Spatio-temporal mapping of ecotourism activities in Buleleng conservation zone: a methodological review

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Abstract. In Bali, economic benefits from tourism in 2017 is IDR 50,241.07 billion and unfortunately still dominated by districts in the south and the east of Bali, e.g., Badung, Denpasar, and Karangasem. Better coastal environment conditions in Buleleng District, environmental problems related to water quality and domestic waste management in the south and the east of Bali, as well as Buleleng new airport planning in 2025, will undoubtedly be a turning point to economic competitiveness in this area. This review represents brief information of the methodology that can be used to identify and to map ecotourism activities spatially and temporally. With this review, the purpose is to give information and solution related to several methodologies, which can be used to address constraints that can lead to inappropriate expectation concerning the outcomes of the study of spatio-temporal mapping of ecotourism activities.

1. Introduction
Ecotourism is a form of tourism which gives benefit to the community as well as still conserves the environment at the same time [1, 2]. In 2017, the largest travel site online in the world (TripAdvisor) announced Bali, with its superiority of natural resources especially in coastal areas, as the world’s best tourist destination [3]. As the world’s best tourist destination in 2017, economic benefits from tourism in Bali in 2017 is IDR 50,241.07 billion [4] and unfortunately still dominated by districts in the south and the east of Bali, e.g., Badung, Denpasar, and Karangasem. Currently, in those areas, there are many environmental problems related to water quality and domestic waste management which can affect the attractiveness and number of tourists shortly [5; Figure 1]. Buleleng District in the north of Bali, which has much better coastal environment conditions when compared to Badung, Denpasar, or Karangasem (Figure 2), merely contributed as much as IDR 5,626.86 billion (11.2%) from tourism in 2017 [6; Figure 3].
Figure 1. Tourism and environmental conditions in Bali.

Figure 2. Bali Island in Indonesia, the world’s best tourist destination in 2017 by TripAdvisor (TripAdvisor, 2018).

Figure 3. The contribution of Buleleng District correlated to the total revenue of Bali from tourism sectors.
Nonetheless, this number has continued to increase since 2011 following to District Head Decree number 523/630/HK/2011 related to Marine Protected Area (MPA) in Buleleng District, later called as Buleleng Conservation Zone (BCZ, see Figure 2 and Figure 3). BCZ offers significant ecological, biological, and species richness benefits, while at the same time augmenting local community incomes. Moreover, Buleleng new airport planning in 2025 will undoubtedly be a turning point to economic competitiveness in this area.

Therefore, the study of ecotourism and coastal development in this area is critical to be done to address issues of economic inequality from tourism in Bali since in addition to conserving their environments through various programs; it is also essential to making BCZ economically productive through tourism and marine applications. There are several types of ecotourism activities in Buleleng district, such as build environmental and cultural awareness with coastal community-based, highlight the biodiversity richness and valuing the ecological services as well as coastal benefits, also facilitate the sustainability of ecotourism activities itself. Meanwhile, in assessing the ecotourism and coastal development, efforts are often hindered by the limited availability of data, lack of data access, and resources for assessment.

This review represents brief information of the methodology that can be used to identify and to map ecotourism activities spatially and temporally. With this review, the purpose is to give information and solution related to several methodologies, which can be used to address constraints that can lead to inappropriate expectation concerning the outcomes of the study of spatio-temporal mapping of ecotourism activities.

2. Methodology for the study of spatio-temporal mapping of ecotourism activities

Geomorphological maps can be used to show the environmental conditions, including morphology, materials, and processes that might be happened in the past, present, and in the future. Besides being able to obtain a present location of ecotourism activities, identification of ecotourism activities in the past can be measured based on the geomorphological analysis through landscape and landform evolution in this area. The geomorphological approach supports a dynamic interpretation of the landscape that supports ecotourism activities, characterizing the spatio-temporal conditions of landform and the processes that have taken place and or might take place in each landform related to ecotourism activities [7, 8, 9; Figure 4]. The geomorphological approach starts from a morpho-structural zoning in which they are group according the forms, and the morphogenetic system such as marine, aeolian, fluvial, and solutional. Then, they can be analyzed by their geospatial position with georeferenced digital mapping [7]. Mapping provide scientific documents for the geomorphological knowledges of user guiding to protect conservation zone and as a tool for manage the coastal area [8].

Following the growing availability of GIS technology and satellite images, many research activities has been carried out to identify and analyze the coastal area conditions, e.g., coastal resources, coastal dynamics, and coastal hazards. Spatio-temporal distribution of coastal resources, e.g., coral reefs, mangrove, and seagrass as well as potential hazard and risk can be obtained by multi-temporal imagery satellite, aerial photography through Unmanned Aerial Vehicle (UAV), and Geographic Information System (GIS) vector analysis [10, 11, 12, 13, 14; Figure 5]. Field measurements should be conducted to validate the analysis from satellite images data, and to gather further information related to the present condition, such as coral reefs cover, mangrove conditions, hydro-oceanographic parameters, and water quality (Figure 6).
Figure 4. Geomorphological approach for the study of spatio-temporal mapping of ecotourism activities.

Figure 5. An example of mangrove density classification in ENVI software. A high density of mangrove will affect the suitability of ecotourism.
3. Summary
An interdisciplinary method between geomorphological approach, remote sensing data and geographic information systems (GIS), as well as field measurements, can be used to identify ecotourism activities spatiotemporally. This review is essential since as the largest archipelago in the world after Canada, Indonesia has more than 17,504 islands and a coastline approximately 81,000 km in length. As an archipelago country, on one hand, Indonesia has many resources and huge potential in the coastal area for the development of culture, industry, tourism, or services that can support the national economy. Moreover, with this review, spatio-temporal mapping of ecotourism activities, especially in Buleleng Conservation Zone, expected to be carried out quickly and efficiently, as well as can be used to address constraints that may exist when using conventional methods.

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