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## Abstract

*Indonesia is known to the world as the "Emerald of the Equator", because of its abundant natural wealth that includes varieties of biological and non-biological resources (geological resources) which are widely spread throughout the archipelago, both in land and water. The Bukit Biru area is known as a fertile area and holds a variety of potential, either from geodiversity, biodiversity and also cultural diversity. Based on those matters, it has the potential to become one of the areas for geotourism prospect location and make it a new creative geotourism area in Indonesia. This area has a geological condition that is dominated by structural landscapes and fluvial plains composed of Medium Sandstone units to very fine sandstone units and alluvial deposits. The research method used is a quantitative assessment of geosite and geomorphosite assessment based on the parameters of a scientific approach, educational value, economic value, conservation value and additional value. The research is divided into 3 stages, namely pre-field, field and post-field. Based on the research, there are 3 geosites, namely Bukit Biru Waterfall, Bukit Biru Summit and Taman Arum. Each geosite is described with detailed location, feasibility value and geological review, as well as tourist attraction products. Improvement of the infrastructure for each geosite needs an increase to create a comfortable tourist attraction as well as to improve the economy of the people in Bukit Biru area.*

*Keyword : Geology, Geotourism, Bukit Biru, Geosite and Geomorphosite*

## INTRODUCTION

Bukit Biru area is known as an area that has various potentials in terms of geodiversity, biodiversity and cultural diversity. It makes Bukit Biru as a potential geotourism area in Indonesia. The diverse potential of geotourism areas owned by Kutai Kartanegara, geological sites (geosites) in the area should be introduced to the outside world with a background of geological knowledge so that later it is hoped that the state of geotourism in the area studied will be very good if developed with knowledge earth through a geological park (geopark). Therefore, this study intends to determine the potential of geosites in Bukit Biru, Tenggarong, Kutai Kartanegara Regency, East Kalimantan Province.

## GEOLOGY OF RESEARCH AREA

The geological condition of the research area consists of three rock units, such as sand deposits, Bukit Biru Sandstone, and Loa Kulu Sandstone. The geomorphology of the research area consists of two original forms, namely structural and fluvial origin with hilly structures, alluvial plains and river bodies (Sodikin et al, 2021).

## SPECIES BIODIVERSITY OF RESEARCH AREA

In research area, there are 2 (two) species of biodiversity that can be observed, namely *Bothrobelum Rugosum* (Fig. 1) and *Eutropis Multifasciata* (Fig.2) (Sodikin et al, 2021).

**a)** ***Bothrobelum Rugosum***

Figure.1. *Bothrobelum Rugosum* species

This species is native of the Borneo forest of which is similar to a millipede, but is relatively short in stature compared to most other millipedes, with only eleven to thirteen body segments and capable of rolling into a ball when disturbed, as a defense against predators. They can also secrete noxious fluids, which may be caustic and toxic, to repel predators. Bothrobelum Rugosum are detritivores (getting nutrients by consuming rotting plants/plants or faeces), eating decaying plant matter, usually found in the humid forests of Borneo. Kingdom Animalia, Phylum Arthropoda, Subphylum Myriapoda, Class Diplopoda, Order Sphaerotheriida, Family Zephroniidae, Genus Bothrobelum, Species Bothrobelum Rugosum.

b) ***Eutropis Multifasciata***

Figure 2. *Eutropis Multifasciata* species

This species is a small lizard, the size is as big as a big toe with a length of between 18 to 22 cm with 60% of its length being the length of the tail. The head is pointed with a very short neck. The body shaped is square. The upper body is dark brown or glossy grayish brown with golden sides near the neck. Sometimes also decorated with small black and/or pale spots on the back and sides of the body. The lower neck is light brown and the abdomen to the anus is pale brown. Muzzle/lips mouth reddish. The tail is the same color as the body, with a faint dark line on the side of the tail. The arms and legs are also the same color as the upper body. These lizards are usually found on the forests edge, gardens, waterfalls, and rice fields. Kingdom Animalia, Phylum Chordata, Subphylum Vertebrata, Class Reptilia, Order Squamata, Family Scicidae, Genus Eutropics, Species Eutropic Multifasciata.

## RESEARCH METHODS

This potential analysis uses 3 stages. The first stage is a literature study on the geological conditions of the research area. The second stage is collecting field data in the form of primary data in the form of documentation and secondary data in the form of images. The third stage is calculating the feasibility of the geosite based on the quantification method contained in the table according to Kubalikova, 2013.

**Table 1.** The value of the quantification analysis based on the geosite and geomorphosite analysis (Kubalikova, 2013)

| ***Scientific Approach and Intrinsic Value*** | | ***Value*** |
|---|---|---|
| Integrity (A) | Badly Damaged Site | 0 |
| | Damaged Site with Recognizable abiotic environments | 0.5 |
| | *Undamaged Site* | 1 |
| Peculiarity/Uniqueness (Number of Sites with similarities) (B) | More than 5 | 0 |
| | 2 – 5 | 0.5 |
| | 0 | 1 |
| Diversities (Number of different Geomorphic processes that produce various features to the site) (C) | Only 1 recognizable feature/process | 0 |
| | 2 – 4 Recognizable Features | 0.5 |
| | More than 5 Recognizable Features | 1 |
| Has the Site Been Scientifically Published and Recognized? (D) | *Site* tidak diketahui | 0 |
| | Pada paper ilmiah setingkat nasional | 0.5 |
| | Diketahui secara luas oleh masyarakat global | 1 |
| ***Educational Value*** | | ***Value*** |
| Representatives, Conspicuousness of processes and features (A) | Low Representative or Non-Conspicuous | 0 |
| | Medium Representative (Recognizable by Academics) | 0.5 |
| | High Representative (Recognizable by public) | 1 |
| Pedagogical Use (B) | Low Character Value with no pedagogical element | 0 |
| | Medium Character Value with limited pedagogical element | 0.5 |
| | High Character Value and pedagogical element, high geo-tourism aspect | 1 |
| Is there any education product on site? (C) | No Informational guidance | 0 |
| | Leaflets, maps, websites | 0.5 |
| | There are information panels on site | 1 |
| Actual site utilization for educational purpose (D) | No actual utilization for education | 0 |
| | Used for fieldtrip or excursion limited for students | 0.5 |
| | Public place for Tourism | 1 |
| ***Economic Value*** | | ***Bobot*** |
| Accessibility , (A) | More than 1 km from parking area | 0 |
| | Less than 1 km from parking area | 0.5 |
| | More than 1 km from public transportation transit | 1 |
| Supporting infrastructure for tourism, (B) | More than 10 km from existing tourism facilities | 0 |
| | 5-10 km from existing tourism facilities | 0.5 |
| | Less than 5 km from existing tourism facilities | 1 |
| Related local products (C) | No local product related to site | 0 |
| | Some local product related to site | 0.5 |

**Table 1.** The value of the quantification analysis based on the geosite and geomorphosite analysis (Kubalikova, 2013)

| ***Scientific Approach and Intrinsic Value*** | | ***Value*** |
|---|---|---|
| | Shopping center for Particular product | 1 |
| ***Conservation Value*** | | ***Bobot*** |
| Actual risks (e.g. flood in fluvial area), (A) | High Threatening Risk (both natural and artificial risk) | 0 |
| | Disturbing risk | 0.5 |
| | Low risk and even with no serious threat | 1 |
| Potential risk (has yet to happen) (, (B) | High Threatening Risk (both natural and artificial risk) | 0 |
| | Disturbing risk | 0.5 |
| | Low risk and even with no serious threat | 1 |
| Latest site status (C) | Impairment has been happening | 0 |
| | Damaged site with prevention management | 0.5 |
| | No signs impairment | 1 |
| Legal Protection for site (D) | No Legal Protection | 0 |
| | Submission Step for Legal Protection | 0.5 |
| | There is Legal Protection for Site Conservation | 1 |
| ***Additional Value*** | | ***Bobot*** |
| Cultural, Religious, and Historical Value of the site (A) | No Cultural Value | 0 |
| | Cultural Value with no significant relation to abiotic elements | 0.5 |
| | Cultural value with significant relation to abiotic element (mystical) | 1 |
| Ecology Value (B) | Irrelevant because of lack of organism | 0 |
| | Relevant but not too important | 0.5 |
| | Geomorphic aspect influences the surrounding ecology | 1 |
| Colors (C) | 1 color | 0 |
| | 2-3 colors | 0.25 |
| | More than 3 colors | 0.5 |
| Aesthetics (D): | Only 1 pattern | 0 |
| | 2 or 3 differentiable patterns | 0.25 |
| | More than 3 patterns | 0.5 |
| Space Structure and Views (E) | No view | 0 |
| | 1-2 views | 0.25 |
| | 3 and more views | 0.5 |

## RESULT AND DISCUSSION

The result from field observations, there are 3 geosites located in the Bukit Biru area, Kutai Kartanegara Regency, East Kalimantan. Each geosite is described in detail about the location, the value of the quantification analysis based on the geosite and geomorphosite analysis tables (Kubalikova, 2013), geological reviews and tourist attraction products. The following are the results of the description of each geosite;

**Table 2.** Bukit Biru Area Geosite and Geomorphosite Analysis Tables

| Parameters | Bukit Biru Waterfall | Bukit Biru Summit | Taman Arum |
|---|---|---|---|
| ***Scientific Approach and Intrinsic Value*** | | | |
| A | 1 | 0,5 | 0,5 |
| B | 1 | 1 | 1 |
| C | 0,5 | 1 | 0,5 |
| D | 0 | 0 | 0 |
| (%) | 62,5 | 62,5 | 50 |
| ***Educational Value*** | | | |
| A | 1 | 0,5 | 0,5 |
| B | 1 | 0,5 | 0 |
| C | 0,5 | 0,5 | 0,5 |
| D | 1 | 1 | 1 |
| (%) | 87,5 | 62,5 | 50 |
| ***Economic Value*** | | | |
| A | 0,5 | 0,5 | 0,5 |
| B | 1 | 1 | 1 |
| C | 0,5 | 0 | 0,5 |
| (%) | 66,7 | 50 | 50 |
| ***Conservation Value*** | | | |
| A | 1 | 0,5 | 1 |
| B | 0,5 | 0,5 | 0,5 |
| C | 1 | 0,5 | 1 |
| D | 0,5 | 0,5 | 0,5 |
| (%) | 75 | 50 | 75 |
| ***Additional Value*** | | | |
| A | 0,5 | 0,5 | 0 |
| B | 1 | 1 | 1 |
| C | 0,5 | 0,5 | 0,5 |
| D | 0,5 | 0,5 | 0,5 |
| E | 0,5 | 0,5 | 0,5 |
| (%) | 75 | 75 | 62,5 |
| **Total (%)** | **73,3** | **60** | **57,5** |

**A) Bukit Biru Waterfall**

This geosite is located at coordinates UTM 50S 497115 E, 9945420 S in the Bukit Biru area, Loa Kulu District, Kutai Kartanegara Regency. It can be reached by land using a motorbike or car, Air Terjun Street, not far from the Sumber Sari Village Office and the Sabilurrosyad Masjid, Loa Kulu. The journey to the waterfall is about 1 km from the crossroads followed by a 150-meter walk, travel time is ±10 minutes, with sloping to steep slope. This waterfall has dimensions of ± 7 meters high and ± 18 meters wide.

Figure 3. Bukit Biru Waterfall, Loa Kulu

Quantification: Table 2 shows the results of geosite and geomorphosite analysis in the form of a scientific and intrinsic approach value of 62.5%, educational value of 87.5%, economic value of 66.7%, conservation value of 75%, and additional value of 75%. Overall, Bukit Biru Waterfall has a feasibility level of 70% to be used as a geotourism place.

Geological Conditions: Bukit Bitu Waterfall is located in a structural hilly area in the Bukit Biru Sandstone Unit. The dominant lithology of this geosite is fine sandstone with a cross-bedding or layered structure, which is part of the Balikpapan Formation.

Tourist attraction products: Bukit Biru Waterfall has a view in the form of a waterfall surrounded by beautiful forests. This place also offers availability of camp sites around the Bukit Biru Waterfall.

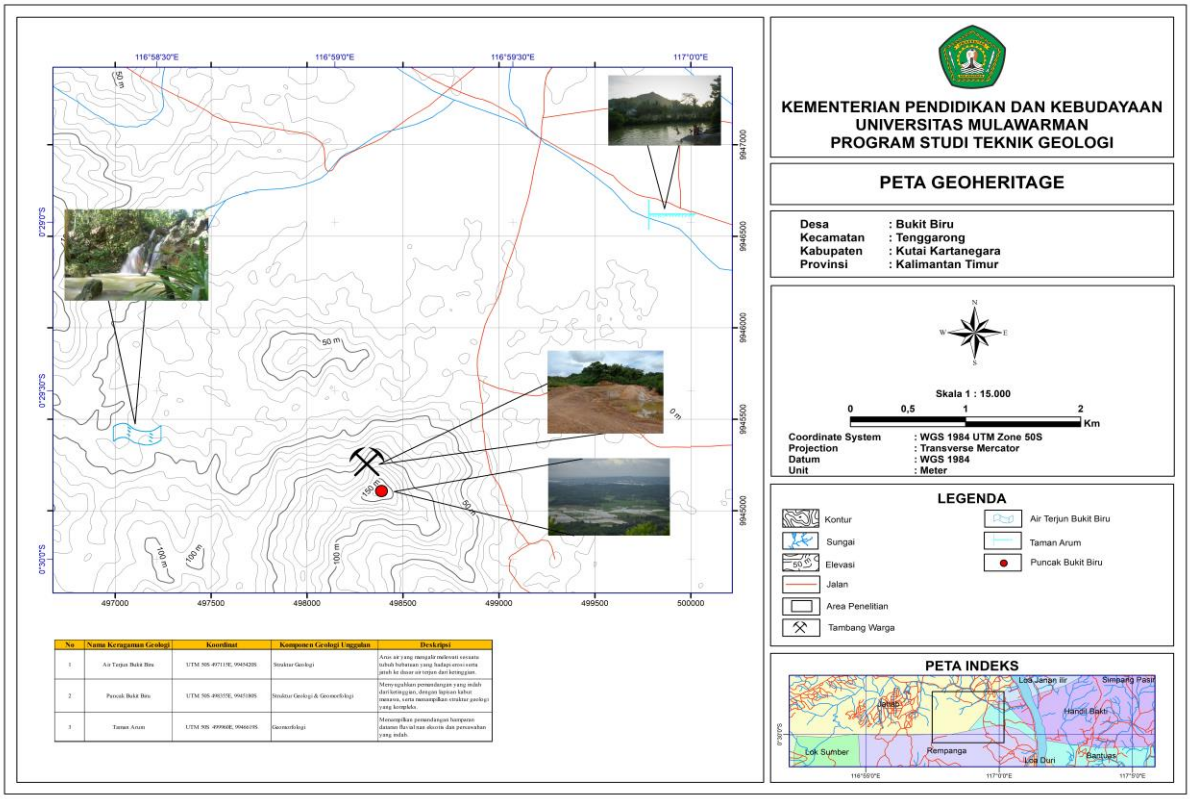


Figure 4. Geoheritage Map of Bukit Biru Area

**B) Bukit Biru Summit**

This geosite is located at UTM coordinates 50S 498355 E, 9945180 S with an elevation of 160 m (from sea level) in the Bukit Biru area, Loa Kulu District, Kutai Kartanegara Regency. It can be reached by land, via Pahlawan street not far from the Sumber Sari Village Office and the Loa Kulu Sabilurrosyad Masjid. The journey to the summit can be reached on foot with a distance of 600 meters, travel time is ± 20 minutes, with sloping to steep reliefs.

Figure 5. View from Bukit Biru Summit, Loa Kulu

Quantification: Table 2 shows the results of geosite and geomorphosite analysis with scientific and intrinsic approach value of 62.5%, educational value of 62.5%, economic value of 50%, conservation value of 50%, and additional value of 75%. Overall, Bukit Biru Summit has a feasibility level of 57.5% to be used as a geotourism site.

Geological Conditions: Bukit Biru Peak is located in a structural hilly area in the Bukit Biru Sandstone Unit. The dominant lithology of this geosite is fine sandstone with a cross-bedding structure and fault breccias which are part of the Balikpapan Formation.

Tourist attraction products: Bukit Biru Summit has a view in the form of a stretch of rice fields surrounded by beautiful hills. The view of the sun rising in the morning and setting in the afternoon. This place also offers the availability of camping sites if tourists want to camp at the top of the hill.

**C) Taman Arum**

This geosite is located at coordinates UTM 50S 499960 E, 9946619 S in the Bukit Biru area, Loa Kulu District, Kutai Kartanegara Regency. It can be reached by land by motorbike or car through Pahlawan Street. The journey to Taman Arum is about 50 meters from the roadside, travel time is ±15 minutes from the Sumber Sari Village office, with flat to sloping reliefs. The area of Arum Park is ±0.3 Ha or ±3000 m2.

Quantification: Table 2 shows the results of geosite and geomorphosite analysis in the form of a scientific and intrinsic approach value of 50%, educational value of 50%, economic value of 50%, conservation value of 75%, and additional value of 62.5%. Overall, Taman Arum has a feasibility level of 57.5% to be used as a geotourism place.

Geological Conditions: Taman Arum is located in a fluvial plain area which is in a fluvial deposit unit. The dominant lithology of this geosite is loose material in the form of silt and clay, which is part of the Alluvium Formation.

Figure 6. Taman Arum Bukit Biru, Loa Kulu

Tourist attraction: Taman Arum has a view in the form of Bukit Biru Summit, surrounded by plantations and beautiful rice fields. The water that flows from the top of the blue hill makes a lake in this Taman Arum.

## GEOLOGICAL HERITAGE OF STUDY AREA

The distribution of geological indications that can be developed into geotourism in the Bukit Biru area is spread over several areas which can be seen in the following table:

**Table 3.** Geoheritage distribution in Bukit Biru Area

| No | Place | Relief | Morphology | Morphogenesis |
|---|---|---|---|---|
| 1 | Bukit Biru Waterfall | Bumpy with steep slope topography | Hills with steep slope | Joints on moderately resistance-lithology, influenced by erosion |
| 2 | Bukit Biru Summit | Eroded hill with very steep slope topography | Structural hillside with very steep slope | Strike-slip fault on moderately resistance lithology, influenced by erosion |
| 3 | Taman Arum | Flat topography | Fluvial plains | Weakly resistance lithology, influenced by erosion and weathering |

Based on the table above, there are 3 places that have the potential as geological heritage: Bukit Biru Waterfall, Bukit Biru Summit, and Taman Arum. Waterfalls with wavy reliefs and steep slopes and have a geological structure in the form of joints on moderately rock resistance and is nfluenced by erosion processes. The Bukit Biru Summit with structural hillside reliefs with steep slopes contained strike-slip faults with moderately rock resistance and influenced by erosion processes. Taman Arum which has a flat topography in the form of fluvial plains with weakly rock resistance and is influenced by erosion and weathering processes.

With the results of the geosite and geomorphosite analysis, the criteria for geological diversity that have the potential to become a geological heritage (geoheritage) are found in table 2. The results of

the Geosite and Geomorphosite Analysis of the Bukit Biru Area, each of which has a rating of geological heritage that has the potential to become geotourism are: Bukit Biru Waterfall is 73.3%, Bukit Biru Summit is 60%, and Taman Arum is 57.5%. After classifying the geological heritage (geoheritage) based on the measured value parameters, it is necessary to consider the threat of damage/risk of degradation to the geological heritage from natural conditions and human activity factors. Some of these factors are:

a) The location of geological objects is close to human activities, so that it can potentially cause degradation, including the existence of local mines.
b) The level of legal protection and access control in locations or areas around the location of geological objects that have not been proposed or are not included in the Regional Spatial Plan of Kutai Kartanegara Regency.
c) Inadequate accessibility conditions, such as roads and parking lots

## NECESSARY DEVELOPMENT PLAN

Several assessments of geosites in the Bukit Biru area have been carried out. Improvement of the infrastructure for each geosite needs an increase so that it creates comfortable tourist attractions and can improve the economy of the people who live around tourist attractions. Here are some of the necessary developments:

1. Development of infrastructure such as roads, signage, public toilets, and regular parking lots as well as public transportation to tourist attractions.
2. Development of community resources regarding the management of good tourist attractions so that people can become guides or play a role in tourism development in their area.
3. Development and promotion by the government of geotourism attraction in the Bukit Biru area.

## CONCLUSION

From the results of this study using geosite and geomorphosite analysis according to Kubalova in 2013, the criteria for geological diversity that have the opportunity to become geological heritage (geoheritage) are obtained. The results of the Geosite and Geomorphosite Analysis of the Bukit Biru area are Bukit Biru Waterfall with a value of 73.3%, Bukit Biru Summit with a value of 60%, and Taman Arum with a value of 57.5%.

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