

Analysis of Spatial Data Infrastructure (SDI) to Support Tourism Village Promotion in Badung Regency, Bali, Indonesia

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Abstract. Indonesia's Tourism Law No. 10 of 2009 states that tourism development needs to integrate diversity, culture and nature uniqueness, and demands. As a popular tourist destination, Badung Regency (Bali, Indonesia) shows similar tourism development across its tourist attractions. Therefore, it is necessary to make a breakthrough in alternatives, including a tourist village. This study aimed to analyze the Spatial Data Infrastructure (SDI), including data, standards, policies, technology, and human resources, to promote tourism villages in the area. The WebGIS-based Tourism Geoportals is a technology built to inform tourists, local communities, tourism associations, and local governments. The results showed that, as yet, the Badung Regency Government was not entirely ready to implement SDI to promote tourism villages. Overall, no standards and policies are governing SDI. In addition, the human resources are limited and not specially trained to organize and operate SDI. The available data are relatively complete but are missing metadata and lacking information on attribute data. Testing of the geoportals as a promotional tool for the tourism villages resulted in an agreement on the benefits of SDI to support the development of tourist villages and the importance of establishing local regulations and standards and improving the quality of human resources.

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1. Introduction

Indonesia's Tourism Law No. 10 of 2009 on Tourism encourages tourism development to factor in the diversity, cultural and natural uniqueness, and people's needs for tourism. According to Purnaya (2016), tourism is a means to actualize reciprocal tourism-culture relationships with dynamically synergistic, harmonious, and sustainable development so as to increase the community's prosperity and preserve cultural and environmental nature in a region.

Law No. 22 of 1999 on Regional Autonomy, perfected by Law No. 32 of 2004 on Regional Government, shifted central authority to regional autonomy wherein regents or majors govern. The law enactment has affected the status and development of several tourism villages in each regency and city in Bali (Arismayanti et al., 2019). Tourism generates the main revenues for many counties and is thereby a major sector in international commerce (Faladeobalade & Dubey, 2014). In addition, tourism has been contributing and, to some extent, directing natural and cultural heritage preservation measures from one generation to the next (Buonincontri et al., 2017). Therefore, marginal and peripheral communities, e.g., in remote and rural areas, can use tourism as a tool to substantially advance community development (Giampiccoli & Saayman, 2018).

In global competitive industries where destinations have to compete to attract visitors, information is vital for the tourism sector. Information is needed in every phase of the tourism decision-making process, i.e., searching for information and sharing and exchanging experiences and opinions. The advancement of the internet and Web 2.0 has

fundamentally changed tourist information search and customer behavior. Internet nowadays serves as a primary source of information for both customers and business providers and an information system used to optimize communication. Purnawan et al. (2019) stated that information on the internet and social media helps customers obtain knowledge of destinations that can influence consumer behavior and affect the promotion of the tourism destination.

One of the infrastructures providing support for tourism promotion is Geographic Information System (GIS) technology (Constantin & Reveiu, 2018). GIS technology enables the analysis of different elements of tourism to achieve a well-informed decision in a spatial context (Shah & Wani, 2015). Since tourism is identical with location search based on interests and preferences, GIS technology can provide a precise picture of a region's condition and tourism potential. Thus, the technology improves and accelerates the integration of tourism and spatial data.

Spatial Data Infrastructure (SDI) determines how and to what extent GIS can be developed for tourism villages. SDI is currently fundamental for geographic information technology and is often used in collaborations with policy and institutional policy for easier access to spatial data (Otero & Torrez, 2017). SDI emerges as a result of geospatial data collection and production to advance surveying and information technologies (Hu & Li, 2017).

SDI optimizes spatial data uses and applications to facilitate local government agencies, communities, tourism

associations, and tourists with access to spatial data. This study analyzes how SDI can be implemented to support tourism village promotion.

As a tourist destination, the Badung Regency also serves as the main entrance gate for international tourists to Indonesia, and, thus, its core business strongly depends on the tourism sector. Tourism has become a leading source of income for the region over the last five years. The industry's subsectors, such as accommodation, food services, and transportation, make up the largest pillars of Badung's economy (BPS, 2019). The development of tourism in Badung tends to rely on conventional attractions, such as the Kuta and Jimbaran Beach areas, which seem to share similarities. Therefore, it is necessary to promote alternative tourist attractions like tourism villages.

This research took place in Badung, a regency in the Province of Bali, Indonesia. Badung Regency is located at the coordinates 8°14'20"-8°50'48" S and 115°05'00"-115°26'16" E, covering an area of 418.52 km² or approximately 7.43 % of the province. Badung is divided into six districts: Abiansemal, Kuta, North Kuta, South Kuta, Mengwi Subdistrict, and Petang (Mahadewi, 2015). This research was designed to analyze SDI components to support tourism village promotion in Badung Regency, Bali Province, Indonesia.

2. Methods

SDI has five major components: data, standards, policies, access network technology, and human resources (Tripathi et al., 2020). SDI is often reduced to simple website technology for displaying and accessing various data maps via a geoportal (Noucher et al., 2017). Geoportals provide users in different areas with access to online geospatial data and increased efficiency in spatial-temporal data representation, visualization, and search within the SDI's framework through a geoportal system. Here, the system acts as an entry point to access relevant spatial data and is created in web portals, mainly consisting of geospatial data search and visualization tools and related services. Geospatial data providers can publish and distribute geospatial content through these geoportals, and customers can access information needed in various social spheres (Fedosin et al., 2019).

The research mainly investigated the availability of data, policies, standards, human resources, and information technologies to promote tourism villages. For this purpose, interviews and field surveys were conducted, and a tourism geoportal was established as a technological aspect in the tourism village promotion.

Data Collection

The research data consisted of primary data and secondary data. Primary data (i.e., information about tourism villages) were collected by interviewing officials at the Tourism Agency of Badung Regency and the Planning Agency (Bappeda), Public Works and Housing Agency (Dinas PUPR), and Communication and Information Agency (Diskominfo) to understand the availability SDI in Badung. In addition, field surveys in the tourism villages were also conducted to collect existing data related to the availability of attractions and facilities in the tourism village. Meanwhile, secondary data were collected from reports and the Badung Regency government institutions.

Data Analysis

The data analysis started with processing the primary data obtained through interviews to investigate the availability of spatial data, policies and standards, human resources, and information technologies to promote the tourism villages. Meanwhile, the field data collected during the survey were processed to create a spatial database consisting of attractions and facilities in each tourism village.

Afterward, to visualize and create maps, the research made a tourism geoportal using a Web Map Service (WMS) developed by the Open Geospatial Consortium (OGC), with the database set in PostgreSQL. WMS is a service to produce maps over the Web, or Web Maps, by renderings (presentations) of the reality (Bert et al., 2017). The WMS uses standard image formats, which offer high accessibility and efficiency. WMS maps can be displayed in standard web browsers presented in several raster formats, such as Graphics Interchange Format (GIF), Portable Network Graphics (PNG), or Joint Photographic Experts Group (JPEG), or in standard Scalable Vector Graphics (SVG) format— i.e., vector-based graphical elements (Putra et al., 2011, Becker et al., 2015).

The main WMS in this research was created using OpenStreetMap, an open-licensed service, to allow easy access from web browsers on personal computers or mobile devices. Further, OpenStreetMap generated the vector-style basemaps of each tourism village, meaning that the maps are zoomed at the three districts where the tourism village is located.

PostgreSQL, often abbreviated as Postgres, is a relational database management server system whose primary function is storing and returning the data to respond to the requests sent from other software applications (Dar et al., 2015). The data stored in Postgres are vector-based or metadata. In this research, the vector data include tourist attractions and facilities in each tourism village, administrative borders, road networks, and river network data.

3. Results and Discussion

The study results include the conditions of the tourism village, availability of Local SDI, and the establishment and assessment of the Badung Regency tourism village geoportal.

Tourism Village Conditions

In most of the villages in the Badung Regency, no policies are regulating the tourism activity and its development into a tourism village. Therefore, from the social and economic perspectives, tourism villages do not grow as much as expected (Arida et al., 2017). Based on these conditions, the local government established the idea of a Tourism Village, as issued in Regulation No. 47 of 2010 on the Establishment of Tourism Villages in the Badung Regency. As a result, there are 11 Tourism Villages distributed in the northern and middle parts of the regency, namely: (1) Bongkasa Pertiwi Village, Abiansemal District; (2) Sangeh Village, Abiansemal District; (3) Pangsan Village, Petang District; (4) Petang Village, Petang District; (5) Pelaga Village, Petang District; (6) Belok Village, Petang District; (7) Carang Sari Village, Petang District; (8) Baha Village, Mengwi District; (9) Kapal Village, Mengwi District; (10) Mengwi Village, Mengwi District; and (11) Munggu Village, Mengwi District. However, tourists are not familiar with some of these villages, warranting the need to formulate a plan or a helping tool to

Table 1. Tourism Village Attractions in Badung Regency.

Tourism Village	District	Attraction
Belok Sidan	Petang	Agrotourism (orange, coffee, marigold, chilies, chayote, durian), Penikit waterfalls, and Penikit hot springs
Pelaga	Petang	Agrotourism (Asparagus Farms), Nung-Nung Waterfall, Bukian Waterfall, Biah-Biah Waterfall, Badung Farm Festival at Tukad Bangkung Bridge
Pangsan	Petang	Agrotourism (Ricefields), tracking around the village
Petang	Petang	Mangosteen Wine Products, Gumi Banten Tourism Park, Petang Agro Tourism, Petang Waterfall
Carangsari	Petang	Tugek House, True Bali Experience, Bali Elephant Camp, POD Chocolate
Bongkasa Pertiwi	Abiansemal	Rafting, ATV trails, Bali Swing, Silver Craft
Sangeh	Abiansemal	Nature Tourism of Alas Pala Sangeh, Taman Mumbul, Pondok Jaka, Tanah Uwuk
Mengwi	Mengwi	Taman Ayun Temple, Ogoh-ogoh Museum, Yadnya Museum
Kapal	Mengwi	Pottery Crafts, Tipat Bantal War
Munggu	Mengwi	Mekotekan, large traditional wooden swings
Baha	Mengwi	Museum of Subak, Goa Perjuangan (caves)

promote them to broader communities. Table 1 shows the attractions that the tourism villages in Badung Regency offer. Source: primary data collection (2020), Regulation of Badung Regent No. 47 of 2010 on the Establishment of Tourism Villages in Badung Regency

Although Table 1 shows that the tourism villages have different, if not distinctive, tourist attractions, they have shared similarities in terms of potential development. For example, the tourism villages in Petang and Abiansemal Districts grow towards agro-tourism and adventure, while the ones in Mengwi District tend to develop into cultural tourism. Several well-known attractions include Alas Pala Natural Tourism, which combines some cultural heritage areas inhabited by thousands of monkeys, Taman Ayun Temple, well-known for the beautiful temple surrounded by river, and Mekotekan, a local tradition in Munggu (Mengwi District) performed in Kuningan Holiday. In Mekotekan, young men would climb to the top of a collection of pyramid

-shaped wooden sticks and, while standing on top of it, give the group of visitors a cheerful speech as a symbol of welcoming the soldiers of the Mengwi Kingdom after a victory over the Blambangan Kingdom in Java. There are many attractions in tourism villages in Badung Regency, but most are not known to tourists.

Profile of Tourism-related SDI

At the regency level, tourism-related components of SDI, namely data, standards, policies, technology, and human resources, were not implemented accurately. Interviews with officials at four governmental agencies: Planning, Tourism, Public Works and Housing, and Communication and Information revealed that the tourism-related spatial data and the standards and policies regulating SDI implementations were non-existent, but Regulation No. 26 Of 2013 on the Spatial Plan of Badung Regency spatial data has already used some basic spatial data, with the standards meeting that the spatial data requirements set by the central government through Geospatial Information Agency (BIG).

Different local agencies have different roles in spatial data management. For instance, the Planning Agency is responsible for compiling, coordinating, and supervising planning activities in each economic sector, including tourism. Meanwhile, Public Works and Housing Agency and Tourism Agency act as data trustees or providers. Finally, the Communication and Information Agency serves as a network node for the spatial data wherein all spatial data are compiled into one integrated system that is accessible to the community.

The spatial data available for the geoportal generation in the regency include administrative borders, transportation networks, hydrological characteristics, and places of interest. Administrative boundaries and hydrology data were obtained from the national institution Geospatial Information Agency (BIG), and transportation data, including road network, were collected from the surveys conducted by private companies or consultants in collaboration with local agencies. Meanwhile, places of interest, such as attractions, hotels, restaurants, homestays, and other tourism amenities, were collected directly in the field during the surveys (primary data). Table 2 shows the tourism-related spatial data available in Badung Regency. In terms of human resources, there is no specific regulation on SDI management. It was found that the human resources were limited and were not specially trained for operating SDI dan spatial technology. Table 3 summarizes the tourism-related SDI profile in Badung Regency.

Regarding data access and sharing, all respondents stated that one could ask the officials responsible for spatial data management at the targeted institutions directly by handing them flash disks or external drives without going through some official procedures or filling in any request forms. However, there were no official platforms or media where data could be accessed easily. Also, most of the data acquired had different scales/resolutions, shapes, and formats, contained inconsistent features and incomplete attributes, and lacked metadata. According to Permatasari et al. (2020), metadata strongly determines to what extent spatial data are documented to allow data transfer and exchange between systems and institutions and minimize standard errors due to scarce data description.

Table 2. Tourism-related Spatial Data Available in Badung Regency

Data	Provider	Data Source	Scale	Format	Latest Update	Meta-data
Regency Borders	Planning Agency	National government	1: 25,000	ESRI Shapefile - Area	2012	No
District Borders	Planning Agency	National government	1: 25,000	ESRI Shapefile - Area	2012	No
Village Borders	Planning Agency	National government	1: 25,000	ESRI Shapefile - Area	2012	No
Road Networks	Public Works and Housing Agency	Primary Data	1: 25,000	ESRI Shapefile - Line	2012	No
River Channels	Public Works and Housing Agency	National government	1: 25,000	ESRI Shapefile - Line	2012	No
Tourism Village Attractions	Tourism Agency	Primary Data	1: 25,000	ESRI Shapefile - Point	2017	No
Hotels, Restaurants, Homestays, Attractions	Tourism Agency	Primary Data	1: 25,000	ESRI Shapefile - Point	2017	No

Source: Data analysis, 2020

Table 3. Profile of Tourism-Related SDI in Badung Regency

SDI Category	Profile
Data	The available data did not have complete spatial information, attributes, and metadata.
Access	No technologies to access data related to tourism
Standards	Standards are according to Indonesia's Geospatial Information Agency (BIG)
Policies	No policies were regulating SDI, although Regulation No. 47 of 2010 on the Establishment of Tourism Villages in the regency has been issued
Human resources	Human resources were limited and were not specially trained for SDI handling

Development of Tourism Village Geoportal

Information technology is essential for the Tourism Village community to accelerate the promotion of the Tourism Village. Therefore, as part of the SDI components, technology can help disseminate information or promotion media. Through the geoportal development, tourists, local communities, tourism associations, and governments can easily access spatial data and information on the infrastructures and attractions at the tourism village.

Tourism Geoportal Requirements

Based on the interviews with officials at local agencies, the tourism geoportal should contain features and be made available online where users could easily access it. Also, it

should facilitate users to discover information about the tourism village location, characteristics, and attractions, including the time and dates of cultural events, if any, and all facilities in the surroundings. It can also be inferred that the spatial map needs to be visualized using satellite images and transformed into vector basemaps, and that there need to be some must-have features in the geoportal that help users identify the attribute data of the tourism village to allow easy understandings of the location and road networks. The data requirements for the geoportal development are listed in Table 2.

The tourism geoportal is visualized in a sequence diagram built with Unified Modeling Language (UML). UML enables experts and practitioners in information technology to model computer applications because of its ability to illustrate or model the design and structure of a software system (Lee, 2012, Ciccozzi, 2019). to illustrate or model the design and structure of a software design

UML creates a practical relation between a system and its users. One of its products is a sequence diagram that illustrates a detailed flow for a specific case of model usage. The UMLs sequence diagram for the tourism geoportal is shown in Figure 1.

There are two types of access in the geoportal: administrator access and user access. First, to start using the GeoNode and access the map, users and administrators must log in. Afterward, users can access information by displaying the tourism village description and location point. Second, users can access the data available in the GeoServer and Postgresql database via the access panel. Basemaps have been created using OpenStreetMap. At the administration level, administrators can also store information and access information in the database.

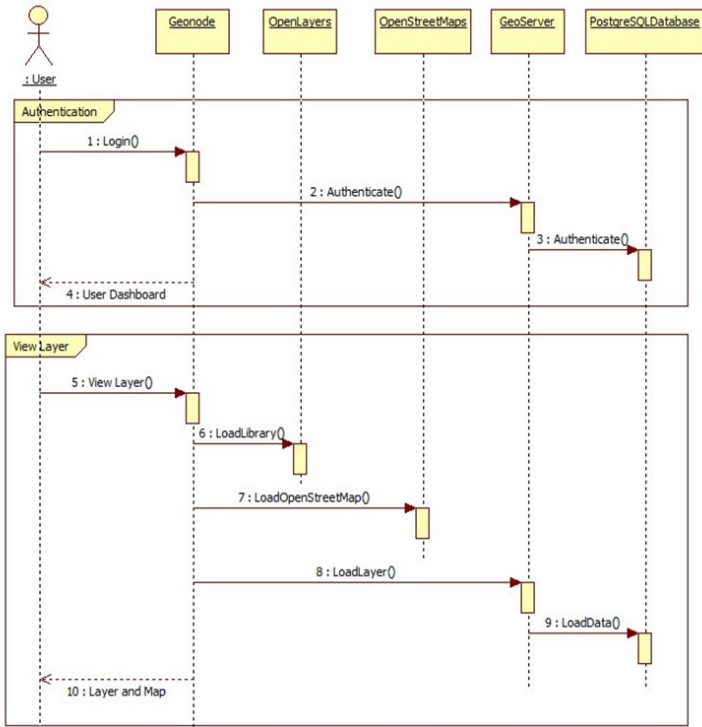


Figure 1. Sequence Diagram Model of the Tourism Geoportals
Source: Data analysis, 2020

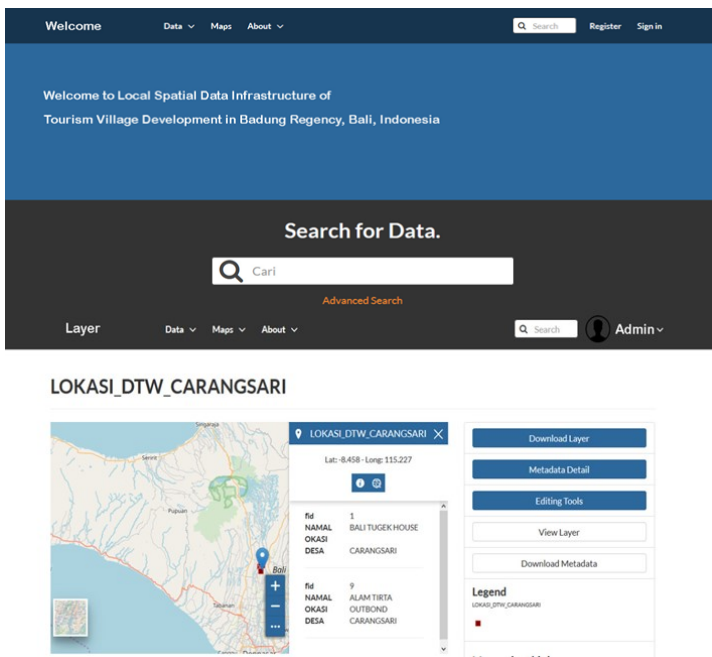


Figure 2. Some Displays of the Features in the Badung Regency Tourism Geoportals
Source: Data analysis, 2020

Tourism Geoportals Development

The tourism geoportals uses the spatial data of Badung Regency and places of interest in three of its districts:

Abiansemal, Mengwi, and Petang. The Badung Regency Tourism Geoportals serves as a promotional tool for the tourism villages, providing easily accessed information for tourists, governments, and communities. It allows fast information sharing through various WMS layers, which can be accessed continuously and contains mounts of diverse, relevant data for share among government agencies in the

regency. Figure 2 shows the user interface of the tourism geoportals.

All geospatial web services were integrated and available in the geoportals, including the administrative borders of the regency, districts, and villages, road networks, river networks, locations of the tourism villages, attractions, hotels, restaurants, and homestays. The map is zoomed at the three districts where the tourism villages are located. Aside from the data layer, the geoportals also attaches on-screen map legends so that users can understand what the map symbols denote (e.g., vector-based icons, network lines, and colors). Nevertheless, the map symbols, layout, and other properties are as straightforward as possible yet represent actual conditions. This way, users can quickly grasp the mapped information—which is one of the requirements for effective data sharing and marketing promotional tools for the tourism villages.

OpenStreetMap (OSM) products were used as the main basemap, making the geoportals accessible through a web browser on a personal computer or a mobile device. Moreover, OSM provided road network data, which this research complemented with locations of the tourism villages, attractions, hotels, restaurants, and homestays, ensuring users the best experience in navigating the location and discovering attractions and amenities close to the tourism villages.

Tourism Geoportals Testing

The testing was intended to evaluate the effectiveness, user satisfaction level, and accessibility of the geoportals, specifically as a marketing/promotional tool for the tourism villages. For this purpose, it employed observation and a questionnaire survey to collect relevant data for tool examination. The questionnaire comprises some open questions to qualitatively measure the level of satisfaction of the test participants with the overall usefulness of the geoportals. Here, participants refer to officials at different government authorities involved in the tourism village development: Tourism Agency, Planning Agency, and Communication and Information Agency.

From the interviews, it is known that all test participants had successfully completed their tasks. They could access the geoportals using different browsers on their portable computers and smartphones. The interview results showed that all participants responded with feeling satisfied with the access to geoportals. They agreed that the presented spatial data were vital to support the development strategies of the tourism villages in the Badung Regency and that the geoportals is an effective means of promoting these villages. Further, the participants found that the information attached in the map attributes satisfying; for example, they could find information about attractions in each tourism village by merely clicking the symbol on the map. This experience and response also applied to information of attractions and amenities (e.g., restaurants and homestays) that the tourism villages and nearby areas offer. Positive responses were also given to the user interface and content of the geoportals.

Overall, the participants share the same opinion: that the local SDI accommodates the proposed web-based strategies of promoting the tourism villages in Badung Regency to broader communities. Furthermore, to enhance the local SDI implementation, they highlighted the need to improve spatial data availability and quality, issuance and

enforcement of local regulations and standards, and availability of updated software and hardware and to increase the quality of human resources in SDI management and operation.

Conclusion

The Badung Regency government is not entirely ready to implement Spatial Data Infrastructure (SDI) to support the promotion of tourism villages. Overall, no standards and policies regulating the local SDI. Human resources are limited and not specially trained for SDI management and operation. The available data related to the tourism village are the regency borders, district borders, village borders, road network, river network, tourist amenities, and information about attractions in each tourism village. Administrative borders and hydrological data were obtained from the national institution Geospatial Information Agency (BIG), while the road network, places of interest (e.g., attractions), hotels, restaurants, homestays, and other amenities) were from surveys involving private companies or consultants in collaboration with local agencies. The available data are, however, missing some information on attribute data and metadata.

The development of geoportal for tourism village promotion is expected to facilitate access to relevant information for local governments and communities, stakeholders, and tourists. Based on the participants' experience and responses in the application testing, the geoportal, as an SDI, is considered beneficial for supporting the development of tourism village in Badung Regency as long as it is accompanied by relevant local regulations and standards and improved human resource quality for SDI management and operation.

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