

Geotourism Development in Post-Mining Area

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Abstract: Generally, the morphology of the post-mining area is steep slopes. Based on geotechnical considerations, the area is no longer allowed for mining areas, because the potential for landslides is very high. The development of the natural potential of the post-mining area in the research area is a geotourism area in the form of outcrops of pumice breccias and karst areas. The positive impact on society is the opportunity to get a job or business opportunity in providing services. Geotourism is a sustainable nature tourism activity with a main focus on the geological appearance of the earth's surface in order to encourage environmental and cultural understanding, appreciation and conservation as well as local wisdom. The concept of geotourism emphasizes the beauty, uniqueness and rarity of a natural phenomenon that is closely related to geological phenomena. The results of the study indicate the potential for geotourism includes views of geological structures, stratigraphy, topography, rock types. Regional planning of geotourism is the making of a grand design for geotourism facilities and infrastructure, including a rock museum in the open air, gazebo, jogging track, hiking track, bicycle track, camping area, and viewpoint.

Key words: Geotourism, geology, grand design, community empowerment, post-mining.

1. Introduction

Over the last decades geotourism has become a dynamically developing branch of tourism. Geotourism has increased rapidly by more than 20% per year [1, 2]. The geotourism model is as follows: environmentally responsible, visits to natural areas that are relatively undisturbed, enjoying and appreciating nature including cultural features, promoting conservation, having an important impact on visitors, and beneficial socio-economic involvement for local communities [3, 4]. Other researchers state five basic functions of geotourism, namely: (a) conservation of natural areas, (b) education, (c) receiving user fees, (d) quality tourism, and (e) local participation [4, 5]. Many other researchers point out that geotourism is based on natural tourism, which is sustainably managed, including environmental education and supporting conservation [6-9]. The post-mining area has the potential to become a geotourism area [10-12].

2. Objective

The concept of area utilization uses the overlay method [13] to determine geotourism areas. There are many models of utilization of post-mining areas [14, 15], but in this study the utilization is as a geotourism area. Research has a publicity impact so tourists visit the post mining area. This research requires planning to arrange natural tourism locations. The research objectives are: (a) determining the geotourism area in the post-mining area, (b) planning the designation of the geotourism area.

Based on the objectives of this study, it can solve the problem of determining and planning tourism in the post-mining area of pumice breccia in a comprehensive manner.

3. Methods and Material

The research methods include: stratigraphic analysis, geological structure, landscape, groundwater, soil types, the feasibility of hill views and social mapping. In addition, interviews with respondents for scoring self-assessment calculations. Interview data are in the form of geological and social information for the geotourism development database. This research was

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conducted in the Bukit Bucu area of Bantul Regency, Yogyakarta Special Region, Indonesia. The determination of the geotourism area in this study is based on weighting the parameters of landscape, stratigraphy, geological structure, groundwater, and soil type (not discussed in this paper).

Bukit Bucu is part of a stretch of hills with pumice breccia as a constituent rock. The diversity of geological structures stretches along the hill and surrounds the landscape of the Bukit Bucu area. Making topographic maps using drones to determine the boundaries of the area and the landscape as a geotourism area, the mapping activity resulted in a situation map to find out the stretch of the landscape in the Bukit Bucu area (Fig. 1).

Researchers found dacitic pumice breccia as a constituent of Bukit Bucu. The local formation of this area is the Semilir Formation, which is Tertiary, Lower-Middle Miocene, consisting of volcanic material. The geological structures in the Bukit Bucu area are faults, joints and fractures. Past tectonic processes in several periods have caused fault structures in the study area. Fig. 2 shows the geological map of Bucu Hill.

The Bukit Bucu area is a wavy plain area with a slope of 8-15%, 25-40%, and > 40% (Fig. 3).

Fractures are the media of entering and leaving water in rocks as part of the subsurface water or groundwater system. Fracture becomes a secondary porosity system

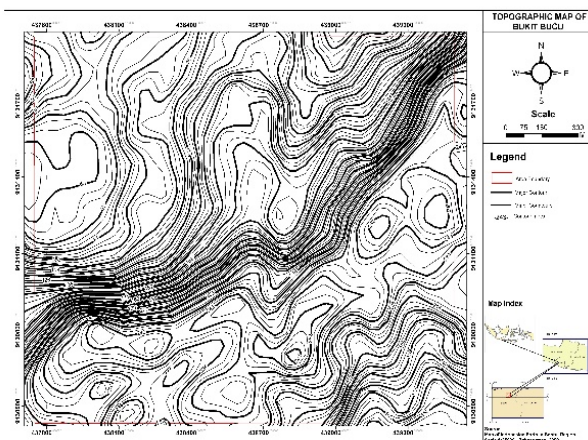


Fig. 1 Topographic map of Bukit Bucu.

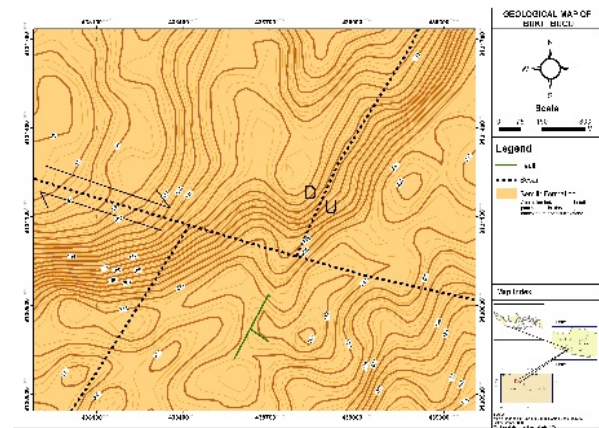


Fig. 2 Geological map of Bukit Bucu.

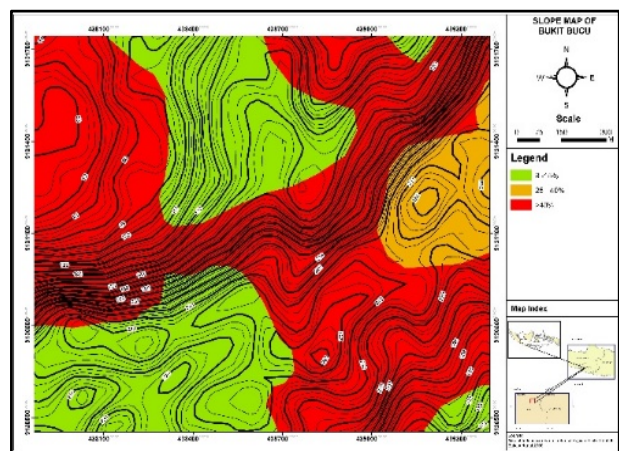


Fig. 3 Slope map of Bukit Bucu.

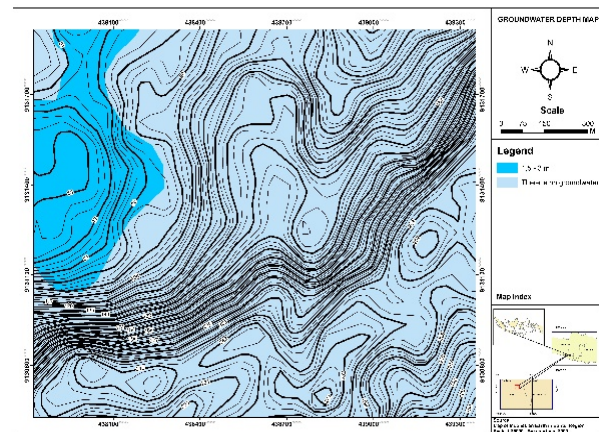


Fig. 4 Groundwater depth map.

for rocks and is part of an important subsurface water system in Bukit Bucu and its surrounding areas. Fig. 4 shows a map of the groundwater level depth.

Soil type in the research area is latosol. Fig. 5 shows a map of soil types.

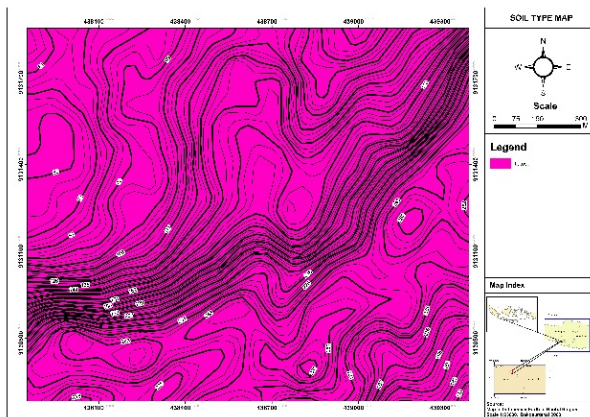


Fig. 5 Soil type map.

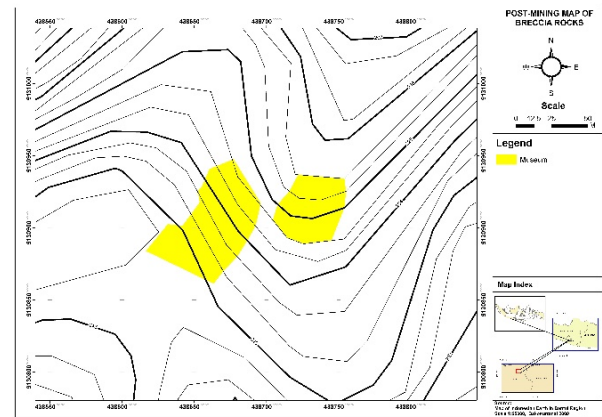


Fig. 7 Post-mining map of breccia rocks.

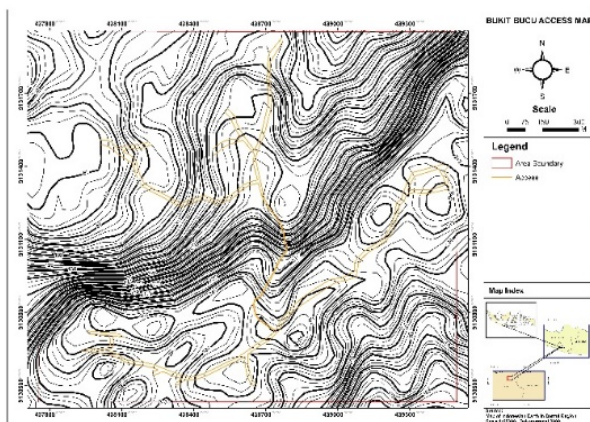


Fig. 6 Bukit Bucu access map.

The development of the potential of Bukit Bucu as a geotourism destination takes into account the following aspects: access, landscape, geological structure, availability of space, wealth of geological phenomena, and community culture. Bukit Bucu access is easily accessible from the nearest town using two-wheeled or four-wheeled vehicles with very good entrances. Fig. 6 shows the Bukit Bucu access map.

The landscape (geomorphology) of Bukit Bucu has natural beauty with green trees and wide views.

The pumice breccia rock forming Bukit Bucu is a post-mining area that forms natural carvings. The morphology makes the natural beauty of Bukit Bucu. Fig. 7 shows the post-mining map of breccia rocks.

The geological structure of the joint forms a systematic pattern in the rock. These joints form various sizes of rock blocks. Sheeting joints give the impression of rock in the form of sheets.

The availability of space at the top of Bukit Bucu allows accommodating many visitors to be used as camping ground. The path to Bukit Bucu has a choice of access routes that are gentle and rather steep. The impression of a steep area becomes learning about landslides from rocks, thereby increasing understanding of geological phenomena. The availability of supporting facilities in the form of a gazebo, viewing post, and enjoying the cultural richness of the community can increase visitor interest.

In the aspect of community empowerment, geotourism has the opportunity to create jobs for local communities. This geo-tourism also creates awareness of visitors and the surrounding community about the importance of preserving the natural environment.

4. Result and Discussion

Statistical tests and feasibility analyses determine the appropriate selection of geotourism areas (not discussed in this paper). The lithology of the geotourism of Bukit Bucu is dacite pumice breccia. Morphologically, this area is a hilly area with a very steep slope (> 40%).

The naturally formed space structure is suitable for areas for jogging, hiking and mountain biking. This tour has the opportunity to provide added value to various culinary products of the local community.

The scenery in the Bukit Bucu area is the object of photography and a potential camping ground (Fig. 8).

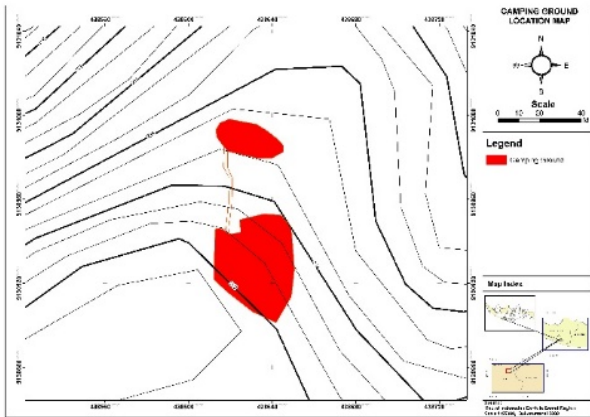


Fig. 8 Camping ground location map.

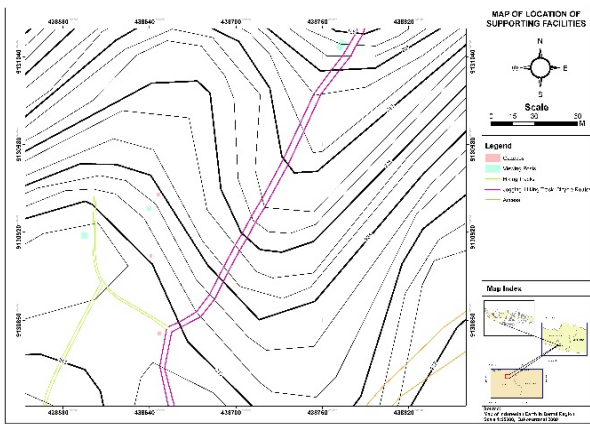


Fig. 9 Map of location of supporting facilities.

The surrounding natural scenery and the beautiful view of Bukit Bucu have the potential for tourists to attract natural beauty, so a viewing post needs to be built.

The construction of a gazebo as a rest point or ensemble point is needed by tourists who are resting in the Bukit Bucu area. The tourism potential in this research area can be related to the tourists' penchant for natural beauty, fresh air in the hill area, the wonders of animal life, species of animals and rare plants.

Geotourism education in this area is a combination of various interests towards environmental, economic and social concerns. Eco-friendly tourism in the area is the activity of seeing, watching, studying, admiring nature, flora and fauna. Tourists have the potential to participate in fostering the preservation of the natural environment by involving local residents.

Developing geotourism in Bukit Bucu requires cooperation between the central government, local governments, and communities around the geotourism object. The concept of tourism development in this area is all activities and coordinated efforts to attract tourists, provide all infrastructure and facilities, fulfillment of goods and services and facilities needed to serve tourists (see Fig. 9).

This tourism industry paradigm is marked by the rapid growth of tourist interest in returning to nature. The growing interest has opened up opportunities for the development of geological tourism.

Analyses of the conditions and development of geotourism for sustainable development are:

- (a) natural considerations;
- (b) land use optimization considerations;
- (c) fairness considerations;
- (d) compensation considerations;
- (e) regional arrangement.

The development of the geotourism area as a sustainable development considers the following aspects:

- (a) things that attract tourists;
- (b) facilities required;
- (c) infrastructure;
- (d) transportation;
- (e) hospitality;
- (f) capital.

Fig. 10 shows a map of the location distribution of geotourism in the Bukit Bucu area.

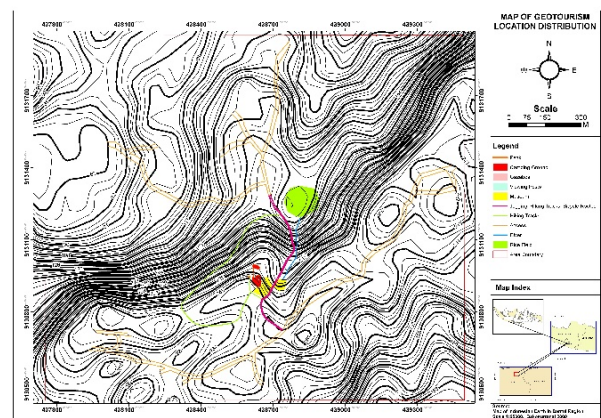


Fig. 10 Map of geotourism location.

The surrounding community from the Bukit Bucu area can leave the mining business illegally. The development of the geotourism area has the potential as a survival strategy. The surrounding community takes advantage of the geotourism location by creating jobs and trying to improve the family economy.

5. Conclusion

Based on the results of research on Bukit Bucugeotourism, it can be concluded:

(1) The potential for geotourism in Bukit Bucu which can be used as a tourist attraction includes geological structures, stratigraphy, morphology, and rock types. This geotourism phenomenon is interesting in the following aspects:

- natural geological science information;
- attraction diversity in one area;
- beauty, authenticity, scientific value and uniqueness of nature;
- natural ecosystem and environmental conservation.

(2) Completeness of facilities and infrastructure for geotourism includes natural museums, camping areas, jogging, hiking tracks, bicycle routes, gazebos, and viewing posts.

References

- [1] Ríos, C. A., Amorocho, R., Villarreal, C. A., Mantilla, W., and Briggs, A. 2020. "Chicamocha Canyon Geopark Project: A Novel Strategy for the Socio-economic Development of Santander (Colombia) through Geoeducation, Geotourism and Geoconservation." *International Journal of Geoheritage and Parks* 8: 96-122.
- [2] Cope, M. A. 2016. "Derbyshire Geodiversity, Historical Geotourism and the 'Geocommercialisation' of Tourists: Setting the Context of the Castleton Blue John Stone Industry." *Proceedings of the Geologists' Association* 127: 738-46.
- [3] Geert, F. V. 2019. "The Uses and Challenges of the Geopark Label as a Place Branding Tool. The Case of the Geopark of the Tremp Basin-Montsec (Catalonia-Spain)." *International Journal of Geoheritage and Parks* 7: 72-84.
- [4] Ross, S., and Wall, G. 1999. "Ecotourism: Towards Congruence between Theory and Practice." *Tourism Management* 20: 123-32.
- [5] Buckley, R. 1994. "A Framework for Ecotourism." *Annals of Tourism Research* 21: 661-9.
- [6] Chylińska, D., and Kołodziejczyk, K. 2018. "Geotourism in an Urban Space?" *Open Geosciences* 10: 297-310.
- [7] Lascuráin, C. H. 1996. "Tourism, Ecotourism, and Protected Areas: The State of Nature-Based Tourism around the World and Guidelines for Its Development." *IUCN Publications Cambridge* 4: 10-21.
- [8] Niemiec, D., Duraj, M., Marschalko, M., and Yilmaz, I. 2016. "Conservation of Selected Churches in the Most Region and Karviná Region and Their Significance for Geotourism." *Procedia Engineering* 161: 2276-81.
- [9] Kubalikova, L. 2013. "Geomorphosite Assesment for Geotourism Purposes." *Czech Journal of Tourism* 2: 80-103.
- [10] Bargawa, W. S. 2014. "Kajian Lingkungan Hidup Strategis Sektor Pertambangan." *Prosiding Seminar Nasional Kebumian* 9: 1-13. (in Indonesia)
- [11] Bargawa, W. S., and Wibowo, A. 2012. "Kontribusi Pendapatan Regional Hijau Dari Industry Pertambangan Mineral Terhadap Pendapatan Regional." *JIK Tek Min* 23: 358-67. (in Indonesia)
- [12] Bargawa, W. S. 2010. "Model Reklamasi Pada Lahan Bekas Penambangan Biji Htimah." *JIK Tek Min* 24: 49-60. (in Indonesia)
- [13] Bargawa, W. S. 2015. "Model Zonasi Untuk Kawasan Pertambangan Mineral Logam Dan Batubara." *Prosiding Seminar Nasional Kebumian* 8: 1-12. <http://eprints.upnyk.ac.id/id/eprint/19586>. (in Indonesia)
- [14] Aditya, M. T., Bargawa, W. S., and Cahyadi, T. A. 2019. "Pemanfaatan Pit Lake Sebagai Program Pascatambang." *Seminar Nasional Sainsdan Teknologi Terapan*, 551-6. (in Indonesia)
- [15] Bargawa, W. S., Sucahyo, A. P. A., and Andiani, H. F. 2019. "Design of Coal Mine Drainage System." *E3S Web of Conference* 76: 1-6. (in Indonesia)