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The Role of the Physical Environment in the Development of Tourism Villages in Indonesia: a Case Study of Geotourism Development in Alamendah and Limbasari Villages

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Abstract

This paper explores the critical role of physical geological environments in driving geotourism-based village tourism development in Indonesia, with case studies from Tourism Villages of Alamendah in Bandung and Limbasari in Purbalingga. Using a literature review method with a descriptive-analytical approach, the study highlights how unique geological features, combined with active community participation, contribute to sustainable tourism development. Indonesia, as a megadiverse country, possesses extraordinary geological potential, including volcanic landscapes, geomorphological formations, and mineralogical diversity, offering significant opportunities for geotourism. These natural assets not only enhance the aesthetic and educational value of tourism destinations but also support environmental conservation and local economic empowerment. Desa Wisata Alamendah exemplifies successful integration of geological potential with local economic activities, particularly through agritourism and digital innovation in tourism management. With monthly revenues reaching Rp1.3 billion, the village serves as a model for sustainable tourism. Meanwhile, Desa Limbasari leverages its geological sites, such as pillow lava and green jasper, to attract tourists, significantly benefiting residents. Despite their successes, both villages face challenges, including limited infrastructure, accessibility issues, and the need for greater community engagement. Geotourism aligns with the United Nations' Sustainable Development Goals (SDGs) by addressing poverty reduction, quality education, gender equality, decent work, climate action, and ecosystem preservation. To ensure sustainability, the study recommends strategies encompassing geoheritage certification, improved accessibility, technological adoption for interpretative purposes, and enhanced community participation. The research concludes that the physical environment plays a pivotal role in geotourism development, serving as both an attraction for tourists and a foundation for inclusive, environmentally-friendly local economic growth. By fostering collaboration among governments, tourism stakeholders, and local communities, Indonesia can harness its geological wealth to drive sustainable rural development while preserving its natural and cultural heritage.

Keywords: Geotourism; Community-Based Tourism; Sustainable Development.

A. INTRODUCTION

Tourism has become one of the most important economic sectors in the world, making significant contributions to economic growth, job creation, and sustainable development (UNWTO, 2021). In the context of sustainable development, community-based tourism offers innovative solutions for integrating economic, social, and environmental aspects (Khalid et al., 2019). Village tourism is a tourism development model that involves active participation from local communities in managing cultural, natural, and other resource potentials to improve overall community welfare (Prakoso et al., 2020).

The physical environment plays a crucial role in the development of village tourism. According to Dowling (2011), geological phenomena such as geological structures, stratigraphy, topography, and mineralogy serve as attractive tourist attractions because they offer meaningful and educational experiences to tourists about the history and remarkable nature of the Earth. Geological structures, such as caves and volcanoes, demonstrate the beauty and complexity of nature. Stratigraphy reveals the diversity of rock layers, depicting the long and complex history of the Earth. Topography offers stunning

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views through diverse landscapes. Mineralogy is appealing due to its educational value and intriguing characteristics, including properties, history, or chemical elements contained within.

Indonesia, as a megadiversity country, possesses extraordinary natural wealth, including geological diversity, which is one of the largest assets supporting sustainable development (Hermawan & Ghani, 2018). Geographically, Indonesia is located at the intersection of three major tectonic plates, the Eurasian, Indo-Australian, and Pacific plates as well as two shallow oceanic plates (Pedrason, 2021). This condition makes Indonesia a region with highly dynamic geological activity, encompassing two major mountain ranges, the Mediterranean and Circum-Pacific ranges and natural phenomena such as volcanoes, valleys, highlands, and stunning coastlines. However, despite this geological wealth providing great potential for economic development, its utilization remains largely limited to the mining and manufacturing sectors (Hermawan & Ghani, 2018).

In recent decades, a new paradigm has emerged in natural resource management, particularly in tourism, known as geotourism. This concept combines elements of geology, geomorphology, and culture to create tourism experiences that not only showcase natural beauty but also raise awareness about the importance of environmental conservation. Geotourism serves as an alternative solution to optimize geological potential economically without compromising its sustainability (Hermawan & Ghani, 2018). Through a holistic approach, geotourism not only offers the beauty and wonders of natural phenomena but also provides added value to the welfare of local communities by increasing income and developing village tourism.

As human interest in natural phenomena grows, places that were once only subjects of scientific research have now transformed into attractive tourist destinations (Indrayati & Setyaningsih, 2017). Geotourism has bright prospects for supporting a country's economy. In Indonesia, this concept is gaining popularity because it promises dual benefits: the sustainable use of natural resources alongside environmentally friendly tourism development. By focusing on five main aspects, identification of natural potential, destination criteria, management, tourism activities, and success indicators, the development of geotourism is expected to become a driving force for village tourism development in Indonesia.

Although numerous studies have addressed the potential of geotourism in Indonesia, most have focused on regional-level planning or isolated geosite analysis without integrating physical environmental variables with governance models at the village scale. Additionally, there is a paucity of comparative village-level case studies that highlight how geological diversity interacts with socioeconomic drivers and community participation to shape sustainable tourism outcomes. Therefore, this paper addresses this gap by examining how the physical geological environment directly influences tourism village development through geotourism strategies, using Alamendah and Limbasari villages as comparative case studies.

This paper aims to examine how Indonesia's physical geological environment drives the development of village tourism. By understanding geological potential and geotourism management mechanisms, it is hoped that effective strategies can be formulated to integrate natural wealth with sustainable local economic development. The theoretical synthesis of geotourism development draws upon the interrelationship between geological assets, community engagement, and sustainable development paradigms. Building on Dowling's (2011) geotourism principles, geological diversity serves not only as a physical attraction but also as an educational and economic resource when embedded within community-based tourism models (Hermawan & Ghani, 2018; Khalid et al., 2019). These theories suggest that physical geography, when interpreted and managed through participatory mechanisms, catalyzes inclusive economic growth and cultural preservation. Thus, this study applies a conceptual framework that sees the physical environment as a foundational asset, activated through geotourism strategies, and moderated by community participation and governance capacities to drive rural development. This

synthesis provides a theoretical basis for understanding the empirical exploration of the Alamendah and Limbasari cases.

B. RESEARCH METHOD

This study employs a literature review method with a descriptive-analytical approach to investigate the role of the physical environment in the development of tourism villages through geotourism. The research focuses on two case studies: Alamendah Village in Bandung and Limbasari Village in Purbalingga. Secondary data were obtained from various sources, including peer-reviewed scientific journals, academic books, research reports, policy documents, and relevant case studies published between 2015 and 2024. To ensure the credibility and relevance of the data, a critical validation process was applied during data collection and synthesis. The review process followed four systematic stages: 1). Identification: Literature was identified using academic databases such as Scopus, Google Scholar, and national journal portals. Keywords such as "geotourism," "tourism village development," "geological potential," "community-based tourism," and "geological heritage" were used to search for pertinent publications. The study also included supplementary sources such as books, government documents, institutional reports, and credible online publications to capture practical insights and current developments that may not yet be extensively covered in academic literature. The inclusion of these diverse sources aimed to enhance the comprehensiveness of the review while ensuring relevance to the Indonesian geotourism context; 2). Screening and Selection: The initial results were screened based on titles, abstracts, and keywords to filter sources relevant to the research objectives. Only sources that discussed the relationship between physical environmental features and tourism development were selected. Priority was given to sources with empirical data, methodological transparency, and relevance to the Indonesian context; 3). Critical Evaluation: Each selected source was evaluated for quality and reliability. The evaluation criteria included publication type (peer-reviewed vs. non-peer-reviewed), author credibility, methodological soundness, and the presence of case-specific data. Sources with unclear methodology, outdated perspectives, or general overviews lacking depth were excluded; 4). Synthesis and Interpretation: The validated sources were then analyzed descriptively and thematically to identify patterns, linkages, and theoretical insights. Key themes included geological phenomena (e.g., volcanology, geomorphology, stratigraphy, and mineralogy), local community participation, geotourism strategies, and alignment with the Sustainable Development Goals (SDGs). Cross-case comparisons between Alamendah and Limbasari were used to highlight context-specific and generalizable insights.

To complement the analysis, this study also incorporated user-generated content from publicly available Google Reviews, specifically those related to tourist experiences in Alamendah and Limbasari Villages. These qualitative insights were used as secondary sources to triangulate community narratives and validate assumptions regarding visitor satisfaction, service quality, and perceived challenges. While not systematically coded, the reviews offered contextual feedback on aspects such as accessibility, guide services, infrastructure conditions, and cultural immersion, allowing the study to present a more balanced evaluation of geotourism performance from the end-user perspective. Through this structured and critical review process, the study ensures that its findings and conclusions are grounded in robust, relevant, and context-sensitive evidence.

C. RESULTS AND ANALYSIS

The Importance of Sustainable Geotourism Management in Supporting the Preservation of Geological Heritage

Sustainable geotourism management plays a crucial role in supporting the preservation of geological heritage. Geological heritage, which includes various unique landscapes and formations resulting from millions of years of natural processes, is a valuable asset that must be protected to ensure its sustainability for future generations. Sustainable geotourism offers a balanced approach between environmental protection and the utilization of its potential to enhance community welfare. A key characteristic of geotourism is its ability to educate tourists about the importance of geological and local cultural heritage (Dowling, R.K. & Newsome, 2006). Tourists who understand these values are more likely to care about conservation efforts. Therefore, support from local communities is essential, as they are at the forefront of maintaining the sustainability of geotourism destinations. Collaboration among governments, tourism industry players, and communities will create strong synergy, ensuring that the goal of preserving geological heritage is achieved without compromising community welfare (Fasa & Berliandaldo, 2022).

Community-based tourism development becomes one of the critical keys in supporting sustainable geotourism management (Prakoso et al., 2020). By involving local communities as the main actors, community-based tourism not only increases active community participation but also ensures that the economic benefits of geotourism can be directly felt by them. Tourists need to be educated and provided with in-depth literacy so they can understand the value of geological heritage and the importance of preservation. Modern technology, such as digital applications or information platforms, can be used to promote geotourism in a more engaging and interactive way (Fasa & Berliandaldo, 2022). In this way, geotourism destinations not only become more popular but also remain preserved for the future.

The Fundamentals That Influence Geotourism

Geotourism is a concept that combines elements of geology, education, and tourism into a harmonious unity, with its main principle based on Earth's heritage (Fasa & Berliandaldo, 2022). Dowling (2009), in the Proceedings of the VIII European Geoparks Conference, outlined several key principles that shape geotourism. First, geotourism must be sustainable, where its existence not only promotes economic development but also maintains environmental balance and improves the quality of life for local communities. In practice, this requires careful planning so that the use of geological sites or natural phenomena does not damage the integrity of the surrounding environment. Additionally, the informative principle is critically important, as through education and interpretation of geological values, tourists can better understand the importance of conserving natural diversity. This education is not only aimed at conveying knowledge but also creating awareness of the need for collective action to protect the planet Earth for future generations.

Moreover, geotourism places local communities at the core of its development and operations because they are the bearers of traditional knowledge and direct providers of services and products for tourists. Active involvement of local communities brings positive impacts both socially, economically, and culturally, making geotourism an effective empowerment tool. On the other hand, the principle of tourist satisfaction is equally important, as the sustainability of the geotourism industry heavily depends on the experiences provided to visitors. Therefore, the information presented must be accurate, relevant, and aligned with tourists' expectations, without compromising the realism and originality of the geotourism site. All these principles are interconnected and support the creation of geotourism that positively impacts both people and the environment.

Correlation between Tourism Development and Sustainable Development Goals

According to Pardede, T. (2021), geotourism has significant potential to support the Sustainable Development Goals (SDGs) through various specific contributions, as follows: 1). No Poverty (SDG 1): Geotourism can help reduce poverty by enhancing community resilience against climate-related extreme events and economic, social, environmental, and disaster-related shocks; 2). Quality Education (SDG 4): Through geotourism, local communities and visitors are educated to apply sustainable development knowledge and lifestyles, appreciate diversity, and promote peace; 3). Gender Equality (SDG 5): Geotourism ensures full participation and equal opportunities for women to make decisions in community life, conservation efforts, and development activities; 4). Decent Work & Economic Growth (SDG 8): The development of geotourism can boost sustainable local economies, create jobs, and promote local culture and products; 5). Sustainable Cities & Communities (SDG 11): Geotourism protects cultural and natural heritage, fostering a sense of pride among communities for their regions; 6). Responsible Consumption & Production (SDG 12): Geotourism educates and raises awareness about sustainable development and harmonious lifestyles; 7). Climate Action (SDG 13): Geotourism improves education quality, awareness, and capacity for mitigating and adapting to climate change impacts; 8). Life Below Water (SDG 14): Geotourism manages and protects marine and coastal ecosystems, enhancing economic benefits derived from marine resources; 9). Life on Land (SDG 15): Geotourism ensures the conservation of terrestrial and mountain ecosystems, including their biodiversity, to enhance their capacity to provide critical benefits for sustainable development; 10). Partnerships for the Goals (SDG 17): Geotourism strengthens network collaboration among local, regional, and international stakeholders across various fields of science and best practices. Thus, geotourism not only contributes to economic growth and environmental preservation but also enhances the overall quality of life for communities in alignment with the SDGs.

Strategies for Sustainable Geotourism Development

The following are some ways for developing geotourism, per Dowling, R.K. & Newsome (2006):

Table 1. Geotourism Development Strategies

No.	Development Element	Dimension	Strategy
1.	Geological	Physical	The designation of geological heritage must be carried out in accordance with regulations to support the optimization of Geoheritage, Geoconservation, Geodiversity, Geotourism, and Geopark. Developing attractions that offer unique experiences compared to other destinations is also important.
		Accessibility	Access to geological areas must be improved so they can be reached by vehicles, both by the general public and relevant stakeholders. Improved access will facilitate mobility and support smooth activities in the area, enabling more people to comfortably enjoy geological potential.
2.	Sustainable	Economic	Geotourism development must focus on empowering the local economy through an inclusive approach. By promoting economic feasibility through sustainable tourism, geological areas can become not only tourist destinations but also livelihood sources for surrounding communities. This creates synergy between environmental preservation and economic welfare improvement.

No.	Development Element	Dimension	Strategy
		Conservation	Environmental preservation is a top priority in geotourism development. The management of geoheritage areas must be conducted responsibly to maintain their beauty and natural authenticity. These efforts include conserving natural resources to ensure sustainability, allowing future generations to enjoy the same geological values as today.
3.	Educational	Informative	Interesting and educational interpretive media need to be developed to provide easily understandable information for tourists. Digital technology can also be utilized to deliver interactive information about geological heritage. Additionally, raising tourist awareness about the importance of environmental conservation should be done through educational and eco-friendly approaches, encouraging them to participate in preserving nature.
4.	Community Participation	Community-Based Development (CBD)	Active participation of local communities is crucial in geotourism development, through empowerment, socialization, and literacy. By involving communities in the planning, implementation, and evaluation processes, they can take full responsibility for managing tourist attractions and enhance their ability to independently control tourism activities. This not only strengthens a sense of ownership but also positively impacts local economic growth.
5.	Tourist Satisfaction	Tourism Services	Comprehensive improvement of tourism services is also important to build trust and visitor satisfaction, including through the use of technology such as e-ticketing. Optimal service will create memorable experiences, encourage repeat visits, and promote the destination positively through satisfied tourist testimonials.

Table 1 presents strategies for sustainable geotourism development based on Dowling and Newsome (2006), emphasizing the integration of geological preservation, community empowerment, education, sustainability, and quality services. Geotourism should protect geological heritage while improving accessibility and infrastructure to enhance visitor experience. It must also promote local economic empowerment and environmental conservation to ensure long-term benefits for communities and nature. Educational efforts, supported by digital interpretation, help raise awareness of environmental protection among tourists. Active community participation strengthens local ownership and management of tourism resources, while high-quality tourism services and the use of technology, such as e-ticketing, enhance visitor satisfaction and encourage repeat visits.

The Potential for Developing Tourism Villages with a Geotourism Concept in Indonesia

Geotourism, as a form of tourism that emphasizes geological diversity and local culture, has emerged as a growing trend in the development of tourism villages in Indonesia. By leveraging distinctive natural assets and integrating them with cultural heritage and community-based management, geotourism not only offers unique travel experiences but also supports sustainable development and rural empowerment. Numerous villages across Indonesia have initiated geotourism programs that package natural features into attractive tourism offerings, supported by adequate facilities and active local participation.

Previous studies have highlighted the importance of geological diversity in driving geotourism (Dowling, 2009; Fasa & Berliandaldo, 2022), yet many overlook the operational role of local governance structures in ensuring long-term success. In contrast to Dowling's global case examples, where geotourism is typically managed by national or park-level authorities, this study underscores the effectiveness of village-scale institutions such as BUMDes, especially when strengthened by community participation and local innovation. While Hermawan & Ghani (2018) point out the underutilization of Indonesia's geological assets, the case of Alamendah shows that such assets can be transformed into economically viable and community-driven tourism through digital integration and institutional leadership. These insights suggest that localized, bottom-up governance models may provide a more adaptable and inclusive pathway for geotourism development, particularly in rural Indonesian settings.

In this context, two villages, Alamendah in Bandung Regency and Limbasari in Purbalingga Regency, serve as comparative case studies of geotourism development at the village level. Despite their different levels of institutional maturity and infrastructure, both villages illustrate how geological heritage, when managed effectively, can contribute to the growth of sustainable tourism and local economies.

Alamendah Tourism Village

The geological environment of Alamendah Village plays a significant role in driving tourism development in the area. Geographically, Alamendah Village is located at an altitude of 1,300–2,350 meters above sea level, offering three tourism potentials that are characteristic of the region: agronomic potential, agro-industrial potential, and nature tourism (Andari et al., 2024). The Alamendah Tourism Village is part of the Ciwidey National Tourism Development Area. This village achieved second place in the ADWI in the Digital Village category in 2021. There are several factors driving the development of the Alamendah Tourism Village, including: 1). Geological diversity, including rare natural phenomena, serves as a significant asset for developing the geotourism concept. This potential can be utilized as an educational platform to study geological processes, biodiversity, and local cultural values that are harmoniously integrated; 2). Alamendah Tourism Village offers stunning natural scenery, from craters with their visual beauty to waterfalls surrounded by lush forests. This natural beauty is the main attraction for tourists seeking to enjoy pristine and refreshing natural surroundings; 3). The region is rich in natural resources, such as coffee plantations, which not only serve as economic products but also as educational destinations for tourists. Additionally, the presence of geothermal energy sources and unique ecosystems in swampy areas adds value to the development of sustainable tourism concepts; 4). Educational activities such as cow milking or traditional food-making demonstrations are among the attractions supporting agrotourism development. These activities provide unique experiences for tourists while increasing local community participation in the tourism industry.

According to research by Andari et al. (2024), the following are some tourist attractions that utilize the geological characteristics of the region:

Table 2. Geological Elements and Tourist Attractions in Alamendah Tourism Village

No.	Geological Element	Object Name	Description	Site
1.	Volcanology, Geomorphology	Kawah Putih (White Crater)	A famous tourist attraction known for its beauty, formed from Mount Patuha. It is a popular destination for tourists, with the Sunan Ibu area offering a great spot to view sunrise.	 *source: Instagram @wisatakawahputih, retrieved June 2025 used for academic non-commercial purpose, with attribution*

2.	Geomorphology, Hydrology	Curug Awi Langit	A natural tourist attraction with a waterfall approximately 70 meters high, surrounded by pine forests. Tourists can play and swim in the clear and refreshing water.	 *source: Instagram @curug_awilangit, retrieved June 2025 used for academic non-commercial purpose, with attribution*
3.	Volcanology, Geomorphology, Hydrology	Ranca Upas	Spanning an area of approximately 215 hectares, it features a unique ecosystem and characteristics. Activities include hiking, camping, and walking. Its uniqueness lies in the deer breeding area where tourists can interact with deer.	 *source: Instagram @ wisatarancaupas, retrieved June 2025 used for academic non-commercial purpose, with attribution*
4.	Topography, Geomorphology, Landscape	Kebun Kopi Curug Padjajaran	One of Indonesia's coffee exporters. Offers experiences such as planting coffee, picking coffee beans, and processing coffee beans.	 *source: website alamendah.co.id, retrieved June 2025*

At the table 2 above through the development of community-based tourism villages, the people of Alamendah Village have integrated the use of physical geology and agricultural products as part of a geotourism development package. The unique geological conditions, such as volcanic craters and natural water sources, serve as the foundation for developing attractive tourist attractions. Existing agronomic potential, such as flowers, onions, green chili peppers, figs, strawberries, oranges, and other crops, has been developed into agro-industrial products, like processed strawberry goods, which have become signature souvenirs of Alamendah, supporting tourism growth in the area.

The institutional framework is also well-established. The presence of the village-owned enterprise (BUMDes) Alenda supports tourism development in the region by collaborating with several companies and promoting local SME products. The management of Alamendah Tourism Village has achieved a monthly revenue of up to Rp1.3 billion (detik.com, 2023). The managers focus on product innovation and tourism package development by utilizing village potential, such as farming, food processing and souvenir making, cow milking, coffee processing, cycling tours, or martial arts training. According to the management, an average of 30 groups or 2,500 people visit the village each month for tourism activities (Lukmana, 2023). With this approach, Alamendah Village has become one of the rapidly growing and sustainable tourism villages, providing significant economic benefits to the local community.

Limbasari Tourism Village

Limbasari Village is located in the Bobotsari District, Purbalingga Regency, Central Java. Geologically, Limbasari Village has several interesting geosites. The village is situated in the Serayu Utara hilly area, which is part of the Northern Mountain Range. This region has a history of volcanic activity, evidenced by the presence of pillow lava and volcanic breccia. This indicates that the area experienced volcanic eruptions in the past. According to (Sunan et al., 2020), the physical environment and its integration with the local culture of Limbasari Village offer several advantages that drive tourism development, including: 1). Interesting Landscape, The hills and clear rivers in Limbasari Village offer beautiful natural scenery and have the potential to become tourist attractions. The physical environment,

consisting of rivers and forests, allows for the development of tourism activities such as river tubing, trekking, and camping; 2). Presence of Geosites, Features such as pillow lava, volcanic breccia, and green jasper stones offer educational value and natural beauty that can be utilized for educational tourism and photography; 3). Cultural and Historical Richness, The presence of prehistoric cultural sites and the unique culture of the local community add to the appeal and attractiveness of tourism in the area.

According to research by (Sunan et al., 2020), the following are some tourist attractions that utilize the geological characteristics of the region:

Table 3. Geological Elements and Tourist Attractions in Limbasari Tourism Village

No.	Geological Element	Object Name	Description	Site
1.	Volcanology	Pillow Lava	Located in the Serayu Utara hills, UTM coordinates 49S 320949, 9197177. This geosite consists of lava and volcanic breccia from the Kumbang Formation. Offers views of igneous rocks formed underwater, mountains, and clear rivers. Activities: river tubing, trekking, photography.	 *source: Sunan et al., (2020)*
2.	Volcanology, Lithology	Volcanic Breccia	Located in the Serayu Utara hills, UTM coordinates 49S 320712, 9196827. Consists of lava and volcanic breccia from the Kumbang Formation. Provides opportunities to learn about volcanic products and enjoy mountain and river views. Activities: river tubing, trekking, photography.	 *source: Sunan et al., (2020)*
3.	Geomorphology, Volcanology	Serayu Utara Hills	Located in the Serayu Utara hills, UTM coordinates 49S 320933, 9197281. This geomorphosite consists of lava and volcanic breccia from the Kumbang Formation. Offers mountain views, clear rivers, and a camping ground for tourists.	 *source: (Sunan et al., (2020)*
4.	Mineralogy, Volcanology	Green Jasper Stone	Located in the Serayu Utara hills, UTM coordinates 49S 320903, 9197320. Features green jasper embedded in pillow lava gaps, with lava as the dominant lithology. Offers high cliff and clear river views. Activities: river tubing, trekking, photography.	 *source: Sunan et al., (2020)*

The development of geological tourism in Limbasari Village has provided significant positive impacts for the local community. Community income has increased through various sources, such as earnings from homestays, sales of local products, and tourism services like river tubing and trekking. The emergence of new business opportunities, such as food and beverage sales and handicrafts inspired by geotourism, has also contributed greatly to the local economy. The management of Limbasari Tourism

Village is carried out by the local Pokdarwis (Community Tourism Awareness Group). The number of tourist visits per year ranges from 500 to 2,500 people, including tourists from Ukraine, Malaysia, Singapore, Thailand, and Australia, both domestic and international visitors (Gibran et al., 2019).

The development of geotourism in the Alamendah and Limbasari Tourism Villages demonstrates great potential in supporting sustainable development in Indonesia, although the two villages are at different stages of progress. Alamendah Village has successfully integrated geological potential with community-based management through BUMDes Alenda, which not only increases local community income but also strengthens environmental sustainability through the utilization of natural resources such as coffee plantations and natural tourist attractions. However, to meet international standards, formalization of geological heritage through Geoheritage certification and the enhancement of digital technology to support educational interpretation and tourism services are necessary.

Comparative Analysis of Geotourism Development: Alamendah vs. Limbasari

On the other hand, Limbasari Village, which features unique geological elements such as pillow lava and volcanic breccia, still faces challenges related to infrastructure, accessibility, and suboptimal community participation. Therefore, improving basic facilities such as roads, public transportation, and information centers becomes a top priority to attract more tourists. Additionally, training for the community on environmental conservation and waste management needs to be enhanced to maintain ecosystem sustainability. Thus, these two tourism villages can serve as models for sustainable geotourism development that not only provides economic benefits but also supports cultural preservation, environmental conservation, and educational values for tourists and local communities. Through synergy between the government, tourism industry stakeholders, and the community, geotourism development in Indonesia can become a driving force for inclusive and environmentally friendly local economic growth.

A comparative analysis of the two villages reveals key differences that shape their respective geotourism outcomes. Alamendah Village has established a more advanced geotourism system, integrating agro-industrial production, digital innovation, and structured management through its village-owned enterprise (BUMDes). This has resulted in substantial monthly revenues exceeding Rp1.3 billion and consistent group-based tourist arrivals. In contrast, Limbasari Village, while rich in geodiversity, including features such as pillow lava and green jasper, exhibits more modest tourism development, with visitation ranging from 500 to 2,500 tourists annually. Its management is driven by a community tourism awareness group (Pokdarwis), and while it emphasizes environmental education and conservation, it lacks digital infrastructure and market access.

From an institutional perspective, Alamendah's strategic partnerships with external stakeholders, including private sector actors and government programs, have facilitated innovation and scale. Meanwhile, Limbasari remains largely dependent on local volunteers and ad hoc initiatives, leading to inconsistent service delivery and limited tourist engagement. Furthermore, Alamendah's use of thematic tourism packages, combining farming activities, crater tours, and culinary experiences, contrasts with Limbasari's singular focus on natural exploration, which lacks supporting facilities or interpretive media. These disparities suggest that institutional structure, digital adoption, and diversification of tourist experiences are key differentiators in optimizing geological potential at the village level.

This comparison also indicates that geotourism success is not solely dependent on geological uniqueness, but on the village's capacity to translate that uniqueness into accessible, educational, and economically viable experiences. Therefore, policy support should prioritize capacity building, digital tourism platforms, and the formalization of geoheritage certification to scale up underdeveloped villages such as Limbasari.

Visitor Perspectives as Triangulation Input

Visitor experiences based on user-generated feedback from Google Reviews provide valuable insight into the effectiveness and appeal of geotourism initiatives in both villages. In Alamendah, tourist feedback highlights a well-organized and immersive experience, characterized by warm community hospitality, diverse agro-based activities (e.g., feeding livestock, strawberry picking, and ecoprint workshops), and access to local products such as fresh milk, Arabica coffee, and traditional snacks. The presence of certified guides, structured packages, and cultural performances like pencak silat and traditional dance enhances the village's experiential depth and sense of place. Tourists also appreciate the village's cool climate, agricultural scenery, and integration of learning-based tourism that brings them closer to everyday rural life. These reviews suggest that Alamendah not only meets but exceeds visitor expectations for comfort, authenticity, and interaction.

Conversely, visitor narratives from Limbasari reveal both the natural charm and the infrastructural shortcomings of the destination. Tourists praise its unspoiled rivers, cool waters, and tranquil forest environment, describing it as a "hidden paradise", yet many also report difficulties related to access, safety, maintenance, and management presence. The absence of adequate signage, steep and slippery paths, and minimal on-site services detract from the overall experience, especially during rainy seasons. Moreover, some visitors express concern about littering and the lack of environmental stewardship facilities, underscoring the need for stronger community engagement and inter-agency coordination. These reflections suggest that while Limbasari holds significant geotourism potential, unlocking it will require not only infrastructure investment but also the creation of visitor-centered programs that ensure safety, cleanliness, and interpretive value.

D. CONCLUSION

This study affirms that the physical environment, particularly geological features such as volcanology, geomorphology, and mineralogy, serves not only as a natural attraction but also as a strategic asset in supporting sustainable tourism village development. Through the comparative analysis of two tourism villages, it becomes evident that geological uniqueness alone does not guarantee successful geotourism; rather, it must be complemented by institutional readiness, community engagement, infrastructure support, and innovation in tourism delivery. One case demonstrates how the integration of geoheritage with agro-industrial activities, digital platforms, and structured governance through local institutions can result in strong economic performance and visitor satisfaction. In contrast, the other case highlights the educational and ecological value of natural assets, but also reveals persistent challenges such as limited accessibility, inconsistent management, and lack of supporting facilities.

These findings offer several practical implications. First, local governments should approach geotourism not merely as an economic opportunity, but as a multidimensional development strategy that also supports education, environmental conservation, and social inclusion. Second, policy frameworks at regional and national levels must facilitate the formal recognition of geoheritage through certification schemes, while simultaneously providing technical assistance for infrastructure development and digital transformation in rural tourism settings. Third, capacity-building programs should be tailored to local actors, especially in geologically rich yet underdeveloped areas, to strengthen their ability to design, manage, and promote community-based geotourism packages effectively.

In many areas, significant geotourism potential remains untapped due to fragmented management, poor infrastructure, and limited attention to the visitor experience. Tourist feedback often points to challenges such as unsafe access, absence of signage and basic amenities, or lack of interpretive media. Addressing these issues requires a phased and adaptive development strategy that balances environmental protection with incremental tourism improvements. Rather than attempting to replicate

advanced tourism models, local stakeholders should focus on establishing clear institutional structures, improving basic services, and involving communities in participatory planning. With adequate policy support and strategic investment, rural villages across Indonesia can transform their latent geoheritage into sustainable economic and educational assets.

For future research, several directions are recommended. First, empirical, field-based studies are needed to quantify the socioeconomic and ecological impacts of geotourism at the village level. Second, further exploration is needed into the dynamics between local governance models, such as village-owned enterprises and tourism awareness groups, and their capacity to scale up tourism innovation sustainably. Lastly, comparative studies across diverse geographies, especially regions beyond Java, could offer broader generalizations and contribute to more inclusive national geotourism policies. Methodologically, incorporating participatory mapping, GIS-based site analysis, or longitudinal data on visitor trends would significantly enhance the precision and planning relevance of future geotourism studies.

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