



Heritage Trail Mapping for Megalithic Stones Using GIS For Ecotourism Purposes

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Abstract- Tourism is an essential industry in Malaysia that significantly influences the economy by contributing to financing, foreign exchange, and marketing. Nowadays, many tourists choose ecotourism as the primary option to be used as a tourist destination. Cultural and Heritage Tourism are one of the types of ecotourism that can attract many tourists either from within or outside the country who love cultural heritage. One of the cultural heritages in our country that can be an ecotourism product is the megalithic culture. This culture is a tradition of worshipping large stones in the ancient society that is becoming extinct. By promoting the heritage trail with megalithic themes can attract tourists to visit the megalithic stone sites. This study produces a megalithic stone heritage trail map for low and high capabilities that can be used as a tourism product for ecotourism in the interior of Sabah, Tambunan. The data used in this study were obtained through fieldwork in Tambunan. This heritage trail map was produced using buffer and kernel density analysis using GIS applications. This study's heritage trail can guide tourism development to increase ecotourism products in our country and help generate our country's economy. Besides, this ecotourism also helps essential to protect nature from being damaged. At the same time, it also preserves the almost extinct megalithic stone cultural heritage in our country.

Keywords: Tourism, Ecotourism, Megalithic Stone, Heritage Trail, GIS

I. INTRODUCTION

Tourism is a type of outdoor exploration activity that must not more than a year for specific purposes (World Tourism Organization, 1994). The tourism industry is the second largest industry contributing to our country's economy after manufacturing (Che Leh and Omar, 2013; Ministry of Tourism Malaysia, 2010). The tourism industry's development has opened up employment opportunities for Malaysians and contributed to income, mainly through tax revenue generated from this industry. Since 1992, Malaysia has begun to focus on ecotourism-based tourism following the Malaysian Tourism Policy, emphasizing the retention and expansion of ecotourism in our country. Based on a study conducted by Fennell (2011), eight basic principles need to be followed to safeguard the importance of ecotourism, including reducing the impact on the environment, minimizing the effects of development, increasing respect for the country visited, and optimizing economic benefits to the country. Most ecotourism areas in Malaysia such as wildlife reserves, national parks, upland, mangrove swamps, forest reserves, recreation, waterfalls, coastal areas, and marine park islands, and so on (Siti *et al.*, 2008; Wallace, 1996; Hausman, 2001; Chan, 2010).

Recently, many tourists choose ecotourism as their tourist destination because of the attraction from the ecotourism location (Jabil *et al.*, 2007). Ecotourism refers to responsible travel and excursions to undisturbed natural areas to enjoy and conserve nature, reduce negative impacts, and preserve local communities (Siti *et al.*, 2014; Chan, 2009). Besides, ecotourism emphasizes sustainable tourism activities. So, tourists who come to visit need to take care of nature by not damaging it and throwing garbage into the bins that have been provided. This action is taken because the arrival of tourism brings benefits to a country and harms the environment. The most apparent effect is waste generation. Unsustainable tourism will lead to the impact of increasing solid waste in our country. Also, heritage and culture are declining, reducing biological diversity, extinction of wildlife, and in turn, leading to pollution of rivers, lakes, and the sea (APEC, 2002).

Malaysia has a diverse culture and natural heritage. So this has become one of its advantages to develop ecotourism. Vigorous promotion related to attractive tourist destinations such as Melaka, Penang, the east coast of the Peninsula, Sabah, and Sarawak has made Malaysia famous in the world's eyes. Nowadays,

Cultural and Heritage Tourism are increasingly attracting tourists to places with history, art, science, lifestyle performances, or heritage of communities, regions, groups, or institutions (Silberberg, 1995). Visitors can gain experiences related to the cultural environment, including landscapes, visual arts and performances, lifestyles, values, traditions, and events. Cultural and Heritage Tourism themed with heritage trail is also the choice of visitors who are fond of cultural heritage. (Mastura et al., 2019; Lai, 2009).

Heritage trails are becoming popular because they provide a purposeful and interpretive route for visitors to explore either with tour guides such as bus drivers or on foot and explore heritage trails on their own (Timothy and Boyd, 2015; Sue, 1995). Besides knowing the cultural heritage, heritage trail's visitors can also enjoy the beauty of the environment along the way to the heritage site. Therefore, heritage trails become the choice for tourists who have a deep interest in a country's cultural heritage and ecotourism. The heritage trail is ecotourism-based tourism, where it meets the environmental, economic, and socio-cultural components (UNESCO and UNEP, 2016). Apart from revealing the community's cultural heritage, enabling tourists to enjoy the beauty of the environment, ecotourism based on heritage trail can also generate the local community's economy and even the national economy. Therefore, this study was conducted to map the heritage trail for megalithic stones in Tambunan using GIS. This study's outcome is a map of heritage trails for low-level capabilities and heritage trails for high-level capabilities. Heritage trail for low-level capabilities is produced on lowland that can be traversed on foot in 10 to 30 minutes. The heritage trails for high-level capabilities made on high, sloping ground areas take walking and hiking time for 1 hour or more. The production of these two levels of heritage trails enables tourists to choose heritage trails to visit megalithic stones sites according to their resilience. This heritage trail map can be used as a guide for tourism developers in Tambunan to construct heritage trails to increase ecotourism in Sabah. In addition, this heritage trail map can also be a kind of documentation to preserve the endangered megalithic stone's cultural heritage.

Heritage Trail as a Tourist Attraction

The trail is a method to provide visitors with experience by providing a route for a purpose (Bozic & Tomic, 2016; Timothy & Boyd, 2015). The trail can be found in urban, rural, coastal, and or underwater areas. A specific themed route is provided either on foot or using specific transport to get through this trail. Heritage trails refer to paths that take tourists to a heritage area. In the heritage trail, a theme will promote heritage tourism, conveying a place or person's history, and appreciating the value of a place's heritage. Heritage trails are defined trails that lead trail users to understand the past, natural heritage, and culture of the area by visiting heritage elements. Heritage trails can be designed to help people who visit a building or location (Dipa et al., 2017).

Nowadays, heritage trails are becoming increasingly popular to promote an area's history, heritage, and culture. Heritage trails are very useful in developing tourism while generating the local economy. Therefore, more and more parties produce heritage trails such as the authorities, non-profit organizations, local communities, and even school students. Generally, trail users usually have brochures showing map routes, stop points (heritage elements), and general information about those locations. Occasionally, heritage trailers will provide signage or road-finding facilities along the path to enhance the trail user experience (Sue, 1995). Next, a variety of information that tourists can use as a guide to go to the trails such as printed literature, road markers provided along the route, the information on websites, or through mobile applications.

Heritage trails are essential to the community in our country to increase awareness of local heritage and stimulate community interest in heritage preservation and conservation activities. Besides, heritage trails can also promote historical areas in a place to visitors who come to visit. The heritage trails are also significant in showing conservation activities openly and providing recreation or education.

The potential of GIS in Tourism

Tourism is the journey of a person to a place outside the usual area to go for a meal, work, and other purposes not less than one day but not more than a year (Cook et al., 2006; Camilleri, 2018). Tourism is an industry that has a considerable impact on the country's economy. With the influx of tourists into our country, the services and industry sector that provides travel experience to tourists will benefit. Among

them are transportation, accommodation, restaurants, entertainment centres, shopping malls, and so on that tourists will visit while in our country.

Besides, when travelling, a tourist must need information related to accommodation, facilities, restaurants, places of interest, ATMs, etc. The information can be collected, processed, compiled, and stored using tools such as Global Positioning System (GPS), Geographic Information System (GIS), and remote sensing. After collecting the data needed, the data is stored in a form that can be taken to enhance tourism by using GIS. Geographic Information System (GIS) is one of the most remarkable technological innovations in tourism planning and decision making. Therefore, information related to the location that can help facilitate travel and tourist references can be presented using GIS. So, this is one reason why GIS is increasingly important in tourism planning because GIS has made it easier for tourists to plan their trips (Shamim Ahmad Shah and Muzafar Ahmad Wani, 2015).

Geographic Information System (GIS) is a computer-based tool for collecting, mapping, analyzing, storing, and displaying spatial and non-spatial data. It is a computer application associated with geographical information. Also, GIS is an application that can display information with multiple layers. GIS also has a database system that shows spatial data and attributes data to provide spatial data information. GIS databases are displayed in horizontal and oval location grid information (Fellaman et al., 2008). Next, GIS also consists of a box containing various techniques to analyzezeit (Wheatley et al., 2002).

Today, GIS has become an important business tool, urban planning, and agriculture and includes tourism to save money, energy, and time spent in decision-making (Delavar and Naghibi, 2003; Iqbal et al., 2006). In tourism planning, GIS plays an essential role in identifying and locating tourist attractions. However, GIS allows the facility to extract various types of information (e.g., tourist attractions, hotels, distance from each other, roads, settlements, plants, land use data, and changes in tourist resources) from maps (Fajuyigbe, Balogun and Obembe, 2007).

Indeed, the field of tourism desperately needs GIS technology in tourism planning to assist in decision making. In addition, GIS is also important to display tourism-related information on the GIS map. With this map, travellers can choose the location they want to go to quickly and easily. Moreover, this makes it easier for tourists to visit and increase tourists' influx because it achieves satisfaction when travelling.

Research Area

This study was conducted in Tambunan, Sabah. Tambunan is a district that still prioritizes the preservation of local culture despite receiving increasing development. Most of the Tambunan district villagers carry out paddy cultivation activities once or twice a year. Apart from that, most of the villagers in Tambunan are Kadazan Dusun, born and raised here. In addition, Tambunan is one of the districts that still have a lot of megalithic stones. Therefore, Tambunan is very suitable to conduct this study because the megalithic tradition is a tradition that does not get the attention of society today. The villagers who are originally from Tambunan and are the older group are the ones who are expected to provide information related to megalithic in this study. Figure 1 shows the map of the study area, which is the Tambunan district.

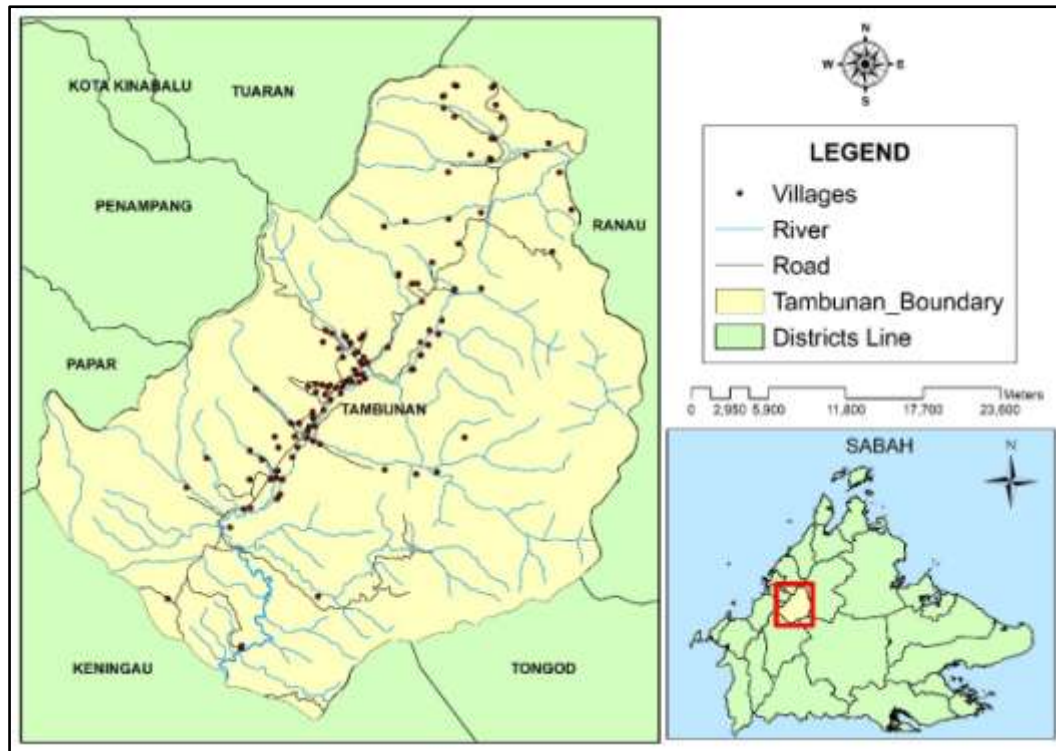


Figure 1: Map of the study area

The Process of Developing GIS Database for Heritage Trail

The development of the legacy GIS database in this study began with the inclusion of megalithic stones data into the GIS software. The location of the megalithic stones is obtained through a location map in the Tambunan district. Apart from that, interviews with the villagers in the Tambunan district were conducted to determine the megalithic stones' location. After knowing the megalithic stones' location, visiting the megalithic stone site is carried out to observe each megalithic stone's coordinates. Next, the megalithic stones' coordinates will be included in the ArcGIS software to develop a heritage trail GIS database.

The second stage is to identify the megalithic stone concentrate area using kernel density analysis in ArcGIS software. The process of identifying megalithic stone's focus areas is important in creating the heritage trails. So the tourists can visit the site of many megalithic stones at a close range. The area with concentrated megalithic stones can reduce tourists' fatigue while visiting megalithic stones and saves time for tourists who are excited about the megalithic stones culture and see more megalithic stones.

The third stage includes the process of identifying tourism elements close to megalithic stones. The tourism element refers to restaurants, transportation, accommodation, facilities, and places of interest. This process is done to determine the distance of the tourist element with the megalithic stones. Furthermore, this process is vital to ensure that the megalithic stones chosen to be visited in this heritage trail are not too far from the tourist element to facilitate tourists' access.

The fourth stage is to insert the DEM data into the GIS application to identify the gradient of the area in the Tambunan district. Slope analysis was carried out using the DEM data. After that, megalithic stones located in low and high areas can be determined. It is important to produce heritage trails for low-level and high-level route capabilities.

The final stage is to identify the megalithic stone's heritage trails. There are two ways to produce trail paths by referring to the gradient of the area. For low-lying areas, heritage trails are generated by connecting concentrated megalithic stones using lines through GIS applications. For high slope areas, heritage trails are developed using the Least Cost Path Analysis (LCPA). Next, buffer analysis will carry out based on the result of the heritage trail. This buffering analysis was conducted to show megalithic stones, heritage trails areas for low and high-level capabilities. Overall, the processes involved in figure 2.

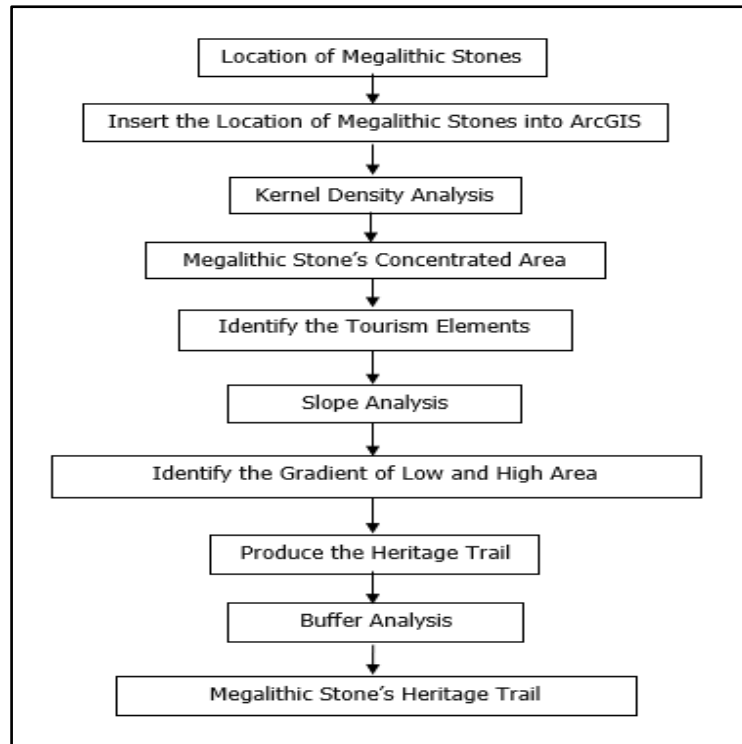


Figure 2: Process of Developing GIS Database for Heritage Trail

Production of heritage trail maps for low-level and high-level route capabilities

A GIS database will be developed before generating a heritage trail map using spatial data and attribute data. Spatial data was developed based on the basic map of the Tambunan district produced by the Director of Land and Survey Sabah (1975). The map digitization process based on the basic map will be carried out using the ArcGIS application. Then, attribute data will be included in ArcGIS to support spatial data.

Next, the production of heritage trail maps began by obtaining the location of megalithic stones in Tambunan. Then, enter the obtained megalithic stones' location into ArcGIS to enable GIS analysis to be carried out, as shown in figure 3.

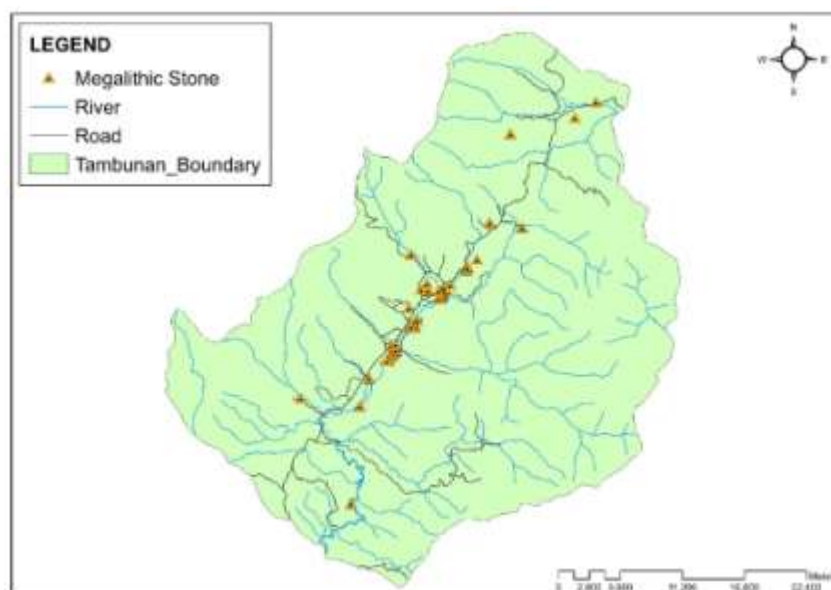


Figure 3: Insert the location of megalithic stones into the ArcGIS application

The megalithic stones location data was used to carry out kernel density analysis to identify the concentrated area of megalithic stones. In this study, heritage trails were produced on the flat land area where the megalithic stones were concentrated and located. The megalithic stones located on the high slope areas were selected to create low and high-level heritage trails. The results of kernel density analysis showing the megalithic stones concentrated area are shown in figure 4.

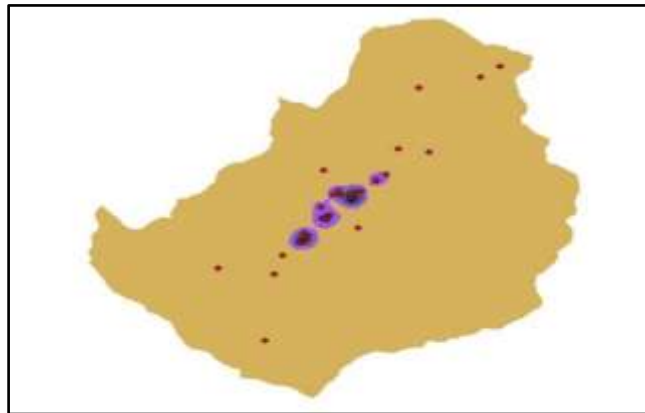


Figure 4: Results of kernel density analysis showing the megalithic stones' concentrated area

After identifying the areas of focus of megalithic stones, the next process identifies the tourism elements found around the megalithic stones. In this study, the locations of tourism elements were identified using Google Map. A tourist area needs to have some tourism elements to attract tourists (Akukwe and Odum, 2014). The tourism elements are transportation, places of interest, accommodation, and places to eat. Therefore, the distance between the tourist and heritage trail areas is best not too far and easy to reach. In this study, the tourist element's distance is about 1 kilometer from the heritage trail area. The tourism elements found around the megalithic stones can be seen in figure 5.

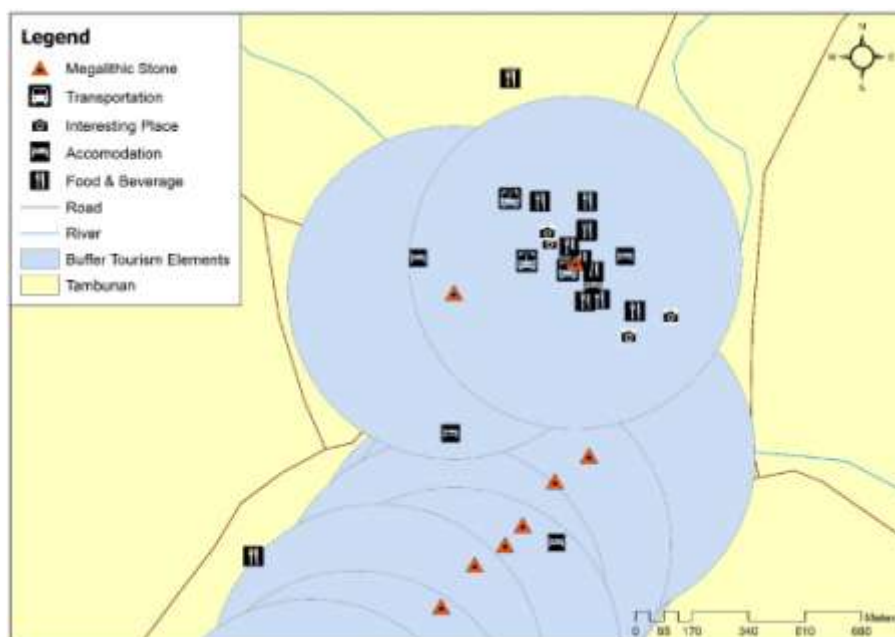


Figure 5: Elements of tourism found around megalithic stones

Figure 5 shows that tourism elements such as accommodation, restaurants, places of interest, and transportation are located around the megalithic stones. The tourist element included in the buffer is the tourist element with a 1 km distance from the megalithic stones.

The next step is to identify low and high areas by reference to DEM data. Therefore DEM data will be included in the GIS application to conduct slope analysis. From the results of the slope analysis, low and high areas can be determined. Figure 7 shows the DEM data of Tambunan, and the slope analysis results are shown in figure 8.

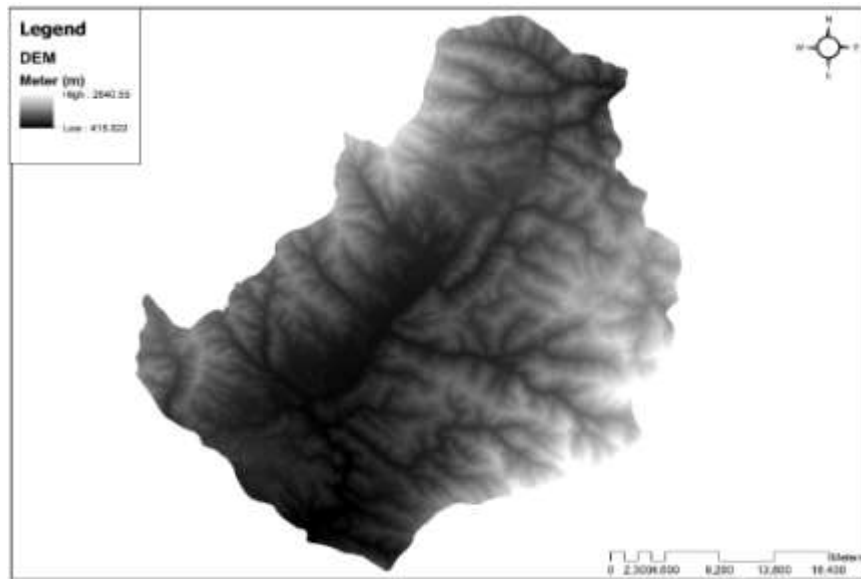


Figure 6: Tambunan district DEM data

The DEM data in figure 6 shows the height of the Tambunan district area. The dark area in figure 7 is a high slope area. In contrast, brighter areas are low slope areas.

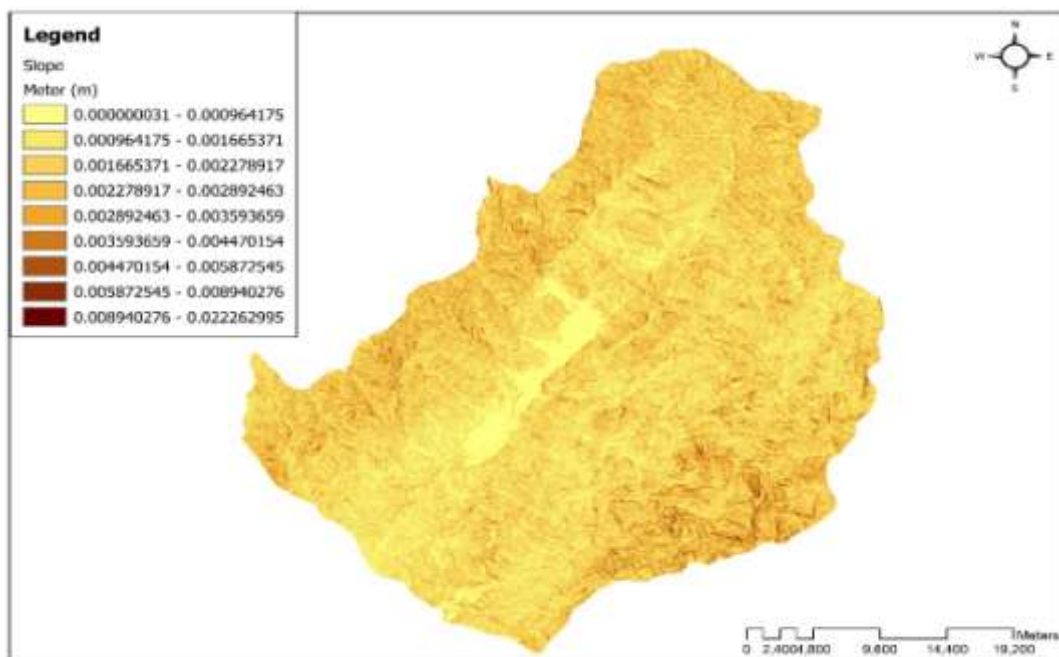


Figure 7: Results of slope analysis

In figure 7, the results of the slope analysis are shown. Dark brown areas show high, sloping area, while light brown areas are low sloping areas.

After identifying the height of the area, the next step is to produce a heritage trail route. For low slope areas, heritage trails are constructed by connecting nearby megalithic stones using a single line through ArcGIS. Then, the heritage trail will be used to conduct buffer analysis. The purpose of this analysis is to show the low-level heritage trail route area.

For high slope areas, heritage trail routes are produced using the lowest route cost analysis (Least Cost Path Analysis - LCPA). Routes created using LCPA can save costs in terms of time, energy or money. This is because the heritage trails created using the LCPA choose the low-slope areas to be used as routes. So, it is easier for the tourist who wants to come and visit the heritage trail. Figure 9 shows the process of running the LCPA.

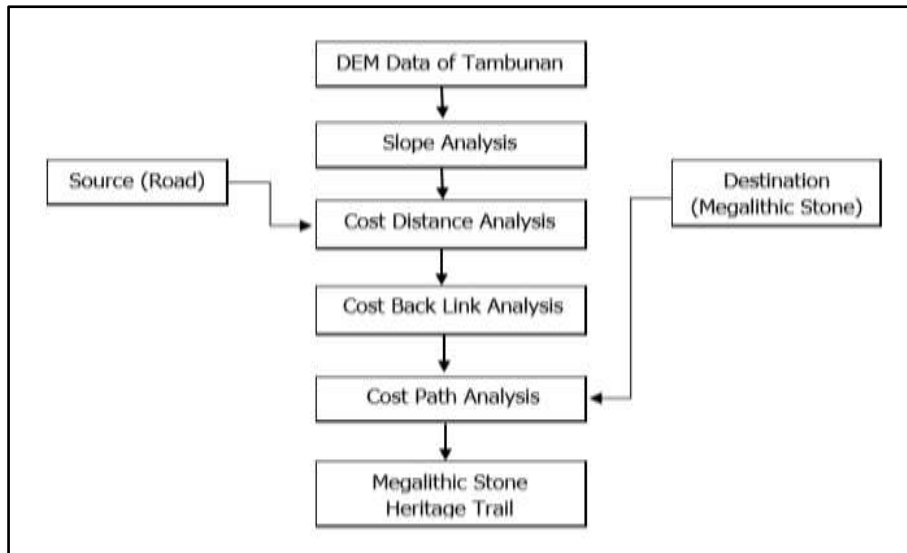


Figure 8: The process of conducting the Least Cost Path Analysis (LCPA) to produce Heritage Trail in sloping areas

As shown in figure 8, the LCPA begins by inserting the TambunanDEM data into the ArcGIS application. Then, using a slope analysis to see the gradient in Tambunan. Next, cost distance analysis using roads as a source and megalithic stone as destinations were carried out. Followed by conducting cost distance analysis, cost backlink analysis, and finally, cost path analysis to produce a megalithic stone heritage trail.

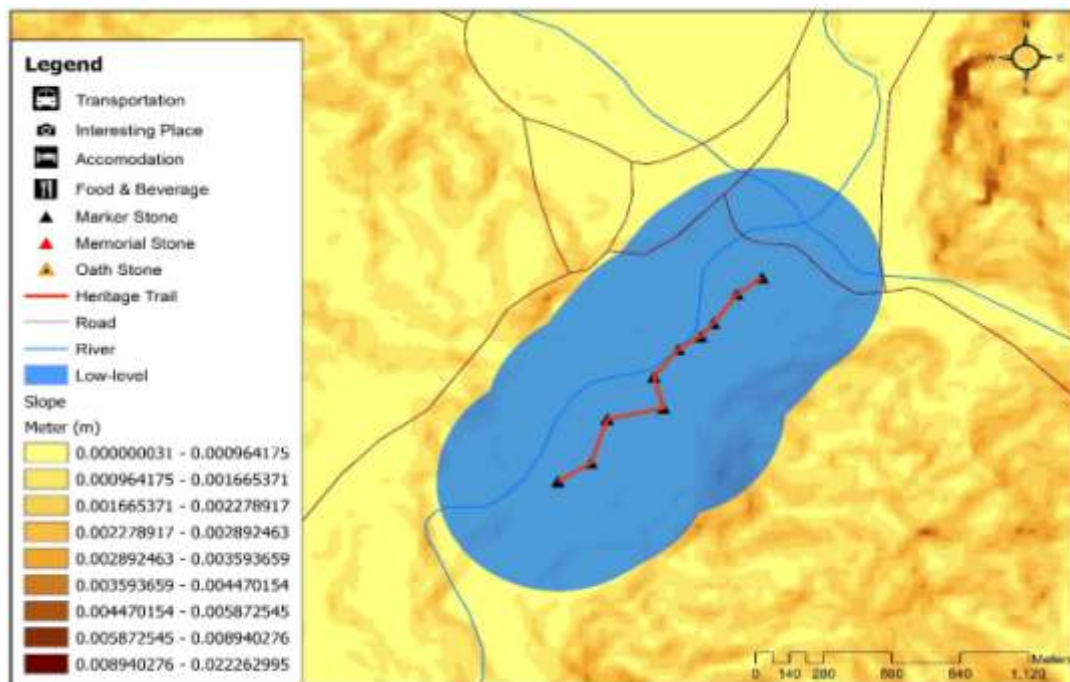


Figure 9: Heritage trail results for low capacity levels in low slope areas

Figure 9 shows some of the heritage trail results for low-level capabilities in low slope areas. The area with dark brown colour refers to the high slope area while the area with light brown area refers to low slope area. The blue colour area around the trail is an area 500 meters from the trail.

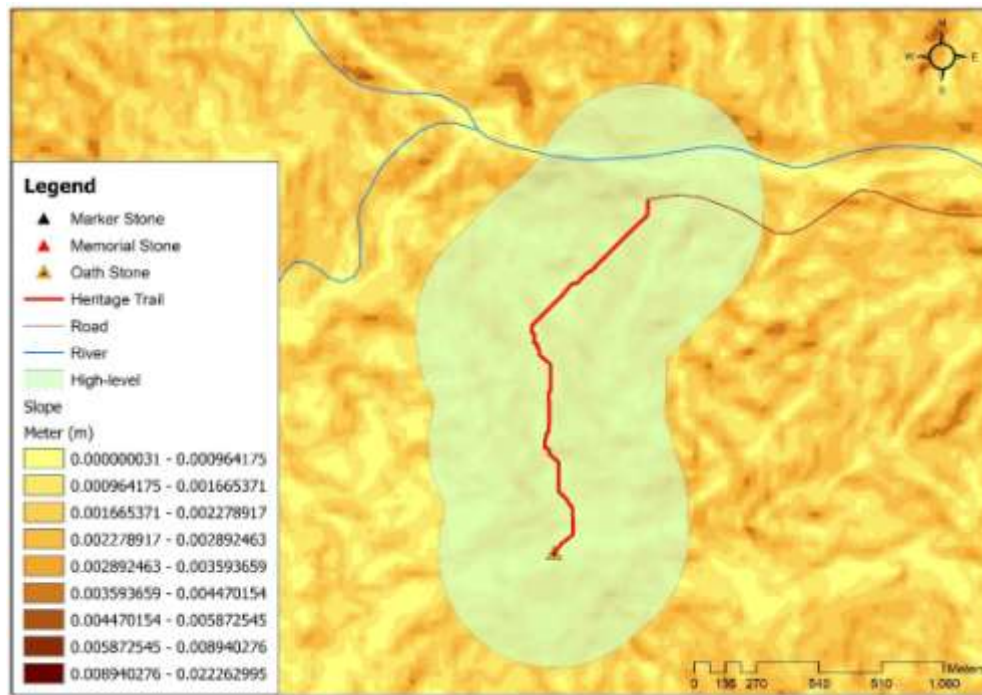


Figure 10: Heritage trail results for high-level capabilities in sloping areas

Figure 10 shows some of the heritage trails with a high level of capability in sloping areas. Trails of this legacy were generated using LCPA analysis. The red line indicates a heritage trail that tourists can traverse to visit megalithic stones sites.

Heritage Trail for Low-Level Capabilities

Three areas focus on megalithic stones, namely Tinompok village, Karanaan village, and Tobilung village. In Kampung Tinompok, eight megalithic stones are consisting of two Memorial Stones and six Marker Stones. The marker stones in Tinompok village are divided into burial area's marker stone, end of house's marker stone, and marker stone for people who are childless. For the burial area's marker stone, both megalithic stones are located at the burial site. One of the stones is told as the sleeping place for Kogut bin Sungkolid after seeing a beautiful stone guard appear. After Kogut died, his grave was built near the stone. Next, there are four house marking stones in Tinompok village that are included in the heritage trail. There are three marker stones at the end of the house located in the paddy fields, and one is located next to the villagers' houses. Finally, the other two megalithic stones are the childless marker stone. In the past, childless villagers would be erected a megalithic stone as a sign of having no heirs.

Next, in Karanaan village, three megalithic stones can be visited. These three megalithic stones consist of a memorial stone and two stones of paddy fields' boundary marker. The memorial stone was erected to commemorate SGN. 485 Gambuli B. Guntami. The American army mistakenly shot Gambuli for thinking he was a Japanese soldier during World War II. Besides, the two stones marking the paddy field boundary are located in the paddy field area. One of the megalithic stones collapsed, and there were cracks.

In Tobilung village, there are ten megalithic stones located in the paddy fields. This megalithic stone is a Paddy Field Marker Stone that is located parallel to the Pegalan River in Tobilung Village. These ten megalithic stones have unique names, namely Boniok, Indik, Masatan, Motinggam, Sabatan, Siawan, Sopihok, Tumbio, Tundugu, and Unjuk. Two megalithic stones, Tumbio and Unjuk have collapsed. Trails of heritage for low-level capabilities are shown in figure 11.

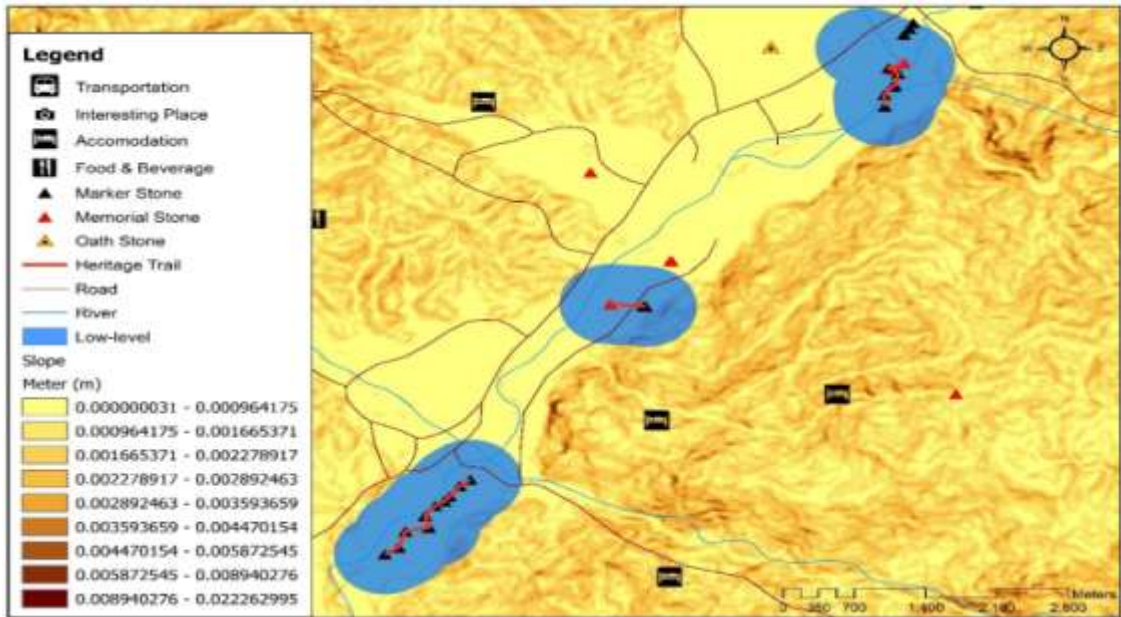


Figure 11: Heritage trails for low-level capabilities

Heritage Trails for High-Level Capabilities

Heritage trails with a high level of capability are located in high slope areas. The two megalithic stones sites selected for this heritage trail are located in Kumawanan village and TinompokLiwan village. This heritage trail was created using the LCPA to obtain a steeper route to track the two megalithic stones. The megalithic stone found in Kumawanan village is a peace oath stone. The purpose of this peace oath was established as a sign of peace between hostile villages. Therefore, this oath stone was erected, and the village heads involved had to swear they would no longer be hostile to the ceremony led by the *Bobolian*. If there is a fight between the villages, a fine will be imposed.

Meanwhile, the megalithic stone in TinompokLiwan village is a protection oath stone erected to protect the village from disease and evil forces. Heritage trail for high-level capabilities is shown in figure 12.

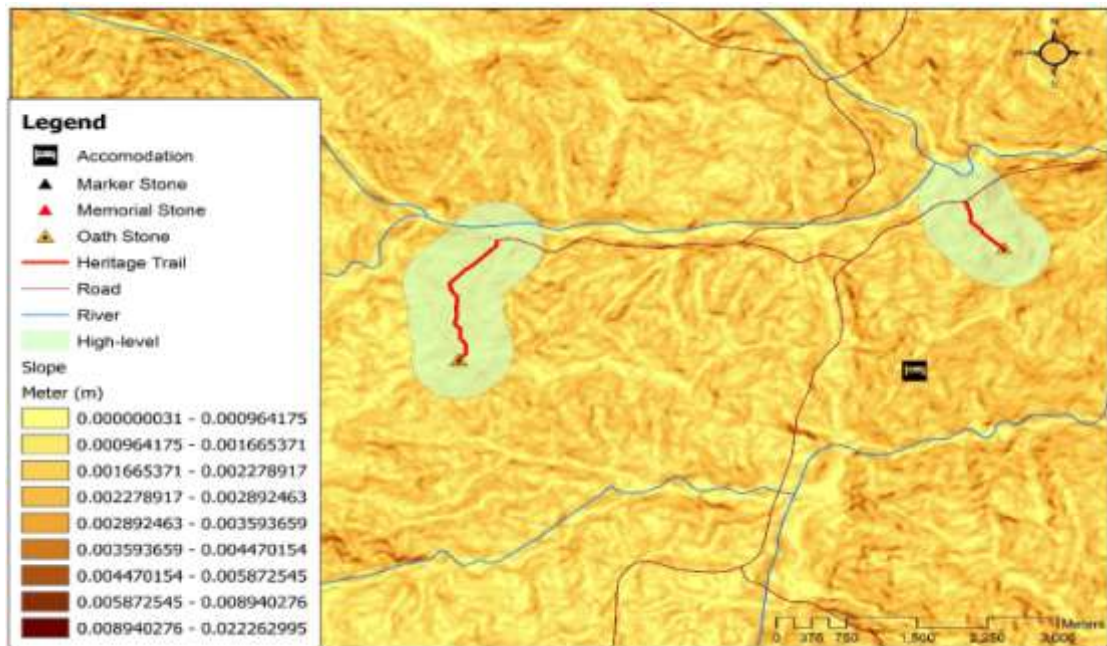


Figure 12: Heritage trail for high-level capabilities

Finally, a heritage trail map that combines both low and high-level capabilities is shown in figure 13. Figure 13 shows that heritage trails for low-level capabilities are shown in blue areas, and high-level capabilities are shown in green areas.

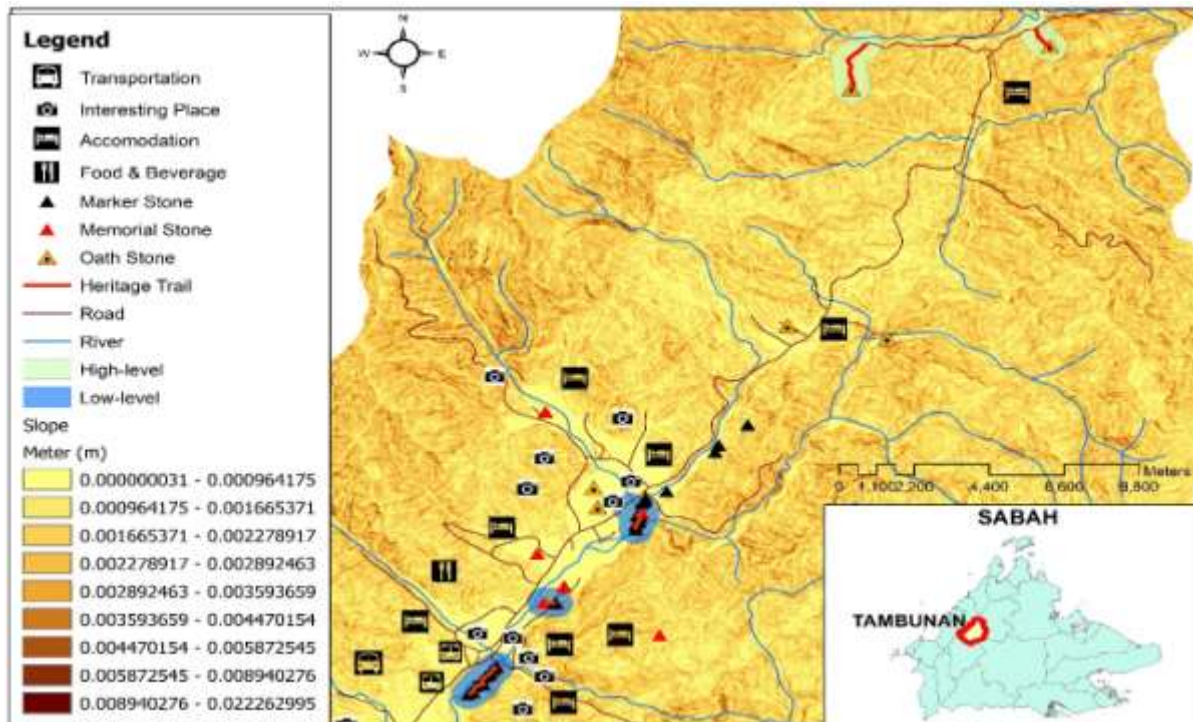


Figure 13: Heritage trails for low and high-level capabilities

II. DISCUSSION

This study's heritage trails are divided into two levels of capabilities: low and high-level capabilities. The difference in this level depends on the difficulty of going through the heritage trail. For heritage trails for low-level capabilities, the problem of going through these heritage trails is low. This is because trails of this heritage are produced in lowland and flat areas. Therefore, tourists who want to visit the megalithic stone site through low-capacity heritage trails only need to walk for 10 minutes to 30 minutes only. In this study, the heritage trails for low-level capacity are located in Tinompok village, Karanaan village, and Tobilung village. The time taken to complete these three heritage trails is different. The heritage trail for low-level capabilities in Tinompok village and Tobilung village takes about 30 minutes to complete. These two villages' heritage trail involves more megalithic stones, which are eight megalithic stones in Tinompok village, and ten megalithic stones in Tobilung village.

Meanwhile, in Karanaan village, it only involves three megalithic stones. Therefore, the time to complete the heritage trail in Karanaan village is 10 to 15 minutes. Thus, tourists can choose to visit these three heritage trails, depending on their interests. For tourists who cannot walk far, the heritage trail in Karanaan village, which takes 15 minutes, is the right choice. For tourists interested in seeing more megalithic stones can choose to visit the heritage trail in Tobilung village because this village has ten megalithic stones.

Next, a heritage trail with a high level of capabilities means completing this legacy trail is difficult. This is because the heritage trail is located in a high slope area. Tourists have to climb all the way to reach the site of the megalithic stones. In this study, the heritage trail with a high level of capabilities is located in Kumawanan village and Tinompok Liwan village. The time to spend each trace of this heritage trail is 45 minutes to 1 hour, depending on an individual's endurance. Therefore, both of these heritage trails are suitable for those who like to do hiking activities.

Both heritage trails for low and high-level capacity are located in different areas such as paddy fields, settlement areas of the villagers, cemeteries, and up hills. Therefore, tourists can enjoy the beauty of green rice fields and breathe fresh air in rural areas. This type of atmosphere is very suitable for tourists who

want to calm their minds from the hustle and bustle of the city while getting to know the megalithic stones culture of the community in Tambunan. In addition, tourists interested in hiking can see the megalithic stones and understand the megalithic stone's background while enjoying nature's greenery activities to keep the body healthy through the heritage trail.

III. CONCLUSION

Overall, cultural heritage, such as megalithic, is increasingly forgotten nowadays. Indeed, megalithic culture is a precious cultural relic. Therefore, measures to preserve megalithic culture are essential. One alternative that can be done is to build a legacy of megalithic stone heritage. Thus, with the help of GIS, suitable areas for building heritage trail can be easily identified. GIS helps in identifying areas where megalithic stones are concentrated. Besides, GIS also can locate the tourism elements that can be achieved around megalithic stones. By using GIS analysis such as LCPA, a route passing through low-slope areas can be created to facilitate tourist travel to the megalithic sites, which is the heritage trails. In the future study, authors will use LCPA to identify the source of the megalithic stone. In addition, the heritage trail helps preserve historic areas and is also important for the local community's economic generation. Tourist visits to heritage trails have indirectly provided economic resources to the locals. They can open food and beverage stalls or handicrafts near heritage trails to generate their economy. Indirectly has helped them to reduce the financial burden in daily life. In addition, for tourists who like megalithic culture and hiking activities, they can make a heritage trail as a place to hiking with friends. Thus, the megalithic stone heritage trail in this study is a way to preserve the megalithic culture, generate a local economy, and also be a destination for recreation.

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