

Original Article

Planning of an Integrated Cocoa Tourism Area Based on Spatial Analysis and Land Suitability in Petang Village, Badung Regency

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Abstract:

The development of agricultural commodity-based tourist areas requires technical planning that considers the physical characteristics of the area, land suitability, and integration with spatial planning policies so that it is sustainable and can be implemented. Petang Village, Badung Regency, has significant cocoa potential, but its use is not spatially directed and risks causing land function conflicts if it is not supported by planning based on technical analysis. This research aims to formulate an integrated cocoa tourism area planning based on spatial analysis and land suitability as the basis for regional development in accordance with the carrying capacity of the environment and regional spatial planning. The research method uses a technical-planning approach through spatial analysis based on geographic information systems by examining the physical parameters of the area including slope, altitude, morphology, soil type, rainfall, vulnerability to soil movement, and land cover, combined with the analysis of the suitability of RTRW and RDTR zoning. Data was obtained through secondary data collection, field observation, and thematic mapping of the planning area. The results of the analysis showed that most of the Petang Village area has biophysical characteristics that are suitable for the development of integrated cocoa tourism areas with medium to high levels of land suitability, especially in plantation zones with low to medium slopes, latosol soil types, and low-medium landslide susceptibility. Regional planning results in the division of functional zones that are integrated between cocoa cultivation, educational tourism, yield processing, and environmental buffer zones. The conclusion of the study shows that the spatial analysis and land suitability approach is able to produce more targeted planning of cocoa tourism areas, adaptive to the physical conditions of the region, and supports the development of areas based on sustainability and spatial planning.

Keywords: Regional Planning, Cocoa Tourism, Spatial Analysis, Land Suitability, Spatial Planning, Evening Village.

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Introduction

The development of tourist areas based on local resources is one of the important strategies in encouraging sustainable regional development in various developing and developed countries ([Wissink, 2023](#)). The integration of the agricultural and tourism sectors through the concept of agro-tourism is considered to be able to increase the added value of commodities, strengthen the local economy, and maintain environmental sustainability if planned appropriately ([Jin et al., 2025](#)). However, various studies show that the development of tourist areas in rural areas often faces problems of environmental degradation and space utilization conflicts due to weak planning based on the physical conditions of the area ([Iannucci et al., 2022](#)). Therefore, regional planning approaches based on spatial analysis and land suitability are becoming increasingly relevant in the context of sustainable tourism development.

In the discipline of regional planning techniques, spatial analysis plays an important role in identifying the biophysical characteristics of land and determining the level of suitability for the development of a regional function ([Shamai & Jafarpour Ghalehtemouri, 2024](#)). The utilization of geographic information systems allows the integration of various physical parameters such as slope, soil type, altitude, and disaster risk to support more objective and measurable planning decision-making ([Kochanek et al., 2025](#)). A number of studies confirm that failure to accommodate aspects of land suitability in tourist area planning often leads to incompatibility of spatial functions and low regional sustainability ([Luo et al., 2023](#)). Thus, a technical approach based on spatial analysis is the main prerequisite in the planning of an integrated tourist area.

In Indonesia, the development of rural tourism areas continues to be encouraged as part of the regional development strategy and economic equity ([Prayitno et al., 2023](#)). The province of Bali, as a global tourist destination, faces serious challenges in the form of increasingly intensive space utilization pressures, including in rural areas that have superior agricultural potential ([Surya Suamba et al., 2022](#)). Petang Village in Badung Regency is one of the areas with the dominant cocoa commodity and has the potential to be developed as an agriculture-based tourist area. However, based on the existing conditions of the area, land use in Petang Village has not been fully spatially directed and has the potential to cause conflicts between cultivation, tourism, and environmental protection functions.

Although much has been done on agro-tourism and agricultural commodity-based tourism, most international research has focused on socio-economic aspects and tourist experiences, with relatively limited attention to the technical dimension of regional planning ([Aderibigbe & Gumbo, 2022](#)). Studies that integrate spatial analysis, land suitability, and tourism area planning comprehensively are still limited, especially in the context of tropical rural areas. In addition, planning approaches are often not directly linked to formal spatial policies, making the results difficult to implement. This gap shows the need for research that combines technical spatial analysis with spatial frameworks in tourist area planning.

In the national context, research related to agrotourism development in Indonesia generally focuses on commodity potential and community-based management strategies,

while land suitability analysis is often presented descriptively without strong spatial modeling support ([Ustriyana et al., 2025](#)). In addition, there are still limited studies that explicitly link the results of the physical analysis of the area with the determination of the zoning of tourist areas that are in line with the RTRW and RDTR. As a result, many tourism area development plans are not integrated with the spatial planning system and have the potential to cause land use incompatibilities ([Widiatedja, 2022](#)). This condition confirms the need for a more technical, measurable, and spatial policy-based approach to tourism area planning.

Based on the background and gaps of the research, this study aims to formulate an integrated cocoa tourism area planning based on spatial analysis and land suitability in Petang Village, Badung Regency. This study specifically analyzes the physical characteristics of the area which includes slope, altitude, morphology, soil type, rainfall, vulnerability to soil movement, and land cover as a basis for determining the suitability of regional development. In addition, this study examines the integration of spatial analysis results with regional spatial planning policies to produce implementing regional planning. Thus, this research is directed to answer the needs of engineering-based and sustainability-based tourism area planning.

This research is expected to make a theoretical contribution to the development of regional planning engineering through strengthening the spatial analysis and land suitability approach in the context of integrated tourism area planning. Practically, the results of the research can be a reference for local governments and stakeholders in planning the development of cocoa tourism areas that are adaptive to the physical conditions of the region and in harmony with spatial planning. In addition, the resulting planning model can be replicated in other rural areas with similar commodity characteristics. Thus, this research contributes to bridging the interests of local economic development, environmental protection, and orderly use of space.

Method

Types and Approaches to Research

This study uses a quantitative-descriptive approach with a spatial analysis-based regional planning research design, which aims to produce directions for integrated cocoa tourism area planning based on physical conditions and land suitability. The quantitative approach is used to process and analyze spatial data in the form of regional biophysical parameters in a measurable and objective manner, while the descriptive approach is used to explain the relationship between the results of the analysis and the applicable spatial policies. The design of this study is appropriate for the study of regional planning which emphasizes the integration between the physical analysis of the area and spatial decision-making ([An et al., 2023](#)). This approach is commonly used in regional planning engineering research to produce applicative and data-driven spatial recommendations ([He & Chen, 2024](#)).

Study Areas and Units of Analysis

The study area of this study is Petang Village, Petang District, Badung Regency, with an area of ±759.92 hectares as stated in the planning document and regional spatial data ([Reviewer, 2025](#)).

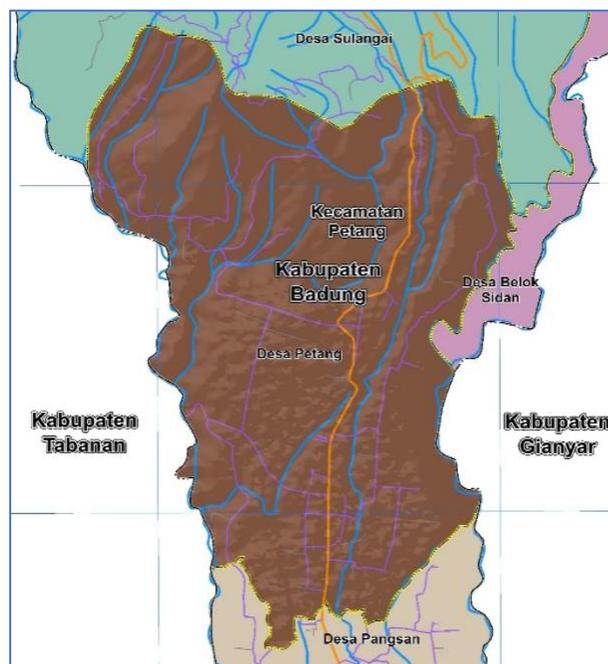


Figure 1. Location and administrative boundary of Petang Village

The research analysis unit is in the form of land units obtained through the process of overlaying various thematic maps, including maps of slope slope, elevation, morphology, soil type, rainfall, vulnerability to soil movement, and land cover. The land unit approach was chosen because it is able to represent the biophysical characteristics of the area spatially and integrated. This unit of analysis is the basis for assessing land suitability and determining functional zones for cocoa tourism areas.

Population, Samples, and Sampling Techniques

The population in this study covers the entire area of Petang Village as a planning area, while the research sample is in the form of a land unit of spatial classification which is analyzed using a non-probability sampling technique with a purposive sampling approach. This technique was chosen because the sample unit was determined based on specific technical criteria relevant to the research objective, rather than based on random chance (Rahman et al., 2022). In addition, field observations were carried out in strategic locations that represented variations in the physical conditions of the area and land use.

Data Collection Techniques

The research data was collected through a combination of secondary data and primary data. Secondary data includes topographic maps, slope slope maps, soil type maps, rainfall maps, soil movement vulnerability maps, land cover maps, and Badung Regency RTRW and RDTR documents obtained from related agencies. Primary data was obtained through field observation to verify the physical condition of the area and the suitability of the spatial data with actual conditions. Documentation techniques are used to collect supporting data in the form of technical reports and relevant planning documents.

Research Implementation Procedure

The research procedure is carried out gradually and systematically, starting from the preparation stage in the form of literature studies and spatial data collection. The next stage is data processing using geographic information systems through the process of correction, classification, and standardization of thematic maps. Furthermore, spatial analysis was carried out with the overlay method to produce land units and land suitability assessments based on the technical criteria that had been set. The final stage of the research includes the preparation of the planning direction of the integrated cocoa tourism area and the verification of the conformity of the planning results with spatial planning policies.

Spatial Data Analysis Techniques

Data analysis was carried out using spatial analysis based on geographic information systems (GIS) with thematic map overlay techniques (Charles et al., 2024). Each physical parameter of the area is given a weight and suitability score based on the level of influence on the development of cocoa tourism areas, then combined to produce a land suitability map. This analysis aims to identify the level of suitability of land classified into suitable, moderate, and less suitable. The weighting and scoring approach in land suitability analysis has been widely used in regional planning research and land evaluation. The results of the spatial analysis were then used as the basis for determining the zoning of the area.

Integration with Spatial Planning and Software Policy

The final stage of analysis is carried out by integrating the results of land suitability with the spatial planning policies of RTRW and RDTR to ensure the alignment of the planned area functions. This integration aims to produce integrated cocoa tourism area planning that is not only biophysically appropriate, but also legal and implementable. The entire spatial analysis process is carried out using ArcGIS and QGIS software as data processing and visualization tools (Folini et al., 2022). An integrative approach between spatial analysis and spatial planning policy is considered crucial in sustainable regional planning.

Results

1. Biophysical Characteristics of the Petang Village Area

The results of spatial analysis of biophysical parameters show that the Petang Village area has physical conditions that generally support the development of integrated cocoa tourism areas. The area with an area of ±759.92 hectares is dominated by areas with low to medium slopes, which are technically relatively safe for cocoa cultivation and tourism activities. These topographic conditions allow for more stable land management and minimize the risk of disturbance to visitor safety and the sustainability of land functions. Slope characteristics of the study area are presented in Table 1.

Table 1. Slope slope

Yes	Slope Slope	Area (Ha)
1	0-8%	184,92
2	8-15%	153,89
3	15-25%	145,94
4	25-45%	232,74
5	>45%	42,44
Total Area of Evening Village		759,92

The condition of the altitude of the area is one of the important parameters in biophysical analysis because it affects the characteristics of the microclimate, the suitability of plants, and the potential for the development of nature-based tourism activities. The height distribution of the Petang Village area is presented in Table 2 below.

Table 2. Altitude of Evening Village

Yes	Height	Area (Ha)
1	100-500 meters	30,00
2	500-1000 meters	729,92
Total Area of Evening Village		759,92

Source: Kontur Bali, 2018

The morphological characteristics of the area describe the shape and structure of the land surface which is the basis for understanding the potential and limitations of space utilization. The morphological classification of the Petang Village area based on the area of each morphological unit is presented in Table 3.

Table 3. Morphology of Evening Village

Yes	Morfologi	Area (Ha)
1	Undulating Terrain	252,33
2	Rolling Hills	11,84
3	Moderate Hills	357,21
4	Steep Hills	138,54

Grand Total	759,92
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Rainfall is one of the climatological parameters that affect hydrological conditions, soil moisture levels, and land suitability for the development of plantation crops and nature-based tourism activities. The pattern of rainfall distribution in the Petang Village area is shown in Figure 2. follows.

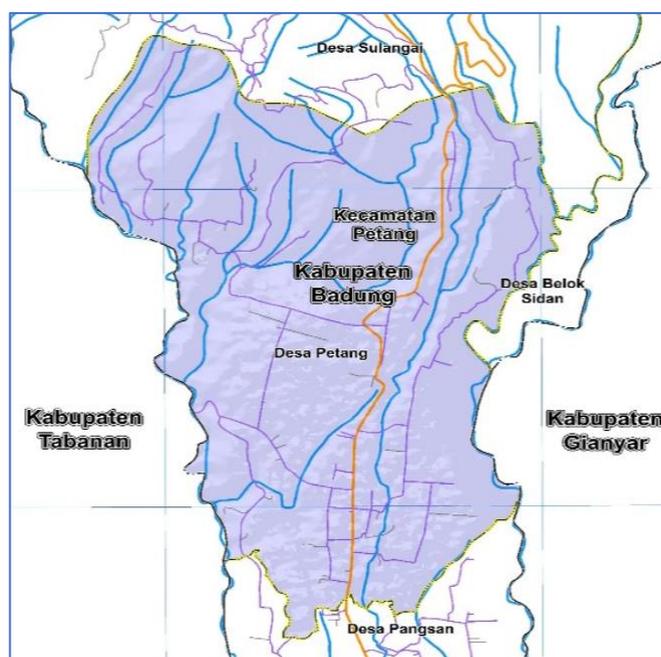


Figure 2. Rainfall in the Evening Village Region

Soil type is the main parameter in determining land suitability, especially for the development of plantation commodities such as cocoa. The distribution of land types in the Petang Village area and its area is presented in Table 4 below.

Table 4. Types of Land in Evening Village

Yes	Soil Type	Area (Ha)
1	Yellowish Brown Latosol	747,93
2	Regosol Yellowish Brown	2,65
3	Regosol Humus	9,34
Total Area of Evening Village		759,92

Source: RTRW Badung Regency, 2013-2033

The level of vulnerability to soil movement is an important factor in regional planning because it is related to the safety and sustainability aspects of space utilization.

The classification of soil movement vulnerability zones in Evening Village based on area area is shown in Table 5.

Table 5. Evening Village Land Movement

Yes	Ground Movement	Area (Ha)
1	Medium Ground Movement Vulnerability Zone	405,63
2	Very Low Ground Movement Vulnerability Zone	331,64
3	Highland Movement Vulnerability Zones	22,65
Total Area of Evening Village		759,92

Source: Image Interpretation, RBI KSP 2018

Information on land cover is needed to understand the existing conditions of space use and as a basis for the formulation of regional development directions. The composition of land cover in Petang Village based on the area of each category is presented in Table 6.

Table 6. Evening Village Land Cover

Yes	Land Cover	Area (Ha)
1	Settlements	77,69
2	Mixed Gardens	646,54
3	Rice Fields	35,69
Total Area of Evening Village		759,92

In terms of agroecology, the type of latosol soil that dominates the study area is a soil characteristic that is suitable for the growth of cocoa plants. This soil has the ability to retain water and good nutrients, thus supporting the productivity of the garden as the main basis for tourism development. In addition, the results of the soil movement vulnerability analysis show that most areas are at low to medium levels of vulnerability. This condition indicates that disaster risk can still be controlled through proper zoning arrangements and spatial design. The summary of dominant biophysical characteristics and their planning implications is presented in Table 1. These biophysical characteristics are obtained through the process of forming land units that integrate various physical parameters of the region. This approach allows each space to be comprehensively analyzed, not just based on a single variable, but as a result of the interaction between parameters. Thus, the conclusion regarding the feasibility of the Petang Village area as a location for the development of an integrated cocoa tourism area has a strong and measurable spatial basis.

Table 7. Bio-Physical Characteristics of the Study Area

Bio-physical Parameter	Dominant Condition	Planning Implication
Slope	Low to moderate	Suitable for cacao cultivation and visitor activities
Soil Type	Latosol	Supports cacao growth and land productivity
Landslide Susceptibility	Low to moderate	Manageable risk with spatial zoning control
Topography	Undulating terrain	Enables stable land management

2. Land Suitability Level for Integrated Cocoa Tourism Development

The results of the land suitability analysis show that most of the Petang Village area is in the medium to high suitability category for the development of an integrated cocoa tourism area. The highest suitability is mainly found in areas located in plantation zones, with a combination of low to medium slope slopes, latosol soil types, and relatively low levels of landslide susceptibility. This finding confirms that spaces that have already functioned as plantation land are the most potential locations for further development.

The assessment of land suitability is carried out through weighting techniques and scoring each physical parameter of the area, then combined using overlay analysis. The results of this process not only show the "suitable" location, but also provide an idea of the relative feasibility level between spaces. Thus, the results of land suitability are not interpreted in black and white, but as a spectrum that can be used to regulate the intensity of space utilization.

In terms of planning, the dominance of medium to high suitability provides a strong basis for developing cocoa tourism without having to change land functions to the extreme. The development is directed to strengthen the existing plantation function, while adding tourism activities gradually and under control. This approach is important to maintain a balance between agricultural productivity, tourism experience, and environmental sustainability.

Table 8. Land Suitability Levels for Integrated Cocoa Tourism Development

Suitability Class	General Characteristics	Planning Direction
High Suitability	Stable slope, latosol soil, low hazard	Priority area for core development
Moderate Suitability	Manageable physical constraints	Controlled and phased development

Suitability Class	General Characteristics	Planning Direction
Low Suitability	Physical or hazard limitations	Environmental buffer or restricted use

3. Integration of Land Suitability Results with Regional Spatial Planning

The results of the land suitability analysis are then integrated with the applicable regional spatial planning policies, especially RTRW and RDTR. This integration shows that areas with medium to high levels of suitability are mostly in zones that do accommodate plantation functions and agriculture-based development in terms of space. Thus, the direction of the development of an integrated cocoa tourism area is not only physically feasible, but also regulatively aligned.

The integration process is carried out through an overlay between the land suitability map and the spatial zoning map. This step serves as a final screening mechanism to ensure that development recommendations do not lead to future space utilization conflicts. Areas that are biophysically appropriate but not in harmony with spatial planning are not prioritized as primary development zones, but rather are geared toward more limited functions or as buffers.

This integration strengthens the position of research results as the basis for implementing planning. The resulting plan does not stop at the concept level, but has considered aspects of legality and policy integration, so that it is more realistic to be applied in the development of cocoa tourism areas in Petang Village.

Table 9. Integration of Land Suitability Analysis with Spatial Planning Policy

Analysis Aspect	Outcome
Land suitability vs RTRW	Generally compatible
Land suitability vs RDTR	Supports agricultural-based tourism
Planning implication	Implementable and legally consistent zoning

4. Classification of Functional Zones of Integrated Cocoa Tourism Areas

Based on the results of biophysical analysis, land suitability, and spatial integration, the planning of an integrated cocoa tourism area results in the division of functional zones that are integrated with each other. These zones include cocoa cultivation zones, educational tourism zones, yield processing zones, and environmental buffer zones. This division is designed to ensure that each function of the space is placed in the location that best suits its physical characteristics and level of risk.

The cocoa cultivation zone is designated as the core zone of the region because it is the main base of economic activities and tourist attractions. The educational tourism zone is directed to areas that have the most stable physical conditions and are easily accessible, so that it is safe for visitors and supports cocoa-related learning activities. The product processing zone is placed in a space that has certainty of function and minimal risk, in order to support production efficiency and added value of commodities.

Meanwhile, environmental buffer zones function as transition and protection spaces, especially in areas with physical limitations or higher risks. The existence of buffer zones is an important instrument in maintaining the carrying capacity of the environment and controlling the impact of tourism development. Overall, this zoning reflects a planning approach that places sustainability as a key principle.

Table 10. Functional Zoning of the Integrated Cocoa Tourism Area

Zone Type	Primary Function
Cocoa Cultivation Zone	Core production and attraction
Educational Tourism Zone	Learning and visitor activities
Processing Zone	Value-added cocoa products
Environmental Buffer Zone	Protection and impact control

5. Implications of Results on the Direction of Regional Management and Development

The results of the study show that the development of an integrated cocoa tourism area in Petang Village has a great opportunity to be developed sustainably if it is based on spatial analysis and land suitability. The combination of relatively stable biophysical conditions and spatial suitability provides a solid basis for planning decision-making. However, the existence of areas with medium vulnerability also confirms the importance of controlling the intensity of utilization and the application of adaptive spatial design.

A carrying capacity and risk-based approach allows regional planning to be oriented not only to utilization, but also to environmental control and protection. Thus, the results of this research not only produce maps and zoning, but also provide strategic direction on how space should be managed and developed. The planning of an integrated cocoa tourism area in Petang Village, in this context, can be understood as an effort to balance economic, social, and ecological functions spatially and measurably.

Table 11. Planning Implications for Sustainable Area Management

Aspect	Key Implication
Environmental capacity	Basis for controlled development
Risk management	Adaptive spatial design
Spatial governance	Balanced economic–ecological planning

Discussion

The results of the study show that the biophysical characteristics of the Petang Village area generally support the development of integrated cocoa tourism areas, especially in spaces with low to medium slopes, latosol soil types, and low to medium soil movement susceptibility. These findings are in line with the theory of land suitability evaluation which confirms that topographic stability and agroecological suitability are the main prerequisites in agricultural and tourism-based area planning (Cox, 2022). In the

context of regional planning, physical suitability not only determines technical feasibility, but also affects the level of risk and costs of future management of the area ([Mansourihanis et al., 2023](#)). Thus, the results of this study strengthen the view that the approach to planning tourist areas based on agricultural commodities must start from a comprehensive biophysical reading of the region. Consequently, the development of cocoa tourism in Petang Village has a relatively strong ecological basis to be developed sustainably.

The dominance of medium to high land suitability in the plantation zone shows that existing production spaces are the main foundation for the development of integrated cocoa tourism. These findings support the concept of spatial function integration, where tourism development is not intended to replace agricultural functions, but rather to strengthen and expand its added value ([Zhang et al., 2024](#)). A number of previous studies have confirmed that agro-tourism that develops on an established production base tends to be more sustainable than tourism development that is land conversion ([Pehin Dato Musa & Chin, 2022](#)). In this study, medium-high suitability is not interpreted as an exploitation-free space, but rather as a space that allows gradual development with intensity control. This expands the understanding that land suitability is relative and must be translated into adaptive space utilization strategies.

The integration of the results of land suitability analysis with RTRW and RDTR shows the importance of integration between technical and policy aspects in tourism area planning. Many international studies show that the failure of the implementation of regional development plans is often caused by insynchronization between the results of the physical analysis and the spatial regulatory framework ([Wen et al., 2022](#)). The findings of this study suggest that the most prospective areas are those that are not only biophysically suitable, but also within zoning that legally accommodates plantation functions and agriculture-based development. Thus, this study confirms that spatial analysis cannot stand alone without being associated with a formal planning system. An important contribution of these findings is the affirmation that land suitability should be understood as a combination of physical feasibility and institutional feasibility.

The division of functional zones into cocoa cultivation zones, educational tourism, yield processing, and environmental buffers reflects the application of the concept of integrated area planning. This zoning approach is in line with the theory of carrying capacity-based planning, which emphasizes the need to differentiate spatial functions based on environmental sensitivity and capacity ([Huang et al., 2023](#)). Environmental buffer zones, in particular, indicate that not all "suitable" spaces should be developed intensively, but rather some need to be maintained as impact control spaces. These findings reinforce criticism of tourism planning practices that tend to maximize space utilization without considering long-term ecological functions. Thus, the zoning produced in this study is not only technical, but also normative in maintaining the sustainability of the area.

Although the results support the initial hypothesis regarding the biophysical feasibility of Petang Village for the development of integrated cocoa tourism, there are factors that need to be critically examined. The presence of areas with medium ground movement vulnerability indicates that risks remain and cannot be ignored in the implementation stage. This is in line with the findings [Rezvani et al. \(2023\)](#) which

emphasizes that the results of spatial analysis should be understood as a decision-making tool, not as a risk-free guarantee. In addition, the limitation of spatial data resolution and reliance on secondary data have the potential to affect the level of accuracy of the analysis results. Therefore, the results of this study need to be read as macro planning directions that require further deepening at the site scale.

The limitations of this study mainly lie in the lack of a detailed analysis related to socio-economic aspects and the institutional capacity of the community in the management of integrated cocoa tourism areas. In fact, a number of studies show that the successful implementation of tourism area planning is greatly influenced by institutional factors and local participation (Tong et al., 2024). For further research, it is recommended to integrate spatial analysis with socioeconomic studies and more detailed risk assessments, including climate change analysis and land use dynamics. In addition, the use of high-resolution data and dynamic spatial modeling can improve planning accuracy. Thus, further research can strengthen the scientific and practical contribution of integrated cocoa tourism area planning approaches based on spatial analysis and land suitability.

Conclusion

This study concludes that Petang Village has adequate biophysical potential for the development of an integrated cocoa tourism area if planned based on spatial analysis and land suitability. The technical approach through the integration of the physical parameters of the area and spatial planning policies shows that most of the plantation space has a medium to high level of land suitability, making it feasible to develop in a directional and controlled manner. The division of functional zones which includes cocoa cultivation, educational tourism, product processing, and environmental buffer zones has proven to be able to accommodate the needs of economic development while maintaining the carrying capacity of the environment. Thus, this study emphasizes that spatial analysis and land suitability are important instruments in the planning of agricultural commodity-based tourist areas that are adaptive to the physical conditions of the region, in harmony with spatial planning, and oriented towards sustainability.

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