capacity Theory

Carrying Capacity Theory is based on the understanding that every destination has ecological, social, and infrastructure resilience limits that must not be exceeded to avoid more serious damage or conflict (Coccossis & Mexa, 2020). However, these limits are often only felt when signs of decline, such as overcrowding, environmental damage, and tourist complaints, become apparent. In the context of an island region like Nusa Penida, the situation is even more critical because physical space and clean water availability are already limited to begin with. When tourism exceeds carrying capacity, the consequences not only include reduced tourist comfort but also an increased potential for conflict with local residents. Therefore, this theory is a very useful tool for mapping the limits of tourism growth and designing more controlled management strategies. Indicators:

- Infrastructure capacity
- Ecological capacity
- Tourist density
- Waste load
- Social pressure

Tourism Infrastructure Development Theory

This theory asserts that infrastructure, ranging from road access and transportation, clean water, sanitation, electricity, and telecommunications, is a strategic element that not only supports tourism operations but also shapes tourist perceptions and satisfaction (Gössling & Higham, 2021). Interestingly, several studies have shown that destinations with extraordinary natural assets can lose their appeal if their infrastructure does not develop in line with growing tourism demand. Furthermore, this theory emphasizes that infrastructure planning must be adapted to geographic conditions and environmental capacity to avoid creating new ecological pressures. It is also important to understand that every infrastructure development decision always has socio-economic implications, especially for local communities that are part of the tourism value chain. Therefore, infrastructure is not merely a complementary technical facility, but rather the primary foundation that determines the sustainability of a destination. Indicators:

- Accessibility
- Availability of clean water and sanitation
- Electricity stability
- Transportation quality

- Waste management

Community-Based Tourism / CBT Theory

CBT Theory stems from the idea that local communities should be placed at the center of decision-making and the implementation of tourism activities in their respective regions (Giampiccoli A, 2015). This approach stems from the realization that sustainable tourism can only be achieved if the economic, social, and cultural benefits are truly felt by the host communities. Interestingly, preserving cultural identity and local practices actually adds value, strengthening the attractiveness of destinations while ensuring long-term sustainability. Furthermore, the CBT model has been proven to increase community economic independence and reduce their dependence on external business actors, especially in destinations vulnerable to the negative impacts of mass tourism. Thus, CBT serves not only as a participatory framework but also as an empowerment strategy that strengthens the social and economic resilience of tourist destinations. Indicators:

- Community participation
- Equitable distribution of economic benefits
- Conservation of local culture
- Strengthening community institutions
- Cross-sector partnerships

C. RESEARCH METHODOLOGY

This research uses a descriptive qualitative approach, epistemologically grounded in a constructivist paradigm, with the goal of understanding the phenomenon in depth through the perspectives of the actors involved. This approach was chosen because it captures the complexity of the social, ecological, and institutional dynamics that influence the readiness of tourism infrastructure in Nusa Penida. Ontologically, a qualitative approach recognizes that reality is pluralistic, contextual, and shaped through social interactions. Therefore, this research is highly relevant for uncovering how various stakeholders interpret infrastructure conditions, tourism pressures, and their implications for destination sustainability.

In the data collection process, this study employed three main techniques: field observation, in-depth interviews, documentation, and literature review, conducted in a planned and systematic manner.

First, field observations were conducted at several key tourist destinations, including Kelingking Beach, Broken Beach, Angel's Billabong, and Crystal Bay. These observations were non-participant, allowing researchers to directly observe empirical phenomena without intervening. Through these observations, concrete data regarding accessibility conditions, supporting facility capacity, infrastructure quality, and tourism activity pressures were recorded and classified for analysis purposes. This technique is crucial given that infrastructure issues often cannot be understood solely through textual data but must be examined through visual evidence and the behavior of actors in the field.

Second, in-depth interviews were conducted to more comprehensively explore the views, experiences, and interpretations of stakeholders. Informants were selected using purposive and snowball sampling techniques, including village officials, tourism actors (business owners, tour guides, transportation managers), local communities, and tourists. The interviews were semi-structured, allowing researchers to explore new issues that emerged during the conversations. This approach provided space for informants to explain the socio-economic dynamics they experienced, their perceptions of infrastructure conditions, and the region's level of preparedness to face rapid tourism growth.

Third, documentation and literature studies were conducted through a review of various documents, such as local government reports, tourism sector regulations, development planning documents, scientific journal articles, and official institutional publications. This technique served as a secondary data source that strengthened the validity of field findings through a process of triangulation. The literature study was also used to develop a theoretical framework regarding sustainable tourism, destination carrying capacity, and the relationship between infrastructure and tourism sustainability.

Data analysis was conducted using the interactive model of Miles, Huberman, and Saldaña, which consists of three main steps: data reduction, data presentation, and conclusion drawing/verification. Data reduction was carried out through coding, categorization, and sorting of relevant data to ensure the focus of the analysis remained consistent with the research objectives. The data presentation was structured in a thematic narrative, allowing researchers to see the relationships between variables more clearly and logically. Meanwhile, conclusions were drawn iteratively by verifying findings obtained from various data sources, resulting in valid and scientifically accountable interpretations.

Therefore, the overall methodological process in this study was designed to produce a comprehensive, in-depth, and credible understanding of the limitations of tourism infrastructure in Nusa Penida and its relevance to sustainability principles. The descriptive qualitative approach used not only captures the empirical conditions as they exist but also provides a crucial interpretative dimension to explain the social, ecological, and policy mechanisms underlying these phenomena. The research findings are expected to provide a significant academic contribution and a practical reference for policymakers in formulating more inclusive, responsive, and sustainable tourism development strategies.

D. RESULT AND DISCUSSION

Nusa Penida's Infrastructure Condition

The condition of basic infrastructure in Nusa Penida still shows a mismatch between the available service capacity and the needs of the region as a rapidly growing tourist destination. Most of the road network does not meet safety and comfort standards, both in terms of road width, construction, and completeness of safety facilities. Many roads have steep contours, damaged surfaces, and a lack of warning signs, increasing the potential for accidents and reducing the quality of tourist mobility and local economic activity. Frequent vehicle use by tourists and businesses accelerates road degradation, creates spatial conflicts, and reduces movement efficiency in key tourist areas.

Clean water availability in Nusa Penida still relies on groundwater sources, which have limited capacity. The island's geological conditions, dominated by limestone, mean that groundwater capacity is relatively low, so clean water demand often does not match the available supply. Water distribution through piped networks is not evenly distributed throughout the region, forcing some residents and tourism businesses to purchase water from tanker trucks at higher costs. The unstable clean water supply poses risks to the quality of sanitation services, the comfort level of tourists, and the sustainability of businesses that are highly dependent on water availability.

The electricity supply and internet network in some areas are also not evenly distributed and stable. Periodic power outages still occur, especially when energy demand increases during the tourist season. The internet network, a basic necessity for modern tourism activities such as communication, navigation, digital transactions, and promotions, cannot optimally support all areas. This unevenness reduces the quality of the tourist experience and limits the scope for businesses to manage services professionally and competitively.

The solid and liquid waste management system in Nusa Penida also does not perform optimally. The capacity of waste processing facilities is still limited, the transportation fleet is inadequate, and waste sorting mechanisms are not consistently implemented. The accumulation of waste in tourist and coastal areas is increasingly visible with increasing tourist activity, deteriorating the aesthetic quality of the environment and creating serious ecological pressures. Liquid waste management faces similar challenges because not all accommodations have wastewater treatment plants that meet environmental standards, increasing the potential for pollution to the soil, coastal areas, and marine ecosystems.

These conditions demonstrate the multidimensional challenges facing tourism development on Nusa Penida, encompassing safety, accessibility, basic services, and environmental sustainability. Inadequate infrastructure has the potential to reduce the region's carrying capacity, impact the quality of the tourist experience, and create ecological pressures that could threaten the destination's sustainability. Improving the quality of basic infrastructure is a crucial prerequisite to ensuring that tourism growth does not conflict with the vision of sustainable development and the well-being of local communities.

Strengthening customary security is a strategic effort to maintain social stability, public order, and the sustainability of local wisdom values in regional governance. In the Balinese social context, customary security is understood not only as a normative mechanism for maintaining order but also as a socio-cultural system that functions to maintain harmony (*kertha*) and balance (*rwa bhineda*) in community life. Therefore, strengthening customary security requires a multidimensional approach that integrates regulatory, institutional, participatory, and adaptive aspects to social dynamics.

Institutionally, local governments need to ensure that customary security structures such as the *pecalang* (traditional village chiefs), *prajuru* (community leaders), and other customary institutions have an adequate legal basis, clear authority, and a synchronized coordination scheme with the formal security apparatus. Integration of these roles is crucial to avoid overlapping authority, increase the effectiveness of handling disturbances, and strengthen the social legitimacy of customary security measures. Furthermore, capacity building through competency-based training, regulatory understanding, conflict management, and a humanistic approach is necessary to enable customary officers to carry out their security functions professionally and in accordance with human rights principles.

From a socio-cultural perspective, strengthening customary security also requires the revitalization of local values such as *menyama braya* (community-based approach), *tatwam asi* (community-based approach), and *tri hita karana* (community-based approach) as ethical orientations for customary officers' actions. These values ensure that security at the customary village level remains grounded in collective interests and respect for human dignity. Furthermore, active community involvement in social control mechanisms needs to be strengthened so that customary security is not merely repressive, but also preventive and educational.

From a public policy perspective, local governments need to design a policy framework that fosters synergy between formal and customary security systems through clear regulations, adequate budget allocation, and measurable monitoring and evaluation mechanisms. This policy must address the dynamics of social change, population growth, economic mobility, and modern challenges such as digitalization, tourism, and the potential for cross-cultural conflict.

Impact on Tourism Sustainability

The increase in tourism activity in coastal areas has multidimensional implications that require a comprehensive analysis through a sustainability framework encompassing environmental, social, and economic aspects. Environmental aspects indicate that the growth

in tourist visits, the intensification of recreational activities, and the expansion of tourist facilities have resulted in a significant increase in waste volume. The capacity of local waste management systems is unable to keep pace with this growth rate, creating an increasingly critical ecological burden. Coastal water pollution, the accumulation of plastic waste in the intertidal zone, and increasing water turbidity threaten the stability of marine ecosystems. Coral reef damage caused by unregulated snorkeling and diving activities exacerbates ecological conditions. Inorganic waste, especially plastic, has a high level of persistence and has the potential to fragment into microplastics, which then enter the marine food chain. This phenomenon indicates a long-term ecological threat to marine life and the quality of the coastal environment, while also reducing the ecological carrying capacity of these tourist areas.

Social aspects demonstrate the complex dynamics resulting from the rapid expansion of the tourism sector. Pressure on local communities' living spaces is increasing due to the high demand for land for the construction of hotels, villas, restaurants, and other tourism-supporting facilities. Rising land and property prices have led to a process of spatial marginalization for low-income communities unable to compete in the tourism property market. Rising prices of basic necessities triggered by increased consumption in the tourism sector have created additional economic burdens for local residents. Changes in social structures are also evident in the reduced dependence of communities on traditional livelihoods and the increasing inequality of economic benefits. The distribution of profits, which flows more to external investors or large-scale businesses, means that some local communities are only involved in informal sectors with marginal incomes. This imbalance creates social vulnerability and potential conflicts of interest between the interests of the tourism economy and the sustainability of local livelihoods.

Economic aspects demonstrate a very high level of dependence on the tourism sector as the primary source of community and regional income. This monosectoral dependence makes the local economy highly vulnerable to fluctuations in tourist visits influenced by external factors such as pandemics, natural disasters, global instability, or changes in international travel policies. A sudden decline in tourist numbers can result in a significant economic contraction, as the majority of households rely on income from tourism activities. The lack of economic diversification limits alternative livelihoods for communities when the tourism sector is not operating optimally. This situation poses the risk of long-term development failure because economic activity becomes concentrated in a single sector, which theoretically contradicts the principle of regional economic resilience. Excessive dependence also suppresses the potential development of other sectors, such as agriculture, fisheries, or the creative economy, which should be supporting local economic stability.

Local Efforts and Initiatives

The Klungkung Regency Government has demonstrated strategic efforts to promote the development of community-based tourism in response to the dynamic growth of tourism in Nusa Penida. This approach is designed to ensure that local communities have a stronger position in the tourism value chain through direct involvement in service provision, such as homestay management, tourist transportation, guide services, and environmental conservation activities. This model aims not only to increase the distribution of economic benefits more equitably but also to strengthen community capacity to maintain cultural identity and preserve the natural resources that are the region's main attractions. The integration of local values into tourism practices is seen as a crucial component for long-term sustainability, particularly in the context of mitigating the negative impacts of mass tourism on the ecosystem and local social structure.

The basic infrastructure development program has shown gradual progress through improvements to the road network in several locations, the provision of clean water access, and the implementation of an integrated waste management system. These interventions serve as fundamental prerequisites for improving destination quality and tourist comfort, while also serving as important instruments for maintaining environmental carrying capacity. Adequate accessibility is a key factor because Nusa Penida's hilly and scattered topography requires consistent infrastructure management based on spatial needs analysis. Providing access to clean water also plays a crucial role given limited groundwater resources and fluctuating demand due to the growth of the tourism sector. The implementation of an integrated waste management system has begun to focus on reducing waste generation in tourist areas through sorting, scheduled transportation, and processing at treatment facilities, although its implementation remains focused on specific areas and does not yet cover all villages in Nusa Penida.

The availability of these programs demonstrates the local government's commitment to gradually improving the quality of the destination. However, limited resources, uneven coverage of interventions, and challenges in coordination between stakeholders remain major obstacles. Policy effectiveness depends heavily on synergy between the government, communities, and tourism industry players, including in aspects of financing, long-term infrastructure maintenance, and capacity building of local human resources. The successful development of community-based tourism requires sustained institutional support, strengthened regulations, and consistent monitoring mechanisms so that the transformation of the tourism sector relies not only on the momentum of visitor growth but also on ensuring the long-term quality and resilience of the destination.

Sustainability Analysis

The lack of infrastructure to support tourism activities in Nusa Penida has the potential to have long-term consequences for the destination's image and the sustainability of its development. Deficiencies in roads, clean water, electricity, and waste management systems create an imbalance between the environmental carrying capacity and the pressures of tourism activities, leading to negative perceptions among tourists regarding the comfort, safety, and quality of the travel experience. A declining destination image will directly impact the region's tourism competitiveness, given that infrastructure quality is a key determinant of tourist visitation decisions, particularly among international tourists who expect higher standards of service and facilities. Long-term threats to the destination's reputation not only impact the number of visits but also the sustainability of local businesses that rely heavily on the tourism sector as their primary source of income.

The need to achieve sustainable tourism requires targeted and coordinated planning through cross-sectoral synergy between the local government, business actors, local communities, and non-governmental organizations working in the environmental and tourism sectors. Multi-stakeholder collaboration is necessary to ensure that every infrastructure development intervention is oriented not only toward growth but also toward environmental conservation and improving the community's quality of life. The involvement of cross-sector actors enables the creation of planning and implementation mechanisms that are more responsive to challenges on the ground, such as geographic limitations, ecological pressures, and tourism market dynamics. Collaborative processes are also crucial to prevent overlapping policies, strengthen inter-agency coordination, and ensure more effective and targeted resource allocation.

Strengthening regulations is a crucial element in ensuring that tourism development adheres to sustainable principles. Strict regulations regarding spatial planning, tourism service standards, coastal ecosystem conservation, and waste management are necessary to

control the pace of development, which often outpaces government oversight. Consistent enforcement of regulations can prevent uncontrolled land conversion, encourage business compliance with environmental management standards, and create a more orderly and long-term development climate. Strong regulations also play a role in ensuring that local communities receive more equitable economic benefits from tourism activities through protection of land access rights, employment opportunities, and business partnerships.

The development of a sustainable tourism master plan is a strategic necessity that cannot be postponed. The master plan document serves as a framework for long-term development direction that holistically integrates environmental, social, and economic aspects. This plan can prioritize infrastructure development, coastal and marine conservation schemes, community-based destination development patterns, and risk mitigation mechanisms against the pressures of mass tourism. The clarity of policy direction in the master plan allows local governments to manage tourism growth in a measured manner, in accordance with environmental carrying capacity and the socio-economic capacity of the community. Integrating conservation and community empowerment concepts into the master plan will strengthen the destination's resilience to changing market dynamics and potential future tourism crises.

E. CONCLUSION

The limited and unprepared infrastructure in Nusa Penida directly impacts the sustainability of the region's rapidly growing tourism. The road network, which still lacks safety standards, clean water distribution relies on limited groundwater sources, an unstable electricity supply, and suboptimal transportation and waste management systems create structural barriers to strengthening the destination's competitiveness. The imbalance between tourist arrival growth and basic infrastructure capacity creates the potential for a decline in the quality of tourism experiences, an increased risk of environmental damage, and a weakening of the destination's long-term competitiveness. The complexity of these infrastructure issues indicates that tourism growth in Nusa Penida still relies on a support system that is not fully prepared to address the dynamics of increasing tourism demand.

The social potential of local communities offers hope for the realization of a more inclusive, sustainable tourism model. High levels of community participation, commitment to cultural preservation, and involvement in tourism economic activities provide important social capital to offset weaknesses in physical infrastructure. This social capital has the potential to strengthen community-based destination management mechanisms that emphasize the principles of collaboration, transparency, and shared responsibility. This social support can serve as the foundation for more resilient tourism management, especially when physical infrastructure is inadequate to support the volume and consumption patterns of tourists.

The urgency of strengthening infrastructure becomes increasingly clear when observing the growing trend of tourism, which does not always align with local ecological and social capacity. Infrastructure unpreparedness risks tarnishing the destination's image, particularly when complaints arise about damaged road access, limited clean water, unstable electricity, and the accumulation of waste in tourist areas. Negative perceptions of tourists can spread quickly through social media and travel review platforms, potentially reducing Nusa Penida's long-term appeal. The region's dependence on the tourism sector further reinforces this urgency, as a decline in tourist interest will directly impact the income of the community, local businesses, and local government revenues.

Sustainable tourism development in the context of Nusa Penida requires a comprehensive, adaptive, and evidence-based policy approach. Integration of spatial

planning, strengthening basic infrastructure, managing environmental carrying capacity, and empowering local communities is a non-negotiable prerequisite. The development of a sustainable tourism master plan is necessary to guide a long-term development strategy that is oriented not only toward growth but also toward ecological sustainability, equitable distribution of benefits, and socio-economic resilience. These policy directives are expected to strengthen Nusa Penida's position as a leading destination that is not only visually appealing but also capable of providing a quality and sustainable tourism experience.

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