

# Land Use Optimization in Ngroto Hill, Pujon District, Malang Regency as an Ecotourism Destination

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## Abstract

Ngroto Village in Pujon District, Malang Regency, possesses significant ecotourism potential due to its natural beauty, cool climate, and abundant local resources in agriculture, animal husbandry, and tourism. The study aims to optimize land use in Ngroto Hill by developing an ecotourism destination that preserves natural and cultural heritage while enhancing local economic sustainability. Data were collected through field surveys, interviews with local residents, and spatial analysis using SketchUp and Lumion software. The research findings categorize the area into three main zones: Cultural Zone, Agriculture Zone, and Local Wisdom Zone. The planning framework aligns with Vitruvian principles, ensuring aesthetic appeal (*Venustas*), structural integrity (*Firmitas*), and functional efficiency (*Utilitas*). This study contributes to sustainable ecotourism development by integrating community involvement, environmental conservation, and local economic enhancement.

**Keywords:** Land Use, Ecotourism, Sustainable Development, Community-Based Tourism, Vitruvian Principles



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## Introduction

Malang Regency is one of the largest regions in East Java, known for its diverse topography, ranging from highlands and mountains to coastal areas. Ngroto Village, located in Pujon District, lies within a strategic tourism corridor between Batu City and Kediri. Its geographical features make it an ideal location for ecotourism, emphasizing sustainable land use and environmental conservation.

Tourism is a significant driver of regional economic development, especially in rural areas where natural landscapes and cultural heritage form the core of attractions. Ecotourism, as a sustainable alternative to conventional tourism, emphasizes environmental responsibility, community participation, and economic benefits for local populations. The demand for ecotourism is growing globally due to increasing awareness of environmental conservation and the need for responsible travel practices. According to the World Tourism Organization (WTO), ecotourism has become one of the fastest-growing sectors within the tourism industry, with an increasing number of destinations focusing on sustainable travel options.

Ngroto Village is characterized by its lush greenery, cool climate, and rich cultural traditions, making it a suitable candidate for ecotourism development. The village's primary economic activities revolve around agriculture and animal husbandry, which can be integrated into tourism experiences through agro-tourism and cultural tourism initiatives. However, the lack of structured tourism planning and infrastructure has resulted in underutilized land resources and limited economic benefits for the local community.

The research explores the transformation of Ngroto Hill into a structured ecotourism destination that integrates environmental sustainability with economic empowerment for local

communities. This study is guided by several research questions: How can land use in Ngroto Hill be optimized to support sustainable ecotourism development, What are the necessary zoning strategies to balance conservation and tourism activities, How can local communities actively participate in and benefit from ecotourism initiatives.

The primary objective is to formulate a zoning plan that accommodates agricultural practices, cultural heritage preservation, and eco-friendly tourism activities. This study builds upon previous research on landscape planning and sustainable tourism development, highlighting the necessity of a well-planned spatial design that balances nature conservation with tourism benefits.

The significance of this study lies in its potential contribution to regional development strategies by providing a sustainable model for rural tourism that aligns with global sustainability goals, such as the United Nations Sustainable Development Goals (SDGs). The findings of this research are expected to serve as a reference for policymakers, tourism planners, and local communities in implementing ecotourism initiatives that foster environmental conservation and socio-economic growth.

## Methods

This study employs a mixed-method approach, integrating both qualitative and quantitative methodologies to ensure comprehensive data collection and analysis. The research framework consists of the following key methodological steps:

### a. Field Surveys and Site Analysis

Direct observations and on-site measurements were conducted to assess the current land use, ecological conditions, and topographical characteristics of Ngroto Hill. The field survey included mapping significant environmental and cultural assets, as well as identifying potential constraints to tourism development.

### b. Community Engagement and Interviews

Structured and semi-structured interviews were conducted with key stakeholders, including village leaders, local entrepreneurs, farmers, and tourism operators. The objective was to gather insights into community perspectives on sustainable land use, traditional practices, and expectations from ecotourism initiatives.

### c. Questionnaire-Based Survey

A survey was distributed among residents and visitors to assess their perceptions of tourism potential, environmental concerns, and preferred tourism activities. The responses were analyzed using statistical tools to determine trends and stakeholder priorities.

### d. Spatial Analysis and Zoning Plan Development

Geospatial analysis tools, including Geographic Information Systems (GIS), SketchUp, and Lumion software, were used to model different land use scenarios and propose optimal zoning plans. The zoning process considered ecological sensitivity, accessibility, and potential economic benefits.

### e. Comparative Analysis of Ecotourism Models

A review of successful ecotourism models from similar rural regions was conducted to identify best practices. This comparative analysis provided insights into management frameworks, infrastructure planning, and community participation strategies that could be adapted for Ngroto Hill.

### f. SWOT Analysis

Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis was utilized to evaluate the feasibility of the proposed ecotourism plan. This assessment helped in developing mitigation strategies for potential challenges, such as environmental degradation, lack of infrastructure, and policy constraints.

By employing this multi-faceted methodological approach, the study ensures that the proposed land use optimization strategies are evidence-based, community-driven, and aligned with sustainable tourism principles.

## Results and Discussions

### 1. Results

The findings of this study highlight a strategic land use plan for Ngroto Hill, integrating environmental sustainability and community development through ecotourism. Based on field observations, community inputs, and spatial analysis, the area has been classified into three main zones, each serving a unique function in fostering sustainable tourism.

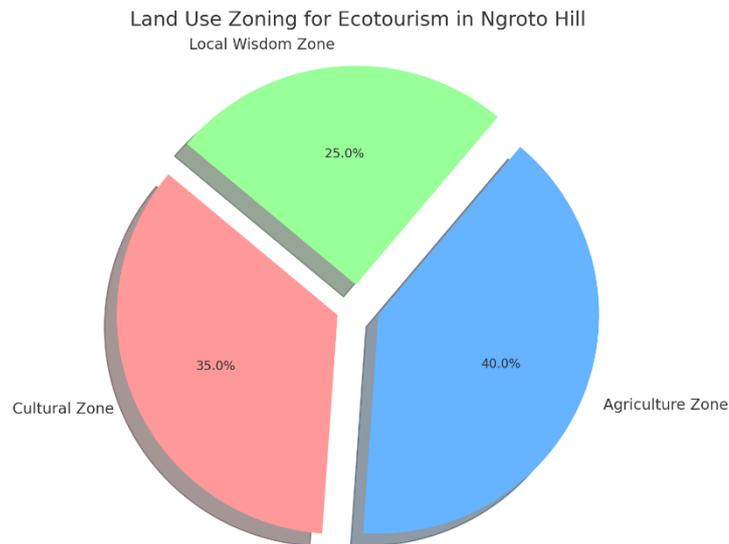


Figure 1. Land Use Zoning for Ecotourism in Ngroto Hill

#### a. Cultural Zone

This zone is dedicated to preserving and promoting local traditions, including arts, crafts, and historical landmarks. Key attractions include traditional Javanese houses, local handicraft workshops, and performance stages for cultural activities such as dance, music, and storytelling. Visitor engagement programs include heritage tours, interactive craft-making sessions, and cultural exhibitions that provide educational experiences about the region's traditions. Infrastructure within this zone includes visitor information centers, small museums, and designated areas for community-led cultural activities.



Figure 2. Theater Stage

b. Agriculture Zone

The agricultural zone focuses on agro-tourism activities, leveraging the village's strengths in organic farming and eco-friendly livestock management. Features include demonstration farms, interactive agricultural workshops, and farm-stay accommodations where visitors can experience rural farming life firsthand. Crops such as tea, coffee, vegetables, and medicinal plants are cultivated using sustainable farming techniques, which also serve as educational exhibits for visitors. Livestock rearing activities include guided experiences on dairy farming, beekeeping, and free-range poultry farming. To ensure environmental sustainability, permaculture practices, composting, and water conservation techniques are implemented.



Figure 3. Nursery Area

c. Local Wisdom Zone

This zone is designed to showcase sustainable living practices, traditional architecture, and community-based conservation initiatives. It features eco-friendly homestays designed in traditional styles, emphasizing the use of natural materials such as bamboo and reclaimed wood. Renewable energy sources, such as solar panels and micro-hydro generators, are integrated to promote off-grid sustainability. Conservation programs include tree planting, habitat restoration, and guided eco-walks that educate visitors on the region's biodiversity. A key attraction in this zone is an educational center that highlights indigenous knowledge systems related to environmental stewardship and sustainable resource management.



Figure 4. Playground

d. Economic and Social Impacts

The development of these zones has the potential to significantly enhance local employment opportunities through job creation in tourism services, agriculture, and handicrafts. Community-driven tourism initiatives empower local artisans, farmers, and cultural practitioners, ensuring that economic benefits are distributed equitably among the residents. The introduction of training programs in hospitality, conservation, and sustainable business practices further strengthens the capacity of the local workforce.



Figure 5. Tourism Market (Greenhouse)

e. Environmental Benefits

The implementation of a comprehensive waste management system, including recycling and composting, minimizes the environmental footprint of tourism activities. Reforestation and habitat restoration initiatives contribute to the preservation of biodiversity, ensuring that the natural landscape remains intact. Zoning regulations restrict overdevelopment in ecologically sensitive areas, preventing habitat fragmentation and soil degradation.



Figure 6. Cottage

By establishing clear zoning guidelines and ensuring community participation in the planning and management processes, the study demonstrates how ecotourism can serve as a tool for both conservation and economic development in rural regions.

## 2. Discussions

The findings of this study provide significant insights into the sustainable development of Ngroto Hill as an ecotourism destination. This section discusses the implications of the zoning framework, community involvement, environmental sustainability, and economic prospects, as well as challenges and recommendations for implementation.

The zoning of Ngroto Hill into Cultural, Agriculture, and Local Wisdom Zones aligns with the principles of sustainable tourism. The integration of agricultural tourism with conservation ensures that natural resources are utilized responsibly. The cultural zone plays a crucial role in preserving local traditions, which not only fosters cultural pride among residents but also offers authentic experiences to visitors. Furthermore, the local wisdom zone acts as a knowledge hub for sustainable living practices, showcasing eco-friendly construction, renewable energy usage, and biodiversity conservation.

The study highlights the importance of community involvement in ecotourism development. By engaging local stakeholders in decision-making, the project fosters a sense of ownership among residents, increasing their commitment to maintaining the ecotourism site. Community participation also enhances employment opportunities through the development of local enterprises, such as homestays, traditional craft markets, and organic farming initiatives. The resulting economic diversification can reduce dependency on conventional agriculture and improve overall living standards.

One of the key contributions of this research is its emphasis on environmental conservation. The zoning strategy ensures that ecologically sensitive areas are protected from overdevelopment. Sustainable land use management practices, such as agroforestry, waste management programs, and water conservation systems, are recommended to minimize environmental impact. Additionally, afforestation efforts and habitat restoration projects within the local wisdom zone contribute to the preservation of indigenous flora and fauna, aligning with global conservation efforts.

Despite the promising potential of the proposed ecotourism development, several challenges must be addressed for successful implementation: Infrastructure Development, Funding and Investment, Balancing Conservation with Commercialization, Climate and Environmental Risks, Community Based Governance Model, Eco-Certification and Sustainable Tourism Guidelines, Educational and Awareness Programs, Monitoring and Adaptive Management.

The current lack of infrastructure, including roads, signage, and waste disposal facilities, may hinder the smooth operation of ecotourism activities. Strategic investment in eco-friendly infrastructure, such as solar-powered lighting and rainwater harvesting systems, is necessary. Securing financial resources from government programs, private investors, and international grants is essential for infrastructure development and capacity-building initiatives. While tourism can generate economic benefits, over-commercialization risks degrading the natural environment. Strict regulations must be enforced to ensure responsible tourism practices. Ngroto Hill is susceptible to climate-related risks, such as landslides and seasonal changes. Adaptation strategies, including reforestation and erosion control measures, should be incorporated into the development plan.

To ensure long-term sustainability, the study proposes the following policy recommendations. Establishing a cooperative management system involving local stakeholders, government authorities, and conservation organizations. Implementing certification schemes to encourage responsible tourism practices and ecological conservation. Conducting workshops on sustainable farming, waste management, and eco-tourism entrepreneurship for local residents.

Regularly evaluating the socio-economic and environmental impacts of ecotourism initiatives to ensure continuous improvement and adaptation.

A comparison with successful ecotourism destinations, such as Ubud in Bali and Gunung Leuser National Park in Sumatra, reveals several key takeaways. These include the necessity of a well-defined regulatory framework, strong community partnerships, and continuous engagement in eco-innovation. Learning from these models, Ngroto Hill can integrate adaptive strategies to enhance its sustainability and attractiveness to eco-conscious travelers.

The discussion highlights the transformative potential of Ngroto Hill as an ecotourism hub while acknowledging the challenges that must be addressed. Through coordinated efforts between stakeholders, strategic investment, and policy integration, Ngroto Hill can become a model for sustainable ecotourism development in Indonesia.

## **Conclusion**

This study highlights the significant potential of Ngroto Hill in Pujon District, Malang Regency, as a sustainable ecotourism destination through an integrated zoning approach. The classification into Cultural, Agriculture, and Local Wisdom Zones ensures a balance between environmental conservation, cultural preservation, and economic development. By optimizing land use in a structured manner, this study demonstrates how ecotourism can act as a catalyst for community empowerment and environmental sustainability.

The findings underscore the importance of community participation in the planning and implementation process. By involving local stakeholders in decision-making and management, the proposed ecotourism model ensures that economic benefits are distributed equitably among residents. Furthermore, the integration of agro-tourism and cultural heritage preservation within the land use framework strengthens the identity of Ngroto Village as a sustainable tourism hub.

From an environmental perspective, this study highlights the necessity of responsible land management practices to minimize the negative impacts of tourism. Strategies such as afforestation, waste management programs, and renewable energy integration play a crucial role in maintaining ecological balance while enhancing the visitor experience. The findings emphasize the role of strict zoning regulations in preventing habitat destruction and promoting biodiversity conservation.

Despite the promising potential of ecotourism in Ngroto Hill, several challenges remain. Infrastructure limitations, funding constraints, and climate-related risks require targeted interventions from policymakers and tourism planners. Strategic investments in eco-friendly infrastructure, along with policy support for sustainable business development, are essential for ensuring long-term success.

Future research should focus on evaluating the long-term socio-economic and environmental impacts of the ecotourism initiative. Continuous monitoring and adaptive management strategies will be crucial in responding to emerging challenges and ensuring the sustainability of the ecotourism model. Additionally, comparative studies with other successful ecotourism destinations can provide valuable insights for further refinement of the development framework.

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