

Sustainable Architectural Master Planning for Ecotourism Development in Mountainous Rural Areas: A Case Study of Pengejaran Village, Bali

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Abstract Sustainable architectural master planning is increasingly critical in mountainous rural areas where tourism development intersects with fragile ecological systems, productive agricultural landscapes, and culturally embedded spatial practices. Despite the widespread promotion of ecotourism, many rural tourism initiatives lack operational architectural and spatial frameworks capable of balancing environmental protection, community livelihoods, and tourism demand, leading to spatial degradation and economic leakage. This study aims to formulate an integrated architectural and spatial planning framework that strengthens rural resilience by optimising local natural, cultural, and financial assets in Pengejaran Village, a highland settlement in Kintamani District, Bali. The research adopts a design-based research approach within a research and development framework, positioning architectural design as both an analytical and generative instrument. Data were collected through field observation, spatial mapping, stakeholder engagement, and document analysis, and analysed using qualitative spatial methods addressing land use, topography, ecological assets, socio-cultural values, tourism potential, and spatial carrying capacity. The results indicate that Pengejaran Village possesses latent spatial capacity to support ecotourism without compromising environmental integrity. This master plan operationalises sustainability and local wisdom through architecture-led spatial planning strategies.

Keywords Architectural Master Planning, Ecotourism Architecture, Rural Settlement Design, Spatial Design Strategy, Sustainable Architecture

1. Introduction

1.1. Background of Research

The development of tourism villages has become a strategic tool in regional and environmental planning to enhance the long-term sustainability of rural systems through the integration of spatial management, natural resource governance, and local economic activities [1-3]. Structurally, rural landscapes are shaped by agrarian land-use systems and subsistence-based spatial patterns that function as both ecological and economic infrastructure [4, 5]. The sustainability of these systems depends heavily on community-based resource governance that ensures ecological continuity and intergenerational balance in land use [6, 7]. Consequently, natural resource management should be understood as a dynamic spatial system that requires adaptive planning mechanisms, with local communities acting as primary agents possessing contextual environmental knowledge embedded in the rural

landscape [8, 9].

In practice, contemporary development pressures and the implementation of nationally driven tourism village programs impose increasing demands on rural spatial systems to accommodate dual functions, namely residential needs and tourism-related activities. Unregulated tourism development tends to accelerate land-use conversion, functional zoning transformation, and the degradation of agricultural and ecological landscapes [10, 11]. In parallel, the reallocation of local labor from primary agricultural sectors to tourism-based services disrupts traditional land-use structures. These conditions indicate the need to restructure spatial governance frameworks and natural resource management as the technical foundation for tourism. In this context, the ecotourism approach is a relevant planning model, as it integrates environmental conservation, community-based spatial management, and controlled spatial intensity in tourism development [12].

Pengejaran Village, located in Kintamani District, Bangli Regency, Bali, is a highland settlement system with significant potential for agriculture, forestry, and water resources, but it has not yet been optimally structured within a comprehensive spatial planning framework. The village functions as a territorial unit comprising land resources, local communities, and institutional arrangements guided by the *Tri Hita Karana* philosophy, which emphasizes balanced relationships between humans and nature, social harmony, and spiritual values. From a regional planning perspective, villages constitute autonomous spatial entities whose resilience is determined by their capacity to regulate land use, manage natural resources, and control development trajectories within administrative boundaries [13, 14].

Natural resources, particularly agricultural land and plantation systems, serve as the primary spatial-economic infrastructure supporting community livelihoods in Pengejaran Village. Long-term rural welfare is therefore contingent upon effective land-use regulation, a balanced spatial distribution of economic activities, and community-based management practices that minimize socio-spatial inequality.

Despite its substantial local potential, Pengejaran Village faces structural limitations related to low regional accessibility and its peripheral position within the broader transportation network. In the absence of an adaptive and integrative spatial planning framework, these local assets risk remaining underutilized and unable to generate sustainable economic value. Accordingly, this study aims to formulate an ecotourism-based tourism village master plan as a spatial development framework that optimizes local potential while strengthening the resilience of the village system. The significance of this research lies in its contribution to developing an operational spatial planning approach that translates ecotourism principles into measurable, context-sensitive architectural and landscape design strategies.

1.2. Literature Review

The literature on tourism village development consistently positions sustainability as the central conceptual framework, encompassing environmental, economic, and social dimensions [15, 16]. Within the context of regional and spatial engineering, sustainability is interpreted as the capacity of spatial systems to maintain ecological and social functions under development pressure through adaptive structural mechanisms [14, 17]. Land-use control and natural resource management thus represent critical variables in balancing production functions, conservation objectives, and tourism utilization.

Previous studies indicate that tourism village development is frequently driven by external actors, resulting in limited local control over spatial decision-making and uneven distribution of economic benefits [18]. These conditions are often exacerbated by overtourism, which arises from a mismatch between tourism activity intensity and spatial carrying capacity, leading to land-use conflicts, increased living costs, and community resistance commonly referred to as tourism phobia [19]. From a regional economic perspective, tourism revenue leakage further weakens local economic multipliers because external operators dominate tourism value chains [20].

Within planning and design discourse, ecotourism is positioned as a mitigation strategy against excessive spatial exploitation by prioritizing environmental conservation, community participation, and controlled spatial intensity [12]. However, much of the existing literature remains concentrated at the conceptual and policy levels, with limited translation of ecotourism principles into operational spatial and architectural strategies. Failure to integrate environmental carrying capacity and ecological thresholds into spatial planning frameworks has been shown to accelerate environmental degradation [21].

In architectural and spatial planning research, the research and development (R&D) approach enables spatial design to function as both an analytical and generative instrument for formulating context-responsive solutions [22]. The integration of empirical, emic, and etic methods facilitates aligning local needs with theoretical sustainability frameworks [23]. Previous studies emphasize that the equilibrium among built form, landscape structure, and community welfare is a key indicator of sustainable spatial planning performance [24-26]. It supports the Sustainable Development Goals, particularly the objective of sustainable development for cities and communities [27].

This review reveals a notable research gap in the development of ecotourism-focused master plans for tourism villages. Specifically, there is a need for plans that explicitly address overtourism, economic leakage, and spatial carrying capacity within integrated architectural and landscape strategies. To fill this gap, this study proposes a local-potential-based ecotourism master plan for Pengejaran Village, integrating environmental, economic, and social sustainability into a spatial planning framework that is both applicable and sensitive to the highland rural

context.

The proposed approach contributes theoretically by transforming the concept of ecotourism into a measurable spatial and architectural planning framework grounded in environmental carrying capacity and integrated with community-based natural resource governance. Conceptually, this study advances the sustainability discourse in tourism village development beyond normative and policy-oriented perspectives toward an operational spatial dimension. It positions environmental carrying capacity, spatial intensity control, and economic leakage mitigation as structural parameters in the formulation of a village master plan. Through this integration, the approach strengthens rural regional planning theory by linking ecotourism principles with spatial engineering strategies and agrarian landscape systems understood as ecological–economic infrastructure.

From an applied perspective, the study offers a locally grounded master-planning model tailored to mountainous rural settlements, particularly those with limited accessibility and strong dependence on agricultural and forestry systems. The resulting framework is designed to be adaptive and transferable, establishing landscape structure, agrarian land-use patterns, local socio-institutional systems, and ecological thresholds as core foundations for planning. Accordingly, the approach may be extended to other highland rural contexts with comparable characteristics, particularly in addressing tourism development pressures, maintaining a balance between productive and conservation functions, and enhancing the long-term resilience of village systems.

2. Materials and Methods

This study employs a design-based research approach within a research and development (R&D) framework, positioning architectural and spatial planning as analytical and generative tools for addressing sustainability challenges in rural tourism development [22]. The research is grounded in a sustainability-oriented planning paradigm, in which environmental conservation, socio-cultural continuity, and local economic resilience are understood as interdependent systems. Ecotourism principles and the *Tri Hita Karana* philosophy serve as the conceptual foundation, guiding the translation of harmonious relationships between humans and, among communities, and with cultural–spiritual values into spatial structures, zoning configurations, and architectural programs [12, 28, 29]. To ensure contextual sensitivity and analytical rigor, the methodological approach integrates empirical–sensory observation with emic and etic perspectives, allowing local knowledge and external planning frameworks to be addressed simultaneously.

Data were collected from a combination of primary and secondary sources to comprehensively capture the spatial, environmental, and socio-cultural characteristics of

Pengejaran Village. Primary data collection involved direct field observations of land-use patterns, settlement morphology, circulation networks, agricultural systems, forest boundaries, water resources, and landscape conditions. These observations were complemented by participatory engagement and informal interviews with key local stakeholders, including village authorities, farmers, community representatives, and tourism actors, to understand local land management practices, cultural values, and development aspirations [30, 31]. Spatial documentation, including photographic records, sketch mapping, and site measurements, was conducted to support architectural and landscape analysis. Secondary data were obtained from village administrative documents, regional planning policies, tourism development guidelines, and relevant scientific literature related to ecotourism, sustainable spatial planning, rural development, and landscape architecture.

Data analysis was carried out using a qualitative–spatial analytical framework that combined descriptive, interpretative, and design-based methods. Spatial and environmental studies were conducted to identify land-use distribution, topographical characteristics, ecological assets, and environmental constraints, forming the basis for determining suitable development zones and conservation priorities [17]. Socio-cultural analysis focused on local traditions, community structures, and cultural values, particularly the *Tri Hita Karana* philosophy, which was interpreted as a spatial organizing principle for sacred, communal, and productive spaces [26, 29]. Tourism potential and spatial carrying capacity were analyzed to regulate development intensity and visitor flow, ensuring that tourism activities remained within ecological and social thresholds. The results of these analyses were synthesized through design-based reasoning, in which architectural and landscape design served as tools to test spatial scenarios, evaluate potential impacts, and refine planning strategies [22].

This study employs a Research and Development (R&D) framework to formulate and validate an ecotourism-based master plan structured around five spatial components: (1) Information Center, (2) Waterfall Yoga Facility, (3) Bathing Tourism Area, (4) Water Spring Conservation Zone, and (5) Distributed Rest Areas. Within this framework, spatial design operates as both an analytical and generative instrument, ensuring that environmental, social, and economic sustainability principles—embedded in local wisdom—are translated into measurable spatial parameters.

2.1. Research Phase: Spatial Diagnosis and Contextual Parameter Identification

The initial phase establishes baseline spatial, environmental, and socio-cultural conditions. Hydrological analysis of the water spring and waterfall includes buffer

delineation, discharge capacity measurement, and contamination risk assessment. Slope stability and erosion risk mapping inform terrain-sensitive construction strategies, particularly for the waterfall yoga platform. Visitor load projections estimate maximum occupancy thresholds, while accessibility and circulation analysis determine optimal node placement to reduce landscape fragmentation.

Environmental carrying capacity is assessed through land capability classification, infrastructure load evaluation (water supply, wastewater, circulation), and ecological sensitivity mapping. Simultaneously, social carrying capacity is examined through community consultations to identify acceptable visitor intensity levels and culturally sensitive zones.

Local wisdom—particularly principles emphasizing balance between humans, nature, and spiritual values—functions as a normative spatial filter. Traditional land-use boundaries, sacred water sources, and agrarian cycles are identified through participatory mapping sessions. These inputs ensure that planning thresholds reflect not only technical limits but also culturally embedded ecological ethics.

Stakeholder engagement is structured across three levels: (1) local communities and customary institutions as knowledge holders and resource stewards; (2) technical experts translating qualitative insights into quantifiable parameters; and (3) regulatory authorities ensuring alignment with regional planning frameworks. This collaborative process enhances technical accuracy, social legitimacy, and governance integration.

2.2. Development Phase I: Spatial Structuring and Sustainability Integration

Based on diagnostic outputs, the master plan adopts a hierarchical node–buffer configuration. The Information Center functions as a controlled gateway, regulating visitor inflow, supporting environmental education, and promoting local products to strengthen economic retention. The Water Spring is designated as a strict conservation core with defined ecological buffers. The Waterfall Yoga Facility is developed as a lightweight, slope-adaptive structure positioned outside critical hydrological zones. The Bathing Tourism Area is located downstream and incorporates water quality monitoring and biofiltration-based wastewater systems. Rest Areas are distributed along pedestrian corridors to disperse visitor concentration and maintain spatial balance.

Economic sustainability is reinforced by integrating tourism functions with existing agrarian systems, preventing excessive land conversion and minimizing revenue leakage. Social sustainability is addressed through equitable access, community-based management structures, and preservation of cultural landscapes. Environmental sustainability is ensured through strict limits on carrying capacity, hydrological protection modeling, and slope-adaptive design strategies.

2.3. Development Phase II: Simulation, Validation, and Adaptive Refinement

The proposed configuration undergoes iterative validation through visitor flow simulation, infrastructure capacity testing, and environmental load modeling. Scenario analysis evaluates tourism growth projections against ecological thresholds and socio-cultural tolerance levels. Land-use monitoring safeguards productive agricultural landscapes as ecological–economic infrastructure.

Stakeholder validation forums review technical outputs to confirm environmental feasibility, economic inclusivity, and cultural appropriateness. Adjustments are made to maintain equilibrium between conservation, tourism utilization, and rural livelihood systems.

Through this R&D process, the master plan operates as an integrated spatial engineering framework in which hydrological stability, slope conditions, community governance, and visitor capacity indices govern architectural form and land allocation. By embedding local wisdom and multidimensional sustainability within measurable spatial controls, the framework provides a technically robust, transferable model for mountainous rural settlements seeking resilient and inclusive ecotourism development.

3. Result and Discussion

3.1. Local Potentials of Pengejaran Village

Pengejaran Village is one of the 33 settlement clusters within the *Pura Puncak Penulisan* cultural landscape, widely recognized as one of the oldest settlement assemblages in Bali. As an early/ancient settlement, Pengejaran Village retains local potentials that have continued to regenerate and persist amid contemporary development pressures. The village's vernacular architecture remains strongly evident in both its spatial organization and built form, while highland cultural practices shape the community's relationship with local resources [32-35]. Community resilience is reflected in the capacity to manage agricultural land, forests, and plantations, indicating an adaptive rural socio-ecological system [14, 36]. Key local assets include agricultural and plantation landscapes, freshwater springs, waterfalls, natural bathing sites, and well-preserved cultural resources. Local concepts underpin the governance of these assets, including transforming previously unproductive land into productive agricultural use, maintaining forest integrity through habitat conservation, proportional forest-land utilization based on community needs, and harvesting non-timber forest products, such as wild honey, as an essential livelihood source.

Dryland farming constitutes the primary livelihood strategy in Pengejaran Village, supporting both household

subsistence and local income generation. Agricultural production is distributed across the village landscape, including maize, shallots, tubers, fruits, vegetables, coffee, and cloves, with citrus farming providing the highest economic returns. These agricultural resources represent a strategic commodity base that can be further developed to strengthen local economic performance and support livelihood security. Currently, the community has begun adding value to citrus production through the development of citrus-based wine in collaboration with private institutions in Bali, as well as the processing of wild honey into consumable, marketable products. Agricultural outputs are distributed to urban markets or purchased directly in bulk by intermediaries. While these assets indicate a relatively robust agrarian base, increasing contemporary needs necessitate innovation through integrated agricultural development within an ecotourism framework, ensuring the long-term viability of agriculture while expanding community benefits.

Another critical asset is the village forest, which functions as the ecological and material foundation for local life. The domestic water supply is sourced from springs located in the southern part of the village. At the same time, bamboo and timber used in traditional housing construction are sourced from village forests in the north. The forest also constitutes an ecological reservoir of natural wealth, including wild honey and coffee growth, indicating high ecological fertility that supports local needs. In addition to springs used for household and agricultural purposes, the Pengejaran Waterfall remains a natural, visually distinctive resource that contributes to the downstream water supply for the surrounding areas. Although the village forest must be conserved to maintain ecological balance and sustainability, it also requires strategic development so that it does not remain solely a locally utilized asset but becomes an integral component of the village economy [37-39]. Beyond natural assets, emerging micro, small, and medium enterprises (MSMEs) have become an increasingly important economic driver, particularly in the processing of wild honey and citrus-based wine. Given the abundance of agricultural and natural resources, the MSME sector holds significant potential for diversification beyond existing products.

A primary challenge in developing Pengejaran as an ecotourism area is the limited availability of supporting infrastructure. Tourism area development is commonly understood to depend on three interrelated variables: potential, management, and infrastructure [2, 40]. While Pengejaran Village is endowed with substantial assets, the infrastructure required to enable efficient access, visitor management, and service provision remains minimal. Three priority zones require infrastructure attention: (1) the freshwater spring zone, (2) the village forest and waterfall zone, and (3) the village core as the information center and public plaza. The spring zone is essential for everyday livelihoods and has therefore been sacralized through customary norms to prevent contamination. However,

access remains inadequate, particularly for maintenance of the water-pumping system. The spring's location within citrus plantations and along river corridors enhances its landscape quality, supporting its proposed development as a purification/ritual tourism zone (*melukat*) complemented by supporting visitor facilities. The village forest zone, with hilly landscapes dominated by mahogany forests, is used for coffee cultivation and supports wild honey production. Its natural terrain and cool microclimate provide strong potential for trekking, while the waterfall and river corridor offer opportunities for meditation-oriented nature tourism.

Nevertheless, the zone currently lacks both access infrastructure and basic visitor facilities. The village core, which contains the village office, meeting hall, and Desa Temple (Pura Desa), also lacks adequate tourism-support facilities such as organized parking, visitor information systems, accommodation services, and related amenities. Consequently, an integrated tourism infrastructure is required to enable the village's ecotourism functions to operate effectively.

3.2. Spatial Concept of Pengejaran Village

Pengejaran Village is situated within a mountainous landscape characterized by pronounced topographic variation. Local settlement formation reflects adaptive responses to this terrain by structuring residential areas, agricultural zones, and village forest landscapes. The village extends predominantly along a north-south axis; residential clusters are located on higher ground, while the Pengejaran River valley forms a lower corridor flanking the settlement. The village forest, located in the northern part of the village, serves as an ecological buffer and environmental support system.

The spatial structure is strongly influenced by the local concept of *luan-teben*, which is contextualized by the village's contour and topographic hierarchy [41]. According to Wijaya, topography provides the basis for determining orientation values of *luan* (upstream/highland) and *teben* (downstream/lowland) [42]. Higher topography is interpreted as primary and spiritually valued space, whereas lower topography is understood as less sacred or secular. This conceptual orientation underpins local spatial ordering. In this study, the spatial concept of Pengejaran is articulated through (1) orientation and (2) spatial hierarchy. The *luan-teben* orientation is reflected in a tripartite spatial structure consisting of a primary zone (spiritual/sacred spaces), a middle zone (residential housing), and a *teben* zone (village forest). The hierarchical aspect divides the village into a core spatial system (the higher contour) that forms the central settlement and a peripheral system (the lower contour) consisting of garden houses, forest areas, and freshwater springs located below the core (see Figure 1). The spatial evidence indicates that Pengejaran forms a mandala-like configuration, with the highest point functioning as the central node and the lower areas as

Figure 6. Design of Waterfall Facility

3.5. Optimization as a Pathway to Village Sustainability

Rural areas are highly dependent on natural resources as the primary basis for livelihood systems [38, 56]—these resources—agricultural landscapes, rivers, and villages. Forests constitute the foundational infrastructure supporting rural socio-economic continuity. Accordingly, such assets must be protected to ensure intergenerational benefits. Pengejaran Village, a mountainous settlement in Bali, is characterised by extensive, fertile agricultural land that serves as the primary economic base for residents. This agrarian landscape is inseparable from forests and river systems that operate as ecological buffers, water suppliers for agriculture, and providers of basic livelihood needs. As such, Pengejaran's ecological structure forms an interconnected system linking natural resources with socio-economic activities.

Despite its abundant natural resources, its contribution to improving community welfare remains limited due to a relatively undiversified rural economy that remains heavily reliant on primary sectors, particularly agriculture and forest products. Enhancing livelihoods, therefore, requires economic diversification through industries with strong potential, particularly environmentally oriented tourism development. In Bali, tourism has become a dominant sector built on natural and cultural assets. Within this regional context, Pengejaran holds strategic opportunities

to develop its natural potential through a sustainability-based tourism model, namely ecotourism. Ecotourism emphasises environmental responsibility and community empowerment to enhance welfare through sustainable resource utilisation.

Optimising local potentials is a key strategy for ecotourism development. Optimisation is the efficient, effective, and sustainable use of resources to improve welfare without compromising environmental integrity [54, 57]. In Pengejaran, this strategy is rooted in local assets, including springs, rivers, village forests, agricultural land, and community-based creative economic activities such as MSMEs. These assets are structured through an integrated ecotourism area plan consisting of: (1) an information center in the village core as the starting node for tourism activities and local product promotion; (2) a spring zone developed as spiritual purification tourism grounded in conservation; (3) a village forest and waterfall zone developed as an educational trekking-based nature tourism corridor; and (4) a natural bathing zone converted into a nature-based bathing destination while retaining its social function for residents. This approach indicates that Pengejaran's ecotourism development is oriented not only toward economic improvement but also toward environmental protection and reinforcement of socio-cultural values. Through governance grounded in local wisdom and community participation, tourism is expected

to generate synergy among village economic actors, the village government, and local communities.

Optimizing local potentials can achieve sustainability across three core dimensions: environmental, economic, and social [44]. In the Pengejaran ecotourism master plan, environmental protection, economic development, and social well-being are framed as interdependent pillars within an integrated sustainability framework. Consistent with sustainable development theory, long-term progress is understood to require the simultaneous advancement of ecological integrity, economic viability, and social equity. Given the village's interconnected landscape of forests, rivers, farmland, and settlements, environmental stewardship forms the foundation of the plan. Forests and spring systems are treated as ecological infrastructure—natural capital essential to long-term socio-economic resilience. Accordingly, interventions such as trekking paths, visitor facilities, and bathing areas are designed under conservation principles, carrying capacity limits, and environmental impact controls to safeguard intergenerational sustainability.

Economic objectives are integrated through diversification toward environmentally based services, particularly ecotourism. Local assets—including MSMEs, agricultural products, and guiding services—are incorporated into an inclusive tourism value chain to ensure that benefits circulate within the village economy. This approach reflects the principle that conservation is more sustainable when it generates tangible local livelihoods, while economic growth must remain within ecological limits.

Social outcomes are positioned as indicators of legitimacy and durability. The master plan strengthens participatory governance across planning, management, and evaluation processes. Sacred springs retain their cultural functions, and public bathing areas remain accessible to residents, preventing social exclusion. Development is thus framed not merely as income generation but as a means of reinforcing social cohesion, cultural identity, and community stewardship.

Balance among ecological, economic, and social dimensions is maintained through periodic evaluations using measurable environmental, economic, and social indicators, reflecting adaptive management principles. Overall, the Pengejaran master plan demonstrates that ecotourism development is most sustainable when ecological resilience, inclusive prosperity, and social integrity are advanced in an integrated and mutually reinforcing manner.

Environmental sustainability is achieved through conservation-oriented resource governance; economic sustainability through productivity enhancement and diversification of livelihood sectors; and social sustainability through strengthened social relations and increased community participation in rural development. Therefore, ecotourism development in Pengejaran Village is expected to become a model of rural empowerment based

on local potentials, oriented toward balancing ecological conservation with socio-economic welfare for present and future generations.

4. Conclusions

This study seeks to formulate an integrated architectural and spatial planning framework to support sustainable rural tourism development in a mountainous setting. Drawing on the case of Pengejaran Village, the research develops a locally grounded master planning approach that harmonizes ecological, social, cultural, and economic dimensions within an ecotourism paradigm.

The findings reveal that Pengejaran Village possesses substantial latent spatial capacity, reflected in its spatial organization, shaped by a mandala-like configuration that distinguishes core and peripheral zones, and the close interdependence among settlement areas, agricultural land, village forests, and hydrological systems. Ecological resources—including freshwater springs, forest landscapes, and waterfalls—alongside agrarian assets such as horticulture and plantations, cultural elements embedded in sacred spatial arrangements and local traditions, and creative economic activities based on wild honey and citrus wine production, can be spatially optimized through an integrated zoning strategy without compromising environmental integrity. The proposed master plan reinforces the village core as an information and economic node, while peripheral zones are developed through ecological architectural principles and low-impact interventions.

From both theoretical and practical perspectives, this research contributes by translating sustainability principles and local wisdom into an operational, architecture-led master planning framework. It addresses a gap in existing rural ecotourism planning approaches, which often remain sectoral or normative, by offering a concrete spatial model rooted in local spatial structures and oriented toward conservation and community-based economic empowerment.

The planning and design implications suggest that development in environmentally sensitive rural and highland contexts requires alignment with ecological systems and local cosmological order. The proposed framework provides guidance for policymakers, planners, and designers engaged in community-based ecotourism initiatives, emphasizing land-use efficiency, adaptive reuse of existing structures, controlled physical interventions, and the strengthening of local value chains.

Nevertheless, the study has several limitations. First, the findings are highly context-specific, as they are derived from a single case study, and therefore should be generalized with caution. Second, the analysis relies primarily on qualitative and spatial assessments, without incorporating quantitative performance indicators for environmental or economic outcomes. Third, the research

has not yet evaluated the long-term socio-ecological impacts of implementing the proposed master plan.

Future research should test the applicability of this framework in other rural contexts with differing ecological and cultural characteristics to assess its transferability. Incorporating quantitative indicators—such as environmental carrying capacity, carbon footprint metrics, economic productivity measures, and community participation indices—would strengthen empirical validation. Longitudinal studies are also necessary to examine the long-term socio-ecological consequences of master plan implementation in relation to community well-being and ecosystem sustainability.

Overall, the optimization of local assets through an integrated spatial and architectural planning framework in Pengejaran Village demonstrates that ecotourism can function as a mechanism for rural empowerment, balancing environmental conservation, cultural identity reinforcement, and sustainable socio-economic advancement.

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