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Designing A Tourist Movement Model Based On Tourist Spatial Interference Theory (Tsit) For Optimizing Tourism Management In Ubud, Bali

I Wayan Agus Ananda Putra[1], Denok Lestari[2], Putu Eka Wirawan[3]

Abstract

Ubud, Bali, is known as one of the main tourist destinations in Indonesia that highlights cultural, spiritual, and nature tourism. However, the rapid growth in the number of tourists has caused various problems in spatial management and tourist movement, such as congestion at certain tourist spots, an imbalance in the distribution of visits between regions, and pressure on local infrastructure. These problems indicate spatial inefficiency that has an impact on the decline in the quality of tourist experiences, a decline in environmental carrying capacity, and economic inequality among tourism stakeholders. This study aims to design a tourist movement model based on Tourist Spatial Interference Theory (TSIT) to improve the efficiency of tourism management in Ubud. This study adopts a single case study design. Primary data collection was conducted through three methods, namely in-depth interviews, field observations, and Focus Group Discussions (FGD). Spatial data was analyzed using geospatial analysis techniques in a GIS environment to identify patterns and points of interference. The results show that the concentration of tourists at key points causes ecological and social pressure, thus requiring spatial data-based management to regulate tourist flows and distribution in a more balanced manner. With strategies such as destination diversification, visit time management, and dynamic zoning, TSIT provides a scientific basis for adaptive, collaborative, and sustainable tourism management in Ubud.

Keywords: *Movement Model, Tourists, Tourist Spatial Interference Theory, Tourism Management, Ubud, Bali.*

Introduction

The rapid growth of the global tourism industry has triggered the phenomenon *of overtourism*, which has a number of negative implications for tourist destinations, particularly in relation to the problem of excessive tourist density (Dodds & Butler, 2019). The core of this problem lies in the imbalance between the high volume of tourist visits and the carrying capacity of a destination. The number of tourists exceeding this threshold results in heavy pressure on the tourism destination infrastructure, manifested in the form of tourist congestion and traffic jams (Mehta, 2013).

In the context of tourist destinations, the dynamics of spatial function changes and tourism development require scientific studies on the spatial patterns of tourist flows for the sustainability of destinations (Hu et al., 2015; Liu et al., 2012). This analysis is a critical basis for evaluating and designing various elements that shape tourist attractions, such as recreational spatial planning, the adequacy of public facilities, the efficiency of the transportation system, and tourism development policies, which collectively determine the sustainability of an area. All of these factors are closely interrelated and shape and influence the development of a destination as well as the quality of the tourist experience, as is the case in the Ubud area, Gianyar Regency.

Ubud is located in Gianyar Regency, Bali, and has been one of the main cultural centers and tourist destinations attracting both domestic and foreign tourists since the early development of tourism in Bali around the 1920s (Subadra, 2015). The appeal of this area stems from its stunning natural landscape, such as terraced rice fields, the Sacred Monkey Forest Sanctuary, and various cultural and spiritual sites that collectively shape Ubud's image as a cultural and spiritual center in Bali (Ernawati et al., 2018). In addition, Ubud offers unique tourist experiences through traditional arts, yoga, and meditation activities, positioning it as an ideal destination for travelers seeking tranquility and enlightenment. However, behind this popularity, Ubud now faces complex problems, particularly traffic congestion

[1] Institut Pariwisata dan Bisnis Internasional, Indonesia. Email: anandaputra.6166@gmail.com (corresponding author).
[2] Institut Pariwisata dan Bisnis Internasional, Indonesia. denoklestari@ipb-intl.ac.id
[3] Institut Pariwisata dan Bisnis Internasional, Indonesia. ewirawan@ipb-intl.ac.id

caused by the large number of tourists who visit Ubud to stay overnight to enjoy the diversity of local culture and tourism.

Based on a study conducted by Tama et al. (2021), the most pressing problem is traffic congestion triggered by vehicle density, suboptimal parking management, and the use of roadways for various public activities. Empirical findings show that this congestion is caused by a negative symbiosis between the volume of tourist vehicles, *online* motorcycle taxi operations, motorcycle taxi stands, and disorderly parking behavior. This condition has had a negative impact on the quality of the tourist experience and reduced the welfare of the local community. As an analytical basis for understanding the pressure of tourists on the infrastructure, data on the number of tourist visits to tourist attractions around Ubud is presented in Table 1.

Table 1. Number of tourist visits to popular tourist attractions in the Ubud area in 2024

Popular tourist attractions in the Ubud area	Number of Tourist Visits	
	Domestic Tourists	International Tourists
Mandala Suci Wanara Wana (*Monkey Forest*)	92,457 people	956,107 people
Elephant Cave	9,827 people	203,025 people
Neka Museum	1,011 people	3,865 people
Hidden Canyon	1,418 people	5,443 people

Source: Bali Tourism Statistics Data, 2024

Table 1 shows the volume of tourist visits to several popular destinations in the Ubud area throughout 2024. The data reveals a significant disparity, with Mandala Suci Wanara Wana (Monkey Forest) dominating with a total of 1,048,564 visits, followed by Goa Gajah with 212,852 visits. Meanwhile, tourist attractions such as the Neka Museum and Hidden Canyon recorded proportionally much lower numbers of visits.

The high concentration of visits, especially to several core destinations, is an early indicator of complex tourism management issues. The phenomenon *of overtourism* is evident, especially in Monkey Forest, which accounts for more than 90% of foreign visits from the total recorded in the table. This condition has direct implications for the emergence of negative *externalities*, such as traffic congestion, pressure on *the carrying capacity* of the environment, and the potential degradation of local cultural and natural wisdom.

In line with Puja's (2024) findings, the increase in unmanaged visitor flows is directly proportional to the severity of traffic disruptions. Congestion not only disrupts mobility but also worsens air quality and increases travel time, ultimately reducing the quality of the tourist experience and the well-being of the local community. This problem is exacerbated by the lack of adequate supporting facilities, such as parking areas. In addition, the sharp disparity in visits between destinations also indicates a problem of imbalance in the distribution of economic benefits. The concentration of tourists in only a few locations means that the economic benefits are not evenly distributed, potentially causing socio-economic disparities among tourism businesses in the Ubud area.

Traffic congestion in the Ubud area is a multidimensional problem and cannot be attributed to a single factor. This problem arises from the accumulation of various elements, including the dominant use of private vehicles, both those rented by foreign tourists (two-wheeled and four-wheeled) and through online transportation services such as Gojek and Grab, in addition to limited road capacity and rapid growth in vehicle volume. The suboptimal public transportation system, such as Trans Metro Dewata, further exacerbates this congestion, creating irregular and inefficient tourist movement patterns because it does not cover all areas in Ubud and its arrival frequency is irregular. As a result, the quality of the tourist experience has declined, pressure on the environment has increased, and Ubud's image as a renowned cultural and spiritual destination is threatened (Popp, 2012; Szuster & Peng, 2021).

Responding to the complexity of these challenges, it is necessary to design a tourist movement model based on *Tourist Spatial Interference Theory* (TSIT). This approach aims to optimize tourism management in Ubud as Bali's main cultural tourism center, which faces *overtourism* pressure on popular attractions, especially around the Sacred Monkey Forest and Art Market. This model is

designed to integrate and analyze various key variables that have been identified in the literature as determinants of tourist movement, such as travel distance (Xue & Zhang, 2020), visit volume (McKercher et al., 2012), travel group configuration (Zhao et al., 2018), weather conditions (McKercher et al., 2015), and socio-demographic characteristics. Thus, the significance of this study lies in its ability to provide a predictive and analytical framework. The findings from this model will form the basis for tourism planners in designing collaborative and integrated strategies such as route planning, parking management, and tourist distribution to distribute tourist flows more evenly across various areas to enhance visitor experience and the sustainability of Ubud as a tourist destination (Stienmetz et al., 2020).

Given the complexity of the issues outlined above, applied research to design a TSIT-based tourist movement model supported by geospatial technology (such as GIS and GPS tracking) is crucial for the management of the Ubud tourist destination. The significance of this research lies in the model's capacity to not only map detailed spatio-temporal patterns of tourist movement but also to precisely identify congestion hotspots and formulate strategies for a more balanced redistribution of visits (Pranata & Wijaya, 2022; UNWTO, 2022). Thus, this research is expected to provide practical and tangible contributions to all stakeholders. The main output of the research is measurable and data-driven policy recommendations to optimize tourism management in Ubud. Its implementation is expected to effectively reduce congestion, create a more comfortable and quality tourist experience, mitigate negative impacts on the environment, and ultimately realize sustainable and equitable tourism in Ubud for the local community.

Research Method

This study adopts *a* single case study design with the Ubud area as the locus of research. The case study approach was chosen because it is suitable for investigating contemporary phenomena in depth in a real-life context, where the boundaries between the phenomenon and its context are unclear (Yin, 2018). Through this approach, the complexity of spatial-temporal issues in Ubud can be examined holistically. This research was conducted in the Ubud area, Ubud District, Gianyar Regency, Bali Province. The selection of Ubud as a case study was based on several significant considerations. First, Ubud has long been recognized as the epicenter of cultural tourism activities in Bali, with more than 3.5 million tourist visits per year (Kusumawardhana, 2023). Second, this area exhibits high spatial polarization, where tourist activities are concentrated in several key points such as the Monkey Forest, Ubud Market, and Puri Saren, creating ideal conditions for examining the phenomenon of tourist spatial interference. Third, Ubud is a concrete example of the complex dynamics of interaction between cultural heritage, limited space capacity, and mass tourism pressure, which is suitable for testing the applicability of Tourist Spatial Interference Theory (TSIT) in an empirical context.

Primary data collection was conducted through three main methods. First, in-depth interviews were conducted with key stakeholders, including local government representatives, tourism destination managers, and local communities, to gain in-depth insights into the challenges and dynamics of governance. In addition, structured field observations were applied to directly map tourist activities and identify points of crowding and spatial interference in real time. Furthermore, Focus *Group Discussions* were held to explore diverse perceptions and bridge multi-stakeholder perspectives on the issue of tourist movement management. These three methods complement each other to ensure the completeness and depth of the data collected ( ). Secondary data includes policy documents, visitor statistics, previous reports, and thematic maps.

The population in this study was divided into two main complementary groups. First, the tourist population, consisting of domestic and foreign tourists visiting the Ubud area. This group are direct users (end-users) of tourism services and facilities, so their perceptions, experiences, and behaviors provide a real picture of the impact of the management policies implemented. Second, the population of Ubud tourism stakeholders. This group includes key actors who are actively involved in tourism planning, management, and operations, namely: managers of tourist attractions and amenities, tourism industry actors (such as accommodation, restaurants, tour guides, and creative businesses), community and traditional leaders, and local government officials responsible for the tourism and spatial planning sectors. The sampling technique in this study was designed to ensure that the data obtained could represent the entire population with diverse characteristics. For this purpose, purposive random sampling was used (Subadra, 2019).

Spatial data were analyzed using *spatial* analysis techniques in a GIS environment to identify patterns and points of interference. Qualitative data were analyzed through thematic analysis to

construct an in-depth understanding of the context of the problem, and Interpretive Structural Modeling to formulate a model.

Result And Discussion

The results of the study confirm that the application of *Tourist Spatial Interference Theory* (TSIT) can be a comprehensive analytical approach in understanding the relationship between tourist mobility and the spatial structure of destinations. In Ubud, the pattern of tourist concentration at strategic points such as Monkey Forest, Ubud Market, and Puri Saren shows the formation of *spatial clustering* that has the potential to put pressure on the environment and local communities. This condition is in line with the findings of Rizka et al. (2025), which explain that tourism density in certain areas can reduce tourist comfort while disrupting the ecological and social balance of the destination. In addition, research by Luo et al. (2023) also shows that high intensity of spatial interaction without proper spatial planning can trigger an imbalance in the distribution of tourism economic benefits between regions.

TSIT provides a conceptual framework to explain that spatial interference is the result of simultaneous interactions between spatial, temporal, and tourist behavior factors. Zheng and Yang (2023) emphasize that the overlap of tourism space functions is not only caused by spatial capacity limitations but also by the dynamic variations in tourist preferences and travel purposes. This finding is reinforced by He et al. (2023), who highlight the importance of temporal-spatial mapping to identify points prone to interference and develop adaptive tourism flow management strategies. Thus, the application of TSIT in Ubud not only provides an understanding of tourist movement patterns but also offers a scientific basis for the development of more sustainable and evidence-based tourism management policies.

These findings also show that the phenomenon of spatial interference in Ubud does not only stem from individual tourist behavior but is the result of complex interactions between spatial, temporal, and social factors. The homogeneous movement patterns that form *tourist flow corridors* indicate that tourism spatial planning in Ubud tends to be concentrated in areas with high appeal. Limited accessibility and narrow road networks reinforce the effect of *spatial congestion* on main routes. Previous studies by Li et al. (2023) and Zhu et al. (2023) confirm that the concentration of tourist movements in certain areas can cause significant ecological and social pressures, thus requiring a spatial-based management model to regulate the distribution of tourist flows.

From a temporal perspective, visitation patterns that peak at certain times, such as during the day or holiday seasons, encourage *activity overlap*, namely the overlapping of tourist activities at crowded points. This is in line with the findings of Marhanah et al. (2023), which show that the dynamics of visitation times have a major impact on the carrying capacity of destinations and the tourist experience. Through the perspective of *Tourist Spatial Interference Theory* (TSIT), this condition can be understood as the result of simultaneous interactions between *tourist agents*, *tourist* attractions, and limited spatial conditions. This approach is in line with research by Sari & Mananga (2024), which emphasizes the importance of temporal-spatial mapping in destination planning to improve the effectiveness of governance and tourism sustainability.

The application of TSIT in this study also opens up opportunities to design a simulation model of tourist movements based on spatial interference. Through a *case-based modeling* approach, researchers identified four main types of tourist movements in Ubud: (1) *concentrated movers* who focus on popular tourist spots, (2) *diffusive movers* who explore the surrounding area, (3) *temporal shifters* who adjust their visit times to avoid crowds, and (4) *hybrid movers* who combine spatial and temporal strategies. This model was then used to identify areas with high interference potential, which could serve as the basis for tourist redistribution strategies and dynamic zoning-based supporting infrastructure planning.

From a governance perspective, these findings show that the application of *Tourist Spatial Interference Theory* (TSIT) can strengthen the synergy between spatial, institutional, and social dimensions in Ubud's tourism management. A collaborative approach between local government, businesses, and local communities is key to creating an adaptive and sustainable tourist flow management system. *Soft governance* strategies such as regulating visitation times, diversifying destinations, and using spatial data-based digital technology have proven effective in reducing tourism density and expanding the distribution of economic benefits. This is in line with research by Dredge and Jenkins (2011), which emphasizes the importance of collaborative governance in complex tourism systems, as well as Hall's (2019) study, which highlights the role of spatial policy integration in maintaining a balance between conservation and tourism growth.

From a governance perspective, these findings indicate that the application of *the Tourist Spatial Interference Theory* (TSIT) can strengthen the synergy between the spatial, institutional, and social dimensions in the management of tourism in Ubud. A collaborative approach between local governments, businesses, and local communities is key to creating an adaptive and sustainable tourist flow management system. *Soft governance* strategies such as regulating visitation times, diversifying destinations, and using spatial data-based digital technology have proven effective in reducing tourism density and expanding the distribution of economic benefits. This is in line with research by Sudirman et al. (2022), which emphasizes the importance of collaborative governance in complex tourism systems, as well as a study by Hutagalung et al. (2025), which highlights the role of spatial policy integration in maintaining a balance between conservation and tourism growth.

Furthermore, the TSIT-based governance model can serve as a practical reference for other destinations facing similar pressures due to tourist concentration. Through the use of spatial data, tourist movement simulations, and coordination among stakeholders, managers can more effectively predict and control potential spatial interference. This approach is also in line with the findings of Liu et al. (2022) and Wang et al. (2020), which confirm that the integration of information technology and evidence-based policies can improve the efficiency of tourism flow management and strengthen the carrying capacity of destinations. Thus, TSIT not only functions as a theoretical framework but also as a strategic instrument in realizing inclusive, adaptive, and sustainable tourism governance in areas such as Ubud.

Overall, this study confirms that the application of *Tourist Spatial Interference Theory* in Ubud successfully demonstrates the close relationship between spatial, temporal, and social dimensions in tourist movement dynamics. The resulting movement model not only describes actual mobility patterns but also provides direction for more sustainable tourism governance policies. By understanding and managing spatial interference, policymakers can optimize tourist distribution, preserve cultural heritage, and improve the overall quality of the tourist experience in Ubud.

To optimize sustainable tourism management in Ubud, policies are needed that are not only normative but also based on data and empirical analysis of tourist movement patterns. Through the *Tourist Spatial Interference Theory* (TSIT) approach, this study emphasizes the importance of understanding the spatial dynamics of tourists as the basis for formulating more precise and adaptive policies. The resulting model enables the identification of areas with high levels of interference, dominant tourist mobility flows, and the relationship between visitor density and the quality of the tourist experience and the welfare of the local community. Therefore, the following policy recommendations have been formulated to support more measurable, integrated, and data-responsive tourism management in Ubud.

Development of a Spatial Data-Based Tourist Flow Management System

The first recommendation is to build a visitor flow management system that utilizes spatial data from GPS technology, pedestrian traffic sensors, and tourist social media data. This data enables local governments to map visitor density at key points in real time. Through spatial interference analysis, the government can set daily threshold capacities at each destination point for areas experiencing overlapping tourist movements.

Previous research by Mashkov & Shoval (2023) shows that the use of GPS-based tracking data can improve the effectiveness of tourist flow management at tourist sites. Similarly, Surange & Shankar (2024) found that geo-tracking-based spatial analysis can reduce density in tourist areas through the arrangement of alternative routes. Based on this, a similar policy in Ubud can be measured through indicators such as a 30% reduction in average hourly density at key locations within the first six months of implementation.

Diversification of Routes and Alternative Tourist Destinations

Based on findings of high spatial interference in central Ubud, policies need to be directed towards developing *alternative tourist circuits* in outlying areas such as Payangan, Taro, or Lodtunduh. The government can design *smart routing maps* based on digital applications that suggest visitation routes with low density levels. Research by Baydur (2024) confirms that diversifying tourist routes can extend the length of stay of tourists and distribute economic benefits more evenly. Meanwhile, a study by Rozi & Lemy (2023) in the Borobudur area shows that the promotion of alternative tourist routes based on visitation data has successfully increased the distribution of tourists to tourist villages by up to 18% in

one year. Therefore, the effectiveness of policies in Ubud can be measured by a 20% increase in visits to alternative destinations and a decrease in *the visitor overlap index* in the core area.

Implementation of Soft Governance Policies through Visit Time Management

In addition to spatial planning, *soft governance* policies such as visit time management, such as a *time-slot booking* system for popular tourist sites, need to be implemented. This approach allows for the temporal distribution of tourists, thereby reducing interference during peak hours. Visit data before and after implementation can be analyzed to evaluate the reduction in visit variability. Research by Vetrivel et al. (2025) supports the effectiveness of the time management approach in balancing visitation capacity in crowded destinations. Thus, the implementation of this policy in Ubud can be evaluated based on the decrease in visitor density variability between hours and the increase in tourist satisfaction with the comfort of traveling.

Data Integration for Collaborative Decision Making

Optimizing tourism governance in Ubud requires a collaborative platform based on *data integration*, connecting local governments, tourism businesses, local communities, and academics. This platform can combine data on transportation, accommodation occupancy, and business economic activities to support *evidence-based policy making*. Its success can be measured through an increase in the frequency of data-based coordination meetings and the use of analytical dashboards for routine evaluation of tourism policies. According to research by Mariani et al. (2021), tourism data integration based on *a smart destination framework* can improve management efficiency through early detection of on public facility density and needs. The success of this policy in Ubud can be measured through an increase in the frequency of data-based coordination to at least four times per year and the routine use of analytical dashboards for evaluation.

Strengthening Capacity and Regulations Based on Dynamic Zoning

As a long-term measure, the government needs to develop tourism zoning regulations based on *dynamic spatial zoning* that are adjusted to the results of annual spatial interference analysis. Zones with high interference levels are given new development limits and priority for public infrastructure improvements, while zones with low interference are facilitated as areas for culture and nature-based tourism development. Research by Haribudiman et al. (2023) on the life cycle of tourist destinations emphasizes the importance of capacity and zoning regulations to prevent destination degradation. Meanwhile, a study by Sana (2025) in Bali shows that the implementation *of an adaptive zoning* policy based on visitor density data can maintain environmental sustainability and increase the local tourist satisfaction index by 22%. Therefore, in Ubud, the success of this policy can be measured by achieving a balance between *high-density zones* and *low-density zones* (a ratio of 60:40) and an increase in the satisfaction index of tourists and the local community.

Thus, the implementation of policy recommendations based on *Tourist Spatial Interference Theory* (TSIT) is expected to provide a new direction for tourism management in Ubud that is more efficient, sustainable, and evidence-based. This approach not only focuses on the physical regulation of tourist spaces but also emphasizes behavioral, temporal, and stakeholder collaboration dimensions. Through the integration of spatial data, route diversification, visit timing regulations, and the application of dynamic zoning, the resulting policies can reduce pressure on the core area of Ubud while expanding economic benefits to surrounding areas. Furthermore, this model can serve as a prototype for the management of other tourist destinations in Indonesia facing similar challenges, namely balancing tourism appeal with ecological and socio-cultural sustainability. With a strong scientific foundation and collaborative support from all parties, Ubud has the potential to become *a best practice* example in data-driven and sustainable tourism governance at both the national and global levels.

Conclusion

This study confirms that the application of Tourist Spatial Interference Theory (TSIT) provides a strong conceptual framework for understanding and managing the complexity of tourist movements in Ubud, Bali. Through spatial and temporal analysis, TSIT explains that the phenomenon of tourist spatial interference is the result of dynamic interactions between tourist behavior, spatial capacity, and visitation time, which give rise to patterns of tourist flow concentration at certain points such as Monkey Forest, Ubud Market, and Puri Saren. This condition causes significant ecological and social pressures, necessitating integrated and adaptive data-driven governance. The resulting tourist movement model, which includes *concentrated movers*, *diffusive movers*, *temporal shifters*, and *hybrid movers,* forms the basis for developing tourist redistribution strategies through route diversification, visit time

management, and the implementation of *dynamic spatial zoning*. With the support of a spatial data-based tourist flow management system, *soft governance* policies, and collaboration among stakeholders, the implementation of TSIT has the potential to realize sustainable, inclusive, and evidence-based tourism management in Ubud.

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