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Utilization of Remote Sensing Data for Natural Tourism Development Surveys towards Sustainable Ecotourism in Lenteng Agung Pingkal Park, Jakarta, Indonesia

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Abstract: *Lenteng Agung Pingkal Park is in Lenteng Agung Village, Jagakarsa District, South Jakarta, DKI Jakarta. The park is in the riparian zone. A riparian or riparian area is a transitional area between a river and the mainland. This study aimed to identify the physiographic conditions of Lenteng Agung Pingkal Park by utilizing remote sensing data derived from aerial imagery and google earth imagery. As well as analyzing the development, the method used in this study is qualitative with a survey approach. Several points in the Pingkal Park area are landslide-prone areas. Lenteng Agung Pingkal Park is suitable for developing into a sustainable ecotourism area. The physiographic conditions (geological processes) of Lenteng Agung Pingkal Park need to be carefully studied so that the potential for landslides in Pingkal Park can be prevented appropriately. The research results show that the right strategy needed for landslide prevention at several points in Lenteng Agung Pingkal Park is to plant tree species that are large, strong, and durable. Community involvement in managing Lenteng Agung Pingkal Park is essential considering the physiographic conditions (geological processes) of Lenteng Agung Pingkal Park, it needs to be carefully researched, and a description is made that is readily accepted by the community, as knowledge of the correct use of tourist areas. This knowledge is taught to residents so that the service of Lenteng Agung Pingkal Park tourist attractions is environmentally friendly and sustainable.*

Keywords: *Ecotourism, Green open space, Physiographic*

Introduction

Jakarta is one of Southeast Asia's most significant metropolitan areas, both in terms of land size and people. The population growth rate influences the growth of suburban cities (Rukmana, 2008). The population density will affect spatial planning, particularly settlements and open areas. Good environmental quality can bring social and psychological benefits to the city's residents and contribute to the city's long-term sustainability (Chiesura, 2004).

The village of Lenteng Agung is located in the Jagakarsa District of South Jakarta, DKI Jakarta. This village is bounded to the north by Tanjung Barat Village, to the west by Jagakarsa Village, to the east by East Jakarta City, and to the south by Srengseng Sawah. The Lenteng

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Agung area and its environs have great natural tourism potential. The potential of natural tourism may be appropriately and sustainably utilized to improve Regional Native Income (PAD). Lenteng Agung Pingkal Park, a park located above the riparian zone, is one of the tourist attractions in Lenteng Agung Village. Riparian areas are significant in ecology, environmental management, and civil engineering due to their significance in soil conservation, the biodiversity they contain, and their influence on aquatic ecosystems. Remote sensing data are required to support surveys of natural tourist development in Lenteng Agung Pingkal Park. It is intended that the development of sustainable ecotourism at Lenteng Agung Pingkal Park will involve the local community while maintaining the ecosystem.

Ecotourism is tourism based on ecology, which merges tourism and nature conservation. Nature that is employed as a tourist attraction will be protected through ecotourism activities, resulting in significant advantages. Lee and Jan's (2018) research indicates that ecotourism activities must be able to provide ecotourism programs that emphasize ecotourism experiences that improve the intention to engage in ecotourism by enhancing the utility of ecotourism activities. For ecotourism to contribute to the development of sustainable pariwsata. The expansion of the tourism industry will impact economic growth by improving family income, business, and employment through community-based tourism. Developing a sustainable tourism industry is still possible with community participation (Sasongko et al., 2019; Singgalen et al., 2019; Thetsane, 2019; Amin et al., 2020).

Literature Review

Ecotourism is ecology-based tourism that combines tourism and nature conservation. Ecotourism operations provide huge benefits since attempts are made to maintain nature used as a tourist attraction. Several studies on ecotourism have been undertaken, as indicated by Boley & Green (2016), who researched the relationship between Tanzania's biodiversity and ecotourism activities. Ecotourism has had a very positive effect on the preservation of the environment's quality. If tourism operations have been established, the next stage is to determine how things utilized as tourist sites can endure and positively affect the local community. Therefore, it is vital to research the governance of tourist attractions. Lee and Jan (2018) research indicates that ecotourism activities must be able to provide ecotourism programs that emphasize ecotourism experiences that improve the intention to engage in ecotourism by enhancing the utility of ecotourism activities. For ecotourism to contribute to the development of sustainable tourism. Using ecological indices, Wang (2021) conducted another study evaluating environmental quality as an ecotourism resource in wetland lakes. The results indicate that the ecological conditions of lakes, which were earlier decreasing due to climate change and human activity, are on the rise. The environmental state of the lake has improved due to ecotourism. Sahani (2019) conducted a study on assessing ecotourism potential using remote sensing techniques and Geographic Information Systems by integrating 12 indicators to identify locations in the Himalayan National Park with the potential for ecotourism. According to the processed data, 77 places have an exceptionally high potential for usage as ecotourism items. Amin et al. (2021) conducted the same research as their predecessors at Pakistan's Gilgit Battan ecotourism location. According to the findings of this study, 16.2% of the study areas had very low suitability, 11.5% had very high suitability, and 37% were in the optimal height range (2600–3200 m).

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Based on the research presented before, the author sees the necessity for the proper strategy in managing nature-based tourism, one of which can be implemented in the development of Lenteng Agung Pingkal Park, which must also include community participation as a tourism manager. The expectation is that the community will be capable of appropriate management and environmental sustainability.

Methodology

Table 1

Research data type and source

Data Type	Source
Aerial Imagery	The image was taken by the drone.
Satellite Imagery	*Google Earth* of 2005, 2010, and 2022

This research applied a descriptive survey methodology to examine the land physiography of Lenteng Agung Pingkal Park in the Lenteng Agung District of South Jakarta. This study requires land physiographic data to identify land changes from 2005, 2010, and 2022 and soil conservation potential data based on landslide-prone areas. The method for data collection consists of collecting both primary and secondary data. The primary data consists of aerial imagery taken with the DJI Mavic 2 Pro Drone at the height of 100 meters. The secondary data consists of satellite images from Google Earth in 2005, 2010, and 2022. This study utilizes Spatial Analysis based on Geographic Information Systems (GIS) to assess land use changes in 2005, 2010, and 2022.

Findings & Discussion

A. Overview of Research Location

Lenteng Agung is a village in Jagakarsa Sub-district, South Jakarta, Jakarta. Tanjung Barat Village to the north, Jagakarsa Village to the west, East Jakarta City to the east, and Srengseng Sawah to the south border the village with postal codes 12610 (eastern region) and 12630 (western part). The Lenteng Agung area and its surroundings have considerable natural tourism potential. The potential of natural tourism may be appropriately and sustainably developed to improve Regional Native Income (RNI). Lenteng Agung Pingkal Park, Jagakara District, South Jakarta City, is one of the tourist attractions in DKI Jakarta. The 14,000 square meter park is a Riparian region, a transitional zone between rivers and land, containing a range of plant life.

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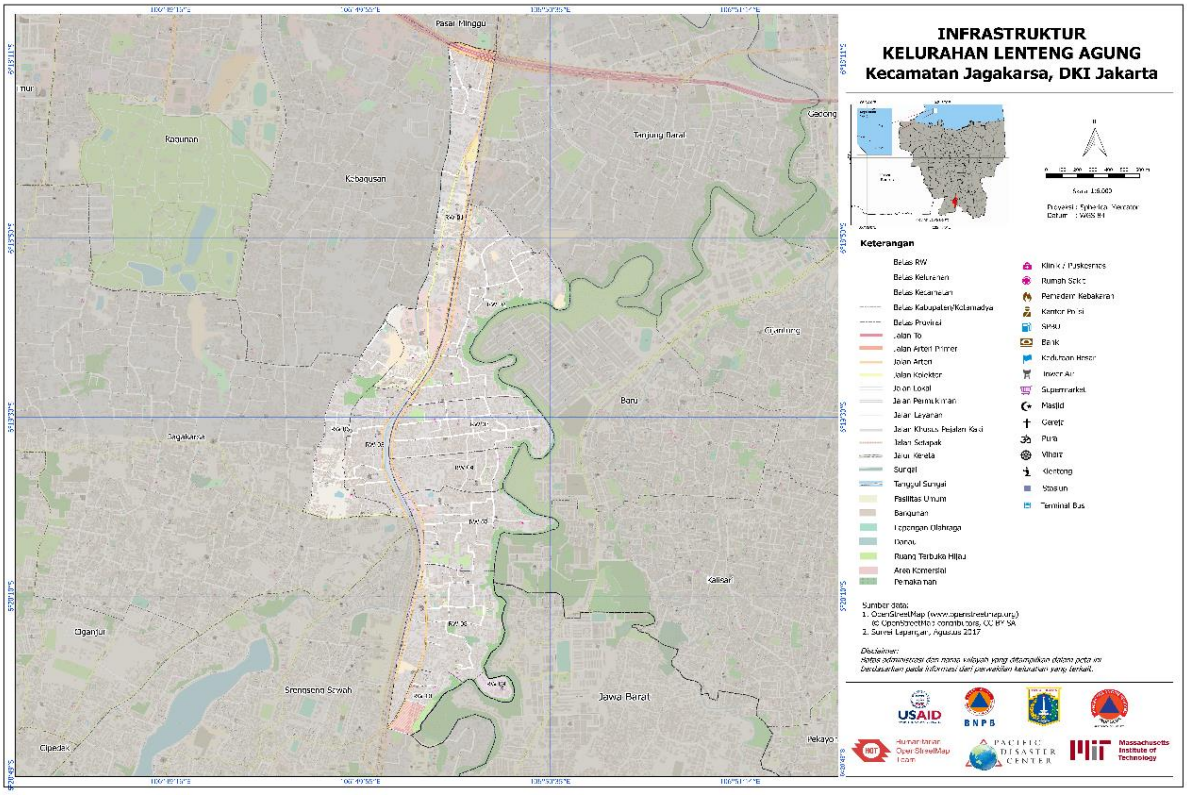
Figure 1

Administration of Lenteng Agung Village



B. Land Change Identification using Gooogle Earth Satelite Imagery

Identification of land changes is made using Google Earth satellite imagery. In 2005, imagery showed that the Lenteng Agung Pingkal Park area was still dominated by green open space areas, with land cover in the form of shrubs, grasses, and trees with high density; on the west side, there are settlements while on the east side there is the Education and Training Building (DIKLAT P2KPTK2) of South Jakarta (see Figure 2 (a)).

The 2010 imagery shows that in the eastern part of Lenteng Agung Pingkal Park, there are additional buildings, namely the SMK Negeri 62 Jakarta building. On the west side, there is an increase in residential density followed by a decrease in vegetation on the outskirts of the river (see Figure 2 (b)).

In the 2022 imagery, it can be seen that land use as a settlement in the Western part has become denser with minimum vegetation on the edge of the river, while on the East side, there is a decrease in vegetation density with the creation of paths made of paving blocks for road access for park visitors, as well as the addition of buildings to the P2KPTK2 Training Building and also SMK Negeri 62 Jakarta (see Figure 2 (c)).

The decreasing green open space in Lenteng Agung Pingkal Park, a riparian area, can cause an increase in the risk of landslides due to reduced soil-retaining vegetation and can reduce the land's ability as a water catchment area (Torar et al., 2018).

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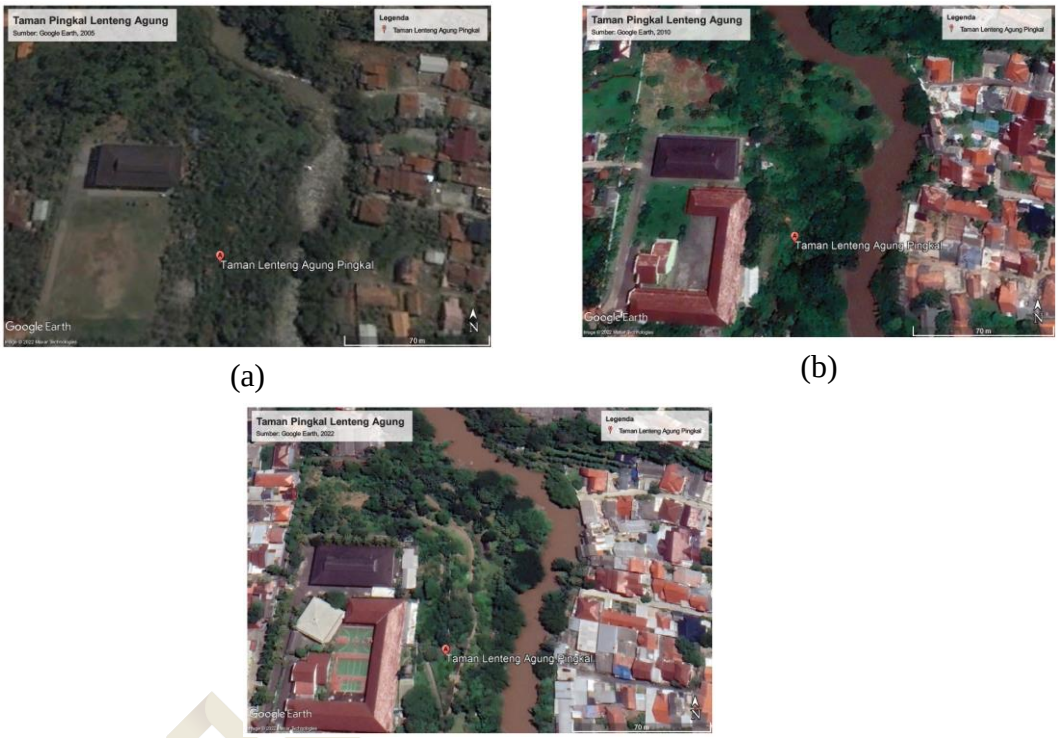
Figure 2

Comparison of Time Series Lenteng Agung Pingkal Park in 2005, 2010 and 2022



(a) (b)

(c)

C. Identification of Land Conservation in Lenteng Agung Pingkal Park using Aerial Photos

Based on aerial photos carried out, Lenteng Agung Pingkal Park is close to residential areas and schools. The red border line on the map is the boundary line of the research area, while the red dots are landslide-prone points in the study area. Land landslide conservation is recommended to be done by planting vegetation with large types of trees, such as fruit trees or other trees that are durable so that in addition to preventing landslides, the surrounding community can also enjoy the results of these trees sustainably, and the environment where the community lives is better maintained.

Figure 3 shows ten landslide-prone point conservation sites to be studied. Areas prone to landslides require appropriate handling so that they can be appropriately resolved and save the natural environment and humans. The author found that at these points, concrete fences have been made to separate the Lenteng Agung Pingkal Park area from residents' settlements. If this landslide conservation point is not immediately appropriately handled, of course, it will have a negative impact on the local community there. The image (Figure 2) shows that Lenteng Agung Pingkal Park is close to residential areas and schools. This is an essential problem so that proper handling to prevent landslides that will have a destructive impact can be carried out immediately.

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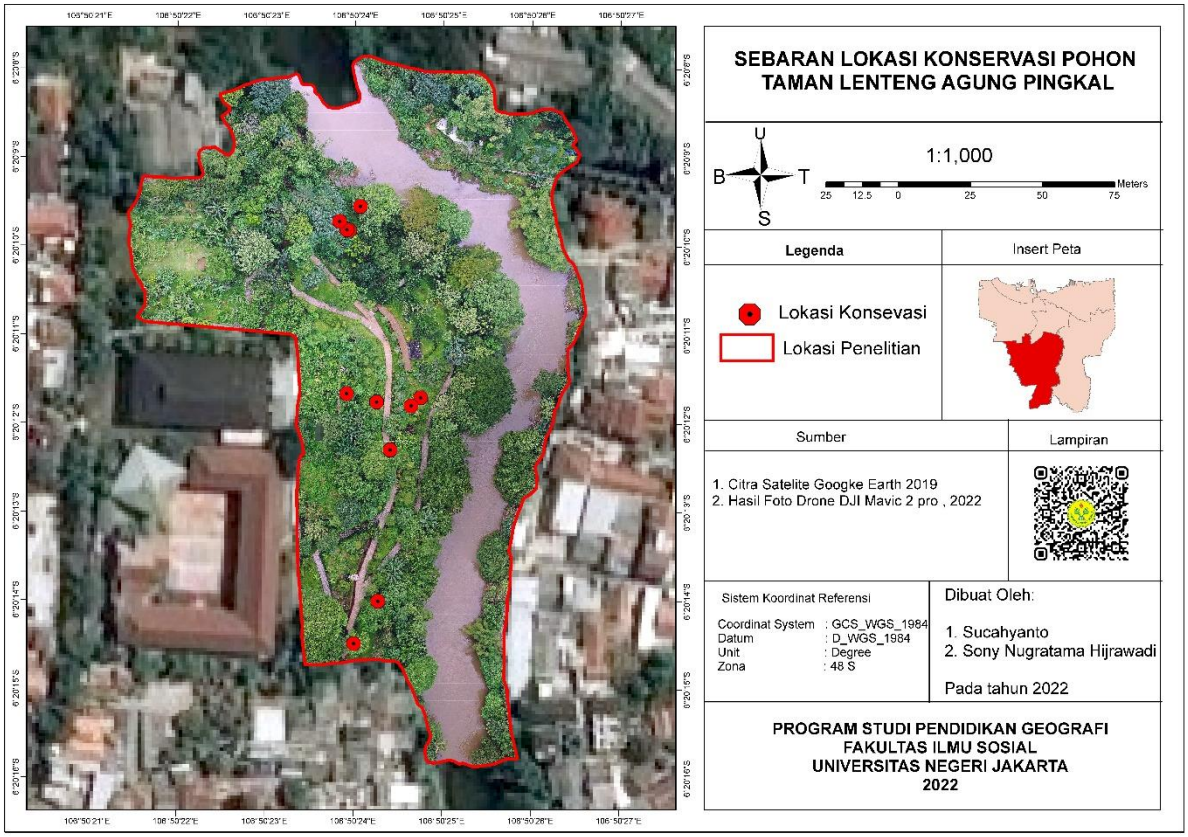
Figure 3

Distribution of Tree Conservation Points in Lenteng Agung Pingkal Park



Based on the conservation location and morphological conditions, Lenteng Agung Pingkal Park which is located in Riparian, the type of conservation that is suitable for the Lenteng Agung Pingkal Park area is the Riparian Buffer Strip or also known as the Filter Strip (Banuwa, 2013; Purbaningrum et al., 2019). The application of this conservation is to plant large and durable trees that can hold soil, shrubs, and grasses along the river bank to hold and capture sediment from the river's upper slopes. Land conservation advice is given to support more optimal land use and maintain the area's sustainability (Prabaningrum et al., 2019).

D. Community Participation in Lenteng Agung Pingkal Park

Community involvement in tourism development can be seen from the cooperation between the surrounding government, private companies or stakeholders, and the local community. This community involvement must include all stages as contained in Amin et al. (2020), namely:

- Tourism planning

  This stage can be in the form of official permits granted by the government for the community around Lenteng Agung Pingkal Park to run a business in the tourism sector; the existence of community-government-stakeholders cooperation in the community empowerment program; community involvement in the tourism planning process so that the community can voice their ideas and can be following the needs of the local community, namely the people of Lenteng Agung Pingkal Park.
- Implementation Process

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This step can be seen from the cooperation between local governments and stakeholders and local communities, where the government can provide training to local communities so that they can be involved in the tourism sector, such as running a culinary business and leasing equipment related to tourism activities around Lenteng Agung Pingkal Park.

- Evaluation Process

  This stage can be in the form of community involvement in the evaluation process of the ongoing program so that the direction and goals remain by the regulations and needs of the community and do not interfere with the environment. The community is involved in providing advice in improving infrastructure that supports tourism activities and maintains tourism sustainability in Lenteng Agung Pingkal Park.

Community involvement in the development of Lenteng Agung Pingkal Park is vital, starting with providing a description that is readily accepted and understood by the community regarding the conditions that include the potential and threats that exist in this area, as a form of knowledge and correct use of tourist areas so that the objectives in the development of Lenteng Agung Pingkal Park that are environmentally sound and sustainable can be achieved.

Conclusions

One of the tourist attractions in DKI Jakarta is Lenteng Agung Pingkal Park, Jagakarsa District, South Jakarta City. The 14,000 m2 park is a Riparian region—a transitional area between rivers and land. Lenteng Agung Pingkal Park can be developed into a sustainable ecotourism object. The location, which is located in Lenteng Agung Village, Jagakarsa District, South Jakarta, can make this tourist attraction an alternative location for tourists. The development of Lenteng Agung Pingkal Park can involve the community, which begins with providing a description that is readily accepted and understood by the community regarding the conditions that include the potential and threats that exist in this area, as a form of knowledge and correct use of tourist areas so that the objectives in the development of Lenteng Agung Pingkal Park that are environmentally sound and sustainable can be achieved.

There are ten landslide-prone points in Lenteng Agung Pingkal Park, so appropriate landslide conservation efforts are needed to prevent landslides in Lenteng Agung Pingkal Park with Riparian Buffer Strip or Filter Strip (Banuwa, 2013; Purbaningrum et al., 2019), by planting large and durable trees that can withstand soil, shrubs, and grasses, So it is hoped that the community will feel the benefits of the existence of these trees and the environment where the community lives is well maintained.

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