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To cite this article: N Sulaiman *et al* 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **842** 012019

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Geoheritage Values Assessment in Aring, Gua Musang, Kelantan

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Abstract. The study conducted in the Aring area, with the latitude of 4° 51' 00" N to 4° 58' 17" N and longitude of 102° 19' 24" E to 102° 24' 40" E. Three geological formations existed in this area, namely the Aring Formation, Telong Formation and Koh Formation. The lithology of the Aring Formation includes volcanic rocks such as lapilli tuff, andesite, autobreccia. Other than volcanic, the Aring Formation also consists of limestone, sandstone, and shale. Roughly similar to Aring Formation, the Telong Formation in this area is comprised of Mudstone Unit I, which consists of mudstone, carbonaceous shale, sandstone and tuffaceous mudstone. Koh Formation, however, has quite distinguished lithology and only comprised of sedimentary rocks. The lithology includes conglomerate, sandstone, shale, chert and Mudstone Unit II; carbonaceous lime mudstone and mudstone. Six fossil phyla, namely Echinodermata, Brachiopoda, Cnidaria, Antropoda, Porifera, Mollusca and unidentified trace fossils, were observed in the study as strong evidence of the paleoenvironment of the Aring area. In terms of geoheritage, the fossil occurrences in Aring were determined as regionally significant and essential for that area's regional geology. Fossil is not significant and rare or unique occurrences to classify the fossil occurrences as high rank for geoheritage value. The development of fossil sites over this area can be considered only for educational and scientific purposes. Although fossils were found to be diversely distributed in several locations at Aring, Gua Musang, Kelantan, the levels of significance and value of Total Heritage Value were not high enough to acknowledge the fossils in Aring as a geoheritage potential site.

1. Introduction

Aring is located in Gua Musang, which lies in the southern part of Kelantan, Malaysia. Most of the area is covered by palm oil plantation (FELDA), hillsides, and rivers, including Sungai Aring on the west, Sungai Lebir on the east, and Sungai Koh in the southeast area. In general, Peninsular Malaysia is divided into three belts: Western, Eastern and Central Belt. The Aring area is located in the Central Belt [1]. The age of the Central Belt is known to be in the Paleozoic period, consisting mainly of Permian clastic with some Carboniferous limestone outcrops [2]. These Upper Paleozoic rocks comprise mainly argillaceous, volcanic rocks with some arenaceous and calcareous sediment from shallow marine environments with sporadic submarine volcanism from Upper Carboniferous to Triassic period.

The Gua Musang and Aring Formations, as well as Taku Schist, are all located in Kelantan. As stated by [3], the Kelantan generally has rock units from Ordovician to Cretaceous. In contrast, the southern part of Kelantan, which includes the Gua Musang area, comprises rocks from Middle Carboniferous to the Triassic period. Narrowing down to the Aring area consists of four formations, namely the Aring, Telong, Koh, and Nilam Marble Formations [3].



The conservation and development of geoh heritage in Malaysia are widespread, as promoting the geoh heritage was initiated by the Malaysian Geological Geoh heritage Group in 1996, followed by a lot of research on the geoh heritage been conducted to date [4]. In 2017, Malaysia's first UNESCO Global Geopark, Langkawi, was nominated. Since then, the development of geoh heritage has constantly been growing in Malaysia. In Kelantan, few geoh heritage research works have been done to study, conserve, and sustain the geological diversity of Kelantan [5,6,7]. The resource diversity in Malaysia was divided into three main groups; rocks, fossils and landscape diversification. According to [8], a few localities in Malaysia were listed for fossil conservation sites. However, none of the sites was from Kelantan.

Therefore, in this paper, the distribution of the fossils in Aring, Gua Musang Kelantan has been used to identify the potential of geoh heritage values regionally rather than focus on limited study area [6] for conservation. The study area and distribution of fossil occurrences in Aring are shown in Figure 1.

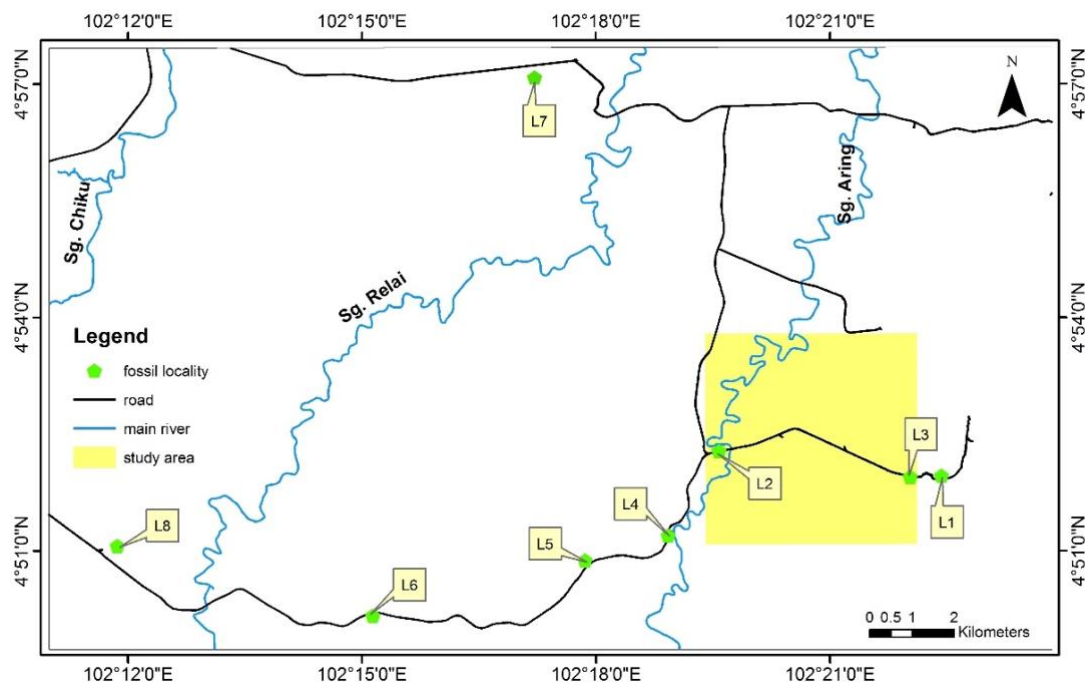


Figure 1: This map shows the fossils distribution localities in Aring, Gua Musang, Kelantan where all the geoh heritage assessment had been evaluated in these localities.

2. Materials and Methods

Geological heritage studies have their ways of geological mapping to identify the geoh heritage potential of an area. The first crucial steps were inventory and qualitative assessment [9], followed by quantitative assessment. The qualitative method was conducted to determine four geodiversity values commonly used in Malaysia -scientific, aesthetic, recreational and cultural [10] and two additional values- appearance and general [11].

The qualitative and quantitative assessment parameters are identify based on the parameters by [11], where the qualitative assessments are focusing on the geoh heritage values; scientific, aesthetic, recreational, cultural, appearance and general, whilst the quantitative assessments are basically the rank or scores of each geoh heritage values.

From all six geoheritage values, the accumulated scores for each value are calculated using the formula by [11], to obtain the Total Heritage Value (H_{VT}) and Total Heritage Value for Development (H_{VD}) using the below equations:

$$\text{Formula for } (H_{VT}) = (ScV) + (EsV) + (RcV) + (CulV)$$

$$\text{Formula for } (H_{VD}) =$$

$$[(ScV \times 40) + (EsV \times 25) + (RcV \times 15) + (CulV \times 10) + (ApV \times 5) + (GeV \times 5)]/100$$

The Total Heritage Value Rank (H_{VT}) is ranking between 0 to 250, where the 0-9 represent low ranking, 91-190 represent the intermediate ranking and 191-250 represent the high ranking. On the other hand, the Total Heritage Value Rank for development (H_{VD}) is ranking between 0 to 60, where the 0-19 represent low ranking, 20-39 represent intermediate ranking and 40-60 is the high ranking.

3. Results and Discussion

In order to assess the qualitative assessments on this study area, six geoheritage values had been evaluated; which are, scientific, aesthetic, recreational, cultural, appearance and general. The scientific values had been divided into nine parameters naming from ScV1 to ScV9 where only ScV1 to ScV7 and ScV9 were present in the study area. These ScV1 to ScV 7 and ScV9 are represent the sedimentology, stratigraphy, structural geology and tectonic, paleontology, mineralization, petrographic and petrology, plutonism and volcanism and scientific report respectively, with the score 0 for the lowest rank to the score 10 for the highest rank . The accumulation score for overall scientific value is 50, where most of the parameters scored exceeding 5 (Figure 2) whilst only three parameters below 5. The aesthetic value scored 47.5, where this value was the accumulation scores for EsV1 (geomorphology), EsV3 (color contrast with surroundings), EsV4 (texture), EsV5 (naturally elements combination), EsV7 (average distant to viewpoints), EsV8 (surface diameter), EsV9 (elevation) and EsV10 (panoramic) .

The recreational value, on the other hand, has six parameters with only five parameters were present in study area; the attraction, accessibility, safety, calmness and comfort and recreational activities (RcV1 to RcV4 and RcV6 respectively). All these parameters accumulated a total score of 30 (Figure 2). The accessibility parameter (RcV2) exhibited a higher score because this study only focus on fossil localities which were found along the roadside or the cutting hills. Next, the cultural value had an accumulation score of 10. The parameter for this cultural value was only focused on the documentation (CulV6), with the score of 10. The other parameters such as CulV1 (legends) and CulV2 (myths) were not present in this study area, most probably because the study area is away from any settlement, thus no culcral events had been recorded. However, there is a significant publications or documentations reported in this study area, which contributed to the full score for CulV6 (Figure 2).

The other two geoheritage values that had been observed were appearance and general values. In the appearance values the accumulation score is only 20, where the highest parameters were uniqueness (ApV1) and integrity (ApV4), whilst the other two parameters; rarity and geodiversity (ApV2 and ApV3) show a score of 2.5 (Figure 2). Lastly, the general value had a total score of 13.5. Only one parameter GeV1 (accessibility) manage to score 10. In contrast, parameter GeV3 (legal protection) had a score of 0 as the action of authority to conserve or preserve this area or protect this fossil site with legal action is none.

From the formula in the methodology section, the value of the Total Heritage Value (H_{VT}) and the Total Heritage Value for development (H_{VD}) are 137.5 and 39 respectively. These calculated values of Total Heritage Value (H_{VT}) and the Total Heritage Value for development (H_{VD}) had been ranked based on [11] ranking scales, where both were fall on the intermediate ranking. The level of significance of

geoheritage values in Aring is determined as regionally significant. Regional significance was rationally substantial for the regional geology and important for the regional system only.

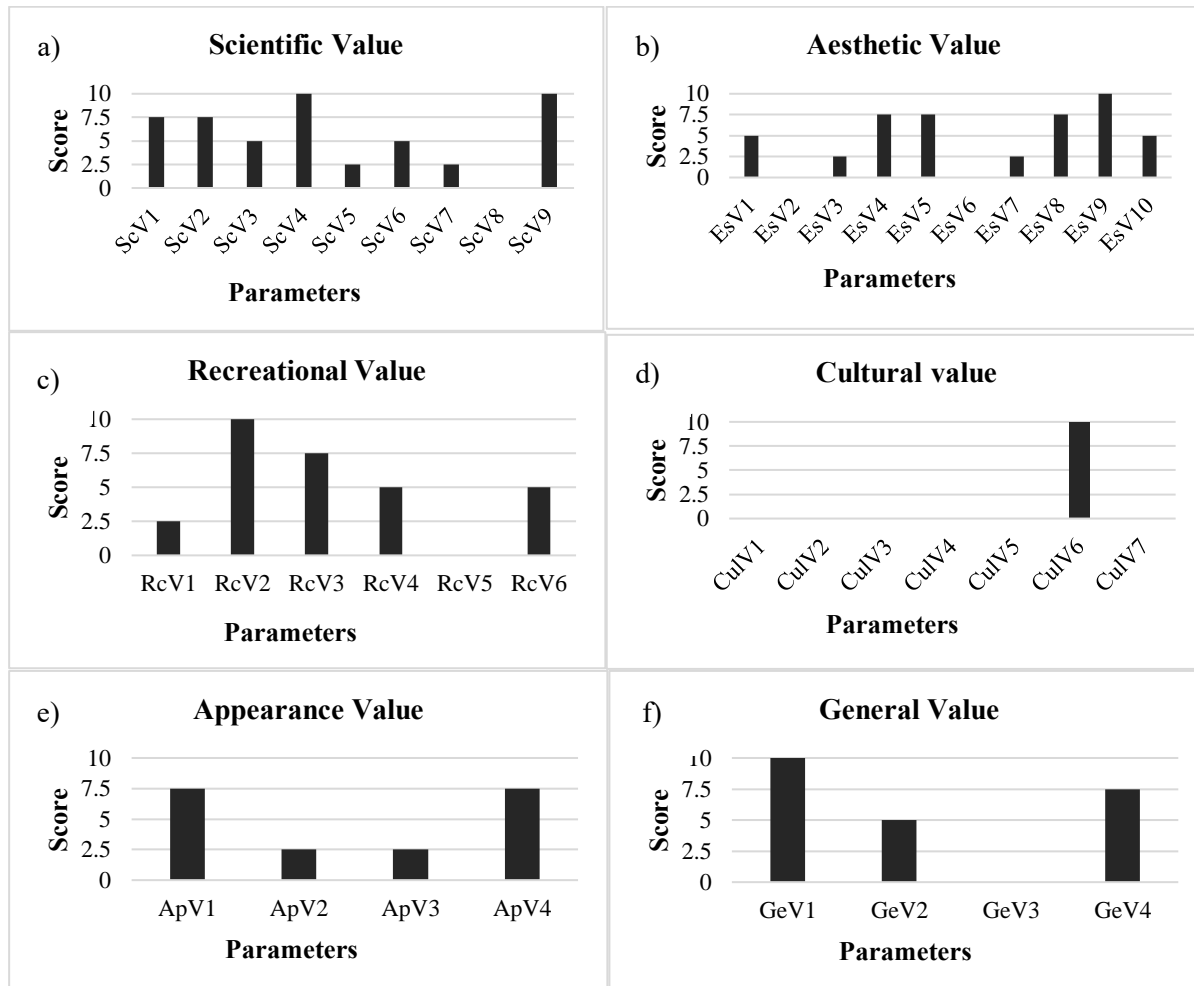


Figure 2: The scores from all parameters used in the study which resemble all the geoheritage values that been assessed: a) Scientific Value (ScV) (where ScV1-sedimentology, ScV2-stratigraphy, ScV3-structural geology & tectonic, ScV4- paleontology, ScV5-mineralization, ScV 6-petrography & petrology, ScV7-plutonism &volcanism, ScV8-metamorphism and ScV9-scientific report); b) Aesthetic Value (EsV)(where EsV1-geomorphology, EsV2-integrity of features, EsV3-color contrast with surroundings, EsV4-texture, EsV5-naturally elements combination, EsV6-number of view/points, EsV7-average distant to viewpoint, EsV8-surface diameter, EsV9-elevation or landscape differences and EsV10-panoramic); c) Recreational Value (RcV) (where RcV1-attraction, RcV2-accessibility, RcV3-safety, RcV4-calmness and comfort, RcV5-scenery, RcV6-recreational activities); d) Cultural Value (CuV) (where CuV1-legends, CuV2-myths, CuV3-belief or traditional faiths, CuV4-religion, CuV5-archaeology, CuV6-documentary, and CuV7-urbanisation); e) Appearance Value (ApV)(where ApV1-uniqueness, ApV2-rarity, ApV3-geodiversity and ApV4-integrity and f) General Value (GeV) (where GeV1-accessibility, GeV2-vulnerability, GeV3-legal protection and GeV4-current condition).

4. Conclusion

The geoheritage values in Aring, Gua Musang, were assessed based on six parameters: scientific, aesthetic, recreational, cultural, appearance, and general values. The scientific values show the highest score with the accumulative 50, and the lowest score is the cultural values with the cumulative score of

10. The aesthetic, recreational, appearance and general values scored 47.5, 30, 20 and 13.5, respectively. All these geoheritage values resemble the importance of the study area based on each parameter used. The scientific values with the highest score reflect that study is suitable for research, education, and other exploration purposes. The cultural values with the lowest score reflect that the study area lacks culture, myths or religion significant as it is situated far from any placements.

The values obtained for both Total Heritage Value Rank (H_{VT}) and Total Heritage Value Rank for development (H_{VD}) were 137.5 and 39.00, respectively. These two values are ranking as intermediate using the ranking scale by [11]. The level of significance is only regional, where these fossil distribution localities are only important for the regional system only. Based on the results and ranking scale from the calculated values of Total Heritage Value Rank (H_{VT}) and Total Heritage Value Rank for development (H_{VD}), it is conclude that the development this study can only be considered for educational and scientific purposes only. It is supported by a good fossil preservation and the only place with regionally distributed fossils in Kelantan, where the paleontological studies can be done [6]. However, the scores and values might be biased as it is only focused on the fossils distributed area without considering the village and town nearby. Further study might be helpful to assess the geoheritage values for the whole Aring area.

Acknowledgement

We would like to acknowledge Universiti Malaysia Kelantan for the short-term grant scheme no. R/SGJP/A08.00/00435A/001/2018/000504. We also like to acknowledge all geoscience students for their contributions in data collection.

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