JPAS Vol. 11, No. 1, pp 28-36, 2026
ISSN 2548-902X
e-ISSN 2541-6979

Journal of Public Administration Studies
URL: https://jpas.ub.ac.id/index.php/jiap

Strategy for Transportation Policy Integration in Sustainable Tourism Development: A Case Study of The Dieng Region

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INFORMASI ARTIKEL

Article history :
Dikirim tanggal : 7 January 2026
Revisi pertama tanggal : 2 Maret 2026
Diterima tanggal : 22 April 2026
Tersedia *online* tanggal : 18 Juni 2026

Keywords: Transportation Integration; Sustainable Mobility; Sustainable Tourism; Public Policy; Dieng Region

ABSTRACT

The Dieng region is a priority destination in Central Java that has been designated as a National Strategic Tourism Area and a Geopark. The increase in the number of tourist visits each year poses challenges to the transportation system, both in terms of access to the area and mobility between destinations within it. The low level of integration between modes of transportation, high dependence on private vehicles, and the absence of an integrated transportation system have resulted in traffic congestion, uneven distribution of visits, and a decline in the quality of the tourist experience. This situation is exacerbated by limited public transportation infrastructure, a lack of information, and insufficient involvement of local stakeholders. This study uses qualitative methods with secondary data obtained from policy documents, government reports, statistical data, and previous studies to analyze transportation integration policies in the Dieng region. The analysis is based on the concept of sustainable mobility, which emphasizes energy efficiency, equitable access, and environmental friendliness to support sustainable tourism development. Policy recommendations include improving intermodal connectivity (terminals, airports, stations), implementing IoT-based digital technology and electronic payment systems, and strengthening community participation through Community-Based Tourism (CBT) schemes. Cross-sector collaboration is a key factor in realizing an inclusive, efficient transportation system that supports sustainable tourism in the Dieng region.

1. Pendahuluan

Wonosobo Regency is one of the regencies in Central Java that has diverse tourism potential, both in terms of natural beauty, history, and culture. Based on the 2021-2026 *Rencana Pembangunan Jangka Menengah Daerah (RPJMD)*, there are six areas that can be developed into tourism areas in Wonosobo Regency, namely the Dieng area, Kalianget area, Sindoro Sumbing area, Pantodomas area, Serayu area, and Lintang Winongsari area. However, the tourism sector has not been optimally managed. As seen in the 2023 Regional Original Revenue, the tourism sector only contributed 5.98% or IDR 15,961,985,119 from the total PAD of IDR 266,786,118,103 (RPJPD Wonosobo, 2025). The number of tourist visits reached 1.7 million (Wonosobo Regency Tourism and Culture Office, 2023).

Tourism plays a role in driving the regional economy, which includes three sectors, namely the accommodation, food and beverage sector, transportation, and other services. During the 2019-2023 period, the transportation sector was the highest component of revenue from tourism services. Passenger transportation services had a high influence on the optimization of tourism in Wonosobo, reaching 48.59%.

In addition, the development of tourism in Wonosobo is also influenced by surrounding regional hubs. One of the strategic hubs in Wonosobo Regency is the Dieng National Strategic Tourism Area. The Dieng area is located in two regencies, namely Wonosobo and Banjarnegara. Cooperation in the management of the

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Dieng is carried out based on Joint Decree No. 485 of 2002 and No. 17 of 2002 of the Regents of Banjarnegara and Wonosobo concerning the Management and Development of the Dieng Plateau Area. This cooperation covers the fields of tourism and culture, nature conservation and cultural heritage, facilities and infrastructure, agriculture, community empowerment, security, and funding. Some of the famous tourist destinations in the Dieng are Sikunir Hill, Mount Prau, Telaga Warna, Telaga Pengilon, Telaga Cebong Dieng, Batu Ratapan Angin, Arjuna Temple Complex, and Sikidang Crater.

The Dieng area was designated a National Geopark under the name Central Java Dieng Geopark on May 7, 2025, based on Indonesian Minister of Energy and Mineral Resources Decree No. 171.K/GL.01/MEM.G/2025. Dieng Geopark consists of 23 geological heritage sites (geosites) and 8 biodiversity sites (biosites). The development of this Geopark will have an impact on Dieng's image at the national level, while strengthening the competitiveness of the tourism sector. Through its designation as a Geopark, sustainable tourism development has become an important aspect of tourism development.

In the context of strengthening fiscal decentralization, local governments are increasingly encouraged to enhance their own-source revenue (OSR). However, the fiscal capacity and economic potential of each region vary considerably, making innovation a critical strategy for reinforcing fiscal decentralization. While some regions benefit from strong industrial sectors that contribute substantially to local revenue, others face greater challenges because their economies rely heavily on agriculture, a sector with limited potential as a sustainable source of local government revenue in the future (Aulia & Firdanisa, 2025). Wonosobo and Banjarnegara, for example, possess distinctive geographical characteristics and natural resources that make tourism their most promising sector for expanding local revenue. Recognizing this potential, local governments have implemented various innovations, including destination promotion, road widening, the development of new transportation access, and the construction of supporting tourism infrastructure. These initiatives have proven effective in increasing tourist arrivals.

The increasing number of tourist arrivals in the Dieng Region has not been accompanied by the development of an integrated transportation system. The area's narrow and winding road network, high dependence on private vehicles, and limited public transport connectivity have contributed to recurring traffic congestion. In addition, the lack of accessible information on transportation routes to and between tourist attractions makes it difficult for visitors to plan their journeys efficiently (Setiawan et al., 2019). Therefore, a policy-oriented study is needed to formulate transportation integration strategies that can support tourism development that is more efficient, inclusive, and sustainable.

Sustainable tourism development has emerged as a key term that encompasses concepts and actions aimed at reducing negative environmental, social, and cultural impacts while increasing positive impacts (Han, 2021) . In addition to promoting the benefits of travel and the environment, sustainable tourism aims to provide education about natural tourist attractions and the responsibility to preserve them (Inchausti-Sintes, 2023) . Transportation connectivity is part of the resources for tourists in introducing natural and cultural objects through tourism destination management (Nguyen et al., 2019).

This study offers evidence-based policy recommendations for strengthening the integration of transportation systems within tourism development. The findings provide insights for policymakers seeking to promote sustainable and environmentally responsible tourism while ensuring convenient and comfortable travel experiences for visitors.

The purpose of this study is to identify the factors contributing to the lack of integration of tourism transportation in the Dieng region and how this affects tourism development. In addition, this study also seeks to provide practical recommendations for policymakers regarding the implementation of sustainable tourism through integrated transportation management.

2. Theory

2.1 Sustainable Mobility

Sustainable Mobility is rooted in the concept of sustainable development, which is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The term sustainable mobility emerged later with the main objective of ensuring that transportation systems can meet the economic, social, and environmental needs of society, while minimizing negative impacts on these three aspects (Gallo et al., 2020).

The socio-economic aspects of sustainable mobility cover various issues that are not only related to the environment and technology, but also the dimensions of fairness and efficiency of the transportation system. One of these issues is the improvement and promotion of public transportation to reduce dependence on private vehicles and encourage more environmentally friendly mobility options (Gallo et al., 2020). Improving the quality and quantity of public transportation services is one of the most efficient transportation policies for

increasing mode share and reducing car use (Vikerman, 2008).

In addition, intelligent transportation systems (ITS) are one of the aspects discussed in Sustainable Mobility. The goal is to provide innovative services related to various modes of transportation and traffic management, enabling users to obtain better information and making transportation safer and more coordinated. ITS does not only depend on road transportation, but also includes integrated technology in all modes of transportation to improve the transportation system and sustainability, thus covering the fundamental aspects of efficiency, environmental friendliness, and safety (Perallos, 2015)

2.2 Sustainable tourism development

According to Sharpley (2000) , the concept of sustainable tourism can be understood from two main perspectives. First, as part of economic activities aimed at creating growth and prosperity; and second, as an important element in the broader framework of sustainable development. In this perspective, tourism is not only seen as a profit-generating sector, but also as a means of supporting the long-term balance between economic, environmental, and social aspects.

The idea of sustainable tourism development began to emerge in the 1980s, along with growing concerns about the negative impacts of economic expansion on the environment and long-term sustainability (Imran et al., 2014) . Over time, this idea has developed into an integral approach that considers the future capacity to meet the needs of the next generation. In this regard, tourism development is required to not only focus on current growth but also ensure long-term benefits.

Tourism itself has a broad impact on various dimensions of life, including economic, environmental, social, and cultural (Pan et al., 2018) . These four dimensions form the basis of what is known as the triple bottom line in sustainable tourism development (UNWTO, 2011) . Therefore, sustainable tourism development must be able to meet the needs of tourists while protecting and improving the quality of life of local communities and preserving the environment for a better future.

However, the application of sustainability principles in tourism often encounters various challenges. As stated by (Pan et al., 2018) , many actors in this sector face difficulties in realizing sustainability as a whole, because there are often trade-offs between the pillars of sustainable development. The economic pillar, for example, is often prioritized over environmental or socio-cultural aspects. This imbalance can hinder the achievement of comprehensive sustainability goals.

In this context, good tourism destination management is a key factor in realizing sustainable development (Mellon & Bramwell, 2016) . This management includes participatory planning, policy formulation, and decision-making processes that involve various stakeholders in tourist destinations. (Pavlovich, 2003)Through collaborative interaction, destination management can be directed to become an integrated system that is responsive to various interests. Furthermore, Pavlovich (2003) emphasizes that stakeholders in tourism are interconnected in a complex system. This is due to the nature of tourism, which consists of various complementary products such as accommodation, activities, food, transportation connectivity, and other infrastructure. Transportation connectivity is one of the important aspects that support the tourism landscape (Nguyen et al., 2019) . This is important in supporting the Dieng Geopark area

3. Research Method

This study employs a qualitative case study approach using secondary data to examine transportation integration policies in the Dieng Region. A case study was selected because it enables an in-depth analysis of complex policy issues within their real-world context, particularly the interaction between transportation systems and sustainable tourism development. Secondary data were collected from multiple sources, including government policy documents, regional development plans (RPJMD and RPJPD), statistical reports published by the Central Bureau of Statistics (BPS), tourism reports from the Ministry of Tourism and the Central Java Provincial Government, laws and regulations, academic journal articles, books, and other official publications related to transportation, tourism, and sustainable mobility. Data sources were selected using three criteria: (1) relevance to transportation integration and sustainable tourism in the Dieng Region; (2) credibility, by prioritizing official government documents and peer-reviewed academic publications; and (3) recency, with preference given to documents published within the last ten years unless older sources represented key theoretical references.

Data analysis followed a qualitative content analysis procedure. First, all documents were reviewed to identify transportation-related issues affecting tourism development. Second, the data were coded and classified into major categories and subcategories, including transportation infrastructure, intermodal connectivity, accessibility, public transportation services, stakeholder coordination, and information systems. This classification technique was used to identify the root causes of the limited integration of the transportation system in the Dieng Region.

Based on the identified problems, policy alternatives were systematically developed using the policy analysis framework proposed by Patton et al. (2015). Existing policies and practices were compared with relevant

literature and successful transportation integration initiatives implemented in other tourism destinations. Finally, the proposed policy alternatives were evaluated according to their feasibility, potential contribution to sustainable mobility, and relevance to the characteristics of the Dieng Region before being synthesized into policy recommendations.

4. Results

4.1 Analysis of the Causes and Impacts of Minimal Transportation Integration in the Dieng Region

The existence of the tourism sector has an impact on various sectors so that its benefits can be felt to the fullest, according to Ismoyowati & Rachman (2023) there are 5 components of tourism that generally need to be maximized to fulfill the multiplier effect of various sectors from the existence of tourism, including what to see, what to buy, what to do (activities at the tourist destination), what to arrive (infrastructure), and what to stay (accommodation facilities), all of which are equally important. Regarding infrastructure, Dieng has been developed gradually with the involvement of various parties to continuously enhance tourism appeal, including transportation access to Dieng and within the Dieng area itself.

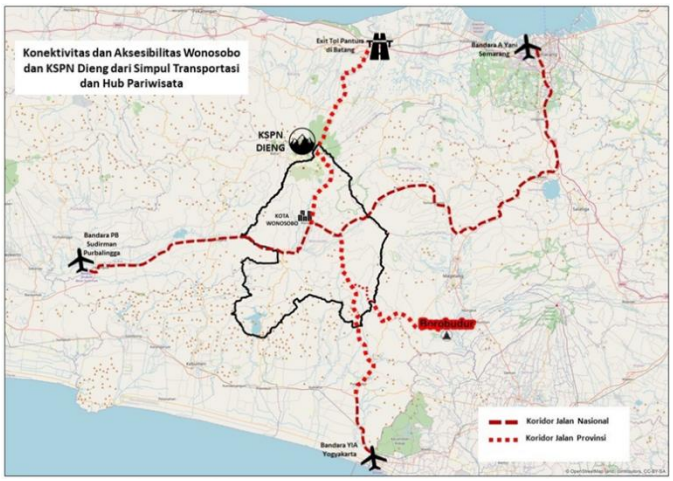

Figure 4.1 Transportation Road Map to Dieng (Rencana Pembangunan Jangka Menengah Kabupaten Wonosobo, 2025)

The Dieng area, which is included in the National Strategic Tourism Area, makes accessibility a primary concern, not only for the Regency Government but also for the Provincial Government and the Central Government. The availability of an integrated transportation system is increasingly important to support a quality tourism experience. Public transportation access to the Dieng tourist area itself is still limited, and tourists arriving by train or plane still have to change modes of transportation several times to reach the tourist location , indicating low integration between modes (Central Java Tourism Statistics Book, 2024). Access to the Dieng highlands can be reached by air or land. There are three nearby airports, with an average travel time of 2 to 3 hours to the Dieng area. This situation poses a challenge given tourists' needs, necessitating an efficient public transportation system. This is important because accessibility plays a crucial role in shaping the tourist experience (Achillas et al., 2024) . Meanwhile, road travel to Dieng by train can only be reached as far as Purwokerto Station, with a further travel time of around 2 to 2.5 hours by private vehicle, bus, or travel. Access between the nearest districts is available via bus routes with the final stop at Mendolo Terminal, Wonosobo District. However, the journey to the Dieng area does not end in Wonosobo, as tourists still have to change modes of transportation again to reach the Dieng tourist area. Access to Dieng by public transportation requires three to four changes of transportation modes (Setiawan et al. (2019) .

The travel chain to the Dieng area remains quite lengthy because the available public transportation system is not yet well-integrated. This condition also affects tourists' preferences in visiting (Zhou et al., 2023) . Transportation integration is important because it can improve the quality of the tourist experience, where good and efficient accessibility is one of the main indicators of a successful tourist destination (Jangra et al., 2023) . This also leads to many tourists choosing to use private vehicles despite the limited access roads to Dieng, increasing the potential for traffic congestion, which can diminish the positive experience of tourists(Jangra et al., 2023). The high use of private vehicles not only causes traffic congestion but also pollution and parking difficulties (Setiawan et al., 2019) .

The Dieng region itself has many tourist attractions that are not far enough away but not close enough to reach on foot. This is an important consideration for tourists when choosing a mode of transportation. Although there are jeep rental services in the Dieng region, not all tourists are interested in using this mode of transportation due to the high costs that tourists must bear (Setiawan et al., 2019) . The use of public transportation often faces several obstacles that greatly influence transportation mode preferences. Aisah & Suseno (2021) explain the criteria for tourist transportation mode preferences in traveling, which consist of five considerations: safety, comfort, time, access, and finally, cost. These considerations determine tourists' choice of transportation mode and simultaneously impact the increase in visitor numbers in the short and long term. Kwanto & Arliansyah (2016) also explain the same thing, that of the five considerations, the ones that tourists consider most are safety and comfort, followed by cost.

The low level of transportation integration between modes of transport to and within the Dieng tourist area is

the main obstacle to efficient and sustainable tourist mobility. Dependence on private vehicles causes traffic congestion and reduces the quality of visits. In addition, there is no integrated public transportation system between destinations within the geopark, which limits tourist movement and hinders the achievement of inclusive, environmentally friendly, and equitable tourism between tourist destinations. If this continues, it has the potential to reduce the competitiveness of Dieng tourism and worsen the environmental carrying capacity of the area, as well as reduce tourist satisfaction due to uncomfortable and inefficient travel experiences. Data from the Central Java Tourism Statistics Book shows that in 2024, tourist visits to the Dieng area for Banjarnegara Regency amounted to 1,167,844 domestic tourists and 5,998 foreign tourists, while in Wonosobo Regency there were 608,409 domestic tourists and 1,151 foreign tourists. However, most tourist activities are still concentrated in main areas such as Sikidang Crater and Arjuna Temple (BPS Banjarnegara, 2025), while other destinations, such as geosites and biosites, tend to be less accessible due to limited transportation connectivity. If not addressed, this condition will exacerbate the gap between tourist destinations and limit the economic impact.

The lack of synchronization between the central, provincial, and local governments has resulted in the suboptimal provision of integrated public transportation. Another issue is the minimal involvement of local stakeholders, such as jeep operators, tourism actors, and local communities, which has resulted in transportation policies that do not fully address the needs on the ground. However, community involvement is key to the development of sustainable community-based tourism, as emphasized by the Ministry of Tourism and Creative Economy (Muafi et al., 2018) , which states that the basic principle of Community-Based Tourism is the active involvement of the community in designing and managing the tourism sector to improve their welfare.

4.2 Strategies for integrating tourism transportation in the Dieng region that can be implemented

a. Improving tourism accessibility

Integrated transportation makes it easier for tourists to reach tourist destinations. The economic dimension shows a trade-off between travel time and time to reach the destination, which indicates that travel demand decreases as travel distance increases (Mckercher & Lew, 2003). Better and integrated tourism infrastructure can meet tourist needs and serve as a foundation for tourism growth (Mamirkulova et al., 2020) . Improvements in transportation infrastructure make travel easier and faster (Wang & Zhang, 2025).

b. Enhancing Regional Tourism Competitiveness

Cooperation between cities can help create a favorable tourism environment and attract cross-border investment to tourism destinations, which will generate additional job opportunities (Luo & Lam, 2020) . Wonosobo and Banjarnegara regencies, which have collaborated in managing the Dieng area, can increase the competitiveness of regional tourism to other parties. Supported by the inclusion of the Dieng area in the National Strategic Tourism Area, the presence of integrated transportation will be a unique advantage for the Dieng tourism area.

c. Enhancing the Quality of Tourist Experiences

High-quality public transportation services significantly contribute to enhancing travel satisfaction for both tourists and daily commuters (Olsson et al., 2020). According to de Oña and de Oña (2015), the quality of public transportation can be seen from two main dimensions, namely perceived attributes and objective attributes. Perceived attributes include aspects that are directly assessed by users, such as the availability of information boards, punctuality, comfort, and safety during the trip. Meanwhile, physical attributes refer to more technical elements that do not always involve subjective user assessments, such as fare structures or service prices, fleet capacity, and the condition of supporting infrastructure. These two dimensions complement each other in shaping a satisfying and sustainable travel experience.

d. Supporting Sustainable Tourism

Through transportation integration, tourist destinations, including those with low visitor numbers, can be integrated to support tourism promotion, thereby promoting economic equality and development oriented towards regional development in line with the objectives of sustainable tourism as outlined in Minister of Tourism Regulation No. 14 of 2016 concerning Guidelines for Sustainable Tourism Destinations. Tourism managers can take the necessary steps to control the flow of tourists.

5. Discussion and conclusion

Transportation integration policy alternatives:

5.1 Transportation Mode Integration with Bus Terminals, Airports, and Stations to the Dieng Tourism Area

The integration of transportation services at the Mendolo Bus Terminal in Wonosobo is a strategic step in providing safe, comfortable, and affordable transportation modes for tourists visiting the Dieng area. As the main entry point for tourists traveling by land, this terminal plays an important role in supporting smooth mobility between tourist destinations in the surrounding area. In the short term, the function of Mendolo Terminal can be strengthened by improving the quality of scheduled and tourist-friendly feeder transportation services. This will provide a better travel experience,

especially for tourists who do not use private vehicles. In addition, connectivity development needs to be expanded to include integration with other modes of transportation such as airports (e.g., Yogyakarta International Airport) and Purwokerto Station. This effort will open up wider access for tourists from various regions, while also encouraging local economic growth through an increase in tourist visits.

It is important to strengthen collaboration between stakeholders, including local governments, transportation agencies, tourism operators, and local communities, in order to create an integrated and sustainable transportation system. Thus, the Dieng tourist area will not only be more accessible, but also able to offer a higher quality travel experience for visitors

5.1 Adoption of IoT Integration and E-Payment Integration Systems

The Internet of Things (IoT) is a network of interconnected physical devices equipped with electronics, software, sensors, and connectivity to enable data exchange (Kumar et al., 2021) . IoT enables physical objects to be identified and monitored remotely through existing network infrastructure (Raghunath et al., 2025) . The function of IoT enables remote monitoring of devices, thereby increasing efficiency and accuracy. Not only can the collected data be monitored, but it can also be used as evaluation material for policy making (Raghunath et al., 2025) . IoT enables the integration of ticketing, tracking, and monitoring systems for buses. QR codes for tickets and GPS trackers for real-time bus location updates improve the efficiency and user experience of bus management systems (Taufik et al., 2021) . This has been implemented in transportation integration in the Special Region of Jakarta. In practice, IoT-based applications provide comprehensive information on bus availability, scheduling, booking, and payment, making public transportation more accessible and user-friendly (Murad et al., 2018). The adoption scheme for the IoT Integration and E-Payment Integration systems is being implemented in public transportation operating in the Dieng tourist area. This integration requires the involvement of the local and provincial governments. The provision of public transportation in the tourist area connects tourist destinations in the Dieng area, which includes Banjarnegara and Wonosobo Regencies. This public transportation is part of sustainable, environmentally friendly tourism. In addition, this public transportation is also equipped with supporting facilities such as transportation mode options, bus stops/stops, information boards to show travel routes and various tourist destinations in Dieng as part of promotion. CCTV security facilities and emergency services, including medical services. The following are the technical applications of IoT and E-Payment integration to and within the Dieng area:

- Procurement of an integrated application that includes information on the Dieng area map using the IoT system so that visitors can find out the location of public transportation (in real time) and the estimated time of arrival at the nearest bus stop or stop. This application also allows for the notification of other information, whether educational or commercial in nature. Furthermore, this application can support top-ups for cards that can be used for various payments supported by E-Money or the card itself.
- An e-ticket system for transportation to tourist destinations with a one-time payment for travel within a single day.
- This system can also be integrated with tourist destination tickets. If tourists use public transportation, they will receive a discount on tourist destination tickets.
- Community-Based Tourism involvement, as a partner in the integration of transportation and tourist destinations. Additionally, this will also boost the local and regional economy and raise awareness of environmental conservation.

Tourism in the Dieng region has great potential to drive local economic growth while strengthening its image as a national and international destination. However, limited transportation system integration is a major challenge that hinders the optimization of sustainable tourism. Long travel chains, low intermodal connectivity, and high dependence on private vehicles cause congestion, pollution, disparities between destinations, and a decline in the quality of the tourist experience.

The concept of sustainable mobility emphasizes that tourism transportation should not only prioritize technical efficiency, but also consider social and environmental aspects. Therefore, the integration of public transportation in Dieng needs to be directed towards: (1) improving connectivity between modes of transportation (terminals, airports, and stations) that are tourist-friendly; (2) implementing IoT-based technology and electronic payment systems to support convenience, transparency, and service efficiency; and (3) involving local communities through Community-Based Tourism (CBT) schemes as transportation management partners and economic beneficiaries. With this strategy, an integrated transportation system can be achieved, thereby promoting a higher quality tourist experience, equal distribution of visits between destinations, and sustainable tourism in the Dieng Geopark area.

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