URBAN SPRAWL MAPPING FOR BEACH TOURISM SUITABILITY USING GIS-AHP MODEL IN KUANTAN DISTRICT.

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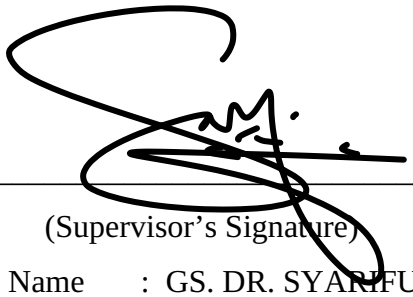

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URBAN SPRAWL MAPPING FOR BEACH TOURISM SUITABILITY USING GIS-AHP MODEL IN KUANTAN DISTRICT.

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Thesis submitted in fulfillment of the requirements
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ABSTRAK

Rebakan bandar yang berkembang telah mengakibat pertumbuhan pesat pembandaran, menimbulkan masalah alam sekitar dan sosioekonomi yang serius, terutamanya di kawasan yang mempunyai sumber semula jadi terutamanya di kawasan pantai. Dengan bantuan model Sistem Maklumat Geografi (GIS) dan Analytic Hierarchy Process (AHP), kajian ini cuba menyelesaikan masalah rebakan bandar dan kesannya terhadap kesesuaian pelancongan pantai di Daerah Kuantan. Kajian ini menggunakan kaedah analisis spatial berasaskan GIS, peta guna tanah/litupan tanah, dan data deria jauh untuk mencapai matlamat ini. Langkah awal memerlukan penggunaan data tutupan tanah sejarah untuk mengenal pasti dan menjejaki dinamik penyebaran bandar di Daerah Kuantan. Jumlah dan kadar pengembangan bandar dari semasa ke semasa akan dikira menggunakan indeks rebakan bandar. Elemen kesesuaian untuk pelancongan pantai kemudiannya akan ditentukan selepas kajian literatur yang menyeluruh dan perundingan profesional. Kebolehcapaian ke pantai, kualiti alam sekitar, infrastruktur dan perkaitan budaya adalah beberapa contoh pembolehubah ini. Menimbang setiap aspek mengikut kepentingannya akan dilakukan menggunakan model AHP, teknik membuat keputusan pelbagai kriteria, untuk menyediakan indeks kesesuaian menyeluruh untuk pelancongan pantai. Untuk menentukan kawasan di mana potensi pelancong pantai telah terjejas oleh rebakan bandar, model GIS-AHP akan mengintegrasikan indeks rebakan bandar dengan indeks kesesuaian pelancongan pantai. Kajian ini akan mengenal pasti lokasi yang lebih terdedah kepada kesan pertumbuhan bandar dan menilai sejauh mana sesuai setiap zon di Daerah Kuantan untuk pelancongan pantai dengan menindih set data ini. Kesimpulan penyelidikan akan membantu perancang bandar, pembuat keputusan, dan peserta industri pelancongan membuat pilihan bijak tentang perancangan guna tanah, pembangunan bandar dan pengurusan pelancongan yang mampan. Untuk mengurangkan kesan negatif pertumbuhan bandar terhadap pelancongan pantai, kajian ini akan membantu mengenal pasti tempat yang memerlukan teknik pemuliharaan dan intervensi khusus.

ABSTRACT

Urban sprawl has expanded as a result of urbanization's rapid growth, posing serious environmental and socioeconomic problems, particularly in areas with great natural resources, like coastal regions. With the help of a Geographic Information System (GIS) and the Analytic Hierarchy Process (AHP) model, this study seeks to solve the problem of urban sprawl and its effects on beach tourism appropriateness in the Kuantan District. The study makes use of GIS-based spatial analysis methods, land use/land cover maps, and remotely sensed data to accomplish this goal. The initial step entails using historical land cover data to identify and track the dynamics of urban spread in the Kuantan District. The amount and rate of urban expansion over time will be calculated using the urban sprawl index. The suitability elements for beach tourism will then be determined after a thorough literature review and professional consultation. Accessibility to beaches, environmental quality, infrastructure, and cultural relevance are a few examples of these variables. Weighing each aspect according to its importance will be done using the AHP model, a multi-criteria decision-making technique, to provide a thorough appropriateness index for beach tourism. To pinpoint regions where beach tourist potential has been compromised by urban sprawl, the GIS-AHP model will integrate the urban sprawl index with the beach tourism suitability index. The study will identify locations that are more vulnerable to the effects of urban growth and assess how suitable each zone in the Kuantan District is for beach tourism by superimposing these datasets. The research's conclusions will help urban planners, decision-makers, and tourist industry participants make wise choices about land use planning, urban development, and sustainable tourism management. To lessen the negative effects of urban growth on beach tourism, the study will help identify places that need specialized conservation and intervention techniques.

TABLE OF CONTENT

DECLARATION

TITLE PAGE

ACKNOWLEDGEMENTS **ii**

ABSTRAK **iii**

ABSTRACT **iv**

TABLE OF CONTENT **v**

LIST OF TABLES **viii**

LIST OF FIGURES **ix**

CHAPTER 1 INTRODUCTION **1**

1.1 General 1

1.2 Background of Study 2

1.3 Problem Statement 3

1.4 Objective of Study 3

1.5 Scope & Limitation of Study 3

1.6 Significant of Study 4

1.7 Thesis Outline 5

CHAPTER 2 LITERATURE REVIEW **6**

2.1 General 6

2.2 Population Changes in Kuantan 7

2.3 Beach tourism in Kuantan 9

2.4 Urban Sprawl for beach tourism 10

2.5 GIS-AHP study in Urban Sprawl 11

2.6 Advantages and disadvantages of GIS for urban sprawl mapping 13

2.7 Impact of urban sprawl to beaches 13

2.8 Summary of Chapter 15

CHAPTER 3 METHODOLOGY 16

3.1 Introduction 16

3.2 Flowchart of urban sprawl mapping for beach tourism suitability 17

3.3 Field data collection 18

3.3.1 Satellite GPS for coordination 20

3.3.2 Local Survey 21

3.4 Summary of Chapter 23

CHAPTER 4 RESULTS AND DISCUSSION 24

4.1 Introduction 24

4.2 Identification of influencing factors 25

4.3 Development of the pairwise comparison matrix 28

4.4 Calculation of Consistency Ratio 30

4.5 Generation of final land suitability map for beach aspect. 30

4.6 Conclusion 32

CHAPTER 5 CONCLUSION AND RECOMMENDATION **33**

5.1 Introduction 33

5.2 Conclusion for Objectives 34

5.2.1 To categorize and map urban sprawl focusing on beach tourism 34

5.2.2 To evaluate the suitability of beach tourism in Kuantan District using GIS-AHP model. 35

5.3 Summary of Research 36

5.4 Recommendation 37

REFERENCES **39**

APPENDICES **43**

LIST OF TABLES

Table 4.1	Table of Fundamental scale for Pairwise Comparison	29
Table 4.2	Matrix for Pairwise Comparison.	29
Table 4.3	Legend and description of urban sprawl mapping result	32

LIST OF FIGURES

Figure 1.1	Teluk Cempedak, a main tourist attraction to Kuantan	2
Figure 1.2	Local’s economy growth by Pantai Teluk Cempedak	2
Figure 2.1	Chart of population growth rate in Kuantan from 1950 to 2023	7
Figure 2.2	Beach tourism activities at Pantai Batu Hitam, Kuantan	8
Figure 2.3	Hyatt Regency Kuantan Resort as a main tourist accommodation	8
Figure 2.4	Most popular beach for locals and foreign tourist	9
Figure 2.5	Cherating Beach in Kuantan	10
Figure 2.6	Example of GIS analysis in Kuantan	12
Figure 2.7	Negative impact of urban sprawl on the environment	14
Figure 3.1	Methodology flow chart	17
Figure 3.2	Fieldwork at Pantai Teluk Cempedak	18
Figure 3.3	Banner showing tourism activities at Pantai Cherating	19
Figure 3.4	Relaxing spot at Pantai Anak Air, Kuantan	19
Figure 3.5	GPS coordinate at Pantai Teluk Cempedak	20
Figure 3.6	GPS coordinate at Pantai Anak Air, Kuantan	21
Figure 3.7	Local survey at Pantai Cherating	22
Figure 3.8	Souvenir shop at Pantai Balok, Kuantan	22

Figure 4.1	Data of Slope	25
Figure 4.2	Data of DEM	26
Figure 4.3	Data of Soil Texture	26
Figure 4.4	Data of Distance to river	27
Figure 4.5	Data of Distance to road	27
Figure 4.6	Data of Land Use	28
Figure 4.7	Land suitability for beach tourism	31
Figure 4.8	Pinpoints on beach spot in Kuantan District	31

CHAPTER 1

INTRODUCTION

1.1 General

The conduct of the study is to determine suitability of beach tourism based on urban sprawl mapping using GIS-AHP model focusing on beaches in Kuantan District. This in line with growth activity of Kuantan City by increasing of tourism recreation. However, for some reason such as cost, land availability, environmental concerns, and interference with socioeconomic systems, may affect the sprawl of urbanization especially for beach tourism. As a result, considerable attention is presently being focused on increasing the population and tourist capacity rather than expanding facilities constructing.

The method of Analysis Hierarchy Process (AHP) in Geographic Information System (GIS) model emphasis the pair-wise comparisons approach which provides a numerical fundamental scale that leads to effective geospatial information and better decision makers in improving their decisions in planning and development.

This integration of multi criteria decision analysis approach provides an environment to the decision makers in citing areas using land suitability analysis procedures.

1.2 Background of the Study

This study is about the process of urban growth that affects the suitability of Kuantan district beaches for tourism. Analysis of the tourism industry's growth takes variety factors, such as accessibility, land use, and environmental quality. The important of tourism to beaches cannot be emphasized in making people understand Kuantan's distinctiveness. The urge to travel and spend time outside promotes a healthy lifestyle.

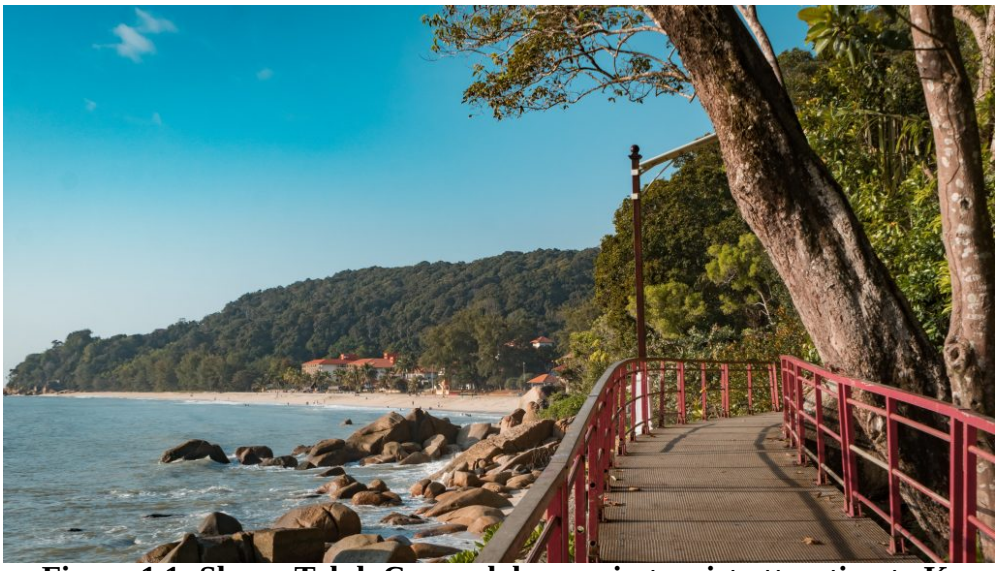

Figure 1.1: Shows Teluk Cempedak, a main tourist attraction to Kuantan.

Figure 1.2: Shows local's economy growth by Pantai Teluk Cempedak.

1.3 Problem Statement

The city of Kuantan serves as the city center. This will result in more urban congestion. Due to the size of Kuantan, many of the town's additional attractions would be unknown to visitors if this study were not done. Other than that, here is no inventory map for sprawl tourism, which is another reason why this study is necessary. Then, beach tourism problems occurred when uncontrolled urban sprawl happens from city to beaches.

1.4 Objective of the Study

The main objective of the study is to categorize and map urban sprawl focusing on beach tourism. Besides, as there is no inventory map for sprawl tourism, it is important to carry on this study using GIS-AHP model to evaluate the suitability of beach tourism in Kuantan District. Lastly, to study problems occurred especially for beach tourism and identify ways to cope those issues.

1.5 Scope & Limitation of Study

The scope of this study covers only beach tourism aspects based on urban sprawl from city to beaches in Kuantan District. In terms of technique, this study prioritizes the use of AHP method in GIS mapping. Other than that, for method we use topography data for GIS and AHP analysis, GPS coordinating and questionnaires for local survey from our fieldwork. For time limitation, we conduct fieldwork and data collection for analysis during our free time together. Next, for tools and equipment we used GPS coordinator and multiple software such as Google Earth Pro and GIS during this study. Lastly, the cost of study is estimated by the grant provided by the institution.

1.6 Significant of study

SDG 11 (Sustainable Development Goal 11) focuses on making cities and human settlements inclusive, safe, resilient, and sustainable. To address urban sprawl mapping for beach tourism using a GIS AHP (Analytic Hierarchy Process) model, we can outline to define and weight the criteria for identify the key factors that contribute to urban sprawl and beach tourism such as population density, land use patterns, transportation infrastructure, accessibility, environmental impact, proximity to beaches, tourism infrastructure, and socio-economic indicators.

For criteria weighting, weights assignation to each criterion based on their relative importance can be done using the Analytic Hierarchy Process (AHP) technique, which involves pairwise comparisons to determine the relative significance of each criterion. For example, a higher weight to factors like proximity to beaches and tourism infrastructure compared to population density.

For data collection and preprocessing, relevant data for each criterion can be gathered involves spatial data collecting from remote sensing, satellite imagery, or existing GIS databases. Additionally, socio-economic data, land use data, tourism statistics, and any other relevant information need to be collected to support the analysis. Collected data also needs to be organized and preprocessed for analysis. This could involve data cleaning, spatial data integration, projection matching, and data normalization to ensure compatibility and consistency across different datasets.

For spatial and AHP analysis, GIS tools and techniques need to be utilized to analyze the collected data. This may involve overlaying different spatial layers, generating heat maps, calculating proximity to beaches, identifying areas of urban sprawl, and assessing the suitability of specific locations for beach tourism development. Application of AHP model is needed to calculate the overall scores or rankings for different areas based on the weighted criteria. This involves pairwise comparisons of different locations against each criterion and calculating their weighted scores to identify the most suitable areas for beach tourism development.

For visualization and interpretation, the results need to be presented in a clear and visually appealing manner using maps, charts, and graphs. This will help stakeholders and decision-makers understand the findings and make informed decisions regarding urban planning, tourism development, and sustainable beach management.

Based on the results of the analysis, policy recommendations and strategies need to be provided to mitigate urban sprawl, promote sustainable urban development, and support beach tourism in the identified suitable areas. These recommendations could include land-use planning guidelines, transportation improvements, conservation measures, and tourism infrastructure development plans. The effectiveness of the GIS AHP model relies on the accuracy and quality of the data used. It's crucial to ensure that the data collection and preprocessing steps are thorough and reliable. Additionally, involving local stakeholders, experts, and policymakers throughout the process will help in gaining valuable insights and fostering ownership of the outcomes.

1.7 Thesis Outline

To conclude, this thesis outlines the importance of conducting a study using GIS-AHP model to evaluate the suitability of beach tourism in Kuantan District. This will be resulting to categorize and map urban sprawl focusing on beach tourism. This thesis also will give a deeper explanation about urban sprawl and its effect on people, country, and nature. Other than that, this thesis also gives exposure to control the urban sprawl in accordance with SDG 11 on focusing making cities and human settlements inclusive, safe, resilient, and sustainable. This thesis also discusses methodology and the type of methods used to collect urban sprawl data and information especially for this project focusing on suitability of beach tourism in Kuantan District. Specificity and validity of data are crucial and plays an important role to ensure assessment accuracy in this thesis.

CHAPTER 2

LITERATURE REVIEW

2.1 General

This chapter explains the definition of urban sprawl and its impact on beach tourism especially in Kuantan District. There are data and statistics shown on how urbanization sprawls from Kuantan center to non-concentrated areas and beaches. Other than that, this chapter also explains type of urban sprawl that may happens along those beaches. This includes on how this urban sprawl started and its process of spreading. This chapter also contains a deeper explanation on how urban sprawl can give a major impact to beaches in Kuantan District. In this chapter, it also explains the usage and application of GIS-AHP model, a modern technology software to analyses and collect data related to urban sprawl. From here, we managed to monitor and map the spread of urban sprawl to match and study its suitability for beach tourism.

2.2 Population changes in Kuantan

Over the years, Kuantan has experienced steady population growth due to its rapid development and industrialization. The city is known for its booming economy, with industries such as manufacturing, tourism, and agriculture contributing significantly to its growth. Additionally, Kuantan is home to several universities and colleges, which attract a large number of students to the city.

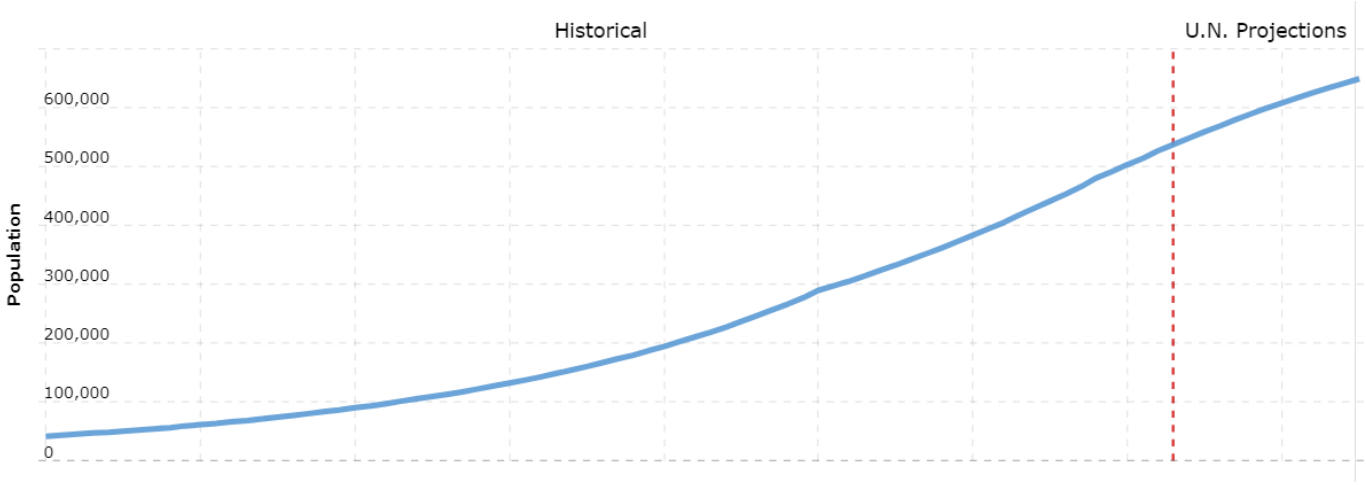

Figure 2.1: Shows chart of population growth rate in Kuantan from 1950 to 2023

(Kuantan, Malaysia Metro Area Population 1950-2023, n.d.)

Chart shows population level and growth rate for the Kuantan, Malaysia metro area from 1950 to 2023. United Nations population projections are also included through the year 2035.

The current metro area population of Kuantan in 2023 is 537,000, a 2.09% increase from 2022. The metro area population of Kuantan in 2022 was 526,000, a 2.33% increase from 2021. The metro area population of Kuantan in 2021 was 514,000, a 2.19% increase from 2020. The metro area population of Kuantan in 2020 was 503,000, a 2.44% increase from 2019. Through current and future predictions on population changes in Kuantan, it is clear that the city has experienced consistent growth and development over time. *(Kuantan, Malaysia Metro Area Population 1950-2023, n.d.)*

2.3 Beach tourism in Kuantan

Figure 2.2: Beach tourism activities at Pantai Batu Hitam, Kuantan.

Figure 2.3: Hyatt Regency Kuantan Resort as a main tourist accommodation.

Figure 2.4: Most popular beach for locals and foreign tourist.

Those figures show the main tourist attraction to beaches in Kuantan district. Beach tourism can be simply defined as holidays taken for the purpose of staying in or near beaches and most common activity for beach holiday is relaxing by means go sunbathing, swim, picnic and play on the beach.

Pahang, a state on the east coast of Peninsular Malaysia blessed with some 210 kilometers of shoreline. Kuantan itself holds 3 main beaches which gain the most popularity among visitors which are Teluk Cempedak, Pantai Batu Hitam and Pantai Cherating.

As the tourism industry in Pahang slowly recovers, the state government is targeting the arrival of 13 million tourists to visit holiday destinations here this year. Pahang's tourist arrivals totaled 10.18 million as of Dec 31 last year compared with 2 million in 2021 when the country's borders were closed due to Covid-19 restrictions. State Unity, Tourism and Culture Committee Chairman Leong Yu Man said as post-pandemic tourism initiatives move into top gear, the Pahang government was looking at marketing strategies and programs to lure domestic and international visitors. "Last year, tourists spent about RM9.14 billion in Pahang compared with only RM1.9 billion in 2021.Beaches, islands, nature tourism spots and highlands in Pahang will continue to become among the favorite holiday destinations." she said. *(T.N.Alagesh, 2023)*

2.4 Urban Sprawl for beach tourism

Urban sprawl refers to the uncontrolled expansion of urban areas into surrounding rural or natural areas. In the context of beach tourism, urban sprawl can have both positive and negative effects. On the positive side, urban sprawl can lead to the development of new beach resorts, hotels, and other tourist infrastructure, which can attract more visitors and stimulate economic growth in the region. This can also create new jobs and business opportunities for local residents.

However, urban sprawl can also have negative impacts on the environment, such as loss of natural habitats, increased pollution, and damage to wildlife. It can also lead to overcrowding and congestion in popular beach areas, which can detract from the overall tourist experience. To mitigate these negative impacts, local governments and tourism authorities can take steps to promote sustainable tourism practices, such as limiting the number of new developments, enforcing environmental regulations, and promoting responsible tourism behavior among visitors. They can also work to diversify their tourism offerings beyond just beach tourism, such as promoting cultural or eco-tourism activities, to reduce the pressure on popular beach areas.

Figure 2.5: Shows Cherating Beach in Kuantan

Pahang targeting to boost island and beach tourism with world- class destinations such as Cherating beach in Kuantan. The East Coast Economic Region Development Council (ECERDC) and the Pahang government will focus on developing strategic economic sectors such as tourism and manufacturing to stimulate economic growth in the state post-pandemic.

2.5 GIS-AHP study in Urban Sprawl

Geographic Information System- Analytical Hierarchy Process (GIS-AHP) model, a mapping online software commonly used tool for environmental management, modelling and planning. This tool makes it easy to monitor the environment using satellite images. Geographic research now has tools for comprehension and collaboration because to GIS technology. It assists people in achieving a common objective, which is to derive useful insight from all kinds of data. In fact, data like GIS maps is accessible to almost everyone and everywhere and is easily shared and embedded in apps and software. GIS utilize spatial location to merge numerous distinct types of data layers. The majority of data has a geographic component, and GIS data comprises base maps, features, and imagery illustrations that are linked to spreadsheets and tables. The spatial analysis feature of GIS is also available for you to assess appropriateness and capability, estimate and predict, analyze and comprehend. Thus, new perspectives and decision making in a project can be made Analytical Hierarchy Process in GIS also will be used due to its high ability to manage and analyze various data.

GIS can be an important tool for helping people map out plans for successfully achieving management strategies that are sustainable both at local and global levels. A good GIS program is able to process geographic data from a variety of sources and integrate it into a map project. GIS can be defined is as "a computer system for handling geographic information in a digital form". *(Michael Goodchild, n.d)*

The method AHP in GIS model emphasis a weighted pair-wise comparisons approach which provides a numerical fundamental scale from 1 to 10 that leads to effective geospatial information and better decision makers in improving their decisions in planning and development especially for urban sprawl mapping for beach tourism suitability in this project. This integration of multicriteria decision analysis approach provides an environment to the decision makers in citing areas using land suitability analysis procedures.

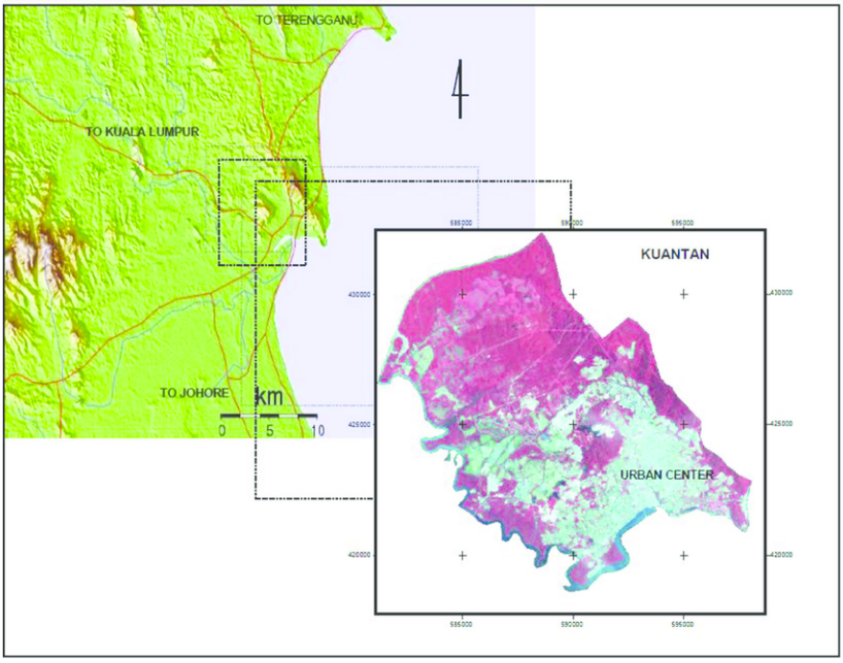

Figure 2.6: Shows example of GIS analysis in Kuantan.

(Norzailawati Mohd. Noor, 2013)

2.6 Advantages and disadvantages of GIS for urban sprawl mapping

One of the benefits of GIS is that it enables users to create maps and sceneries that organize and show the various levels of data. Another benefit of GIS is that it can clearly visualize different types of data, allowing users to spot patterns, trends, and other changes as well as react to events and make better decisions. In addition, GIS can improve efficiency and lower costs when it comes to fleet movements, maintenance schedules, and scheduling calendars. In addition, GIS makes it simple to maintain records, making it straight forward for individuals in charge of monitoring and recording data changes to record geographic changes.

However, GIS also has its drawbacks such as the period to learning curve on GIS software can take a longer time and the software shows spatial relationships, but it does not supply with absolute solutions. This may create difficulties to integrate with traditional map. Besides, GIS tools are expensive. Other than that, it becomes more risks when it comes to privacy violation as data privacy and integrity is an important asset of GIS.

2.7 Impact of urban sprawl to beaches

For years, scientists have argued that sprawling urban and suburban development patterns are creating negative impacts including habitat fragmentation, water and air pollution, increased infrastructure costs, inequality, and social homogeneity (Ewing 1997; Squires 2002). Although some would argue that urban sprawl has its benefits, such as creating local economic growth, urban sprawl has many negative consequences for residents and the environment, such as higher water and air pollution due to the increases of surface runoff, which channels oil and other pollutants into streams and rivers. Poor water quality is associated with a variety of negative health outcomes, including diseases such as gastrointestinal disorders, kidney illness, and cancer.

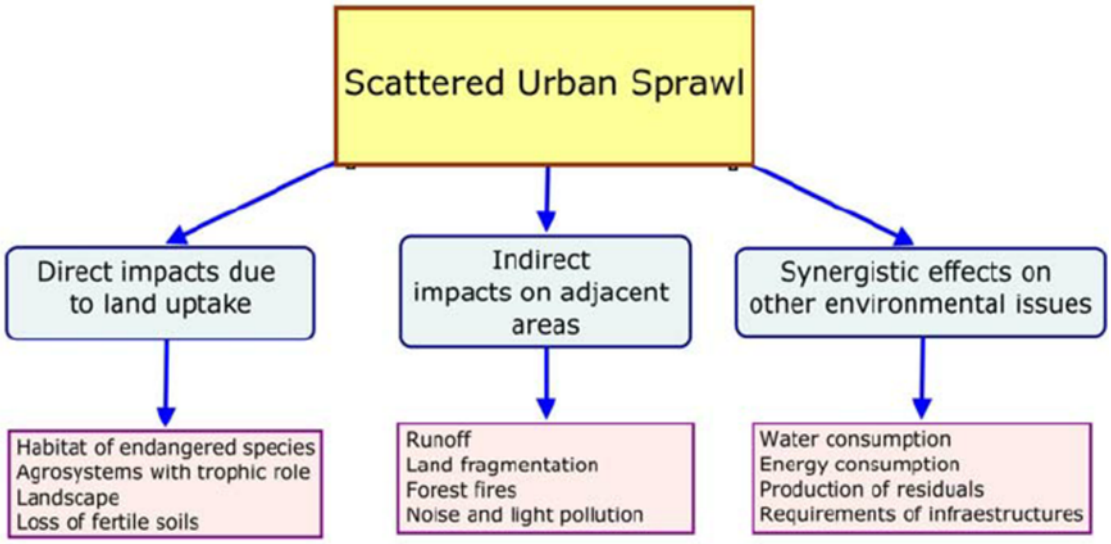

Figure 2.7: Shows negative impact of urban sprawl on the environment.

(Miguel Angel et al, 2009)

The negative effects of urban sprawl include loss of agricultural land, household and industrial waste pollution, entry of immigrants into the village, reduced community ties, loss of heritage, loss of occupation as a farmer, traffic congestion, etc. *(Christiawan, 2019; Masoumi et al., 2018)*

However, urban sprawl can be seen brings positive impact to socioeconomics as leads to economic production which encourage to increasing of opportunities for employment. Better opportunities and better services creating better living conditions, and better lifestyles as people can move companies into less-competitive areas and have more accessibility.

In addition, positive effects include cultural diffusion, taxes and land rent, agglomeration, road improvement and the use of public transportation, drainage improvement, adequate freshwater service, the growth of entrepreneurship, opportunity for residents to move into house or store rental among others. *(Christiawan, 2019; Masoumi et al., 2018)*. Many tenants want better residence, comfortable space, and calm and safe environment, which they discover in the new suburban growth far separate from the center of the city. This kind of expansion requires the addition of utilities and the transport network, as well as the precautions of services such as education, amusement, medical facilities, and commercial services. *(Paramasivam & Arumugavelu, 2020)*

2.8 Summary of Chapter

To conclude, this chapter has introduced and explained urban sprawl and the effects it will have on humankind and the natural world if the problem is not taken care of properly. Even urban sprawl can be seen brings many benefits, in order to control negative impact of it especially from endangering our environment and way of life in the future, it is up to us, the intellectual species that inhabits this planet, to discover solutions to it and develop alternatives. In order to achieve sustainable growth and turn into a more earth-friendly species on this planet, human technology and authority play a significant role in preventing any issues related to urban sprawl.

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter outlines the methodology of the study to achieve the objectives to map the urban sprawl in evaluating the suitability of beach tourism in Kuantan District. In this chapter too will explain in detail the criteria of AHP in GIS model. For our project, several data were collected from our fieldwork such as satellite data and questionnaires. These data play important roles to analyze and classify urban sprawl especially to beach areas in Kuantan. Thus, this chapter also explains the data verification for accuracy assessment by keying in the data in GIS. The end of the chapter would be explained the outcome of urban sprawl mapping for beach tourism in Kuantan District.

3.2 Flowchart of urban sprawl mapping for beach tourism suitability in Kuantan District

Figure 3.1 illustrates the flowchart of the study. To begin with, there were types of data which fulfill the needs for urban sprawl mapping such as satellite data, road data, demographic data, topographic data, and questionnaire from field visit. In our study, we only used three types of data for AHP modelling which are satellite data, demographic data and questionnaire from locals. This data was collected from our fieldwork and gathered together for AHP modelling by keying data in GIS. A weighted pair-wise comparisons approach in AHP provides a numerical fundamental scale from 1 to 10 leads to an outcome whether it is suitable for tourism or otherwise. If not, AHP modelling in GIS needs to be redone until it reaches suitability and if it succeeded in getting suitability at the first place, final results of urban sprawl mapping will be obtained for beach tourism suitability in Kuantan District.

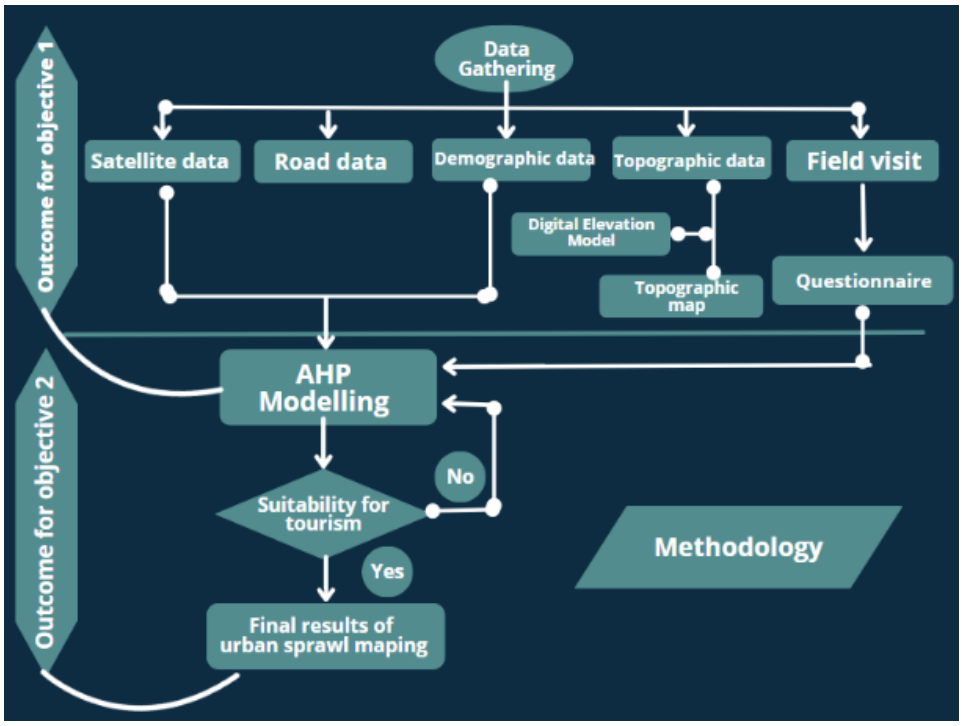

Figure 3.1: Methodology flow chart

3.3 Field data collection

For data collection, fieldwork was done to gain satellite data and local survey. Field visits to hot spots beaches in Kuantan District such as Pantai Teluk Cempedak, Pantai Cherating, Pantai Balok and Pantai Anak Air to verify data and confirm accuracy assessment.

Figure 3.2: Shows fieldwork at Pantai Teluk Cempedak.

Figure 3.3 : Banner shows tourism activities at Pantai Cherating.

Figure 3.4: Shows relaxing spot at Pantai Anak Air, Kuantan.

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3.3.1 Satellite GPS for coordination

Figures 3.5 and 3.6 show some beach coordinates from GPS (Global Positioning System) which are used in our fieldwork. This GPS uses satellites circling Earth to locate a receiver on the ground. GPS receivers use signals from multiple satellites to determine the user's position on Earth, usually in the form of latitude and longitude coordinates. By measuring the distances to multiple satellites, the GPS receiver can triangulate the user's position on Earth with a high degree of accuracy. Coordinates were taken and recorded at every beach visited. This coordinates later need to key into GIS to confirm urban sprawl through AHP modelling.

Figure 3.5: Shows GPS coordinate at Pantai Teluk Cempedak

Figure 3.6: Shows GPS coordinate at Pantai Anak Air, Kuantan.

3.3.2 Local Survey

Figures 3.7 and 3.8 show some places visited for local survey. We believe questionnaires are important as they provide more accurate information from locals. Several questions were asked related to urban sprawling especially for beach tourism such as their opinion about density of visitors to beach, tourism activities at the beach, problems rase from those activities, benefits of tourism activities to local communities and suggestion to control urban sprawl from become out of hand. Different opinions were gained locals and we took that as diversity in people's knowledge and experience. Those data and information also become important tools as accuracy assessment to analyze and classify urban sprawl through AHP modelling in GIS.

Figure 3.7: Shows local survey at Pantai Cherating.

Figure 3.8: Shows souvenir shop at Pantai Balok, Kuantan.

3.4 Summary of Chapter

To conclude, this chapter simply explains the type of methods used to collect urban sprawl data and information especially for this project focusing on suitability of beach tourism in Kuantan District. Through this methodology, we can see the flow of data collection process to fulfill the requirement of GIS-AHP modelling for beach tourism suitability. Our fieldwork to gain satellite data and local survey is believed to become important elements to confirm beach tourism suitability of urban sprawl in Kuantan District. Validity and details of information is very important to ensure accuracy assessment in research.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

From chapter 3, the flow of methodology to complete this study was described. This chapter will cover the process of analyzing the data that was collected. The most crucial step of a study is the analysis process, and the conclusions drawn from it will be utilized to determine whether the objective goals has been met or not. In this study, data were analyzed using variety software such as SW Maps, Google Earth Pro, and ArcGIS. The best data application is used to support results obtained.

4.2 Identification of influencing factors

In this section of the study, we identify the key variables that have a major impact on the mapping of urban sprawl for beach tourism. The local level of influencing factors was determined based on statements gained from local experts working in related government authorities such as the Town Planning Departments, Local Councils, and Federal Planning Departments. To accomplish the goal of this study, six key criteria were selected. The primary factors employed in this study were slope, DEM, soil texture, distance to river, distance to road, and land use.

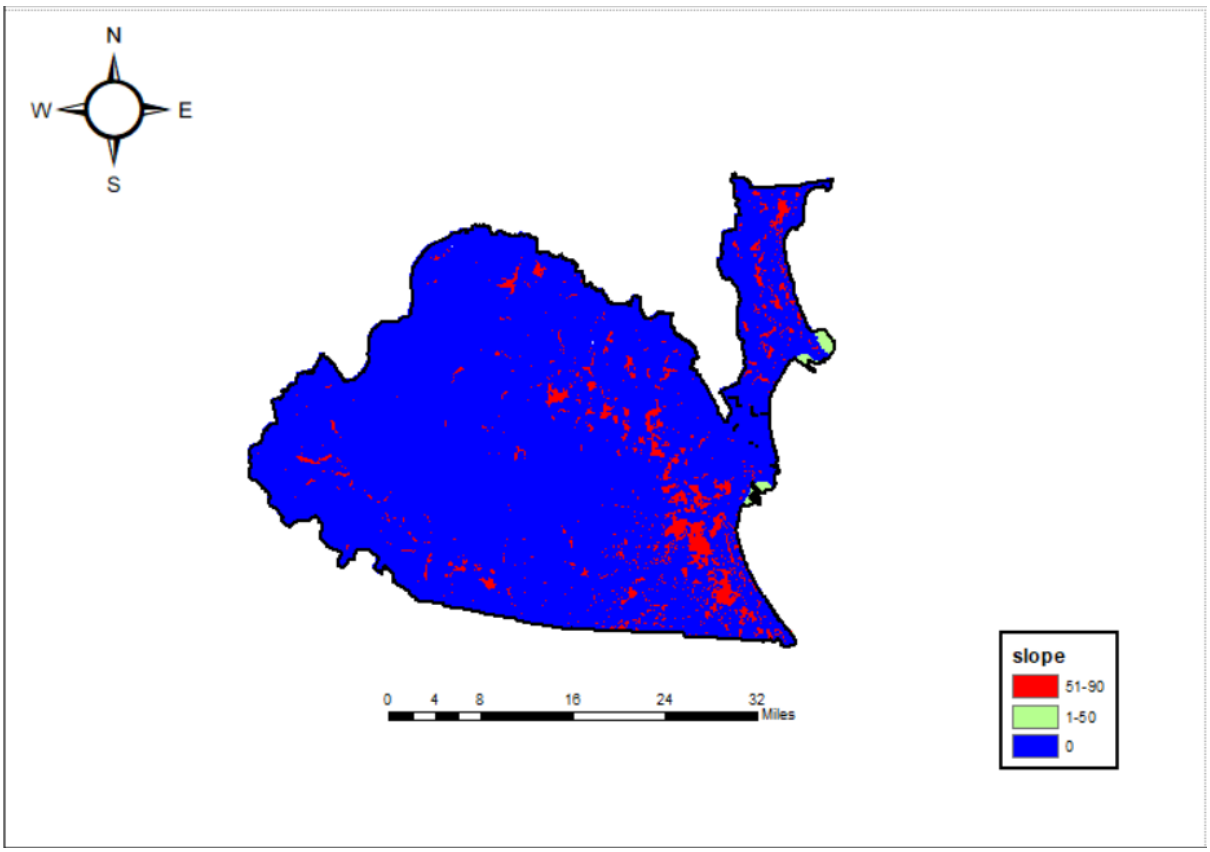

Figure 4.1: Shows data of Slope.

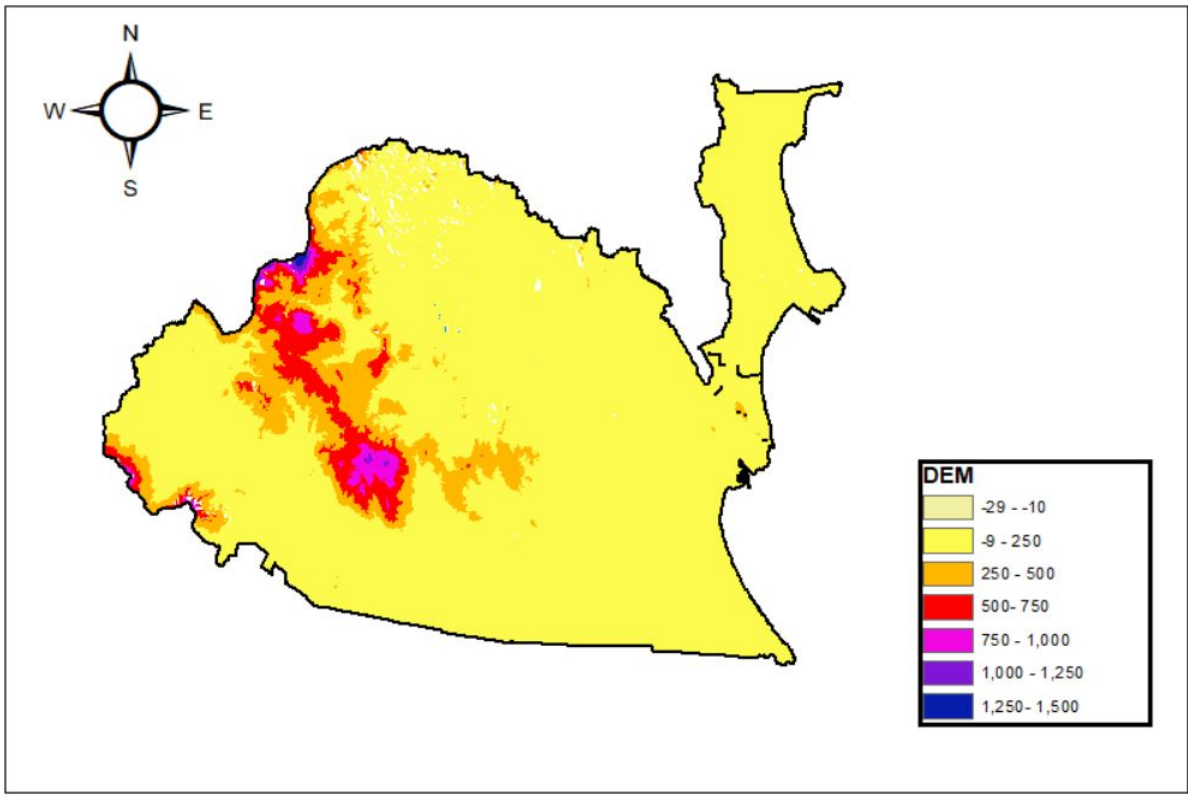

Figure 4.2: Shows data of DEM.

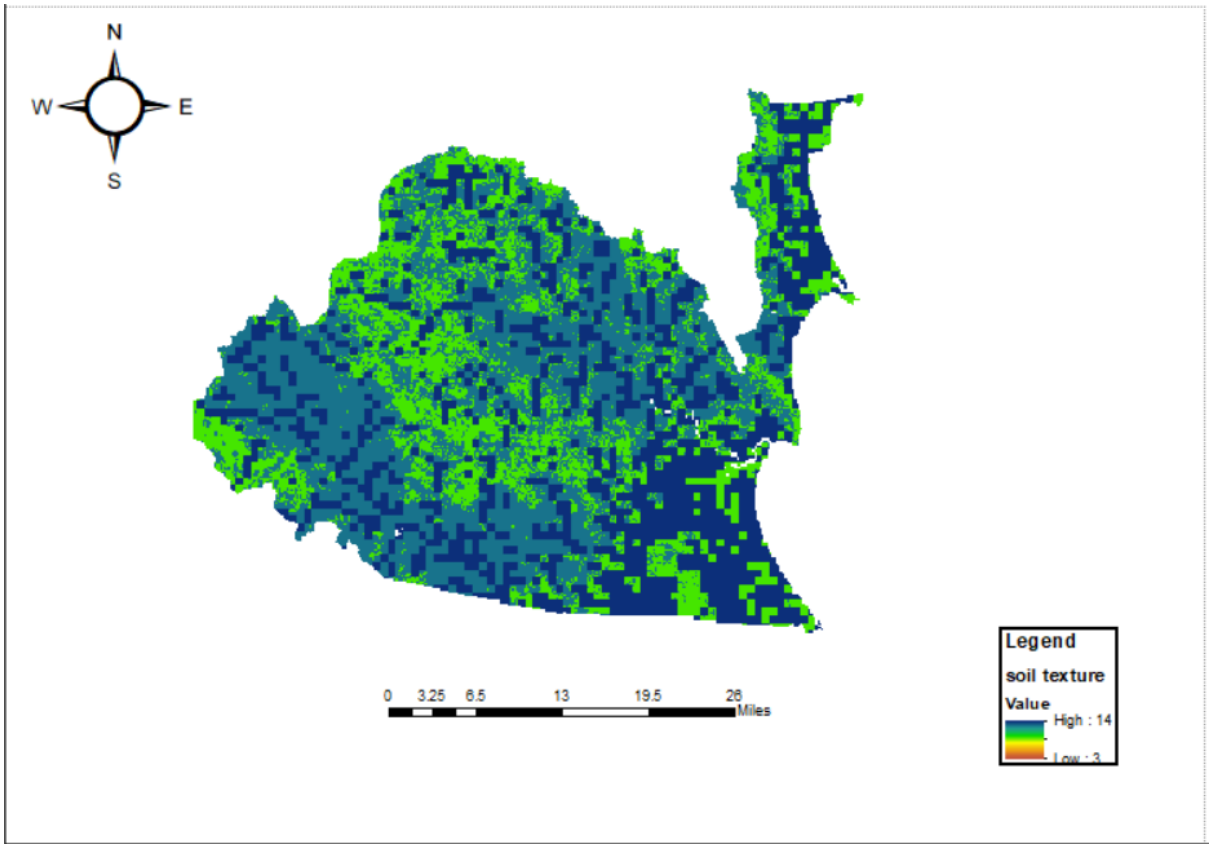

Figure 4.3: Shows data of Soil Texture.

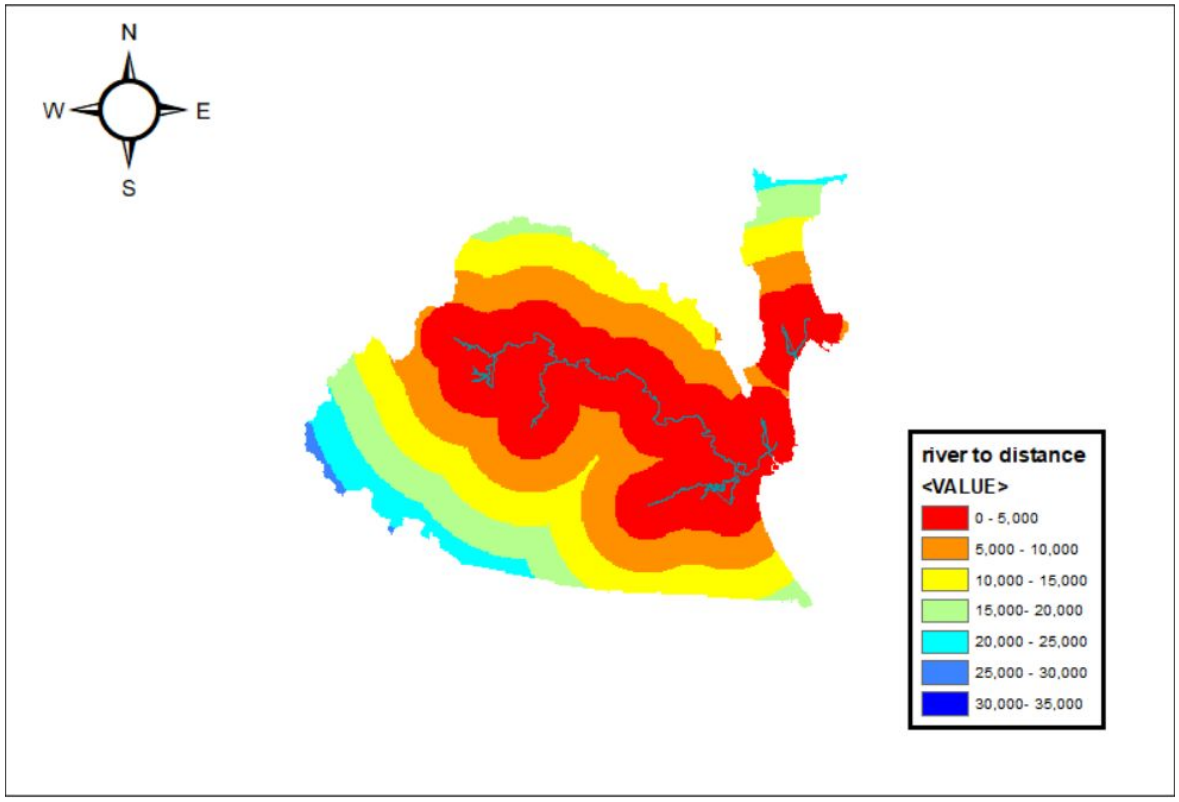

Figure 4.4: Shows data of Distance to river.

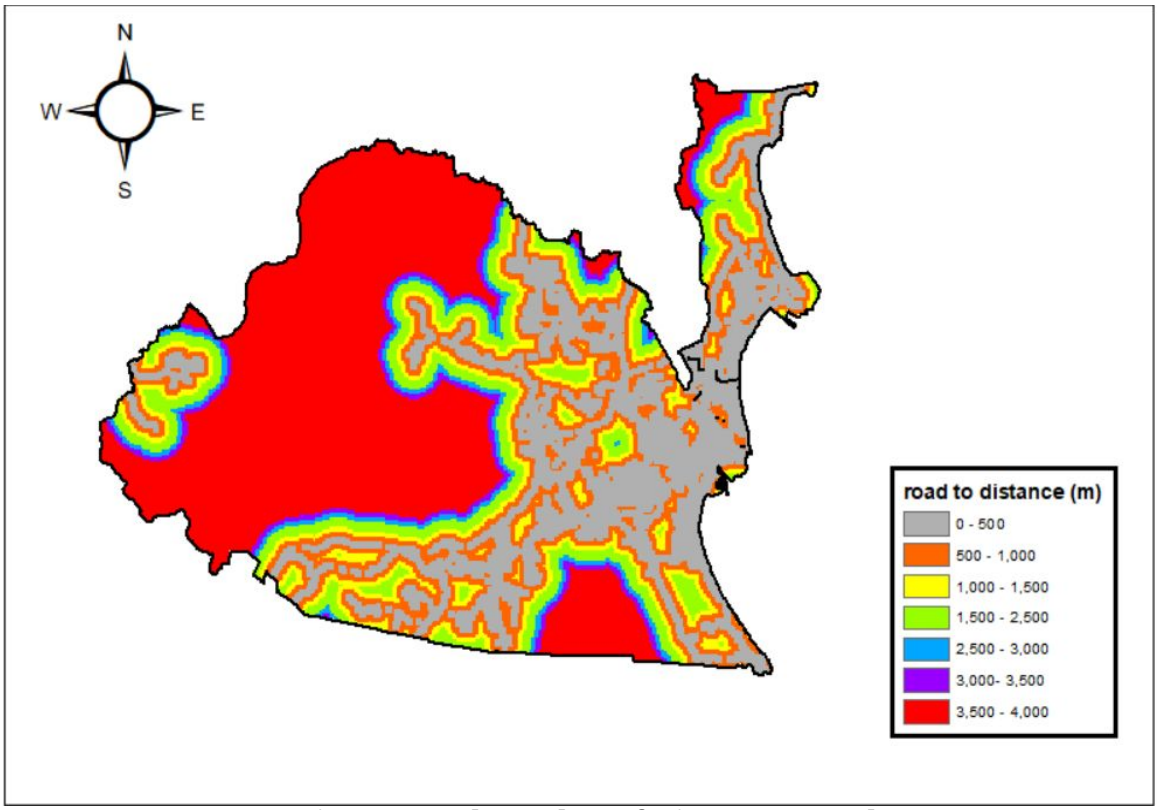

Figure 4.5: Shows data of Distance to road.

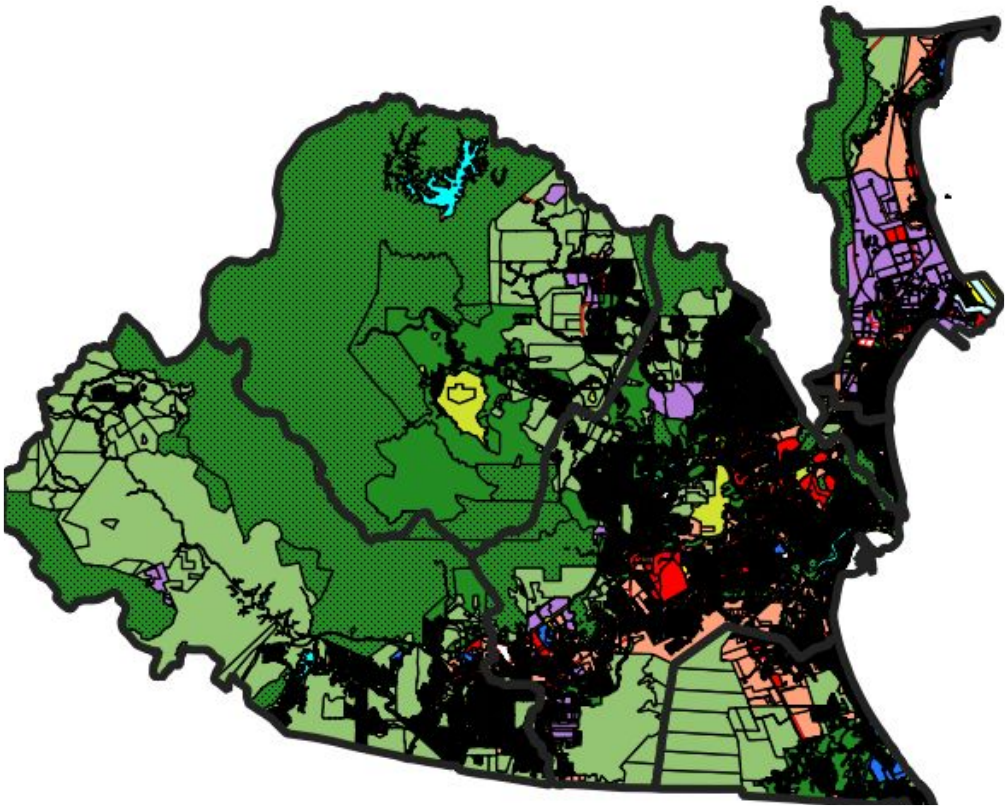

Figure 4.6: Shows data of Land Use.

The factors that are used in GIS-AHP analysis are Data of Slope, DEM, Soil Texture, Distance to River, Distance to Road and Land Use.

4.3 Development of the pairwise comparison matrix

A pairwise comparison matrix was developed with the support of the main factors. After the development of the ratio matrix, the main factor was normalized. Then, the relative weights were calculated for each factor using the pairwise comparison method.

The Fundamental Scale for Pairwise Comparisons

Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment moderately favor one element over another
5	Strong importance	Experience and judgment strongly favo one element over another
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation

Intensities of 2, 4, 6, and 8 can be used to express intermediate values. Intensities o
1.1, 1.2, 1.3, etc. can be used for elements that are very close in importance

Table 4.1: Shows table of Fundamental scale for Pairwise Comparison

From Table 2 we can decide the Scale for Pairwise Comparison and get the results at Table 3.

PARAMETERS	Distance to river	Distance to road	DEM	slope	Land use	Soil texture	PRIORITIES	RANKING	PERCENTAGE
Distance to river	1	2	1/5	1/9	1/9	1/2	0.028	6	11
Distance to road	3	1	1/2	6	1/5	5	0.119	3	21
DEM	4	1/9	1	1/5	1/2	3	0.053	5	13
slope	1/5	4	1/5	1	5	1/2	0.055	4	14
Land use	7	5	6	1/7	1	2	0.426	1	43
Soil texture	6	1/5	3	7	4	1	0.319	2	41
							Total = 1		

Table 4.2: Shows the matrix for Pairwise Comparison.

4.4 Calculation of Consistency Ratio

The CR is important for identifying whether the study's comparisons are consistent. Condition 1: λ must be equal or greater than the number of factors used. The value of λ in this study = 4.1, which means that it satisfies this condition. Computation of consistency index (CI) is done using equation (1):

$$I = (\lambda - n)(n - 1)$$
$$CI = (4.1 - 4)(4 - 1) = 0.033$$

Computation of consistency ratio (CR):

$$CR = \frac{0.033}{0.9} = 0.4 * 100 = 4\%$$

Condition 2: Consistency ratio, CR (0.04) <0.10, refers to the reliable level of consistency in the pairwise comparisons. Thus, the CR value meets the requirement of condition 2, indicating that the weights obtained are accepted.

4.5 Generation of final land suitability map for beach aspect.

All six-factor shape files were converted into a raster format. Therefore, a score can be identified for each pixel. Next, all factor maps were combined and overlaid, and a final location suitability map was generated (Figure 4) using the following formula:

Land suitability map= (slope*0.055+ DEM*0.053 + soil texture*0.319 +distance to river*0.028 + distance to road*0.119 +land use*0.426).

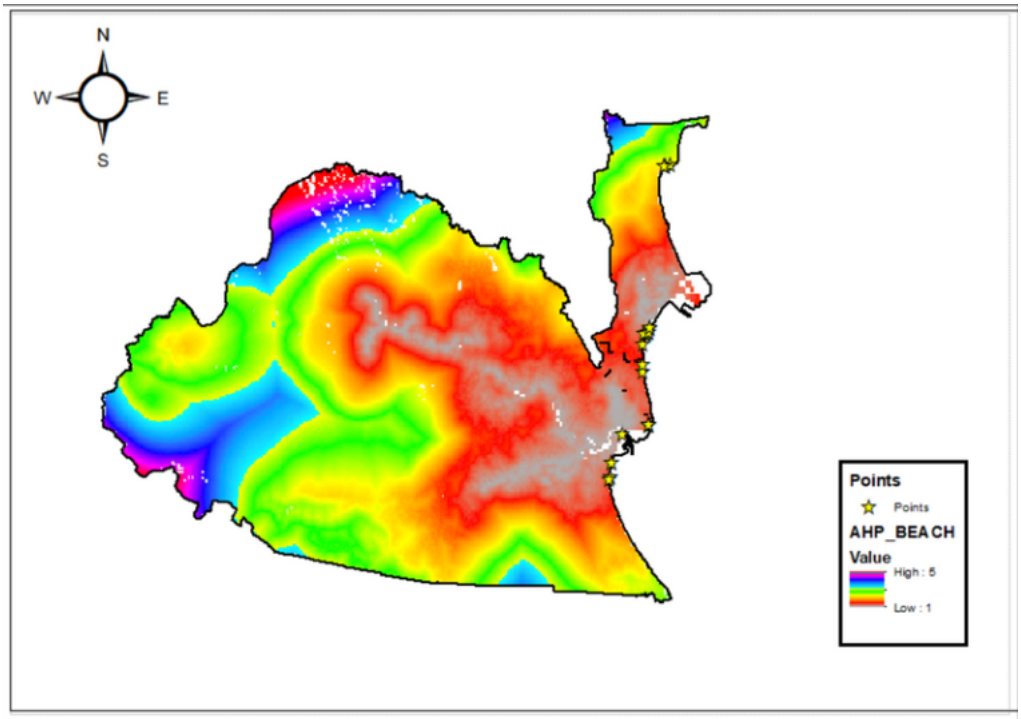

Figure 4.7: Shows land suitability for beach tourism.

The land suitability for beach tourism reveals that Kuantan can be divided into seven suitable categories. This result shows that there are many places that are suitable for beach tourism around Kuantan. The figure below shows some of the beach spots that already exist in Kuantan for now and places that are suitable for beach tourism in the future according to the factors used in this project.

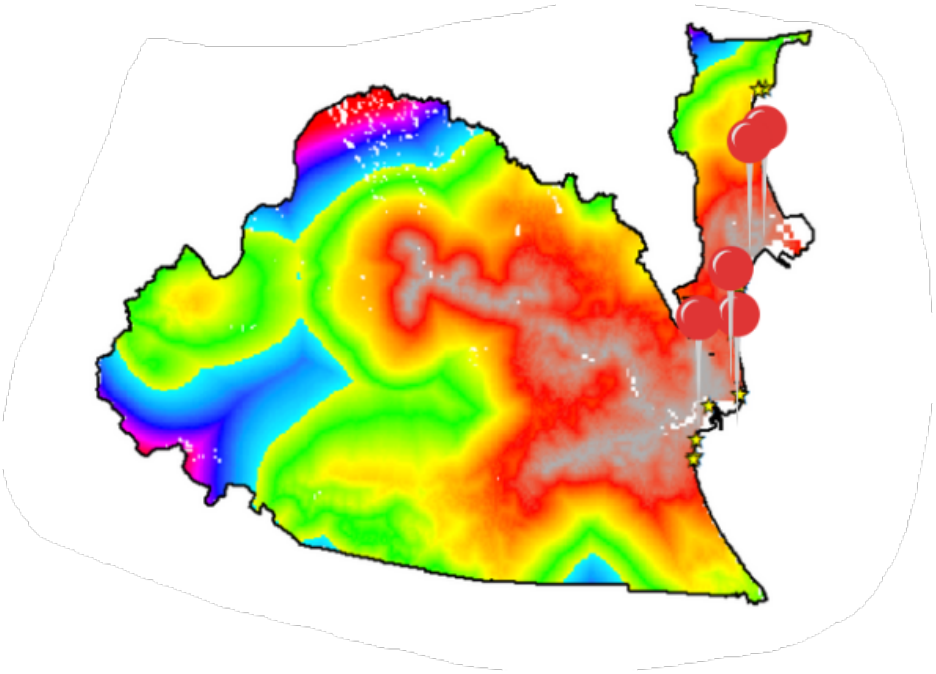

Figure 4.8: Shows pinpoints on beach spot in Kuantan District.

LEGEND	DESCRIPTION
	• **Beach spots that already exist in Kuantan.**
	• **Beach spots that are suitable for beach tourism.**

Table 4.3: Shows legend and description of urban sprawl mapping result

4.6 Conclusion

This study conducted a Land Suitability Analysis (LSA) to determine the best locations for urban sprawl in Kuantan using an integrated GIS-AHP model. The results confirm that the GIS-AHP model is a useful technique for urban planning. To achieve the second objective, these factors were used to get the most suitable places to assess tourism suitability in the Kuantan district. Through urban sprawl shown from the result, we can see that there are more places that fit for beach tourism according to those six factors. To conclude, urbanization can be proven not only concentrated in the center of Kuantan City, but sprawl widely especially according to beach tourism suitability in Kuantan District.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

In this final chapter, elaboration on investigation study is made based on literature reviews. The conclusion is being made to ensure every objective is achieved. Recommendations will be listed out regarding this research. Suggestion and recommendation are provided based on the given solution, so this study made would offer awareness certain parties. The achievement in the objectives will be discussed from the outcome of the study obtained.

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5.2 Conclusion for Objectives

The objectives of the study are achieved and can be made as the followings below:

5.2.1 Objective 1: To categorize and map urban sprawl focusing on beach tourism.

The first objective of this study is to categorize and map urban sprawl focusing on beach tourism. In this research, it is critical to categorise and map urban sprawl with a focus on beach tourism in order to comprehend the urban expansion. Significant difficulties in managing and sustaining coastal environments have resulted from urbanisation and beach tourism's rising popularity.

We can learn a lot about the spatial patterns of development and their effects environment by classifying and mapping urban sprawl. With the use of this knowledge, effective policies and strategies can be developed to lessen the detrimental effects of urbanisation on beach tourism sites. Identification of places that are particularly sensitive to urban sprawl and its effects is one of the main advantages of categorization and mapping. With the use of this information, legislators and urban planners can put in place specific conservation policies and restrictions on how land is used, protecting the natural and cultural resources of beach resort regions. Additionally, the classification and mapping of urban sprawl in beach vacation spots might offer important data for sustainable urban planning and design. Understanding the geographic distribution of tourism infrastructure and development can help manage transportation systems, optimise resource allocation, and improve visitor experiences while reducing ecological impact.

Decision-makers can also gauge the success of conservation and development initiatives and make any necessary adjustments by tracking and monitoring urban sprawl over time. This adaptive strategy is essential for guaranteeing the long-term viability of beach vacation spots and the coastal ecosystems that surround them.

In conclusion, a crucial tool for comprehending and controlling the intricate connections between urban expansion and coastal habitats is the classification and

mapping of urban sprawl with a specific focus on beach tourism. By adopting this strategy, we may encourage sustainable development, protect natural resources, and raise the adaptability and allure of beach tourism locations for both tourists and local populations.

5.2.2 Objective 2: To carry on this study using GIS-AHP model to evaluate the suitability of beach tourism in Kuantan District.

Through this research, with using the GIS-AHP model to assess whether beach tourism in the Kuantan District is appropriate has proven to be a useful and effective strategy. The spatial dynamics and factors impacting the suitability of beach tourism have been clarified by this study, offering useful information for stakeholders, policymakers, and tourist planners.

The examination of numerous criteria and sub-criteria connected to beach tourist suitability has been made possible by the integration of Geographic Information Systems (GIS) with the Analytic Hierarchy Process (AHP). The GIS-AHP model has offered a comprehensive framework for decision-making in the tourism industry by taking into account elements including beach quality, accessibility, infrastructure, environmental sensitivity, and visitor preferences.

The locations of the Kuantan District that are best suited for the growth of beach tourism have been highlighted by the study's findings. These findings might help tourism planners pinpoint suitable areas for infrastructure construction, environmental preservation initiatives, and marketing plans. Limited resources can be properly allocated by concentrating on the places with high appropriateness in order to maximise the beneficial effects of beach tourism while minimising any negative effects.

The GIS-AHP model also provides a dynamic and flexible tool that may be improved over time. The model can be modified to reflect changing circumstances and ensure the ongoing sustainability of beach tourism in the Kuantan District as new data becomes available or priorities change. This iterative method allows for constant monitoring and review, encouraging the use of evidence when making decisions.

Additionally, it is crucial to recognise the limits of this study. The correctness and dependability of the data are important factors in the GIS-AHP model's reliance on them. Additionally, because the model's results depend on the standards and weights set by experts or other stakeholders, the review process may be prone to subjectivity and prejudice. To increase the model's robustness and accuracy, future research should concentrate on modifying its criteria and adding new variables.

In conclusion, the use of the GIS-AHP model has given valuable insights and a methodical framework for decision-making in assessing the feasibility of beach tourism in the Kuantan District. This study has added to the body of information regarding tourist planning and management, providing a basis for the responsible and sustainable growth of beach tourism in the area. Policymakers and stakeholders can make well-informed decisions that strike a balance between the economic advantages of tourism and environmental preservation and community well-being, thereby assuring the long-term success of beach tourism in the Kuantan District. This is done by utilising GIS and the AHP technique.

5.3 Summary of Research

In a nutshell, the purpose of this study was to map out the best locations for developing beach tourism and to look at how urban sprawl affects beach tourism in the Kuantan District. The Analytic Hierarchy Process (AHP) and Geographic Information Systems (GIS) integration allowed for a systematic assessment of numerous criteria and sub-criteria related to beach tourism suitability and urban sprawl.

The GIS-AHP model made it possible to take into account a wide range of variables, including tourist preferences, infrastructure development, accessibility, and land use patterns. The programme produced a suitability map that indicated locations most appropriate for beach tourism growth and areas prone to urban sprawl by allocating weights to these parameters based on expert judgements or stakeholder preferences. The findings of this study revealed the extent of urban sprawl in the Kuantan District and its potential impacts on beach tourism. By overlaying urban sprawl data with beach tourism suitability assessments, the model highlighted areas where development pressures and

encroachment on coastal zones could negatively affect the quality and attractiveness of beach tourism destinations.

The mapping results provide valuable insights for tourism planners, policymakers, and stakeholders in making informed decisions regarding land use planning, infrastructure development, and conservation efforts. By focusing on areas with high suitability and low risk of urban sprawl, limited resources can be effectively allocated to promote sustainable beach tourism development, preserve natural assets, and enhance visitor experiences. However, it is critical to recognise the GIS-AHP model's limits in this situation. The quality and availability of the data utilised determine the model's accuracy and dependability, and the subjective nature of deciding how much weight to give each criterion introduces some subjectivity and bias. Future studies should work to improve the model's accuracy and applicability by adding more criteria and incorporating real-time data sources.

In summary, the GIS-AHP model's use in mapping urban sprawl for beach tourism in the Kuantan District has shed important light on the spatial dynamics of urbanisation and its effects on the viability of beach tourism. The findings help to clarify the potential and problems associated with controlling urban sprawl and encouraging the growth of a sustainable beach tourism industry. Stakeholders may adopt successful strategies and make well-informed decisions to ensure the long-term success of beach tourism in the Kuantan District while minimising the negative effects of urban sprawl by utilising the power of GIS and the AHP technique.

5.4 Recommendation

Several suggestions and recommendation can be adopted from this study as below:

1. Strengthen Land Use Planning: Enhance land use planning regulations and enforcement to stop urban growth and safeguard regions with a strong potential for beach tourism. Implement zoning regulations that prioritise coastal zone protection and limit development in critical locations.
2. Develop Sustainable Infrastructure: Focus on creating environmentally friendly infrastructure in locations that have been determined to be good for beach

tourism. This entails making certain that there are sufficient road networks, transport systems, waste management facilities, and public amenities while reducing environmental consequences.

3. Encourage conservation initiatives: Promote conservation efforts by putting them into action to save the environment and maintain ecological balance in beach tourism zones. This could entail creating protected areas, encouraging eco-friendly tourism methods, and educating both tourists and locals about the value of environmental preservation.
4. Conduct Periodic Monitoring and Evaluation: Keep a close eye on how urban sprawl is evolving and how it affects the viability of beach tourism. Update the GIS-AHP model frequently with fresh information to represent changing conditions and guide adaptive planning and management approaches.
5. Enhance Environmental Education and Awareness: By putting in place educational initiatives to inform tourists and locals about the significance of eco-friendly travel strategies and the need to protect the environment. Encourage an attitude of stewardship and accountability towards the coastal ecosystems.
6. Encourage Academic Institutional Collaboration: Work together with academic institutions and research organisations to carry out continual analyses and evaluations of urban sprawl and the viability of beaches for tourism. This partnership can enhance data gathering and analysis methods, assist the GIS-AHP model be improved, and offer insightful information for decision-making that is supported by facts.

By putting these suggestions and recommendations into practice, the Kuantan District can control urban sprawl, protect its coastal resources, and encourage the growth of sustainable beach tourism. The long-term viability and appeal of the district's beach tourism sites will be guaranteed by the integration of the GIS-AHP model into decision-making processes, which will facilitate strategic planning and informed decision-making.

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APPENDIX

APPENDIX A: QUESTIONNAIRE FORM

FINAL YEAR PROJECT

PROJECT TITLE:

"Urban Sprawl Mapping for beach tourism suitability using GIS-AHP Model in Kuantan District"

These questionnaire form were made to gain local's opinion and information in identifying urban sprawl especially for beach tourism in Kuantan District.

List of questions:

1. Do you often visit the coastal area?

2. How did you come to this area?

3. How far is your area from here?

4. What do you think about the density of visitors to this area?

5. What activities do you often do when you go to the beach?

6. Do you believe that the increase in tourism activities in this area can contribute to the spread of the municipality?

7. What challenges or problems can you see especially for people and the environment when tourism activities in this area increase?

8. Are there any initiatives or efforts to solve this problem?

9. On the positive side, do you believe that the spread of municipalities from the city to the countryside can benefit the local community?

10. Do you have any suggestions or ideas so that urban sprawl from the city to the countryside can be controlled, especially in coastal areas?

APPENDIX B: GPS COORDINATING


GPSmap 76CSx
GARMIN


GPSmap 76CSx
GARMIN


GPSmap 76CSx
GARMIN

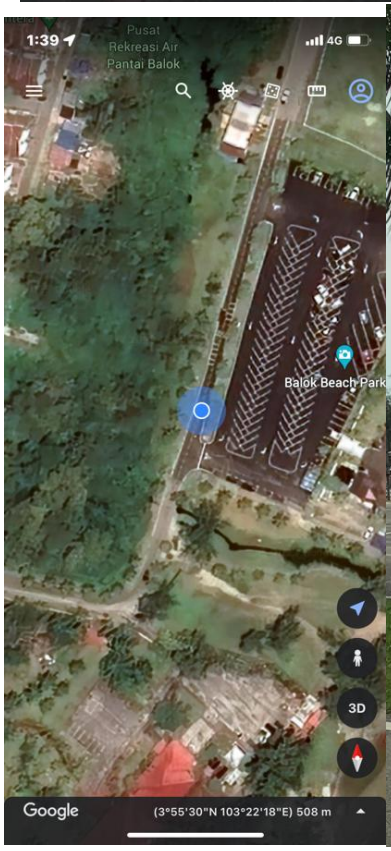







1:38
4G
3D
Google
(3°55'26"N 103°22'11"E) 508 m


Iftar
Ramadan


1:39
4G
Pusat
Rekreasi Air
Pantai Balok
Balok Beach Park
3D
Google
(3°55'30"N 103°22'18"E) 508 m

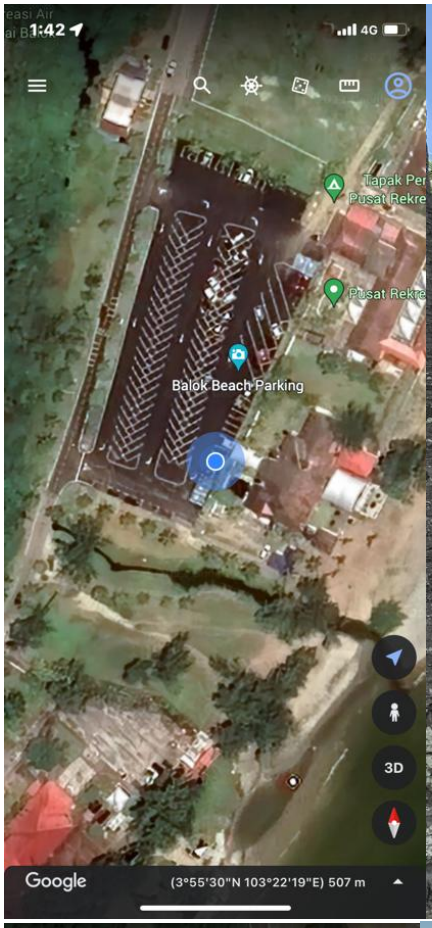

PUSAT REKREASI AIR
BALOK


1:41
4G
Sejahtera
Tapak Perkhemahan
Pusat Rekreasi Air Balok
Woodball TP
Homeground
3D
Google
(3°55'32"N 103°22'20"E) 1 km

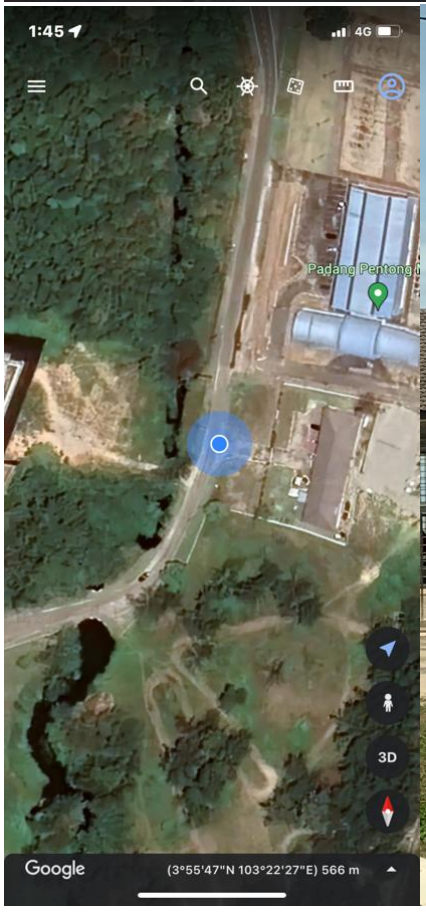

Tapak Caravan
Tapak Perkhemahan
Bilik Persalinan
Tandas Awam


PUSAT REKREASI BALOK
1. KEMUDAHAN YANG DISEDIAKAN
Tapak Perkhemahan
Gelanggang Petanque
Gelanggang Woodball
Gelanggang Sukan Pantai (Bola Tampar, Bola Sepak)
Gelanggang Bola Joring
Gelanggang Sepak Takraw
Pentas Terbuka
Dewan Terbuka Bilik Mesyuarat
Peralatan Sukan dan lain-lain
2. AKTIVITI YANG BOLEH DIJALANKAN
Hari Keluarga
Hari Sukan
Majlis Perkahwinan
Karnival
Pelbagai Program / Majlis
PERINGATAN
DILARANG BERENANG DA
MANDA DIKAWASAN BERB
MAJLIS TIDAK
BERTANGGUNG JAWAB
SEBARANG KEMALANG
BERLAKU. RISIKO
TANGGUNGJAWAB SENDI

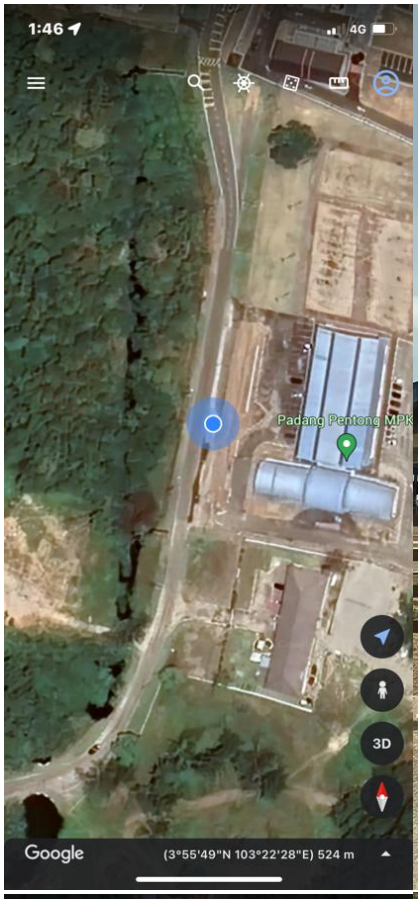

P
Selamat Datang Ke
Pusat Rekreasi Balok
HARAP MAAF


1:42
4G
Balok Beach Parking
3D
Google
(3°55'30"N 103°22'19"E) 507 m

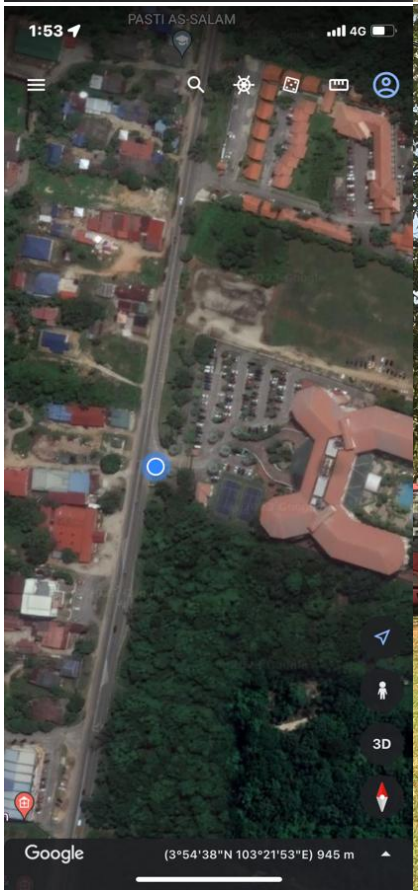

COLEK COLEK @MINT
ICE CREAM
KAFE
MINT pizza
014-8403314
013-9161117
017-2618810


1:45
4G
Padang Pentong
3D
Google
(3°55'47"N 103°22'27"E) 566 m

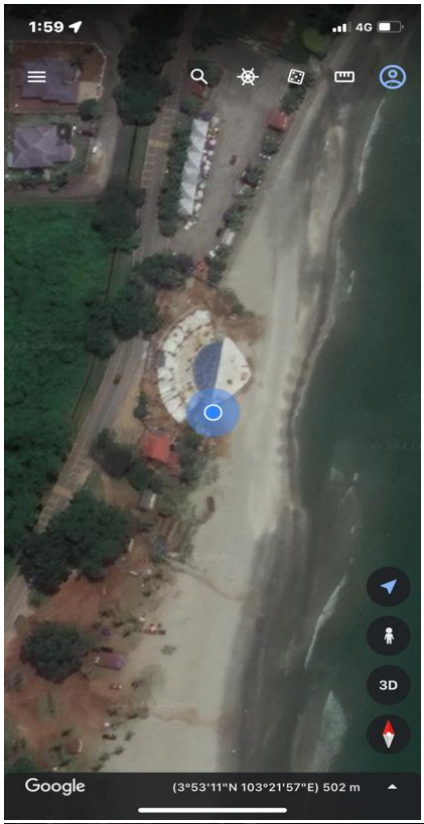

PUSAT LATIHAN
PERAHU LAYAR
NEGERI PAHANG

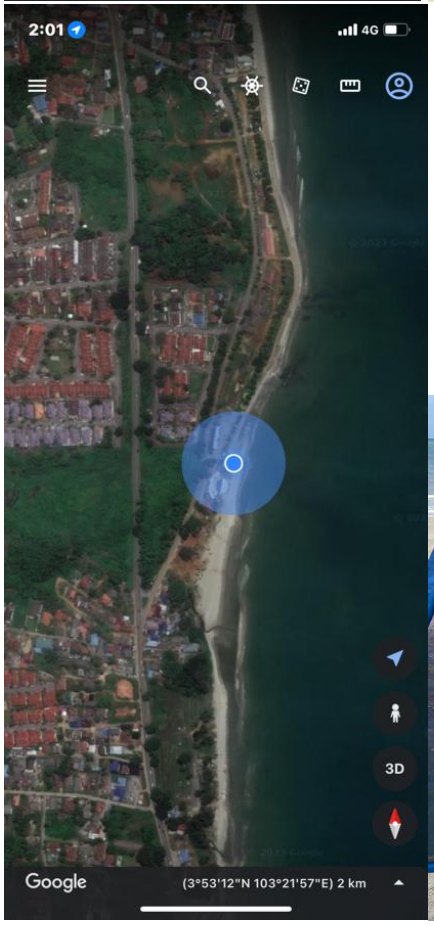

1:46
4G
Padang Pentong MPK
3D
Google
(3°55'49"N 103°22'28"E) 524 m


ARENA PETANQUE
MAJLIS BANDARAYA KUANTAN

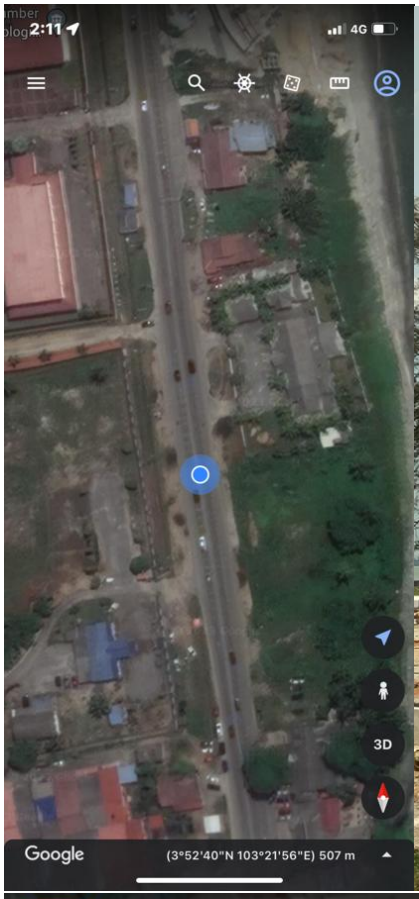

1:53
PASTI AS-SALAM
4G
3D
Google
(3°54'38"N 103°21'53"E) 945 m


SWISS-GARDEN
BEACH RESORT | KUANTAN
Welcome
THE GARDEN TERRACE
THE BLOSSOM
MALIBU
SWISS DELI


1:59
4G
3D
Google
(3°53'11"N 103°21'57"E) 502 m

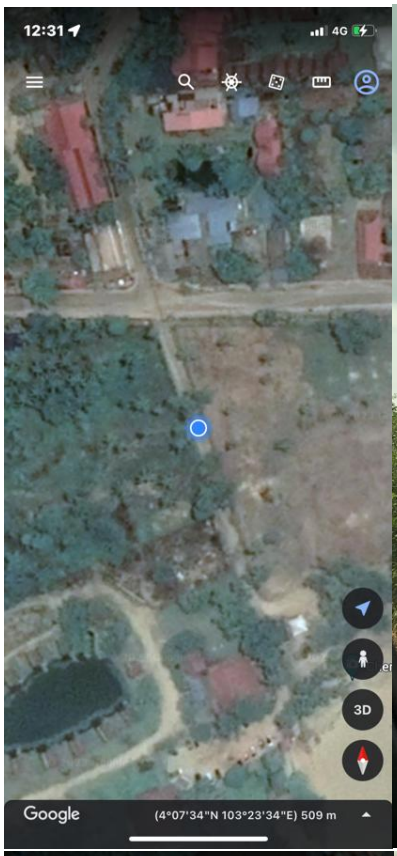

2:01
4G
3D
Google
(3°53'12"N 103°21'57"E) 2 km


Selamat Datang Ke Welcome To
Pantai
Batu Hitam
Kuantan City of Nature
Kuantan Beach City
Love Our Beach
1 Pocket 1 Plastic Bag
KUANTAN
Majlis Bandaraya Kuantan
mbkuantan

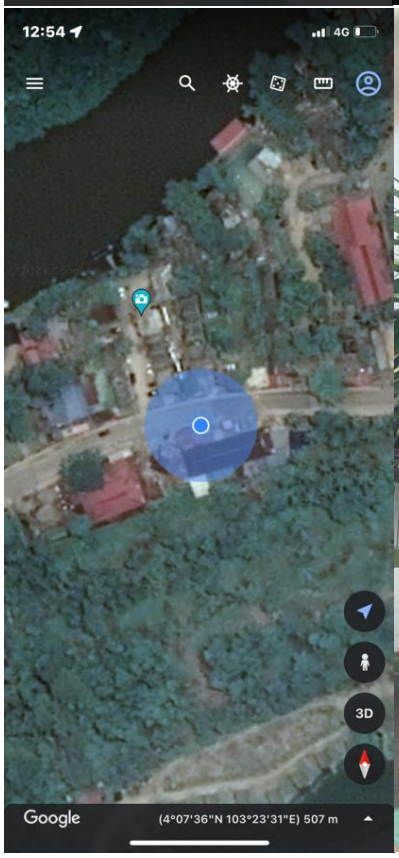

2:11
4G
3D
Google
(3°52'40"N 103°21'56"E) 507 m


BATU HITA

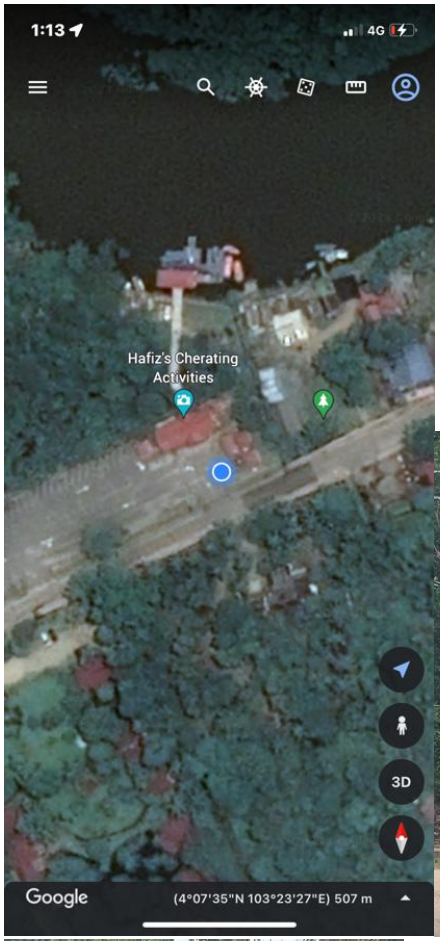

12:13
4G
3D
Google
(4°07'31"N 103°23'36"E) 507 m


12:31
4G
3D
Google
(4°07'34"N 103°23'34"E) 509 m


CHERATING
ATV
4447
FEEL THE THRILL
013-7742742

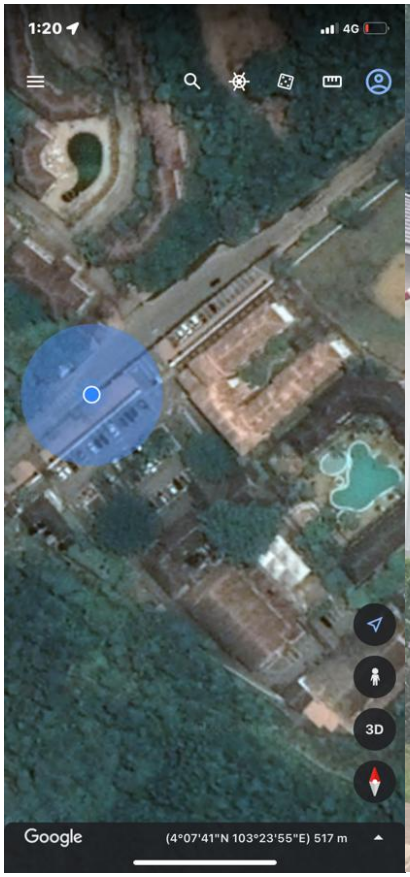

12:54
4G
3D
Google
(4°07'36"N 103°23'31"E) 507 m


SARRA KITCHEN'S
SELAMAT DATANG


1:13
4G
Hafiz's Cherating Activities
3D
Google
(4°07'35"N 103°23'27"E) 507 m


INTAN SEAFOOD
RESTAURANT
Tel: 017-921 4954 / 017-926 6545
Lorong Kubur
CHERATING BAYVIEW RESORT


GOLDEN BEACH


1:20
4G
3D
Google
(4°07'41"N 103°23'55"E) 517 m


هوتيل
Royale Chulan
QHERATING
CHALETS