

Geoheritage Assessments of Cascades and Waterfalls in Batu Melintang, Jeli, Kelantan, Malaysia

Nursufiah Sulaiman^{1,2,3*}, Siti Nur Adilah Yazizul Rahman², Wan Ahmad Aqil Fahmi Wan Ahmad Khalil¹, Azri Sulaimi Safai¹, and Noorzamzarina Sulaiman^{1,2}.

¹Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan.

²Tropical GeoResource & Hazards Research Group, Faculty of Earth Science, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia

³Natural Heritage & Geoheritage Research Group, Faculty of Earth Science, Universiti Malaysia Kelantan, 17600 Jeli, Kelantan, Malaysia

Abstract. The study area is between a dense forest and a rubber plantation in Kelantan's Jeli District. This study aims to assess the geoheritage values of Lata Hokkaido, Lata Janggut, Marina Waterfall and Lata Bobby. The lithology of the study area is composed of different kind of granitic rock-quartz rich granitoid and alkali feldspar granite, with several enclaves of metamorphic rocks under the subunit of Noring Granite, Stong Migmatite Complex offer. To assess the geoheritage values, the qualitative and quantitative assessment have been carried out. Based on the qualitative assessment, Lata Janggut and Lata Hokkaido have a potential for geotourism sites, as the level of significance were state, whereas the Lata Bobby and Marina Waterfall can be a local level of significance only. On the other hand, the quantitative assessments shown that all four localities have a potential to be a part of geosite based on the survey taken from local people and tourists. It is highly recommended to the authorities to enhance facilities, information and all details about these four localities to be a part of Stong Geopark's geosites.

1 Introduction

This study is located at Kampung Lata Janggut, Kuala Long, Jeli, Kelantan. The study area situated within longitude N 5° 41' 1" to E 101° 44' 39" and latitude N 5° 38' 18" to E 101° 47' 22". The cascades and waterfall are beautiful and captivating with different uniqueness in the Jeli District. The cascades and waterfall are situated in the Batu Melintang, which is sub-district of Kampung Lata Janggut, about 17 kilometres from Jeli Town. It is a tributary of the Pergau River and flows through the Gunung Basor Forest Reserve. A major fault drives the Long River's formation and growth: the Long Fault that runs northeast to southwest along the river.

* Corresponding author: nursufiah@umk.edu.my

A geological concept known as "geoheritage" or "geological heritage" focusses on distinctive, remarkable, and emblematic geological features that are valuable in terms of geoheritage (have a geoheritage value) [1]. Malaysia, a nation rich in geoheritage resources, is renowned for its proactive conservation and development efforts. According to [2], the Third Malaysian Plan (1976–1980) established the necessity of safeguarding geological memorials and landscapes, which marked the beginning of Malaysia's early attempts to conserve its geological resources. The founding of Malaysian Geological Heritage Group in 1998 marks the beginning of deliberate efforts to support geological heritage protection. Since then, majority research projects were subsequently carried out to examine and characterise several geo-heritage sites for growth and maintenance.

Geotourism, or geological tourism, is based on the Earth's geological heritage, whereas geoheritage refers to the valuable geological elements and features. One of the smaller sub-components of tourism that is centred on the geological environment is geotourism [3]. When determining the probable location of geological significance, conditions such as unique occurrence, rarity, and representativeness of specific geological features required measurement [4]. They also classified geological heritage into its scope which are mineralogical site, geomorphological site, hydrogeological site, structural site, petrological site, and others that related to geological characteristic elements. This study aims to assess the geoheritage values of all four (4) waterfalls in Kampung Lata Janggut, namely Lata Hokkaido, Lata Janggut, Lata Bobby and Marina waterfall, located at Kampung Lata Janggut, Kuala Long, Jeli, Kelantan

2 Method and materials

The geoheritage assessment method was based on the qualitative and quantitative approaches. The qualitative method conducted by assessing the study area involved geoheritage and potential of geotourism. The qualitative method was focusing on geoheritage value of the site, mostly the use of their scientific (educational), aesthetic, recreational, economic and functional values as they support geotourism potential principle [5, 6]. Next, the significance level of each site will then be determined based on the geoheritage resources, such as international, national, statewide, regional, and local [4].

On the other hand, the qualitative method focused on the authors own opinion supported by the questionnaire survey. This questionnaire survey was conducted by analyzing and interpreting public opinions on geoheritage and geotourism to support the results from assessment approaches [7]. The questionnaire was collected using a semi-structured questions type. The students, lecturers, geoscience professionals, ecotourist, local, tourists, and public are the survey's target group. The sample of respondents is systematic, which were considering the demographic aspects such as age (13 – 60), gender (female, male), education level (high school, pre-university, degree and doctorate) and origin (local, non-local). The questionnaire was covered with 38 questions ; definition (term), awareness, importance, benefits of geoheritage and geotourism, recognition geological and geomorphological features, and geoheritage values. In total, 50 respondents filled out questionnaires survey distributed via Google forms.

3 Result and discussion

The qualitative assessment of potential geotourism sites in the study area on the basis of geoheritage values and levels of significance (ranking) is summarized in (Table 1). Additionally, the quantitative approach is the numerical assessment related to the need to

numerically assess the geological sites (valuing) or score of the sites. This method was conducted by assessing the potential geoheritage features based on their geodiversity and geoheritage values for potential of geotourism development. This method will be carried out by establish six classes of values: 0 – 5, represents none, very poor, poor, fair, good, very good respectively (Kubalikova, 2013). Table 2 presents the quantitative assessment scores obtained for all sites. Equations should be centred and should be numbered with the number on the right-hand side. This quantitative assessment was supported by the responses from respondents on the questionnaire survey, as shown in Table 3.

Table 1. Qualitative assessment on different geosites.

No.	Geological site	Scientific (and educational) value	Aesthetic value	Recreational value	Economic value	Functional value	Level of significance
1	Lata Hokkaido	Pink megacrysts K-feldspar in granitic rock of Noring Granite	Attractive landscape of cascade area with fresh and clean water	Sightseeing, picnic, camping, barbeques, fishing, jungle trekking, swimming and photography session	Potential to generate income from tourism and recreational activities	As recreational site and breeding freshwater fish activities	State
2	Lata Janggut	The formation and development of the river influenced by a fault	Attractive waterfall, river and rock structure	Sightseeing, picnic, camping, barbeques, jungle trekking, swimming, diving, and floats activities	Potential to generate income from tourism and recreational activities	As tourism and recreational site	State
3	Marina Waterfall	Coarse grained granite dominated with quartz and feldspar	Attractive waterfall	Sightseeing, jungle trekking, and photography session	Potential to generate income tourism activities	-	Local
4	Lata Bobby	Pink megacrysts K-feldspar in granitic rock of Noring Granite	Attractive cascaed and powerfull waterfall	Sightseeing, picnic, barbeques, jungle trekking, swimming and photography session	Potential to generate income tourism activities	-	Local

Table 2. Quantitative assessment on different geosites based on authors’ interpretation.

No.	Geological site	Scientific (and educational) value	Aesthetic value	Recreational value	Economic value	Functional value	Total
1.	Lata Hokkaido	5	5	4	1	1	16
2.	Lata Janggut	5	5	5	2	2	19
3.	Marina Waterfall	5	5	1	0	0	11
4.	Lata Bobby	5	5	4	0	0	14

In total, 50 respondents responded to the questionnaire via google form. From the demographic background in section 1, 68% were women and 32% men (Figure 1). The age distribution was as follows; up to 17-21 years: 12%, 22-25 years: 74%, 26-29% years: 2%, 30 and above: 12%. Regarding education, the structure was the following: 4% respondents with diploma and doctorate level : respectively, 8% respondents with pre-university level and 84% respondents with degree level. The origin; 76% were non-local and 24% were local respondents. As for the groups respondents; 34% were both students and tourist/public, 24% local, 4% ecotourist, and 2% were both lecturer and professional geoscientist.

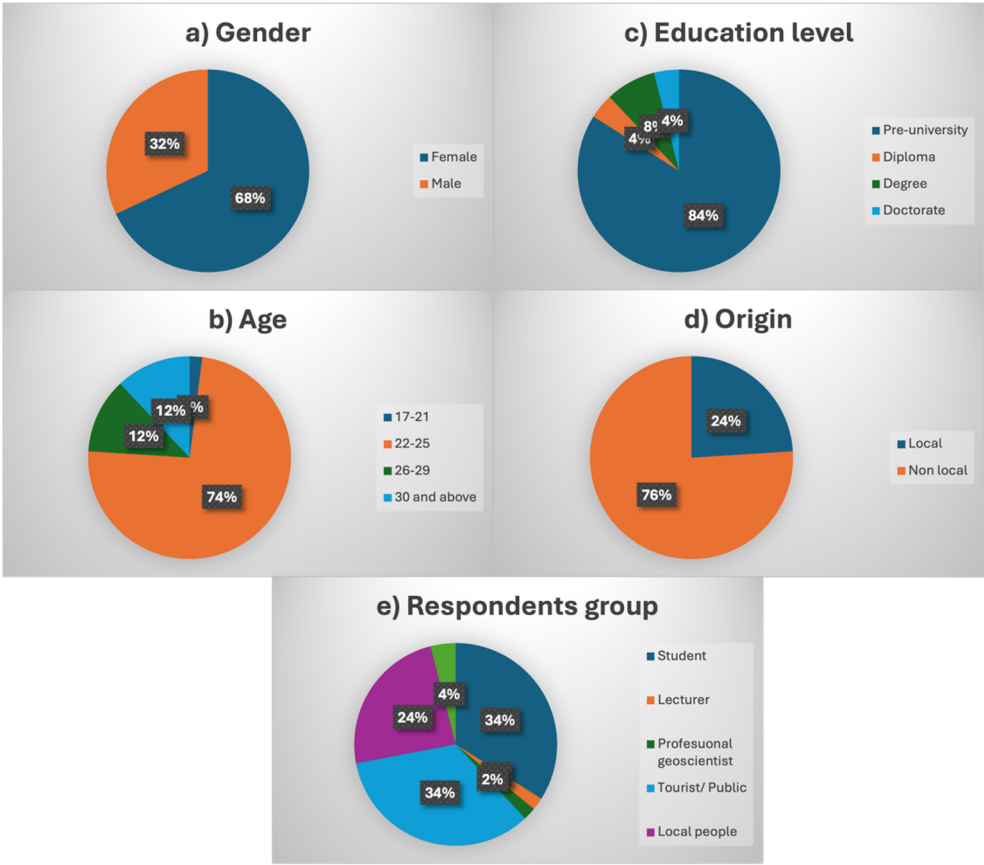


Figure 1. The demographic background of the respondents which was referred as section 1 in questionnaire.

Section 2, was divided into two parts. The first part was focused on the general knowledge of geoheritage, whilst the second part was focused on the geotourism knowledge (meaning, awareness, importance, benefits and recognition) (Figure 2 & 3). From the feedback for first part of section 2, approximately 56% of respondents known and be able to explain the “geoheritage” term (Figure 2); 42% of respondents have heard the term, but do not know its exact meaning meanwhile the remaining respondents (2%) have never heard of the term. About 92% of respondents aware that geoheritage features were existed in their surroundings. However, majority respondents known the waterfall as the geoheritage feature with 82% because of it aesthetically attractive while other features were varied from 50%-78%. The majority of respondents (50%) agree that the protection of geoheritage features is insufficient and 78% strongly agree that the following objects should be protected (karst, waterfall, cave, hot spring, cascade and river).

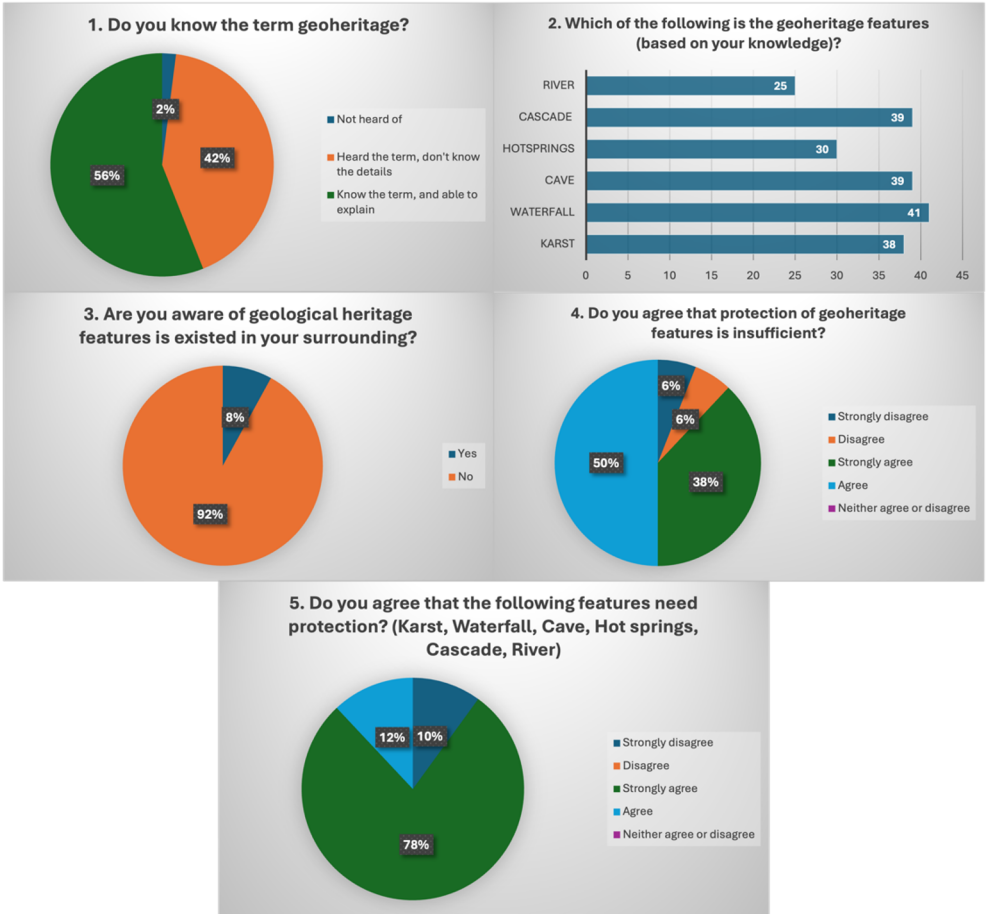


Figure 2. The questions and answers (question 1 to 5) of the respondents’ general knowledge about geoheritage which referred to section 2 in questionnaire.

The second part of section 2 was focused on geotourism knowledge (Figure 3). 75% of respondents have heard "geotourism" term and 22% of respondents claimed to have heard the word, but unsure of its meaning. Only 4% have never heard of it or absolutely do not know what it is. Approximately 58% of respondents strongly agreed the tourism and

recreational activities can generate benefits to local economy growth. 70% of the respondents agreed the karst, waterfall, cave, hot springs, cascade and river features were attractive to them as a tourists. Respondents strongly agreed that student can learnt about “Geoeducation” by non-formal activities such as outdoor learning to the geoheritage sites (e.g., karst, cave, waterfall, river, etc) with 54%.

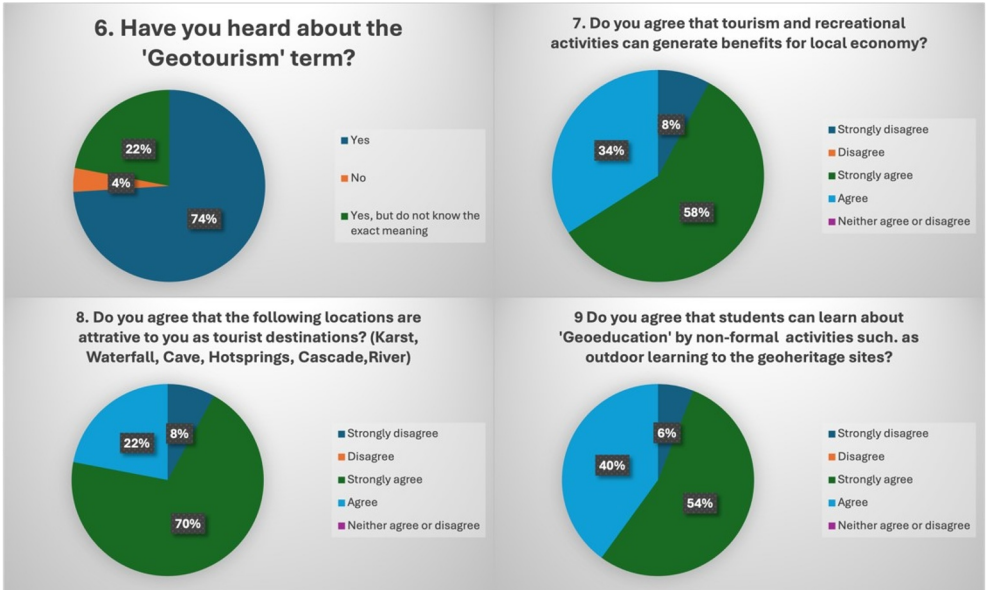


Figure 3. The questions and answers (question 6 to 9) on the second part of the second section were focused on the geotourism’s knowledge of the respondents.

Table 3. Quantitative assessment based on respondents’ perspective.

Questions	Lata Hokkaido	Lata Janggut	Marina Waterfall	Lata Bobby
Do you know any geological background of this waterfall? Type of rocks, landscape etc (Scientific Value)	3	4	0	4
Based on your experience or picture above, do you think this waterfall is beautiful and captivating cascade? (Aesthetic Value)	5	5	4	4
Do you think this waterfall is suitable for recreational spot? (Recreational Value)	4	5	4	4
Do you think this waterfall can generate economy from tourism and recreational activities? (Economic Value)	5	5	4	5
Do you think this waterfall is suitable for tourism and recreational site? (Functional Value)	4	5	4	4
Total	21	24	16	21

Based on the quantitative assessment from authors' perspective (Table 2) and respondents' feedback (Table 3), Lata Janggut shows the highest value, which are 19 and 24 respectively. This is due to the popularity of this sites and it is easy to access. The second site that can be consider as popular area is Lata Hokkaido, which received 16 marks from authors and 21 marks from respondents. Lata Bobby and Marina Waterfall were the least favoritism places as, it is located in the rural area and within the highest elevation- some of the respondents are not even familiar with this waterfall area which give overall marks of 14 from authors, 21 from respondents for Lata Bobby and 11 marks from authors and 16 marks from respondents for Marina Waterfall.

4 Conclusion

The results from qualitative and quantitative assessments show that Lata Janggut have a higher quality of geoheritage site, followed by Lata Hokkaido, Lata Bobby and Marina Waterfall. This result might be influenced by level of development and popularity of these geosites. Lata Janggut have been developed and is a part of recreational area in Jeli, whereas the other waterfall such as Marina Waterfall and Lata Bobby were not really popular among tourists. Nevertheless, based on the quantitative assessment from public- local people and tourists, these four sites can be a part of geosite based on the survey taken. This study suggests the promotion, facilities enhancement and information details need to be develop in order to attract more tourists to these four localities.

References

1. C. D., Prosser, D. R. Bridgland, E. J. Brown, J. G. Larwood, *Proceedings of the Geologists's Association*. **122**, 337-342 (2011)
2. I. Komoo, *Geological Heritage of Malaysia (theoretical framework and assessment of geoheritage)* 221-230 (2004)
3. R. Dowling, *Czech Journal of Tourism* (2013)
4. M. Brocx, V. Semeniuk, *J R Soc West Aust* **90** 53-80 (2007)
5. M. Gray, *Geodiversity: Valuing and Conserving Abiotic Nature*, 434 (2004)
6. M. Gray, *The George Wright Forum* 4-12 (2005)
7. L. Kubalikova, *Czech Journal of Tourism*, **2(2)**, 80-104 (2013)