



The Penta Helix Collaboration Model in Village Tourism Management (A Study on Pupus Village, Ngebel District, Ponorogo Regency)

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ABSTRACT

This study examines the implementation of cross-sectoral collaboration in tourism management in Pupus Village, Ngebel District, Ponorogo Regency. The objective of this research is to describe the Penta Helix collaboration model and identify its obstacles and supporting factors. A descriptive qualitative method was utilized with data collection techniques comprising observation, in-depth interviews, and documentation. The research informants included academics, village government officials, MSME managers, BUMDes/Pokdarwis communities, and media managers. The findings indicate that collaboration operates effectively through the roles of academics (providing innovation and management mentoring), business (MSMEs providing agrotourism products), community (acting as the operational drivers of tourism), government (serving as regulators and infrastructure facilitators), and media (handling digital promotion). However, this implementation encounters several obstacles, such as low participation from certain community segments, limited human resource quality, inadequate road infrastructure, and seasonal dependence on specific tourism products. The primary supporting factors include absolute legality through Village Regulation Number 5 of 2025, regular coordination among stakeholders, mentoring support from the regional government, and the high efficacy of social media promotion. In conclusion, the Penta Helix model has been well implemented but requires continuous strengthening of infrastructure and human resource capacity.

INTRODUCTION

Tourism plays a crucial role in national development because its contribution is not limited to state revenue but extends to job creation and equitable regional development. The tourism sector has become an integral part of sustainable economic programs aimed at improving community welfare. Data from the Ministry of Tourism of the Republic of Indonesia (2025) states that the foreign exchange contribution from the tourism sector has continuously increased annually, reaching IDR 1,283.9 trillion in 2024. This figure confirms that tourism remains a *prima donna* in supporting the economy outside the oil, gas, and tax sectors.

At the regional level, East Java Province is an area with massive tourism potential, encompassing both terrestrial and marine destinations. However, this potential has not fully aligned with the growth rate of the Gross Regional Domestic Product (GRDP). Based on data from the Central Bureau of Statistics (2025), East Java Provinces GRDP experienced a deceleration from 5.34 percent in 2022 to 4.95 percent in 2023, and 4.93 percent in 2024. The optimization of tourism management is believed to be capable of accelerating economic growth, as this sector creates a multiplier effect that boosts the consumption and production of local services.

Ponorogo Regency is one of the strategic areas in East Java with the highest number of tourism villages, totaling 28 villages (East Java Province, 2019). Demographically, the majority of Ponorogos topography is mountainous. The poverty rate in Ponorogo Regency remains a significant challenge; in 2024, the number of people living in poverty reached 80.05 thousand, with a Human Development Index (HDI) of 73.70, ranking 22nd in East Java (BPS, 2025). The population growth rate of 4.74 percent (2024) has not been optimally balanced with the utilization of local human resources in the tourism governance system.

Pupus Village, located in Ngebel District, Ponorogo Regency, possesses extraordinary ecotourism and agrotourism potential, such as Mloko Sewu, Mloko Jajar, Selorejo Waterfall, as well as flagship commodities including palm sugar, coffee, porang, and Etawa goat milk. Remarkably, Pupus Village won two categories in the provincial-level *Festival Dewi Cemara* (FDC) in 2025. However, this village faces a fundamental phenomenon: 54% of its population works as traditional farmers, and 63% still possess low educational backgrounds (elementary school level). This condition causes a sluggish drive in tourism management due to limited human resource quality and a community mindset that is not yet fully oriented toward the tourism service industry.

There are various research gaps regarding the management of Pupus Tourism Village. Previously, destination management (such as in Mloko Jajar) was handled by various actors without a clear structure, resulting in an uneven distribution of profits, a lack of mutual agreements, and sluggish government regulation (Lestari et al., 2021). Furthermore, previous studies concerning the Penta Helix model have predominantly focused on urban creative economies (Rozikin, 2019) or property sustainability (Prabantarikso et al., 2018). Research regarding the Penta Helix synergy in village tourism that integrates the

agrarian sector with tourism management in poverty-prone mountainous regions remains highly limited. The urgency of this research lies in Pupus Villages need for a structured collaborative governance model to alleviate poverty and enhance village independence through the ABCGM (*Academic, Business, Community, Government, Media*) synergy.

Based on the aforementioned phenomenon and urgency, this research was conducted to address two primary problem formulations. First, how is the Penta Helix collaboration model implemented in the management of Pupus Village Tourism? Second, what are the obstacles and supporting factors of the Penta Helix collaboration model in the management of Pupus Village Tourism?

LITERATURE REVIEW

Public Management

Public administration encompasses activities related to the administration of public affairs. According to Henry (in Meutia, 2017), public administration is a complex blend of theory and practice aimed at promoting an understanding of the government so that it can provide the best service to society. In a modern context, public management has transformed toward inclusive governance. A collaborative approach, or collaborative governance, has become crucial. Collaboration is a form of interaction, cooperation, and compromise among various elements (individuals, institutions, direct/indirect parties) to achieve common goals and mutual benefits (Haryono, 2012).

Furthermore, collaborative governance represents a fundamental paradigm shift from traditional, top-down public management to a more horizontal, multi-actor network approach. According to Mindarti (2016), modern public administration requires the government to act not merely as a sole provider but as an enabler that facilitates synergy among various stakeholders. This approach emphasizes shared decision-making, mutual trust, and transparency, ensuring that public policies including tourism development are formulated through consensus rather than hierarchical mandates.

In the context of rural development, implementing collaborative governance serves as a strategic instrument to overcome limitations in local resources. When village governments collaborate with external entities such as academics, private sectors, and local communities, they create a robust institutional capacity (Suryawati et al., 2024). This synergy ensures that public management is not only administratively efficient but also socially equitable, allowing marginalized rural communities to actively participate in the policy-making process and reap the economic benefits of their regional development.

Concept of Tourism and Tourism Villages

Tourism refers to travel activities driven by facilities and services provided by the community, entrepreneurs, and the government with the aim of recreation or understanding local uniqueness (Susilo & Dharmawan, 2021). Meanwhile, a Tourism Village is a form of integration between attractions, accommodations, and supporting facilities presented within a community life structure that blends with prevailing traditions (Dewi et al., 2013). Tourism

villages require the full participation of local residents to create sustainable tourism that brings welfare to the village itself.

At the core of a tourism village is the concept of Community-Based Tourism (CBT). Pitana and Diarta (2009) emphasize that CBT is a tourism development approach that prioritizes community empowerment, ensuring that the local community holds substantial control over management and development. This approach guarantees that the majority of economic benefits generated by tourism activities remain circulating within the village, thereby preventing economic leakage and significantly reducing local poverty levels.

Furthermore, the successful development of a tourism village depends on fulfilling fundamental tourism components: attractions, accessibility, amenities, and ancillary services (institutional support). A tourism village must offer authentic experiences, whether through cultural heritage, agrotourism, or natural landscapes, while maintaining ecological balance. By integrating these components with active community participation, a tourism village can achieve sustainable tourism a state where economic growth, environmental preservation, and socio-cultural integrity are harmoniously maintained (Susilo & Dharmawan, 2021).

The Helix Concepts

The concept of helix governance has evolved from the Triple Helix (Government, Academics, Industry) to the Penta Helix, keeping pace with the complexity of the social ecosystem. Lindmark et al. (2009) state that this is an advanced strategy to foster comprehensive innovation. The Penta Helix model involves five main stakeholders, known as ABCGM. Based on Halibas et al. (2017) and Mardiatmi et al. (2020), the detailed roles of these five elements are as follows:

1. Academic: Serves as the drafter, research agent, and provider of management education. Academics provide literacy, standardize innovations, and offer direct mentoring (focus group discussions) to local communities.
2. Business: Represents the private sector or MSMEs acting as added-value creators, economic drivers (profit), resource preservers (planet), and financiers of infrastructure continuity.
3. Community: Acts as an accelerator and connector. Local communities have the right to control policies and operational decisions within their territory. They are the primary executors on the ground.
4. Government: Functions as a regulator, facilitator, and coordinator. The government formulates public policies, grants legalities/permits, provides infrastructure, and allocates both physical and financial assistance.
5. Media: Plays a vital role as a communicator and promotional tool. The media is tasked with publishing the positive image of the tourism village, provoking visits, and opening broader markets across geographical boundaries.

METHODOLOGY

This research utilized a descriptive research design with a qualitative approach. The selection of this design aimed to provide a holistic and in-depth depiction of social phenomena in the field, specifically regarding the village tourism management system (Creswell, 2019). The research focus was directed toward the application of the five elements of the Penta Helix collaboration (Academics, Business, Community, Government, Media), along with the identification of obstacles and factors supporting the tourism governance.

The research was conducted in Pupus Village, Ngebel District, Ponorogo Regency, which was determined as the target area due to its status as a flagship tourism village in Ponorogo. The collected data originated from primary and secondary sources. Primary data was obtained directly through in-depth interviews with key informants representing the Penta Helix elements, including the Village Apparatus/Secretary (Government), UMPO Community Service Program Students (Academics), Palm Sugar MSME Managers (Business), BUMDes and Youth Organization Administrators (Community), Dewata Pupus Media Managers (Media), and Forestry Commission (Perhutani) employees. Secondary data was retrieved from Village Regulation documents, BPS statistical data, and government reports.

Data collection techniques involved non-participant observation, semi-structured interviews, and documentation. Data analysis was operated using Creswells (2019) interactive model, which encompasses the steps of data preparation, reading the entire data, coding, theme description, narrative presentation, and interpretation. To ensure the validity and reliability of the findings, the researcher applied source triangulation (comparing perspectives among stakeholders) and method triangulation (cross-referencing interview results, field observations, and written documents).

RESEARCH RESULT AND DISCUSSION

The Penta Helix Collaboration Model in the Management of Pupus Village, Ngebel District, Ponorogo Regency

The synergy of collaboration in Pupus Village is evaluated based on the five elements (ABCGM) that play active roles in the cycle, from formation to tourism operations:

1. Academics

The role of academics in Pupus Village is tangibly manifested through the involvement of students undergoing the Community Service Program (KKN) from Universitas Muhammadiyah Ponorogo (UMPO) and other institutions. Students immerse themselves directly in the field to mentor local MSME actors, teaching basic business management, simple accounting systems, and initiating packaging innovations (label and product design) to make agrotourism commodities more commercially viable. Furthermore, to support the enhancement of literacy, students also contributed to the establishment of the village library.

Analytically, the presence of these academics functions as an effective knowledge transfer agent. They bridge the competency gap between the rural community and the operational demands of the modern tourism industry.

Academics do not merely provide theoretical knowledge in a classroom setting; they also facilitate communication through Focus Group Discussions (FGDs). These FGDs bring together village youth, the village government, and business managers to dissect problems and design systematic tourism package integrations.



Figure 1. Documentation of UMPO Community Service Program (KKN) students providing education and product innovation training.

The visual documentation of the KKN students activities (Figure 1) affirms that knowledge transfer is not limited to theory but involves applied practices with direct impacts. This significantly bridges the gap between academic theories and the actual needs of rural MSMEs. Training programs, such as organic fertilizer production and production management improvement, have proven to accelerate the pace of local innovation and foster a higher level of self-confidence among the local community in managing their tourism professionally.

This phenomenon aligns with research conducted by Aribowo et al. (2018), which emphasizes that the role of academics in the Penta Helix model is to provide data-driven insights and analysis to formulate appropriate strategies for enhancing the domestic economy through research and human resource development. The involvement of academics in Pupus Village has proven successful in injecting a spirit of innovation into the community's social structure.

2. Business

The business element in Pupus Village is represented by local Micro, Small, and Medium Enterprises (MSMEs) producing the village's flagship commodities, such as palm sugar, typical Pupus coffee, porang, honey bees, and Etawa goat milk. Uniquely, businesses in this village are directly integrated with tourism attractions. Tourists who visit are not merely directed to purchase souvenirs but are offered educational tourism packages, where they are invited

to observe the Etawa goat milking process, as well as the tapping and cooking stages of palm sugar in the residents traditional kitchens.



Figure 2. Documentation of Palm Sugar production as part of the Educational Tourism Attraction.

The presence of documentation in Figure 2 confirms that there has been an economic paradigm shift in Pupus Village, moving from an extractive economy to an experience economy. The palm sugar production process, which was previously a daily domestic activity for residents, has now been commodified into an interactive educational tourism attraction. This proves that the business element functions not only as a static provider of local commodities but also plays a crucial role in creating dual value-added, namely economic gain from the sale of physical products and appreciation from the authentic experiences felt directly by tourists.

Table 1. Integration of MSME Products in Pupus Village Tourism Packages

Type of MSME Product	Role in the Tourism Ecosystem	Business Collaboration Model
Palm Sugar	Educational tourism attraction for sap tapping & cooking; unique souvenirs.	Integrated with Pokdarwis for tourists live-in packages.
Etawa Goat Milk	Farm educational tourism; welcome drink consumption for tourists.	Supply cooperation with BUMDes and homestay managers.
Pupus Local Coffee	Culinary products for local cafes (Mloko Jajar) and souvenirs.	Marketed integrally through the digital storefront of village tourism.
Resident Homestays	Providing live-in accommodation for guests.	Standardization facilitated by private partners (Hotel Maesa).

Referring to Table 1 and Figure 2, it is evident that the tourism supply chain in Pupus Village is entirely supported by local business circulation. There is almost zero economic leakage outside the village because the majority of attractions, accommodations, and consumption logistics originate from local MSME production. The resilience of this business sector is also high; MSME actors continue to produce to fulfill orders from outside markets even when

there are no holiday tourist visits. This proves that the business element creates a robust circular ecosystem for the welfare of the village residents.

The optimization of the business elements role is strongly supported by the findings of Suryawati et al. (2024), which state that applying the Penta Helix approach to MSME units has proven capable of helping build the institutional capacity of local businesses, thus positively impacting productivity and creating social benefits for the community. The collaboration of local business sectors with other stakeholders in Pupus Village has successfully transformed raw agrarian commodities into highly marketable edutourism products.

3. Community

The principle of Community-Based Tourism (CBT) is deeply rooted in the management of Pupus Village. The community element is collectively driven by the Village-Owned Enterprise (BUMDes) Sumber Makmur, the Tourism Awareness Group (Pokdarwis), and the village Youth Organization (Karang Taruna). They hold the execution control in the field and establish tactical decisions. This community is the one that flexibly creates and designs the variations of the Staying in Pupus Package, ranging from arranging homestays in residents houses, providing jeep adventures, to showcasing local gamelan cultural performances.

An analysis of the communitys role indicates that the people of Pupus Village are not merely passive objects of tourism development projects but are sovereign primary subjects. The intensive coordination meetings held almost daily create robust social capital in the form of mutual trust and a sense of belonging. The noble policy of the Village Government to not collect retributions from tourism profits ensures that the financial circulation is fully absorbed to revolve community operational funds and directly prosper the villagers.



Figure 3. Active involvement of BUMDes and Youth Organization elements in tourism management training.

Figure 3 represents the strengthening of institutional capacity at the grassroots level. Through consolidation and training initiated and enthusiastically attended by BUMDes and Pokdarwis members, the community demonstrates its commitment to elevating its capacity from merely being agrarian rural residents to becoming destination managers aware of hospitality.

This active, cross-generational participation is the key to the resilience of village tourism against potential management stagnation.

This dominant community involvement aligns with and justifies Swarbrookes theory in Mardiatmi et al. (2020), which underscores that local communities ideally have full control over strategic policies and tactical decisions in tourism development within their territorial areas. This is also supported by the research of Dewi et al. (2013), which concludes that a tourism village is fundamentally the integration of community life and attractions, where community empowerment is the primary foundation.

4. Government

The government acts as a stabilizer by holding multi-roles: initiator, regulator, and facilitator. In the embryonic stage, the Ponorogo Regency Government acted as an initiator by partnering with a third party, the Desa Institute, to provide specific mentoring to the managers of Pupus Village. At the grassroots level, the Pupus Village Government (Pemdes) established formal legality by issuing Village Regulation Number 5 of 2025 concerning Tourism Villages. This regulation serves as a bureaucratic and legal compass that guarantees the security of tourism governance.



Figure 4. Village Regulation Number 5 of 2025 concerning Tourism Villages as Legality.

The legal document in Figure 4 represents a highly crucial institutional foundation in the collaborative governance ecosystem. The existence of this Village Regulation (Perdes) is not merely of administrative value, but also serves as a juridical basis that binds the rules of the game for all stakeholders. This regulation provides legal certainty for management activities by BUMDes and Pokdarwis, guarantees the protection of the tourism areas territorial boundaries, and acts as a mitigation instrument against potential socio-economic conflicts in the future. Through the issuance of this regulation, the

village government has positioned its role not merely as a facilitator, but as a sustainability guarantor for local tourism.

Table 2. Forms of Multi-Role Government Support in Pupus Village

Form of Support	Government Actor	Implementation Description
Regulation & Policy	Pupus Village Gov.	Ratification of Village Regulation (Perdes) No. 5 of 2025 as the legal umbrella for village tourism governance.
Infrastructure Dev.	Pupus Village Gov.	Allocation of funds for repairing the concrete road in Toyomarto Hamlet to facilitate tourist access.
MSME Production Fac.	Pupus Village Gov.	Grants of physical equipment (pots, strainers, machines) to palm sugar artisans and other local producers.
Ecological Oversight	Perhutani (KPH Lawu Ds)	Supervising the tourism forest area to ensure managers do not alter forest functions or reduce tree stands.
Conceptual Mentoring	Ponorogo Regency Gov.	Partnering with the Desa Institute for tourism management mentoring, leading Pupus to win provincial-level competitions.

The data in Table 2 visualizes how the government intervenes in the tourism ecosystem holistically, from the upstream (regulation) to the downstream (equipment assistance, training, and road repairs). This comprehensive intervention proves that the government does not simply wash its hands after granting administrative permits but continuously guards the growth of technical capacity and the physical viability of the destination. The cross-agency role (Village Gov., Regency Gov., Perhutani) positions the government as a stabilizing pillar in this colossal collaboration.

This structural synergy is highly relevant to the conceptual study by Halibas et al. (2017), which emphasizes that the government bears a vital responsibility in supporting the public innovation system; ranging from infrastructure provision, the creation of public innovation policy, to the support of partnership networks. The birth of Perdes No. 5 of 2025 and these multi-aspect interventions serve as validation that the government legally umbrellas the collaborative ecosystem so that the vision of sustainable village tourism is systematically realized.

5. Media

The media element in Pupus Village does not rely on third-party agencies; rather, it is managed entirely and independently by the village youth utilizing the rapid penetration of digital platforms. They manage the flow of information through the Instagram account @dewatapupus and the official village website. The management of this media is designed to go beyond acting merely as a digital bulletin board; they routinely produce aesthetic content that packages

visual storytelling of cultural richness, the beauty of the mountain slope landscapes, and the authenticity of local agrotourism MSME products.

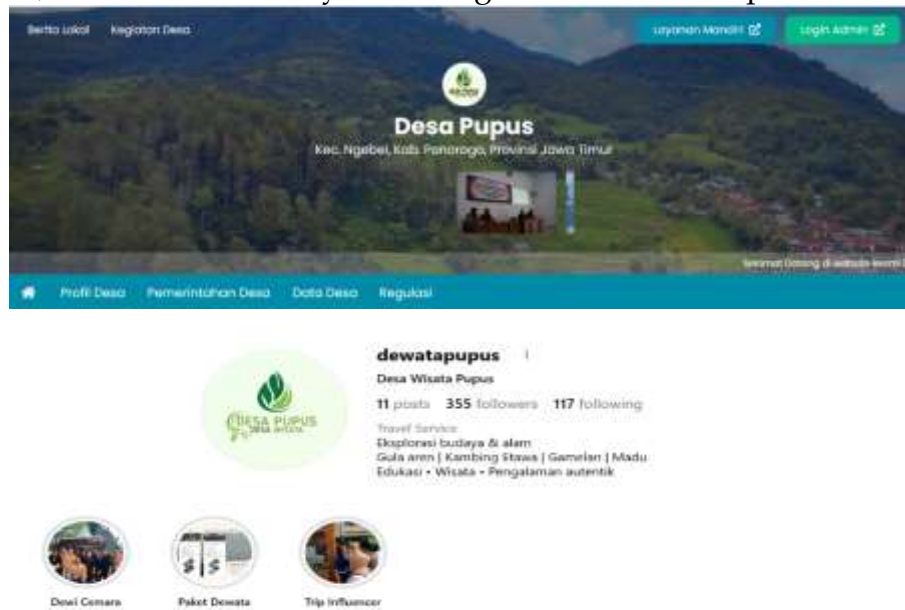


Figure 5. The interface of the digital Instagram platform and the official Website of Pupus Tourism Village.

The visualization of the media platforms in Figure 5 reinforces the shift in the marketing paradigm of Pupus Village toward full digitalization (borderless marketing). Through interactive interfaces and consistent content updates, the media not only disseminates destination information but also builds legitimacy, credibility, and professional branding in the eyes of potential tourists. This media also functions to cut through bureaucratic chains, allowing tourists to make direct reservations for tourism packages or purchase products via the direct message feature.

The achievement of this digital strategy is in line with the exposition by Muhyi et al. (2017), concluding that media plays a crucial function in promoting products, building business images, and responding to information dynamics as a form of open interaction with external consumers. In Pupus Village, the media has proven to break geographical isolation, evidenced by the presence of transnational tourists (such as tourists from Thailand) who discovered this destination exclusively through social media algorithm exposure. This proves that the media has successfully positioned itself as the spearhead of the villages economic conversion.

Table 3. Summary of Penta Helix Stakeholders Roles Analysis in Pupus Village

Element	Implementing Actor	Form of Collaboration / Role
Academic	UMPO / IPB KKN Students	Educating MSME management, packaging innovations, FGD facilitators, literacy (village library).
Business	Local MSMEs (Palm Sugar, Milk, Coffee)	Providing production educational attractions (added value), economic

		drivers, homestay and logistics providers.
Community	BUMDes, Pokdarwis, Youth Org.	Managing tactical tourism operations, designing tour & travel packages, central coordination of residents.
Government	Pupus Vill. Gov., Ponorogo Regency Gov., Perhutani	Issuing Perdes No.5/2025, building road infrastructure, providing production tool assistance, preserving forest ecology.
Media	Media Managing Youth (@dewatapupus)	Managing digital promotional content (Instagram, website), tourism village branding, opening global markets.

Obstacles and Supporting Factors in the Management of Pupus Village Tourism

The collaborative governance process of tourism in rural areas always faces internal and external dynamics. Based on the analysis, various factors acting as barriers and drivers were discovered.

Management Obstacles

The most significant challenge faced is the quality and awareness of Human Resources (HR). The educational level, dominated by elementary school graduates, affects the slow adaptation to service industry concepts. Community and youth participation is also uneven; the majority of the agrarian community still prefers to focus on their conventional agricultural fields. From a physical aspect, basic infrastructure, particularly road accessibility from Ponorogo City and Ngebel Lake to the Pupus Village location, is still bumpy and damaged in several spots, which can decrease the interest in visiting. Finally, there are natural (seasonal) obstacles, such as palm sugar production depending on the sap tapping season, meaning educational tourism packages cannot always be comprehensively showcased.

Management Supporting Factors

On the other hand, the Pupus Village ecosystem possesses highly robust supporting foundations. The primary factor is legal certainty in the form of Village Regulation No. 5 of 2025. From a social institutional perspective, the high intensity of informal discussions held daily among BUMDes, Pokdarwis, and the Village Government breeds solid social capital and communal trust. The presence of third parties, such as the *Desa Institute* mentoring program, hospitality training (in collaboration with Hotel Maesa), and the influx of academics, accelerates knowledge transfer. The massive optimization of social media centralized by the youth has exploded the villages popularity, acting as a key supporting catalyst ensuring village products are directly absorbed into the tourism market.

Table 4. Obstacles and Supporting Factors of Collaboration

Aspect	Field Findings
Obstacles	1. Low awareness and participation of youth and parts of the agrarian community. 2. The quality of HR competencies in tourism management still requires improvement. 3. Road access infrastructure (accessibility) remains inadequate. 4. The characteristics of MSME tourism attraction products are seasonal.
Supporting Factors	1. Absolute legality from Village Regulation Number 5 of 2025 concerning Tourism Villages. 2. Harmonization and intensive daily communication among the community and government. 3. Continuous mentoring from the Regency Government, Desa Institute, and Academics (KKN). 4. Massive optimization of digital media platforms (Instagram/Website).

CONCLUSIONS AND RECOMMENDATIONS

The Penta Helix collaboration model in the management of Pupus Village tourism, Ngebel District, has operated in an integrated manner and delivered tangible impacts on the economy and the strengthening of local identity. Each actor mutually covers the existing weaknesses. Academics act as bearers of management innovation and literacy; the Business sector (MSMEs) has successfully merged daily commodities into highly marketable educational attractions; the Community holds control over operations and service design; the Government provides protection through Village Regulation legality while supporting physical facility needs; and the Media serves as the backbone for expanding the tourism market into the international realm.

Nevertheless, this ideal implementation is still hindered by various technical and sociological challenges. The adapting quality of human resources, inadequate access infrastructure, and nature-based attractions bound by seasons are the primary obstacles. These factors are counterbalanced by exceptionally high social capital in the form of routine deliberation, a willingness to learn from external institutions, and policy protection from the village level to the forestry commissions environmental regulations.

Based on these conclusions, it is recommended that the Village Government intensify the portion of the village budget (Dana Desa) for repairing main tourism roads and providing specific capacity building in hospitality for residents. Academics need to design multi-year community service programs to ensure mentoring does not cease after the KKN period ends. For MSMEs, it is advised to innovate by creating long-lasting palm sugar derivative products to circumvent seasonal weaknesses. For future researchers, it is recommended to conduct a quantitative evaluation of the Penta Helix performance effectiveness on the increase in the Income per Capita of the tourism community.

ADVANCED RESEARCH

Future research should move beyond descriptive analysis by developing an integrated evaluation framework that quantitatively measures the causal effectiveness of the Penta Helix collaboration model on sustainable rural tourism development. Advanced studies may employ Structural Equation Modeling (SEM), Social Network Analysis (SNA), or mixed-method approaches to examine the interrelationships among stakeholder collaboration intensity, governance quality, community participation, innovation capacity, tourism competitiveness, environmental sustainability, and local economic outcomes such as household income, employment generation, and village-generated revenue (PADes). Longitudinal and comparative studies across tourism villages with different governance capacities are also recommended to identify the critical success factors, collaboration maturity levels, and policy interventions required to build a resilient, adaptive, and internationally competitive community-based tourism ecosystem.

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