An attempt for ensuring sustainable tourism by examining the landscape and water supply: A case in Gunung Padang

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Abstract. As a cultural site, Gunung Padang is a tourist location that can play a major role in nature and cultural conservation efforts. We have to ensure efforts to maintain this site's sustainability inland security and environmental protection and the maximum benefit for the community. This research intended to explain the attempt to ensure sustainability in Gunung Padang as multidisciplinary studies (civil engineering, environmental engineering, and communication studies) using mixed methods. Data were collected both in laboratory and field study. Results show that to measure the site and water supply's safety landscape and convey to the local community and the broader community that the Gunung Padang site must be maintained for its sustainability.

1. Introduction

The Gunung Padang site is located on a hilltop working by valleys and hills [1]. Concerning its location, the Gunung Padang Site has become a landslide disaster in 2012 and June 2019. In 2012, soil and rock landslides occurred at 20 points, which had closed the access road to the site area but did not damage the core zone [2]. In June 2019, landslides occurred again on the eastern and western slopes. It is reported that the landslide on the eastern slope has a width of 30 m along 67 m, while on the western slope, it is only 7 m (see Figure 1). Even though it did not destroy the core zone as before, this time, the landslide was only 100 m from the core zone of the Gunung Padang Site. The stones at the Gunung Padang Site are also said to be safe because direct precautions have been taken by fixing the bamboo terracing system by the Center for Cultural Heritage and Archeology [3].
The Gunung Padang site, as the tourism potential of the Cianjur Regency, is, of course, the local government's primary focus to be developed. Previously, a restoration decision was stipulated in Presidential Decree No. 148/2014 concerning the Development, Protection, Utilization Research, and Management of the Gunung Padang Site. One of the concrete actions to develop the Gunung Padang Site is the Gunung Padang National Cultural Heritage inauguration. Also, both the central government, the provincial government of West Java, and the Cianjur regency government have built facilities to support the Gunung Padang Site.

As a cultural site, Gunung Padang is a tourist location that can play a significant role in nature and cultural conservation efforts. We have to ensure that efforts to maintain this site's sustainability in terms of land security, environmental protecting, the needs of water supply, and the maximum benefit for the community. As the tourism industry continues to expand and evolve, it significantly impacts natural resources, consumption patterns, pollution, and social systems. It is ironic that while tourism, in many instances, relies on the natural environment, it also destroys it. In order to manage and mitigate such negative impacts of tourism, there is a need for sustainable/responsible planning and management throughout the tourism industry. Economic, social, and environmental aspects of sustainable development must account for all stakeholders' interests, including the local communities, tourists, private organisations, and public bodies.

Human-centered tourism or community-based tourism which includes increasing product diversification, services according to the needs of community behavior, service patterns and efforts to increase the power of local wisdom which eventually becomes a unique selling point. This must be maintained, maintained and managed with the support of quality human resources in the future. Also, it is necessary to apply domestic sustainability values such as resilience and local wisdom and balanced tourism.

According to the background of the previous explanation, this study was proposed to investigate the slopes' stability in the Gunung Padang Site area, especially the eastern slopes included in the buffer zone. The investigation then continued with determining a slope reinforcement method that is geotechnically safe and safe from an environmental aspect. The Gunung Padang site, as one of the tourist sites based on geo-tourism, is required to have good supporting facilities that can meet visitors' needs, such as a clean water supply system and domestic wastewater management. However, the water supply system's existing conditions at the Gunung Padang Site have not been able to meet the highest visitor needs. With the background of this explanation, it is necessary to have a clean water supply system that is adequate and can meet tourists' needs. The aims of this research related to slope stability and water supply system for surrounding sites area then become one of the bases in developing destination branding, especially in the field of geo-tourism.
1.1. Conceptual and theories

World Tourism Organization (WTO) defines sustainable tourism as Tourism that takes full account of its current and future economic, social and environmental impacts, addressing visitors’ needs, the industry, the environment, and host communities. Also, sustainable tourism defined as tourism which is developed and maintained in an area (community, environment) in such a manner and at such a scale that it remains viable over an infinite period and does not degrade or alter the environment (human and physical) in which it exists to such a degree that it prohibits the successful development and well being of other activities and processes [6].

Sustainability principles refer to the environmental, economic, and socio-cultural aspects of tourism development. A suitable balance must be established between these three dimensions to guarantee its long-term sustainability. Thus, aspects of sustainable tourism development must: (1) Make optimal use of environmental resources which are crucial elements in tourism development, maintain ecological processes and take part in preserving natural heritage and biodiversity in a tourist destination; (2) Ensuring viable long-term economic activities, providing equitable socio-economic benefits to all stakeholders, such as permanent employment, opportunities to earn income (opening a business) and social services to local communities, as well as helping reduce poverty, (3) Respecting social authenticity the culture of the local community, preserving the values of their cultural and customary heritage, and contributing to increasing tolerance and understanding between cultures. Sustainable tourism development requires the participation of relevant stakeholders as well as strong political leadership to ensure active participation and agreement between stakeholders

The achievement of sustainable tourism is a continuous process. It requires constant monitoring, the innovation of preventive measures and necessary improvements to the impact of tourism activities must also be carried out. Sustainable tourism must also maintain the level of satisfaction and ensure a meaningful experience for tourists, improve their awareness of sustainability issues and invite tourists to participate in promoting acceptable environmental management practices around them

The Gunung Padang Megalithic Site consists of crushed columnar joints of andesite rock cemented by clay. According to data obtained during excavation, drilling, geo electricity, geo radar, and seismic tomography carried out independently and integrated by the research team. There is a lava body at a depth of 15 meters. This lava body shows the natural formation of the Padang volcano. Human cultivation, such as in Gunung Padang, is indicated by the rock column position, which is well arranged almost parallel to the layer plane. In contrast, in fact, the column joints’ orientation is perpendicular to the direction of magma/lava flow. In addition, there is a matrix between the stone columns at Gunung Padang. The Gunung Padang Megalithic Site is classified as a cultural tourism site, a subcategory of the young megalithic Stone Age [7].
The slope can be defined as a land surface tilted at a certain angle to the horizontal plane, which can occur naturally or artificially. If the ground surface is not flat (has an angle to a flat plane), then the soil’s weight component parallel to the slope can cause the soil to move downward or experience landslides. The greater the angle to the plane, the more susceptible the slope to landslides. In civil engineering, especially geo-technics, slope stability checks or better known as slope stability analysis, are everyday things to do. Slope stability analysis is carried out by calculating and comparing the shear stress formed along the most likely crack surface with the shear strength of the soil concerned. Slope stability analysis is to determine the safety factor (SF). In simple terms SF can be interpreted as a comparison between the magnitude that resists landslides (the relevant soil shear stress) with the magnitude that causes landslides (the shear stress formed along the most likely crack surface).

2. Method

This research on the Gunung Padang Site uses mixed methods and examines two aspects, namely engineering and scientific aspects and social and cultural aspects. This research method includes the case study description and research period and describes the data collection and analysis. The data used in the study were divided into primary data and secondary data, which were collected according to the hierarchy of data collection stages. The data collection method was done by interview, observation, geometric slope measurement, and soil investigation.

2.1. Case study location and period

The research was conducted in the Gunung Padang Site area, which is located in Cianjur Regency, West Java. Based on engineering and scientific aspects, the research objectives are focused on the eastern side of the slopes of the Gunung Padang site buffer zone, water supply needs inside the site, while based on social and cultural aspects, it is focused on the Gunung Padang Site area as a whole geo-tourism object. All stages of this research are completed within 6 months, starting from February to July 2020.

2.2. Data collection and analysis

As stated in the previous paragraph that this research used a mix methods from various disciplines. Data collection and data analysis at each of these stages will ultimately produce recommendations related to slope stability and strengthening, water supply systems, and destination branding. To describe the research steps described in the flow chart below (see figure 3.)

![Flowchart method](image)

**Figure 3.** Flowchart method.
For data collection related to slope stability and strengthening, the first step is slope geometric measurements include measuring the elevation and slope of the eastern side of the buffer zone of the Gunung Padang Site. This data is used to model slopes both to investigate slope stability and to determine slope reinforcement. Soil investigation was carried out to describe the soil's characteristics on the slope of the eastern side of the Gunung Padang Site's buffer zone, which was also used to model slopes in the slope stability program/software. Soil investigation was carried out in two stages, as follows:

1. Field Investigation, in the form of hand boring
2. Laboratory investigations, including index properties test, Atterberg's limit test, sieve and hydrometer test, and tri-axial test, to obtain data related to physical properties and mechanical properties of soil

Furthermore, it is the data collection related to water supply, data collection for the water supply facilities is divided into four stages:

1. The first stage is to collect monthly and annual visitor data to calculate the total water demand.
2. The second stage is to take a water sample from the spring and check each parameter's quality and compare it with the standard of Minister of Health No.492 of 2010. This activity aims to be able to study the appropriate technology options.
3. The third stage measure the actual discharge at the water source with the aim to be able to calculate the gap between the actual water supply and the total water demand
4. Final stage is measuring the distance from the water source point to the reservoir plan and measuring the elevation so we can. This activity aims to be able to define the appropriate line and diameter of the pipe.

The stages in data collection and data analysis related to destination branding that case study data can be obtained from all parties concerned, either through interviews, participation, and documentation. Data was collected through interviews with stakeholders, analysis of documents and library materials, and field observations. The data obtained from various ways are essentially complementary. Case study data can be obtained from the case under study and from all parties who know and know the case well. Data or information can be from many sources but should be limited to the cases under study. To obtain in-depth information on a case, reliable informants who qualify as informants are needed, namely the maximum variety, namely people who know a lot about the problem being studied. However, they do not have to have high academic degrees. Apart from interviews, observations were also carried out to determine the real conditions in the Gunung Padang Site area, both related to land cover and the community's social and cultural conditions.

3. Results and discussion

3.1. Safety of tourism site

Safety is an essential factor in tourism, including for Gunung Padang site. Considering its location surrounded by valley and hills, required it to be safe from landslide [1]. Moreover, based on the elevation of Gunung Padang site, which is > 900 msla, and the buffer zone slop, which is 21°, landslide type B potentially occurs [8]. Thus, slope stability analysis is carried out to investigate the safety of one section of Gunung Padang site, i.e., the buffer zone's stability. The buffer zone is shaped in 21° slope under the soil type of clayey sand. The analysis results using the finite element method indicate that the buffer zone is safe from landslide with a safety factor value of 2.955 (see Figure 4).
The results of soil investigation, the soil found on the slopes of the buffer zone of the Gunung Padang site was dominated by clay sand, and from the results of the analysis, it is stated that the conditions of the slope are relatively safe, according to that condition we can recommend for the reinforcement is not constructed because it is likely to require quite expensive costs. Furthermore, preserving the safety of the buffer zone by soil bioengineering (planting vegetation) is proposed. Vegetation plays a role in maintaining and strengthening the slope stability, preventing erosion, and reducing infiltration and runoff through its roots that binding the soil skeleton. Therefore, selecting suitable vegetation is an essential key in the success of soil bioengineering for slope stability. According to (8) the slope with potentially type B landslide is suitable to be supported by Cempedak, Candlenut, Jackfruit, Cashew Nut, Palm tree, Bamboo, Kenanga, Johar, Durian, Eucalyptus, Bungur, Rambutan, Petai, Avocado, Mahogany, Clove, and Laban. And the area of the soil bioengineering will be 241 m$^2$ (see Figure 5).

In addition to vegetation selection, the arrangement of vegetation spacing needs to be considered as well. Vegetation spacing is influenced by crown density, so the vegetation with many crowns is planted between rows of plants. Meanwhile, the vegetation with low crowns is planted under vegetation with medium crowns.

Figure 4. Potential slip surface.

Figure 5. Plan area of soil bioengineering.
The Gunung Padang site is at an altitude of > 950 masl, and the landslide location is at an altitude of > 900 masl. Then the landslide location on the slope of the Gunung Padang Site's buffer zone is at a slope of 21 degrees or ± 36% so that it can be categorized as a type B zone. The area of this vegetative engineering plan is 241 m$^2$.

3.2. Water supply facilities

The Gunung Padang site, as one of the tourist sites based on geo-tourism is required to have good supporting facilities that can meet visitors' needs. However, the existing condition of the facilities of clean water supply system and domestic wastewater management at the Gunung Padang Site have not been able to meet the highest visitor needs, where with the highest number of visitors of 18,111 people, a debit of 0.51 l/s is required to meet visitor needs. The water demand per person is 20 liters/person/day, according to SNI 03-2399-2002.

Clean water at the Gunung Padang Site comes from springs located at an altitude of 1031 meters above sea level and is approximately half a kilometer from the Gunung Padang Site. Based on the survey, clean water is distributed using PVC pipes that are not neatly arranged where the pipes are not well embedded, then in some segments, it is only connected using a water hose, which can be seen below.

![Existing condition of water supply facilities.](image)

The transmission and distribution system planning is carried out by gravity and using a closed system. The system's evaluation criteria include the length of the pipe, the number of reservoirs, the pressure in the pipe, and the velocity. From the hydraulic calculations, the pipe used is HDPE pipe with a diameter of 32 mm. Like the transmission system, this distribution system is designed using HDPE pipes with a 32 mm diameter and flowed by gravity.
In this research, water samples from springs were tested in the Environmental Laboratory of DKI Jakarta. The result of the sample that there are still 5 parameters tested that do not meet the quality standards, these parameters are TSS, TDS, iron, turbidity, and total coliform. The result is according to the standard of Minister of Health No.492/2010 and PP No 82/2001 class 1 water, which is to be used as raw water for drinking water.

Based on the above considerations and total values, a slow sand filter was chosen as the technology to be used in clean water treatment at the Gunung Padang Site. The type of sand to be used is silica sand with grain sizes ranging from 0.2 to 0.4 mm and a thickness of up to 70 cm by the requirements set by [9]. The efficiency of slow sand filter removal can be seen in Table 1. below
Table 1. The Efficiency of Slow Sand Filter Removal.

| Treatment Units | Parameter | TSS (mg/l) | TDS (mg/l) | Turbidity (NTU) | Iron (mg/l) | Total coliform (jml coliform/100 ml) |
|-----------------|-----------|------------|------------|----------------|-------------|-----------------------------------|
| Initial Concentration |            | 5350       | 2500       | 280            | 0.57        | 300                               |
| Range Removal | % removal | 99.9%       | 99.9%       | 99.9-99.9%     | 30-90%      | >99%                              |
| SSF | Result | 99%         | 99%         | 99%            | 30%         | 48%                               |
| | Standard | <5000       | 500         | 5             | 0.3          | 0                                 |
| Compliance standard | with | Meet        | Meet        | Meet           | Unmeet      | Meet                               |

Based on Table 1. above, it can be seen that the parameters of iron and total coliform still do not meet the quality standard. The efficiency of iron removal can be increased by varying the filter media's thickness, and the type of filter media used [10]. To reduce the concentration of total coliform or other bacteria, it is recommended to use spring protection facilities or spring catcher facilities following the Minister of Public Works and Housing Regulation No. 27/2016 on the Implementation of a Drinking Water Supply System. These facilities serve to protect springs or water sources from contamination, such as animal waste and other waste.

3.3. Sustainable tourism: local empowerment and destination branding

The Gunung Padang site is the largest megalithic relic in Southeast Asia, with an ancient building area of about 900 m² and a site area of about 3 hectares [11]. The International Council on Monuments and Sites states that cultural tourism includes all experiences that visitors get from a different place from the environment in which they live. In cultural tourism, visitors are invited to get to know the local culture and community, local sights, values and lifestyles, museums and historical places, performing arts, traditions and culinary delights from the local population or indigenous communities [12]. Therefore, cultural tourism development cannot be separated from the management of cultural assets that become an attraction. This is one of the things that is considered in the development of cultural tourism destinations.

According to Law No. 10 of 2009 concerning Tourism, Tourism Destinations are geographic areas located in one or more administrative areas in which there are tourist attractions, public facilities, tourism facilities, accessibility, and communities that are interrelated and complement the realization of tourism. Mount Padang Megalithic Site is a place that has a cultural tourist attraction. The tourist attraction lies not only in Mount Padang's archaeological site but also in other supporting attractions, including the culture of the local community and people who still make this site a ritual place for worshipping the Old Sundanese beliefs.

The Gunung Padang Megalithic Site is located in Campaka Subdistrict, which is included in the RIPPDA 2009-2013 Cianjur Regency is included in Sub-SKKP II.1. Sub SKKP are grouped based on the area development pockets according to competitiveness, capability and tourism products. Sub-SKKP II.1 is an area for Agro Tourism, including Penyairan Tea Plantation, Nusamba Tea Plantation, PT. Linggasari Ciaharum, Nangka Sand Tea Plantation, and Gunung Padang Site In addition to the main attraction of Mount Padang, around this site, there is the Lampegan Station and Tunnel, which is the first station and the first railway line connecting Bandung with Jakarta before the Padalarang train line was built. This train functioned in 1879 – 1882.
This site is being planned to become a tourist destination, but currently, the planning stage has not been completed, the number of visitors has increased dramatically [11]. Meanwhile, infrastructure, such as roads, restaurants and other supporting facilities, are incomplete. There has been the construction of facilities such as the construction of an information center, ticket booths and viewing towers. The restaurant is only available on weekends. Infrastructure such as police posts or health posts have not been built in this area. The existing infrastructure is still inadequate and in an inadequate condition.

The Gunung Padang Megalithic Site consists of crushed columnar joints of andesite rock cemented by clay. According to data obtained during excavation, drilling, geoelectricity, georadar, and seismic tomography are carried out independently and integrated by the research team, and there is a lava body at a depth of 15 meters. This lava body shows the natural formation of the Padang volcano. Human cultivation such as in Gunung Padang, indicated by the position of the rock column which is well arranged almost parallel to the layer plane, whereas the orientation of the column joints is perpendicular to the direction of magma/lava flow. Also, there is a matrix between the stone columns at Gunung Padang. The Gunung Padang Megalithic Site is classified as a cultural tourism site, a subcategory of the young megalithic Stone Age [7].

Ensuring the sustainability of Gunung Padang is in the interests of the communities surrounding the site. The gift that is owned must be preserved so that it will exist and last; be pride and donation to the World. The development of the site must accommodate the interests of the community, so this research in Civil Engineering then focuses on measuring the stability of the slope to ensure the safety of the site area. The Environmental Science Study also confirms the availability of water sources, which happen to be in the site area, which is also a source of water for the community.

According to the WTO, sustainable tourism should:

1. Make optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity.
2. Respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance.
3. Ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation.

Ensuring that the sustainability of tourism in Gunung Padang can be achieved by maintaining the natural and social environment in a balanced manner. Mount Padang has long been sacred and used as a place of worship. The recommended destination branding is a myth that the site is over forty thousand years old and may contain a technology level that hitherto has not been able to dismantle and understand. For the people around us in particular and Indonesia in general, this site's existence is part of the builders of the image and self-esteem that our ancestors had high culture since thousands of years ago.

One of the explanations for the concept of sustainable tourism stated on the WTO website is facilities. Facilities are critical in tourism development, which in turn can develop the economy at large. According to the WTO website, he study was presented at the T20 Ministers’ Meeting in Merida taking place in Mexico, and in the Declaration issued by the Tourism Ministers of the G20 (T20) calling for priority to be given to facilitating travel as a means to boost economic growth and create jobs and led to the recognition by the G20 world leaders of the importance of Travel and Tourism as a driver of jobs growth and economic recovery in the G20 Leaders Declaration.

In this case, the sustainability of the Gunung Padang site is capital for the community. Not only so that people get economic benefits, but more significant than that, the benefit is self-esteem. Pride. Identity. Therefore, the site sustainably' existence and maintenance are ensured to protect from landslides that might bury all of that pride.

The recommended destination branding for Gunung Padang is the Mystery Mega pyramid to show a gimmick and also promise a fluttering feeling that visitors will enjoy. It builds pride that an older and greater culture was once here. Generate an inquiry to uncover what is behind all the charming stone
columns that are now scattered about. Furthermore, according to a paleo-megathrust expert from Bakrie University, "researching Gunung Padang is an attempt to uncover the civilization and history of disasters in the past for knowledge of mitigation in the present".

4. Conclusion
The safety of the site environment by preventing landslides from occurring is an effort to conserve the site itself and ensure the safety of visitors and the surrounding community. Therefore, we recommend implementing soil bioengineering (planting vegetation) to maintain and strengthen the slope stability, prevent erosion, and reduce infiltration and runoff through its roots that bind the soil skeleton. On the other hand, the availability of a quantity and quality water supply is also to maintain the comforts of visitors, but also has more significant benefits for the communities around the site, by using HDPE Pipe with diameter 32 mm and gravity system and also using a slow sand filter for the water treatment technology. Furthermore, for the destination branding we recommend for Gunung Padang using a unique name, Mystery Mega pyramid shows a gimmick and promises a fluttering feeling that visitors will enjoy. It builds pride that an older and greater culture was once here. By preserving the natural environment, the surrounding community must get the maximum benefit from this site's existence. For the wider community's culture and knowledge, this site is one of the legacies of the past that may be a lesson for the future as well as a rich and capable Indonesian cultural identity.

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