



LANDSCAPE ECOLOGICAL ASSESSMENT OF POTENTIAL ECOTOURISM IN MALAYSIA

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ABSTRACT

Globally, tourism industry growing rapidly and ecotourism has been a focus in the developing countries due to high demand. However, a conflict occur when the tourisms resource was capitalize to earn high foreign exchange without compromising sustainability of those resources. This study aims to identify the potential of ecotourism activity in three study areas (Gua Madu, Ketitir Lake, Jedip Village) in Gua Musang, Kelantan, Malaysia for future sustainable ecotourism site planning. The integrated approach of landscape ecology and community-based management was applied in this study by using remote sense data of 2012, Geographical Information System (GIS) and landscape metric. This study found that Gua Madu is the most potential ecotourism sites with low patch number, high landscape patch index, high patch density and favourable ecotourism activity. This study helps ecotourism development towards reducing the overexploit of resources and secure ecotourism sustainability in future.

Keywords: Spatial structure and pattern, Ecotourism, Community-based management.

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1. INTRODUCTION

A mass tourism has grown rapidly to become one of the world's foremost economic and social phenomena compared to ecological or environmental based tourism [1]. The World Tourism Organization estimates that international tourist arrivals in 2022 will reach 1.6 billion worldwide and tourism recipients will exceed more than US\$2 trillion [2]. Tourism industry growing rapidly due to high demand that indirectly influence the developing countries such as Asia, Africa, Oceania and Latin America. These country currently focus on ecotourism by using their nature resource attractions. Ecotourism can be best defined as a nature-based tourism that involves education, interpretation of the natural environment and is managed to be ecologically sustainable [3]. This explained that the 'natural environment' including cultural components and 'ecologically sustainable' involved in assessing the potential of sustainable ecotourism as an appropriate return to the local community and long-term conservation of the resource [4].

However, most of local community and ecotourisms' stakeholders in Malaysia do not understand the potential of sustainable eco-tourism that can give benefit to them in present and for future generation. This is due to the lack of awareness among them about concerning the nature especially land use impact on nature-based tourism. These can be seen when less assessment has been done on the potential of ecotourism among them and lack of motivation to develop their area towards the upgrade facilities, transportation and infrastructure development. Furthermore, lack of knowledge on landscape level assessment has caused incomprehensible-community based management in order to explore the sustainable ecotourism potential where most of the natural landscape gets transformed into leisure area [5]. This situation can cause the permanent ecological pressure increasing directly due to the behaviour of the holiday makers produce rubbish, sewage, exhaust fumes, trampled on and remover of plants and animal, and noise. Lack of information on land use and local community activity will give impact to ecotourism with the improper implementation of sustainable planning and management [6]. All this notably claim for lack of quantitative data information to measure the reliability and validity of the information on land use and community activity for assessing the potential of sustainable ecotourism in Malaysia.

Therefore, the identification of potential of ecotourism in Gua Musang is still limited. This made the identification of potential of ecotourism becomes the issue of ecological landscape. Thus, decision support tools are needed for sustainable tourism that can reconcile the natural and social environment with the sustainable economic and development. With regard to the overall research approach, a case study in Gua Musang was gaining prominence in the identification of potential of ecotourism using landscape ecology approach. To some extent, it could be predicted that some gaps between theory and practice of ecotourism would be improved by promoting its sustainability based on ecotourism products' impact the local community. As a whole, using a landscape ecology approach to achieve ecotourism toward sustainable already explored as a broader conservation strategy. Thus, promoting the sustainable ecotourism awareness and understanding the potential of sustainable ecotourism is important to improve the sustainable land management to the community-based nature development.

Therefore, this study quantified the landscape structure pattern of land use in Gua Musang, Kelantan for sustainable ecotourism by using a landscape ecology approach towards the quality of life of the local community. Thus, its provide the valuable data and information for management and planning for assessing the ecotourism potential sites as one of the thrust areas that have been actively engaged. Besides, the data from this study are important for

conservation and monitoring of the potentially sustainable ecotourism in order to maintain the healthy ecosystem and quality well-being of local communities.

2. METHODOLOGY

2.1. Study Area

Based on the potential of Gua Musang to be developed as a sustainable ecotourism destination, three study areas are selected for sustainable ecotourism assessment which is Gua Madu, Ketitir Lake, Jedip Village, Pos Brooke, Lojing, Gua Musang (Fig 1).



Figure 1 Ecotourism area of Gua Musang

2.2. Data Collection and Processing

In this study, the data analysing of landscape structure was conducted by using land use map of Gua Musang for 2010. The class of land use in Gua Musang are reclassified by Anderson [7] into arable land, permanent crops and other any land not arable or under permanent crops. Then, several data of local overlaid on the population data such as the distribution of local communities, local activity, land use class and the ecotourism activity done by the local community in the study areas in Gua Musang.

2.3. Data Analysis

2.3.1. Land uses and landscape structure analysis

Land use data using land use map of Gua Musang, 2006 source from the Department of lands and mineral to quantify the effect of the landscape structure on ecotourism was quantified using land use map of Gua Musang for 2010. Four landscape metric was used to analysed the landscape structure such as number of patches, mean patch-area, patch density and largest patch index by using FRAGSTAT (Version 3.3) [8,9]. (Table 1).

Table 1 Landscape Metrics Analysis

Landscape metrics	Abbreviation	Description	Units	Range
Class area	CA	$CA = \sum \frac{a_{ij}}{10000}$ CA equals the sum of the areas (m^2) of all patches of the corresponding patch type divided by 10,000(to convert to hectares)	Hectares	CA> 0, no limit
Number of patches	NP	ni = number of patches in the landscape of patch type (class) i.	Number of patches in landscape	
Patch density	PD	$PD = \frac{n_i}{(10000)(100)A}$ The number of patches per 100 ha	Number per 100 hectares	PD>0,constrained by cell size
Mean patch size	AREA MN	$MN = n \sum \frac{x_{ij}=1}{n_i}$ The area occupied by a particular patch type divided by the number of patches of that type	Hectares	MPS > 0, no limit
Largest patch index	LPI	$LPI = \frac{\max(a_{ij})}{(100) A}$ LPI equals the area (m^2) of the largest patch of the corresponding patch type divided by total landscape area (m^2), multiplied by 100 (to convert to a percentage)	Percent	0 < LPI < 100

2.3.2. Correlation

Correlation analysis used to identify the relationship between the landscape structure pattern of land use and ecotourism activity of study area. Indirectly, the significance of this impact land use activity analysis to the sustainable ecotourism can be identified to determine the sensitivity level of landscape ecological approach to assess the sustainable ecotourism in the study area.

2.3.3. Ground truthing

Ground truthing was conducted to verify the existence of physical features and determine the reliability of the source maps. Next, the validation method done by combining data of land use pattern (features and matrix), and local land-used. So that, the landscape ecology approach integrated with the GIS database and interviewed method can determine the potential of the sustainable ecotourism area in Gua Musang.

3. RESULTS AND DISCUSSION

3.1. Perception of Local Community

The topography of Ketitir lake environment is attractive. The development of potential land use especially build up area were attentive to the local community for enjoying the fresh and comfortable environment. Besides Ketitir Lakes, the topography of Gua Madu is also very attractive. On the contrary, Gua Madu has local history as former communist activities hotbed. Instead of lakes attraction, the caving activities is one of attraction in Gua Madu. This activities can keep tourists busy with many routes, magnificent rock formations and historic cave wall paintings. Besides that, the Neggiri River near the Gua Madu has completed the surrealistic view. In additional the cave's cool temperature will give a pleasure to the visitors.

Jedip Village was located at Lojing area that is currently has been exposed to human activity like logging. Indirecyly, the current physical condition of the area for trekking and watching *Raflessia Kerri* in the forest near the Jedip Village is facing impairment. The topography based on the environment is attractive and there still maintain the forest for the development of the potential land use. However, the surrounding area of Jedip Village had been exposed as mention by Head of Jedip Village "There are many project on-going in Lojing for vegetation and agriculture sector and this soon may affect this village because out 18 villages in Lojing, there are some people from other village need to move to another area for their living".

Accommodation in the Ketitir Lake and Gua Madu is confined to towns, although there are designated campsites at a number of natural locations [10]. Jedip Village and surrounding still lack of infrastructure. There just only aboriginal settlement and forest for tourist facility which may not attracting them to visit the Jedip village. So, creating an inventory of accommodation and other supporting infrastructure is an essential component of resource assessment and has a bearing on those areas suitable for marketing to different types of eco-tourists.

The development of potential land use especially build up area were attentive to Ketitir lake for sightseeing, relaxing and recreation with activities that are environmental friendly like paddle boat in the lakes. Gua Madu also has honeycomb formations also known as honey nest hanging create a mesmerising view. The passages are both smooth and jagged requiring tourists to be extra careful while doing the exploring so are some of the tight squeezes. Without any source of light, the caves are as dark a place as one can be. Thus, visitors need an experienced guide to do the caving and they are encouraged to bring their own torchlight or headgear. The Jedip Village community attracts tourist that have holiday visit to Cameron Highland for tracking in the jungle in Jedip forest and watching *rafflesia* by a tourist guide. As those study area have their own attraction that will increased the accessibility due to high demand of visiting the area.

Regis et al. [12] came up with two attributes of ecotourism in the development of the ecotourism project for Gua Musang, Kelantan which is a species and ecosystem conservation, and livelihood for local communities. Based on the interview, most of visitors visits the study areas due to the physical features attraction of the area. For examples, Jedip Village famous as one of habitat for *Rafflesia* that became an attraction for them to watch the growth of *Rafflesia* which also one of the attraction for Sarawak eco-tourisms. The existence of *Rafflesia* in Jedip Village, Pos Brooke also has provide alternative employment opportunities

for indigenous people through tourism activities such as a tour guide, selling crafts and others.

Aboriginal community involvement in tourism activities is very important in terms of protection and conservation of nature. It also will indirectly educate indigenous people to conserve the habitat of the Rafflesia for generating sustainable income from selling. Rafflesia in Lojing is very potential to be promoted as an international tourist attraction to visit Kelantan. Universiti Malaysia Kelantan has proposed to the state government and government agencies related to an area of 650 ha in Lodging that is realized as Rafflesia Conservation Area [13]. Whereas Gua Madu located at cave area that become an attraction for foreigner and local people for extreme outdoor activities like cave climbing. The other attraction is river that suits for fishing and picnicking. However, the condition of Nenggiri River located at Gua Madu is not favourable for any activity. Providentially, the infrastructure in Gua Madu and Ketitir Lakes completely in good condition and become one of the visitors attraction. There have a lot of facilities for outdoor activities provided like a playground, paddle boat and jogging track.

3.2. Land Uses Analysis

The results show four types of land use namely built-up area, vegetation, cleared land and waterbody at the study areas. Compared to other study areas, Gua Madu landuse cover equally with all four types of land use which shows this place has a potential ecotourism area as it land use. As the accessibility and infrastructure can be easy to be upgraded at high resources at variety of landused. The activity of people does there was caves hiking, sight-seeing, picnic with family and recreational activity [11].

Figure 2 shows the graph on landuse area covered at the study areas. Based on the figure, Gua Musang area was occupied mostly by vegetation area and least occupied were waterbody. The highest percentage of land use area in Gua Musang was vegetation (98.6%), followed by built-up area (0.56%), cleared land (0.46%) and the lowest percentage was waterbody (0.38%). Aboriginal community involvement in tourism activities is very important in terms of protection and conservation of nature. It also will indirectly educate indigenous people to conserve the habitat of the Rafflesia for generating sustainable income from selling. Rafflesia in Lojing is very potential to be promoted as an international tourist attraction to visit Kelantan. Universiti Malaysia Kelantan has proposed to the state government

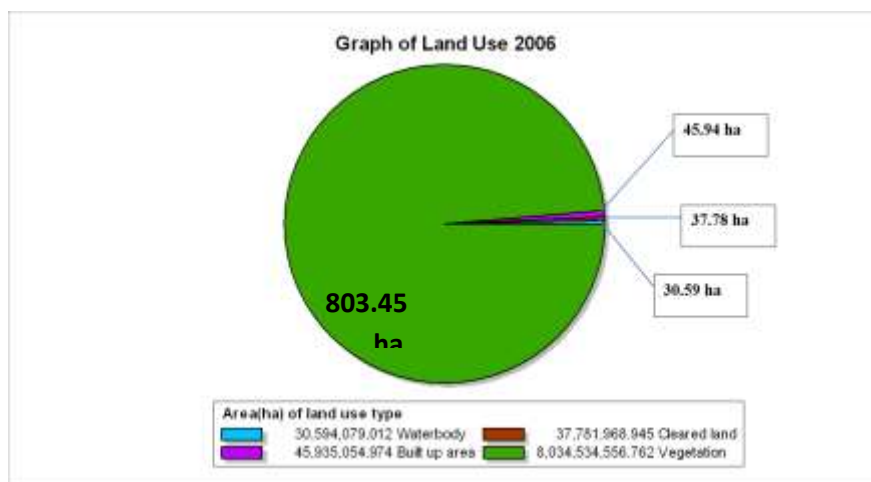


Figure 2 Land use at study areas.

The results indicate that the vegetation is still maintained but it needs to be conserved and monitored to sustain the resources for future generation. Beside the development of ecotourism within the new array of ‘green’ products and services, ecotourism claims to combine environmental responsibility with the generation of local economic benefits that will have both a development impact and serve as conservation incentives [14]

3.3. Landscape Structure Analysis

Based on Figure 3, the landscape structure of Ketitir lake vicinity surrounded by developed building compares to Gua Madu which more to vegetation area being analyzed. Even though, both of this area located mainly in the centre of Gua Musang. Table 3 shows the comparison of all study areas as a potential ecotourisms sites in Gua Musang based on landscape metric analysis at all study areas. Figure 3 and Table 3 indicate that the municipality of Jedip Village has the highest land use of vegetation compared to other study areas.

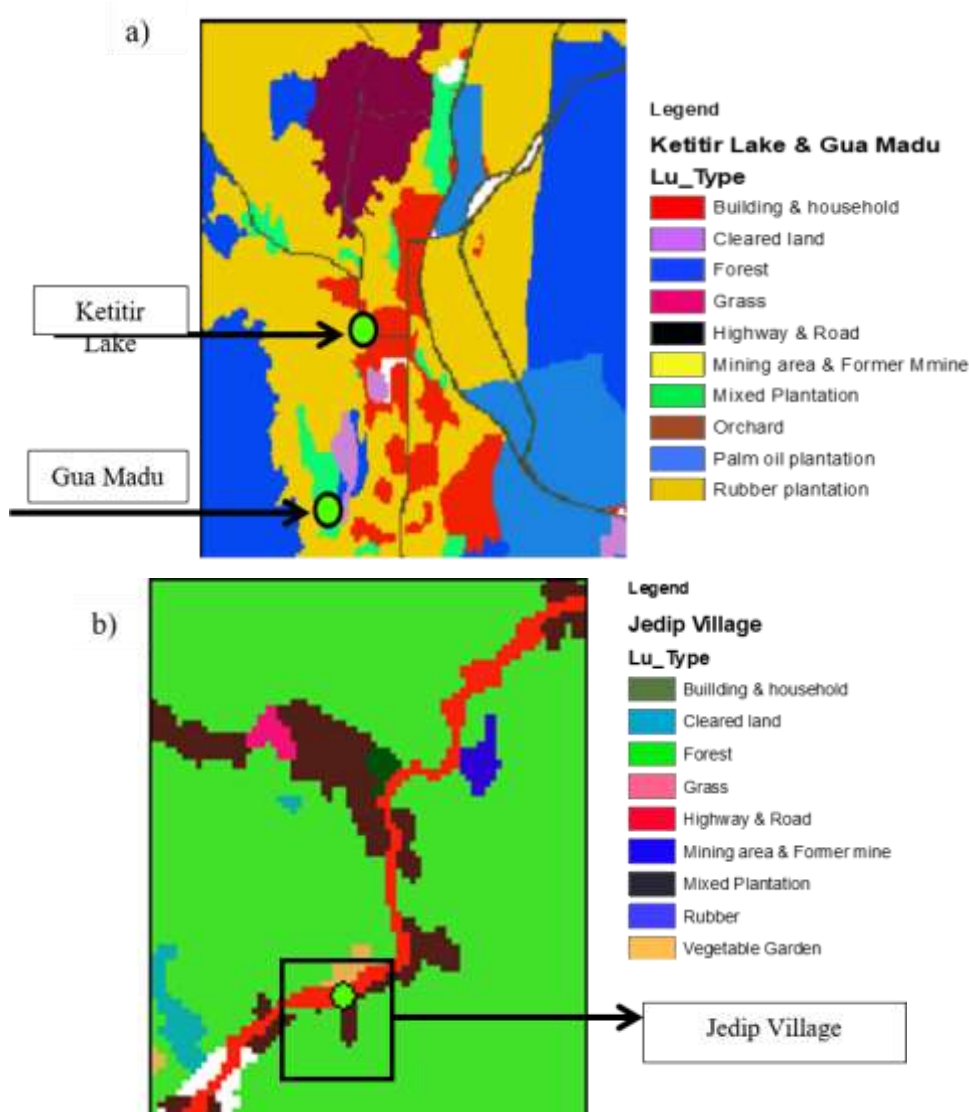


Figure 3 Patch analysis of a) Ketitir Lake, Gua Madu and b) Jedip Village based on land use type

This is believed due to increase in the number of patches, a decrease mean patch area and the reduction of largest patch index (Table 3). While water body has lower number of

patches, mean patch area and the largest patch index in the Jedip Village. The comparison between Gua Madu and Ketitir Lake show a slightly significant different in this four landscape patches (Figure 3). The area of both places is near and located at the centre of Gua Musang. The number of a patch of Gua Madu and Kititir Lake is similar. While patch density of Ketitir Lake is higher compared to Gua Madu. The mean patch area was decreased and reduction of largest patch index because of human development and their activity.

Table 3 Comparison among landscape metrics on study areas potential on ecotourism in Gua Musang based on land cover types.

Landscape Metrics/Places	Land Use Land Cover type			
	Vegetation	Built up area	Cleared land	Water bodies
NP				
GuaMadu	91	34	30	25
Ketitir Lake	91	38	37	4
Jedip Village	94	2	3	59
PD				
GuaMadu	0.05	0.10	0.30	0.12
Ketitir Lake	0.10	0.15	0.42	0.10
Jedip Village	0.40	0.04	0.28	0.05
AREA_MN				
GuaMadu	1576	28050	372	15.62
Ketitir Lake	1560	28040	400	15.61
Jedip Village	39185	439	185	190.00
LPI				
GuaMadu	106.36	6.40	1.41	0.30
Ketitir Lake	104.36	10.40	5.41	0.24
Jedip Village	161.04	1.80	0.76	0.28

Note: NP: Number of patches, AREA_MN: Mean patch area (ha), PD: Patch density (patch number/100ha), LPI: Largest patch index

Generally, the population distribution of local community will affect the potential of sustainable ecotourism in sustaining the ecotourism [15] because the local community distributes their land, vegetation, facilities and management to improve the overall condition of ecotourism in Gua Musang. This can be more specifically followed ecotourism development needs to consider additional environmental problems which can be controlled using sustainable ecotourism site planning areas to minimize the fragmentation and duplication of planning in this study areas. Aforementioned, Ketitir lake and Gua Madu located in the centre of Gua Musang. Therefore, these areas have more development and easily assessed by visitors [16,17]. According to Gua Musang District Council, Ketitir Lake is a former mining area that been transformed into a recreational area that makes attraction of many people to on-going their activity. Gua Madu natural attraction of the caves and bees that surrounded by forest and near to the Nenggiri River. On the other hand, Jedip village area vicinity surrounded by vegetation especially on the mixed plantation. As proved, the Jedip villager, Temiar tribe exposed their activity on planting cassava honey opposite their house area.

Therefore, the effect on this natural attraction and human activity develop the factor on the fragmentation as the change of this both place been observed and analyze. For examples, Ketitir Lake has potential on highly fragmented land structure compare to Gua Madu and Jedip Village. Land cover and landscape changes represent an important and sensitive indicator that echoes the interactions between human activity and the natural environment [18]. Therefore, it can be seen the Jedip village (Figure 3) have the potential to be a suitable place for doing an ecotourism activity with large space and easily assessed. Next is Gua

Madu as it is natural ecotourism site in Gua Musang with the geographical structure of the cave with honey bees. The least potential is Ketitir lake as it been exposed the attraction of people to do ecotourism activity like a recreational activity, the activity such as jogging, walking, cycling, and paddle boat in the lake.

High accessibility and demand for ecotourisms leads to the increasing of landscape fragmentation when the uncontrolled development happened [19]. According to Marzuki et al. [20], a control development is required to achieve a sustainable ecotourisms at any ecotourisms site. Therefore, the landscape fragmentation can be highly occur in Ketitir Lakes compared to Gua Madu, while Jedip Village have a potential to be fragmented due to uncontrolled development. The relationship between spatial pattern and ecological processes was not restricted to a particular scale [21] by quantifying the degree of fragmentation requires measuring the pattern of habitat on the landscape [22]. Thus, the most potential ecotourism site to be more sustainable between the study areas is Gua Madu

3.4. Relationship between the Landscape Structure Pattern and Ecotourism Activity

The significant correlation analysis (r^2) between land use type area and ecotourism activity is 0.6. This means there is strong significant correlation between all the ecotourism activity done in the type of land use. Based on the correlation analysis, Gua Madu is the most potential ecotourism area. Gua Madu usually visited by family and group vacation to have the sightseeing at the bridge connected with Kampung Batu Papan to see the Neggiri river, recreational activity, and cave hiking. Cited by Irhanida [23], Gua Musang could benefit from being more interesting place of its role and its relationship with other tourism destinations that travelers visit before and after their arrival. Therefore, attraction place most basically focused toward recreational activity then followed with the picnic with family, sightseeing and the least is caves hiking. Besides, the caves hiking is attracted mostly to the tourist who loves in the adventurous and challenging game as deposited their memorable and enjoyable visit

3.5. Determination of Potential Ecotourism Activity for Sustainable Ecotourism

It is expected the tangible relationship between the potential ecotourism activity and local land use type in the study areas in Gua Musang is strongly significant with the value 0.6 which are more than 0.5. The landscape metric analysis is a lower number of the patch and increases in patch density in Gua Madu with the correlation significant compare to Jedip Village and Ketitir Lakes OR The landscape metric analysis shows the lower number of the patch and increases in patch density in Gua Madu with the correlation significant compare to Jedip Village and Ketitir Lakes.

4. CONCLUSION

Gua Madu is the most potential ecotourism as it has a good arrangement of landscape structure. The patch of Gua Madu has the lowest number, largest patch index and favorable place based on the ecotourism activity compare to Ketitir Lake and Jedip Village. However, excessive logging activity causes a lot of pollution especially water and soil pollution that effects local business in ecotourism and ecotourism activities. Therefore, it is suggested by the Head of Jedip Village to gazette the indigenous community areas to ensure the continuity of their role in sustaining the diversity of cultural and biological landscape. Therefore, Gua Musang act as a model for a landscape ecology approach to assessing the potential of

ecotourism to be developed as a sustainable area. This can be linked with the local people as the distribution of the local population in Gua Musang will affect the study of the potential of sustainable ecotourism in Gua Musang.

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