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Geological landscape and public perception: A case for Dataran Lang viewpoint, Langkawi

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Abstract: In order to understand the aesthetic value of geological landscape, a study was conducted at Dataran Lang viewing point, Kuah, Langkawi based on horizontal viewpoint landscape mapping and public perception survey method. From the mapping exercise several types of landforms and landscapes have been identified and were associated to their various geological formations. In addition to these natural landforms, several man-made landscapes were also identified. Data obtained were transformed into a simple schematic sketch to relate the landscapes with the rock types. Using this sketch as a guide, a public perception survey was carried out to find out the visitors' understanding and perception on landscape of scenic beauty and their relationship with geology. The survey has shown that most visitors agreed that landscapes seen from Dataran Lang have scenic appeal or aesthetic value. The sketch was useful to help them relating the different landscapes with different geological or scientific information. The schematic geological sketch interpretation is an important tool for enhancing public understanding on geological landscape, geoheritage, and geotourism as well as a tool in future development planning related to the aesthetic geological landscapes.

Keywords: geological landscape, public perception, geoheritage, geotourism

INTRODUCTION

Geological landscape is a term used to describe the natural physical landscape or natural environment that is viewed from a geological perspective. From this perspective a natural landscape is perceived as an assemblage of landforms that contains enormous intrinsic value associated with its formation. In understanding the origin and the formation of natural landscape it is crucial to understand the properties of the earth material which form the landscape, the natural processes responsible in crafting various landforms, and the evolutionary stages which make it unique at present time and scenario. Therefore, the beauty of the landscape is the mixture of intrinsic value of the above assemblages and the extrinsic value manifested informs of mountain, gorge and hill

Geological landscape has been closely connected to man since the existence of human kind. The terms such as hill, river, gully, barrow and mountain in name of places are a manifestation of landscape in most geographic destination or addresses clearly indicated human appreciation to geological landscape. Among world famous geological landscapes are, Arthur's Seat of Edinburg, Scotland which is an extinct volcano system, Table Mountain of Cape Town, South Africa, a mesa made of sandstone bed, and Sugarloaf Mountain of Rio De Janeiro, Brazil, a granite bornhardt landform. As long as man and landscape live side by side, they will always tried to explain this connection in various manners through various perspectives.

In Malaysia, geological landscape has been fundamental to most of the ecotourism industries, even before the word ecotourism was created (Ibrahim Komoo, 1997a; Mohd Shafeea Leman, 1997). Tourists from local and abroad for examples have flocked to Langkawi, Tioman, Taman Negara, Gunung Kinabalu and Gunung Mulu merely to enjoy the natural beauty behind these geological landscapes. As a matter of fact it was due to these phenomena that the Malaysian Geological Heritage Group was established to look at matters pertaining to research on geoheritage conservation in this country (Ibrahim Komoo, 1997b).

Public without adequate geological background often looks at geological landscape solely on its beauty, hence only value it based on the geometrical shape and vegetation cover. Various studies in the past decades have recognised that substantial components of the world's landscapes were shaped not on the Earth's surface, but at the base of the regolith (Twidale, 2002; Garcia-Quintana *et al.,* 2004). Surface geomorphic processes are strongly influenced by the physical properties of the rocks, in terms of restively toward weathering and erosion, the chemical properties as well as the structural properties of the rocks. Therefore, understanding on basic geology is as important as understanding on geomorphic processes in the study of geological landscape. This paper wills elaborate on the relationship between geological landscape and the geology that formed the landscape. A horizontal view from Dataran Lang Langkawi from where geological landscapes of various origins are seen will be ideal to demonstrate this relationship.

Landscape as perceive by human is an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factor (Council of Europe, 2007). Human perception is therefore very important in determining the significance, the potential for sustainable utilisation and the need for conservation of geological landscape. The establishment of first national park in America i.e. Yellowstone National Park in 1872, a conservation statue for large area was due to the aesthetic beauty of its

landscape (Yard, 1920). Based on this understanding this current study aims to introduce the geological component embedded within a landscape and how it has influenced the beauty or aesthetic of an area

In conservation geology the increasing awareness in geology among the public will benefit the long term protection and management of geological heritage resources (UNESCO, 2006). Thus, there is a need to provide and implant as much as possible of geological information on geological heritage of a sites on this case a geological landscape. This has been done through publications of geological material, exhibitions on geology, series of talk, seminars and dialogues with various stakeholders as well as on site information on panels (Dias & Brilha, 2004; McKeever, 2009). However, more often than not information given was either very highly scientific or very dilute, hence losing some essential the facts and meanings. In general it can be said that the geology are yet to reach the public at large.

In tackling these issues a study has been conducted on evaluating efficiencies of geological communication to the public using simplified geological landscape.

GEOLOGICAL LANDSCAPE FOR THE PUBLIC

Numerous studies have been carried out in interpreting and assessing the values of landscape to the public, such as Zube *et al*. (1974, 1982) through public perception assessment on landscape of scenic beauty. This work identified differences on the results based on the types of evaluator known as expert technique, quantitative survey, focus group and individual experiential. The application of this landscape assessment approach was carried out in various subjects and perspectives. Among the sound approach was from psychology perspective by Bernaldez & Parra (1979), Kane (1981), Daniel (1990), Purcell & Lamb (1998) and Canas *et al*. (2009), management approach as promoted by Brown *et al*. (1990) and Ulrich *et al*. (1991) and cultural perspective by Zube *et al*. (1974), Tips & Savasdisara (1986), Hull & Grant (1989) and Terkenli (2001). The common principle of assessment in these studies indicates differences between the onsite and indoor approach by using photographs, slides and at the landscape while filling in the questionnaires (Shafer & Brush, 1977; Kaplan & Kaplan, 1989; Canas *et al*., 2009).

Most of these studies were dealing with landscape as a land cover or cultural landscape parallel with the definition of European convention on landscape. For such, the landscape means an area, as perceived by the people, whose character is a result of the action and interaction of natural environment and/or human factors. The assessment of landscape beauty by integrating geology and landscape or geological landscape has been introduced by Tanot Unjah & Ibrahim Komoo (2004; 2005; 2007). They have made their assessment based on the physical component of geological landscape. The physical component includes types of rock that form the landscape, geological structures that control the landscape (e.g. bedding properties, joints and faults) and geological processes that continue to shape it (e.g. erosion, dissolution and mass wasting). Basically, the appreciation and understanding of these physical components of the landscape is the key to sharing geological knowledge to the public. Application of landscape beauty assessment using geological landscape components had been applied at Lata Chenai, Kelantan and while horizontal landscape mapping had been experimented at Kilim and Selat Kuah, both in Langkawi, Kedah.

Previous experiment on horizontal landscape mapping at Kilim only developed basic technique and procedures on viewpoint landform mapping and characterization of carbonate rock landform. The need for more comprehensive study on the characterization of other types of rock is critical. Beside the ability of the landform data to be used as part of the knowledge tourism, is crucial in creating appreciation toward the landscape. In order to incubate appreciation we have to understanding how scientific knowledge contributes to the beauty of the landscape.

DATARAN LANG

A study was conducted at Dataran Lang, Kuah in Langkawi Geopark (Figure 1), the first national geopark in Southeast Asia and the 52nd member of Global Geopark Network supported by UNESCO. Being part of the geopark, it is crucial to have protected geological, cultural and biological sites. For this purposes numerous tourism sites have been promoted either by adding simple geological information for existing cultural sites or establishing new geologically based sites such as Pantai Pasir Hitam (Black Sand Beach), Pantai Pasir Tengkorak, Gua Kelawar (Bat Cave,) Tasik Dayang Bunting and Pulau Anak Tikus (Mohd Shafeea Leman *et al*., 2006; 2007).

Dataran Lang is one the well-known site for viewing Langkawi's beautiful landscape. It is where the grand eagle statue that signified Langkawi's identity was erected. It is a small esplanade at one corner of the Straits of Kuah, connected by bridges to the Lagenda Park and the Kuah Jetty Port. The area was developed by the local authority with recreational facilities such as benches, gardens, craft arcades, tiled pathways and open spaces (Local Management Plan District of Langkawi, 2003).

APPROACH AND METHODOLOGY

Horizontal Viewpoint Landscape Mapping

The viewpoint mapping is the mapping of landforms from a selected viewing point. The best viewpoint is a site where one can observe a landscape at horizontal level with furthest distance of clarity (Tanot Unjah & Ibrahim Komoo, 2005). Landforms observed from the selected viewing point are sketched and described based on their rock types with related geological structures and processes.

The mapping can be divided into four levels known as identification of view point, scope of observation, field landscape sketch and landscape analysis. A viewpoint is identified from the topographic map, having the best view of the surrounding areas with minimum crossing angle of observation. This is followed by identification and selection

Carbonate sedimentary rock		Clastic sedimentary rock		Igneous rock	
L1	Mogote is isolated hill with rounded top and vertical slope	S1	Rounded to almost flat top with medium slope hill	G1 h, w>h	Symmetrical hill. The width is larger than the height.
L2	Cone tower hill with flat top	S2	One sided cone hill with bedding influence	G2, ø>30°	Flat top hill with gentle slope
L3	Cone hill with rounded top	S3	Irregular top and gentle slope hill	G3	Ridges types of landform
L4 ø, ø>45°	Coconut shell-like hill usually small in size with rounded top and convex slope	S4	Low cone with gentle slope hill		
L5	Structure control landfform is a hill with irregular top and slope	S5	Flat top with gentle slope hill		
L6	Rock stack, isolated thin hill with sharp or irregular top and vertical slope	S6	Sea stack, isolated hill due to erosion		
L7	Mogote is isolated hill with flat top and vertical slope				
ø<45°, L8, ø	Dome is a convex hill with gentle slope				

Table 1: Landform classification based on types of rock (modified after Tanot Unjah & Ibrahim Komoo, 2007 and Tanot Unjah, 2011).

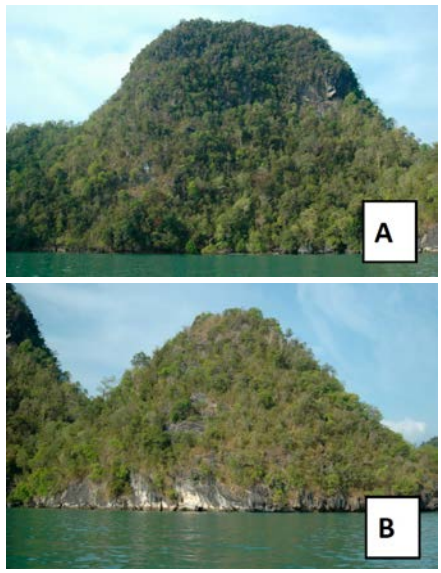

Figure 1: Among the carbonate sedimentary rock landforms at Kilim Geoforest Park are cone tower hill (trapezoid) or L2 (A) and cone hill or L3 (B).

on scope of observation. The scope of observation is read based on 360° degrees in the horizontal view. It can be captured during field observation and later confirmed using a topographic map. Next is the field landscape sketching and this can be divided into two levels of sketching, i.e. general landscape on the area and the specific sketch of the landform. Basically, the general sketch directly captures the whole area with a degree of observation while the specific sketch of the landform component must consider the distance between the view point and the landform. Groups of landforms are later sketched based on 0.5 km intervals up to the last visible object. Each landform component is identified as one of several shapes simplified into an alphabetical code to minimize the space in the sketch. Analysis of data was then carried out to understand the dominant landform, and to interpret the major geological processes and history of the area.

Landscape analysis was carried out using the landform classification by Tanot Unjah & Ibrahim Komoo (2005; 2007). The classification is an identification of landform according to rock type. Three types of rock in the area are carbonate sedimentary rocks, clastic sedimentary rocks and igneous rocks (Table 1). Examples of the landform representing different types of rock are shown in Figures 1, 2 and 3.

Carbonate sedimentary rock landforms

Tanot Unjah & Ibrahim Komoo (2005) classified carbonate rock into 10 major landforms. The landforms are mogote with rounded top (L1), mogote with flat top (L2), cone tower hill (L3), cone hill (L4), coconut shell-like hill (L5), pinnacle (L6), karst stack (L7), structure-control hill (L8), dome (L9) and structure-control pinnacle (L10). Some images on the observed carbonate sedimentary rock landforms are shown in Figure 1.

Clastic sedimentary rock landforms

Clastic sedimentary rock was classified into six main landforms (S1 to S6). Each of these landforms shows the influence of bedding and erosion. The landforms are: rounded to almost rounded to flat top with medium slope hill (S1), one sided cone hill (S2), irregular top and gentle slope hill (S3), low cone with gentle slope hill (S4), flat top or ridges-like with gentle slope hill (S5), and sea stack or isolated hill due to erosion (S6). Some images of the observed clastic sedimentary rock landforms are shown in Figure 2.

Igneous rock landform

There are three types of igneous rock landforms in Langkawi (G1 to G3, Figure 3). They are symmetrical hill with gentle slope (G1), flat and almost rounded top hill with medium slope (G2) and ridge-like hill (G3).

Public Perception Survey

Surveys were carried out using a set of questionnaire on respondent's personal particulars, basic ideas of scenic landscape, perception on scenic landscape in Langkawi, scientific input on geology and perceived plan for future development of the area surrounding the landscape.

Questionnaire was prepared specially for groups that directly interact with the landscape. In this study, tourists were the main aim as it was purposely used to identify the beauty of this area. The questionnaire was based on the focus group method, usually used for social research techniques to understand and describe the feelings and perceptions of groups of people who interact with the landscape (Zube *et al*., 1982). A simplified questionnaire was prepared to test the participant understanding on the scenic value of a landscape in relation to its scientific geological input. A total of 35 respondents mainly tourists that visited Dataran Lang were interviewed at different times over several weeks of

Figure 2: Among the clastic sedimentary rock landforms at Pulau Ular are identified as S2 (A) a low con with gentle slope at Tanjung Baru Besar, and Pulau Tuba (B) identified as S4.

Figure 3: Among the igneous landforms observed in Langkawi are A) symmetrical cone hill with height equal to half of the width at Gunung Raya known as G1, and B) rounded top with medium slope at Burau bay or known as G2.

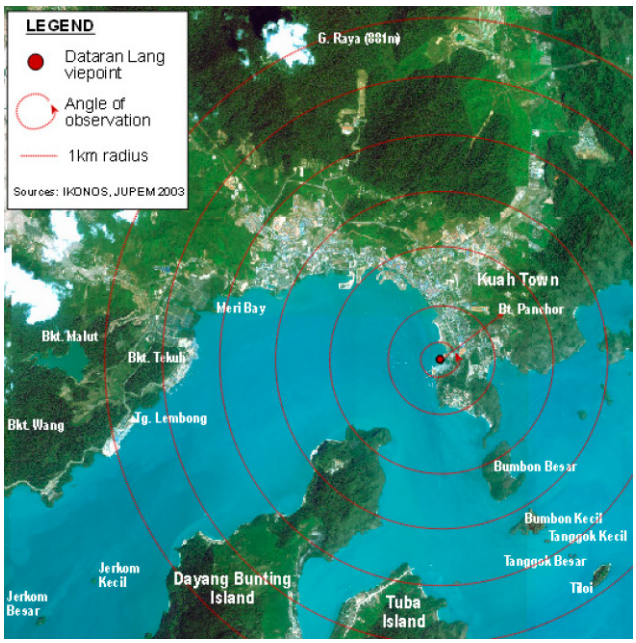

Figure 4: Dataran Lang viewpoint and the angle of observation from the area.

Carbonate sedimentary rock		Clastic sedimentary rock		Igneous rock	
L1	2	S2	5	G1 h w>h	1
L2	2	S3	2	G2 θ>30°	3
L3	5	S4	3	G3	3
L5	1	S5	1		

Table 2: Landform distribution according to rock type observed at the Dataran Lang viewpoint.

2008. The data from the questionnaire was later analyses using a Statistical software (SPSS).

RESULT AND DISCUSSION

Topographic sketches of landforms for each 180° have been made from Dataran Lang with Bt Panchor being referred as starting viewing angle (i.e. 0°). Dataran Lang is a perfect viewing point where various landforms can be observed for a complete 360° circle up to 6 km without much object of interference (Figure 4). From these sketches, three groups of landforms reflecting clastic sedimentary, carbonate sedimentary and igneous rocks can be observed and classified in detail. The clastic sedimentary rocks are represented by the Machinchang and Singa formations, while the carbonate sedimentary rocks are represented by the Setul and Chuping formations. The igneous rock is made up of Gunung Raya Granite. Quaternary sediments are less obvious as much have been cover by vegetation or part of the man-made landscape.

The observation from Dataran Lang view point identified four types of landform each for clastic and carbonate sedimentary rocks and three types of igneous landform (Figure 5 and Table 2). The carbonate landforms are represented by two mogotes (L1), three cone towers (trapezoid) (L2); five conical hills (L3), and one structurally controlled hill (L5). Meanwhile clastic sedimentary landforms consist of five one sided cone with bedding influence (S2), two hills with irregular top and gentle slope (S3), three low conical hills with gentle slope (S4) and one flat top hill with gentle slope (S5). On the other hand igneous landforms are identified as one symmetrical hill with gentle slope (G1), three rounded hills with gentle slope (G2) and three ridges (G3).

Although the landscape is dominated by sedimentary rocks, rare igneous landscapes are still outstanding in size

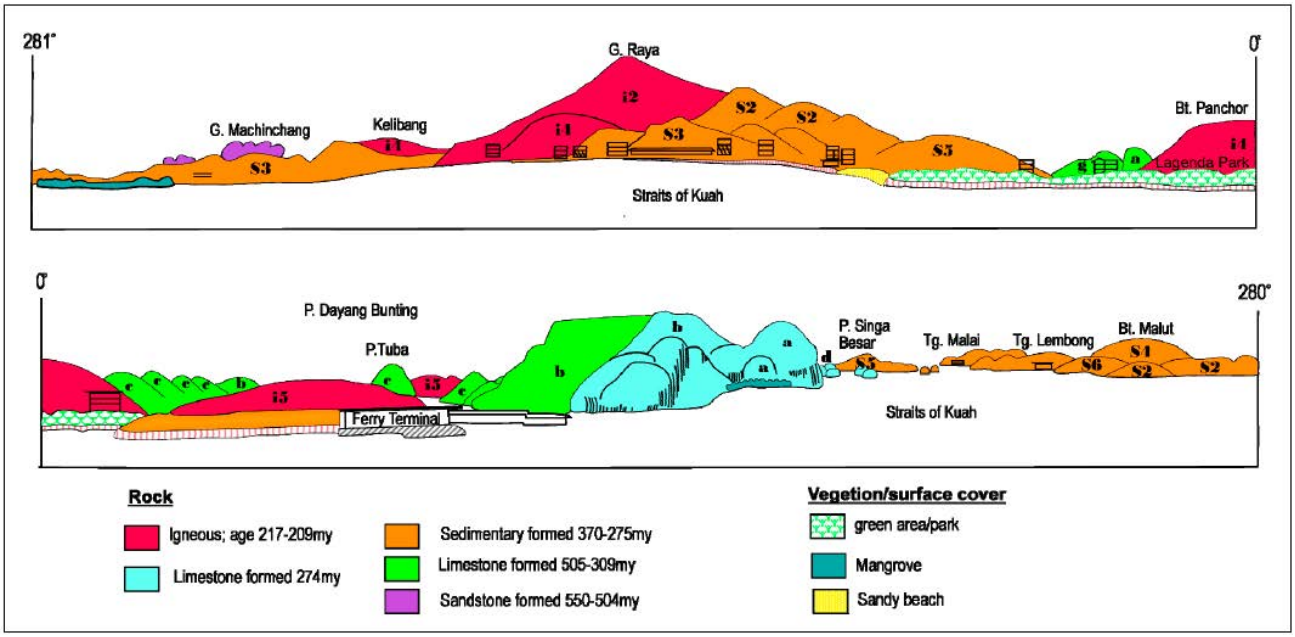

Figure 5: Landform sketches from the Dataran Lang viewpoint.

and height as seen in Figure 5. The landforms observe from this viewpoint are mainly due to weathering and mass wasting. Heavy annual rainfalls contributed to the well-formed carbonate rock and symmetrical peak of the igneous rock landforms. Mass wasting which include rock falls and landslides create steep slopes and rugged peaks.

Perceptions obtained from questionnaire survey revealed that 82.9% of the respondents are domestic tourist and 17.1% of the visitors are foreign tourists mostly from Australia, Brunei, Singapore, Indonesia and Taiwan. The high number of the local tourist in comparison to the international strongly indicates their appreciation on local tourist destination. Perhaps this is due to the extensive promotion by the Tourism Ministry and the local authority on the natural beauty of the island as well as its reputation as duty free island. Most tourists are English literate. In terms of age, 40% of the respondents come from 25 to 34, 22.9% from 35 to 40, 20% from 15-24, 14.3% from 45 to 54 and 2.9% from 55 to 64 years age groups (Figure 6). The highest age group are also known to be generation X and Y which they are known to have the powerhouse in generating next economic and they are known as educated buyer (William & Page, 2011).

In term of educational background most of the respondents are degree holder (42.9%), the rests are senior high school students and school leavers (40%) and diploma holder (11.4%). Others are students from junior secondary schools (2.9%) and Master or PhD holder (2.9%). For the detail of the distribution please refer to Figure 7.

Most of the respondents (88.6%) came to Dataran Lang as part of their holiday trip to Langkawi, while 8.6% of them are on official trip and only 9% are local people. In terms of occupation, 40% of the respondents are working with private company, 20% are student and retiree, 17.1 % are government employee, 8.6% each are involved in academic and business and 5.7% as professional (Figure 8). The survey also shows that only 31.4% of the respondents come to Dataran Lang for the first time while others have been to this place several times.

On their basic idea of scenic landscape, all of them agree that the landscapes viewed from Dataran Lang have great scenic beauty. However, their criteria or element of scenic beauty vary from mixture of natural and man-made landscape (54.3%), totally natural landscape (40%) and solely man-made landscape (5.7%).

For comparative beauty 34.0% of the respondents considered this area as the most scenic spot in Langkawi, while 25.0% of them choose Machinchang Cable Car, 17.0% choose Pantai Chenang and 3.0% each refer to Gallery Perdana, Padang Matsirat, Pasir Tengkorak, Porto Malai, Tanjung Rhu, Telaga Habour and Telaga Tujuh as the most scenic spot in Langkawi (Figure 9).

On perceived scientific inputs toward the sketched on display, 88.6% of the respondents indicated that they have never came across such a sketch. However, 82.9% of them say that they can relate the actual landscape with the sketch, while the other 17.1% cannot. For those who respond, their understanding of the sketch and landscape were varied from natural topography at 31.4%, man-made topography with 17.1%, panoramic perspective in the sketch with 17.1%, diversity of geological and geomorphological 45.7% and sketch that portray the landscape with 34.3%.

After being briefed on the science of the sketch , more than 57% respondents agree that the information give additional value to the landscape while 34% consider it does not add any value, while 9% thought the information somehow degrade the value of the landscape beauty.

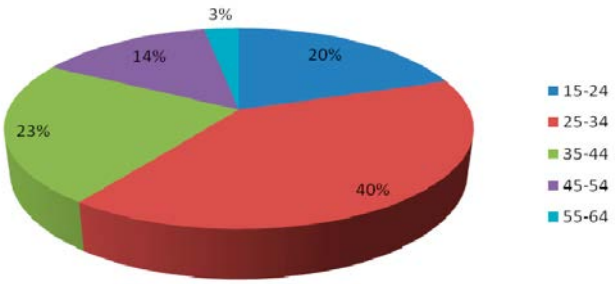

Figure 6: The distribution of the age of the respondents.

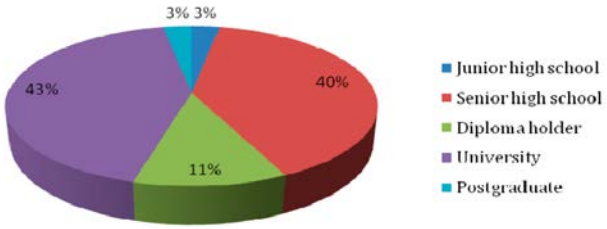

Figure 7: The education background of the respondents.

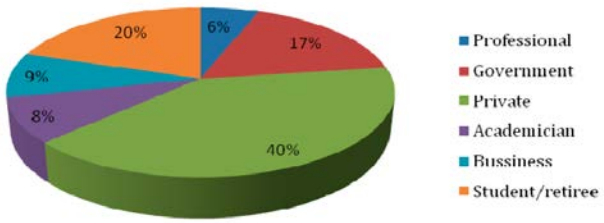

Figure 8: The occupation of the respondents.

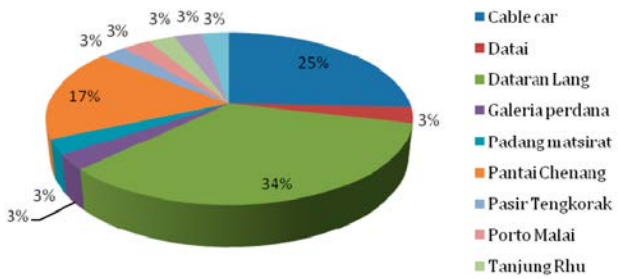

Figure 9: The distribution of comparative beauty of scenic spots in Langkawi.

CONCLUDING REMARKS

The finding of this study concludes that geological landscape approach have the ability to link observed landforms recognised through their physical appearance with knowledge on geological structure, as well as physical properties and erosion attribute to different types of rocks. Observation through horizontal viewpoint has the advantage of having a common view with general tourists. It provides a platform to enhance the observed landscape by providing various scientific values. This approach has the ability to expose the various hidden value of natural resources for ecotourism or specifically geotourism in landscape perspective.

The survey on public perception on landscape of scenic beauty shows that the common public recognised the importance of geological sketches in promoting the scenic value of the area. The survey offered more option for tourists in terms of their preference on viewing and understanding of scenic landscapes on the island. As mentioned by Fyhri *et al*. (2009) research on the qualitative survey of public perception is vital in areas where tourism is a key economic factor. It is also very important in understanding the awareness level among the local residents and in assessing development and other environmental challenges that have visual consequences. As a global geopark, Langkawi has the responsibility to enhance current tourist attractions by introducing knowledge based tourism, particularly knowledge on geology

The study also agree with Jensen & Koch (1998) that this kind of research seeks for better comprehension of various recreationists' landscape preference by looking forward for nature management staff and several other landscape–related decision-makers on their perspectives of scenic beauty. Therefore, their expertise and knowledge contribute to better recommendations on recreation and tourism with respect to nature and various environmental problems (Vining, 1992). As for Langkawi, since public knowledge enhancement, geotourism and environmental sustainability are among key objectives of the transformation of Langkawi into a geopark (Mohd Shafeea leman *et al*., 2007), data and other types of information gathered through this landscape study approach will certainly be very useful in future development planning of the geopark.

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