IDENTIFICATION OF SUITABLE LOCATION FOR URBAN FORESTRY USING REMOTE SENSING AND GIS TECHNIQUE

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Abstract: This study aims to assess the capability of integrating remote sensing and GIS to provide information for urban forest potential sites surrounding southern Johor. The location has been chosen because lot of urbanization currently developing in that area by the Iskandar Regional Development Authority (IRDA). SPOT-5 satellite data with 10m resolution imagery is taken and processed to get the accurate location. Then the imagery is digitally processed and analysed using remote sensing and GIS technique. Furthermore, for ancillary data such as topographical map, landuse map, soils group and hydrology map, DEM aster 30m and soil series map were used to support the satellite data. The objective of this study is to identify suitable environmental parameters for urban forestry location and to analyses and map the potential areas for urban forest landscapes. For this study, some parameters were provided as the pilot of the research. The parameters such as slope, soil texture, drainage, spatial area, and availability of natural resource and also the vicinity of urban area is considered as pilot in this research.

INTRODUCTION

Nowadays, the urban forestry has become an important value for their effectiveness in the environmental control and health. Due to the richness in plant biodiversity, there is a potential to plan and developing urban forest landscape in our country cities. Remote sensing is already well known in the world as well as Malaysia also using it. The advanced in the remote sensing technology and geographic information system or called as RS & GIS technique have provided an effective tool not just for monitoring the change of environment but also very useful for planning, managing and developing of urban forest landscaping.

In 1995, the government of Malaysia under the Ministry of Local Government and Housing introduced the National Landscape Guidelines. From (anonymous 1995), Malaysia is committed to build a beautiful country with a view of green landscape and a systematic plan. Currently, the environment has been in the devastation and destruction resulting from rapid development. In order to stop environment from abused, steps should be replicated to curb environmental destruction and protect from the extinction. Therefore, in order to maintain the stability of natural ecosystems around the urban areas, urban forestry will be the best method to maintain and control the ecosystem of green space in our country.

Urban forestry is an initiative to maintain ecosystem stability in an urban area. According to the Portal Dictionary of Forestry Headquarters, Peninsular Malaysia, the term "*forestry*" refer to the knowledge related to forests, such as maintenance, use and protection. Urban is the place or area that has been developed in line with economic and social development of a place or region. (Jensen, 2000) states that remote sensing is the science and art to obtain information about the object, area, or phenomenon through the analysis of data acquired by a device that is not contiguous with the object, area or phenomenon under review. For the purpose of conservation and forest management, GIS and remote sensing techniques are very useful and a very important tool in the study. By doing the classification method, the land-use can be differentiating type and terrain. Space remote sensing is one of the processes of obtaining information about the earth from instruments mounted on satellite (Anonymous 1991). Many

studies (Makoto et at. 1997; Mazlan and Norhan 1997; Honda et at. 1997) have proved that the integration of remote sensing and GIS can be reliable and fast information with affordable cost and workforce for decision-making in forest resource planning and landscaping.
The general objective of this study is to assess the applicability and usefulness of integrating remote sensing satellite data and GIS for urban forest landscape mapping. The specific objectives are (i) to identify suitable environmental parameters for urban forestry location and (ii) to analyses and map the potential areas for urban forest landscapes.

The study area is located in the southern of Johor. The area of study includes district of Pontian and also Gelang Patah area. Johor's vast landscape is characterized by plantations of pineapple, rubber, coconut and oil palm on the fringes of which nestle tranquil kampongs and quaint fishing villages. Retaining much of its natural splendors, the state has miles of golden sandy beaches and beautiful offshore islands as well as lush dipterocarp forests. Figure 1 show the study area location. This study covered area from latitude 1 33 26.54 N and longitude 103 24 21.11 E (upper left) to latitude 1 15 59.25 N and longitude 103 39 13.93 E (lower right). Simon Richmond, 2007 has stated that the temperature in Johor ranges from 21°c to 32°c, with an average humidity exceeding 82%. Although there is rain through the year, the wettest months are from May to December.

The SPOT-5 digital spectral data was taken in April 2010 and acquired with spatial resolution 10 m in the form of raster data. The image was obtained from National Remote Sensing Agency (ARSN) in Kuala Lumpur. Secondary data are acquired to support the satellite imagery which is the SPOT-5 image. They are 1991 topographical map, 2006 land use map, soil series map and also soils group and hydrology map. Throughout in this study, all of the secondary data were also used as reference map for ground truth and also visual interpretation stage. The ERDAS 9.2 version and Envi 4.7 version software with supported by arcGIS software were used in this study for digital image analysis and GIS technique processing. Software's that been used have the ability to digitize image as well as map, perform image processing, and data analysis. It is very useful and is one of the sources for GIS as the data types that are in digital form.

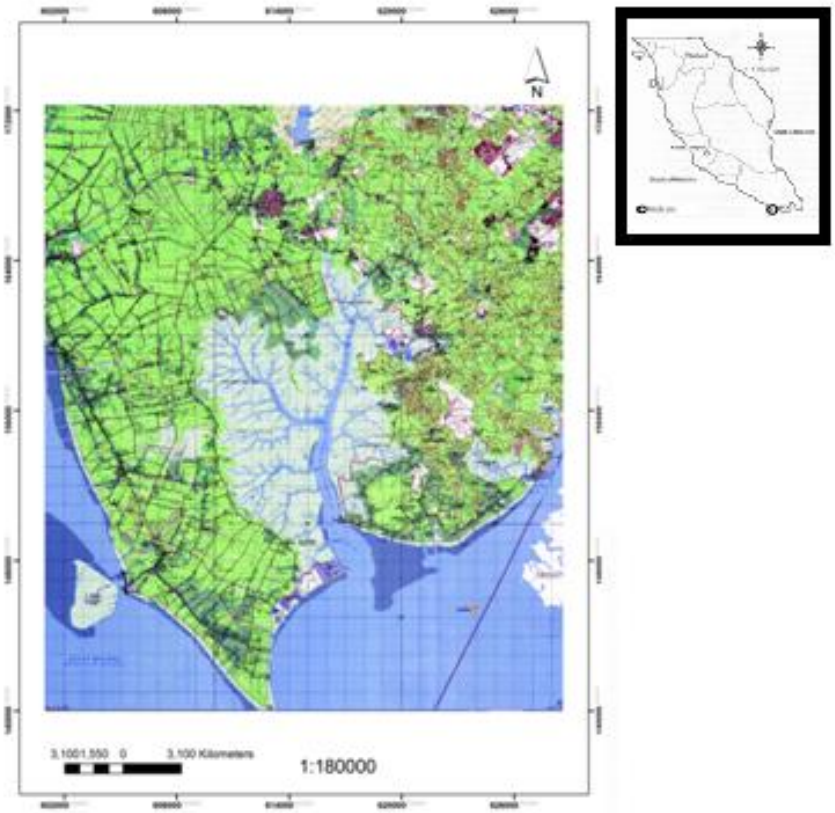

Figure 1: Peninsular Malaysia map showing the study area location

METHODOLOGY AND EQUATION

The procedure of this study involves various steps of processing such as data acquisition, pre-processing, processing and lastly Multicriteria analysis (MCA) to get the final result. The classification of landuse types from SPOT-5 image involved both visual interpretation and computer assisted analysis. Comparison of spectral signature is important for the prediction of land cover or landuse features.

The selection of an area for the purpose of urban forest landscaping was focused on develop and undeveloped areas surrounding the area of southern Johor. The approach was to take and assessment and evaluation according to several factors or parameters.

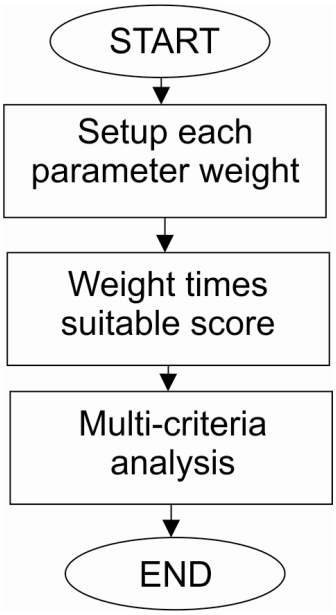

Figure 2: Multicriteria analysis flow chart procedure

In this study, the analysis of multi criteria or parameter is carried out to determine the potential of urban forest area. Therefore, before performing the analysis, each parameter must be set priorities. This study involves 6 parameters. Among the parameters involve which were slope, soil type, drainage, availability of natural resources, land area and vicinity from residential areas or urban areas. The analysis of parameters and suitable score mark shown in the table 1.

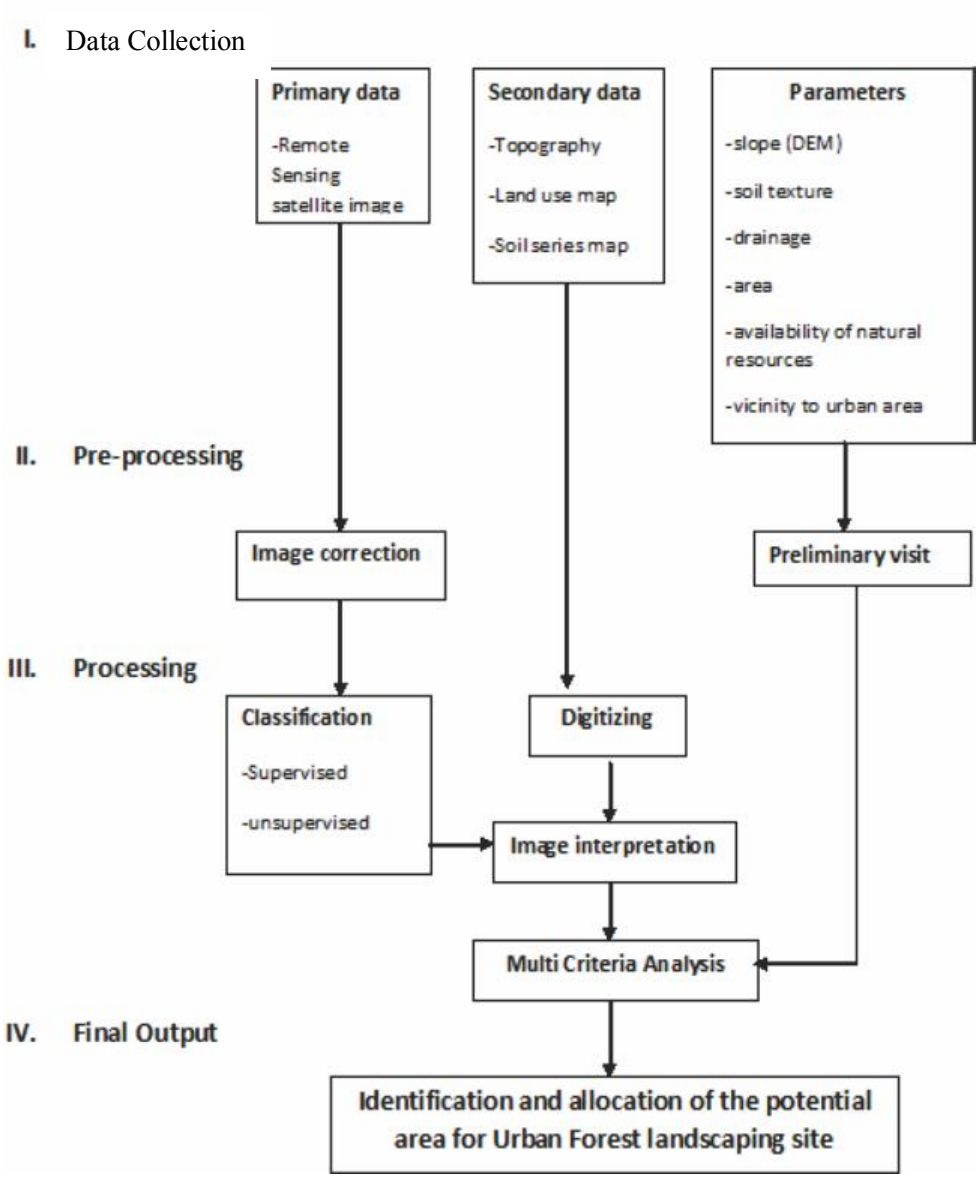

Figure 3: Flow chart of identification suitable location for urban forestry landscape procedure

RESULTS

In this study, bands 1,2,3 and 4 of SPOT imagery were tested for selection and combination. One essential study for SPOT imagery is to produce enhanced color composite image in order to interpret land cover or landuse types. Through the visual interpretation of SPOT imagery, it was claimed that combination of band 4-1-2 showed better differentations of vegetation categories or types.

Supervised and unsupervised classification is done to get the latest landuse or land cover map of southern Johor. In this study, supervised classification showed better results than unsupervised classification because of the manually area of interest been created. Formation of the options in this study is to obtain the highest accuracy. The area was chosen as the reference option for forming a new area using supervised classification process. From here the accuracy can be seen in the final results of this study.

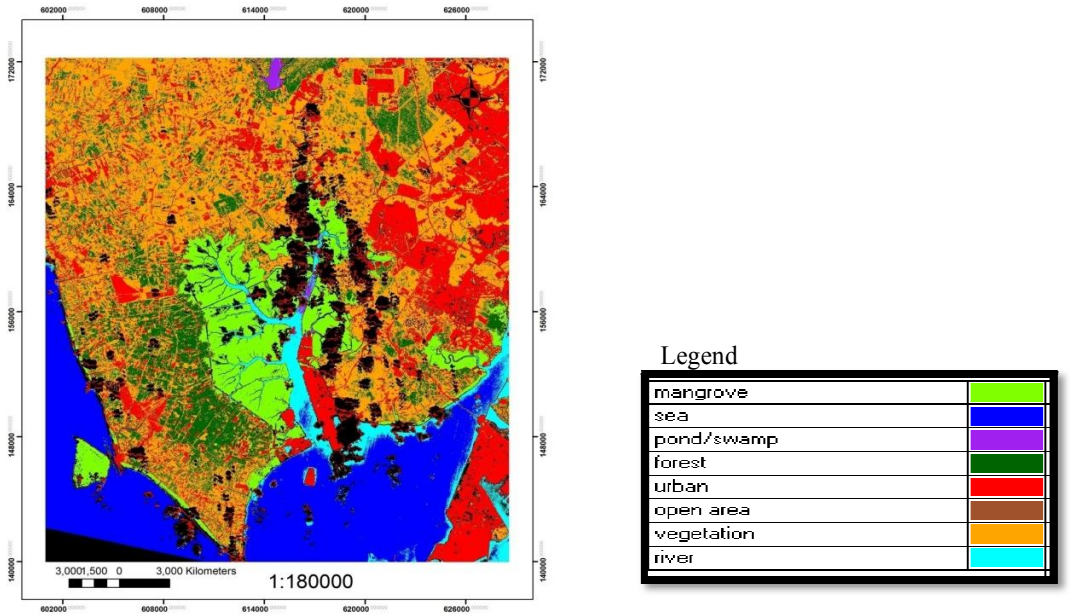

Figure 4: Supervised classification map.

The result of accuracy assessment which is confusion matrix was expressed in tabular form and shown in table 1. The percentage listed in the table represents the accuracy of classification of 8 classes of land cover types. Using Erdas 9.2, the accuracy assessment of classification of the study area produced the overall accuracy was 86.99% and kappa statistic is 0.8353.

Among the classes, water bodies which were sea and river showed the highest accuracy. However, forest and pond or lake gave the lowest accuracy. It is because of confused with the vegetation, mangrove and urban area.

After Multicriteria analysis process carried out, each parameter has the value of their weights. All parameters consisting of suitable criteria were given rank 1 to 6 depends on indication of the priority parameters for urban forest landscaping and development as shown in the table 2. At last, the site potential and final score mark is summarized in table 3.

Table 2: Weight value for parameters

	Parameter	Position/Ranking	Weight (n-rj+1)	Normal weight	X100
1	Slope	1	6	0.3	30
2	Soil Texture	2	5	0.25	25
3	Drainage	3	4	0.2	20
4	Area	4	2	0.1	10
5	Availability of Natural Resources	5	2	0.1	10
6	Vicinity to Urban Area	6	1	0.05	5
TOTAL			20	1	100

Table 3: Final Score Mark and Suitable Site Potential Analysis

Parameter		Suitable Score	Weight Value	Score Mark
Slope	0%-10%	3	30	90
	11%-20%	2		60
	21%-35%	1		30
	>35%	0		0
Soil Texture	Fine loamy to mederate, clay loam, deeply devloped soil with detectable accumulation of organic material	3	25	75
	Sandy, silty and clavey alluvial soil	2		50
	Sandy soil, silty, clavey alluvial and graveled alluvial deposits	1		25
	Very pebbly soil	0		0
Drainage	Good drainage, good aquifer, surface water and infiltration zone	3	20	60
	Moderate drainage, interfloor water and spring zone	2		40
	Excessively drained, high runoff	1		20

	Bad drainage and not suitable for urban forestry location	0		0
Area	>50m^2	3	10	30
	50m^2–30m^2	2		20
	30m^2 – 10m^2	1		10
	<10m^2	0		0
Availability of Natural Resources	Dense forest, pond lake, and river, vegetation and plantation area	3	10	30
	Secondary forest, stream, vegetation and plantation area	2		20
	Open area, bare land and swampy	1		10
	Reserved forest	0		0
Vicinity to Urban Area	<3km	3	5	15
	3km – 5km	2		10
	5km – 10km	1		5
	>10km	0		0

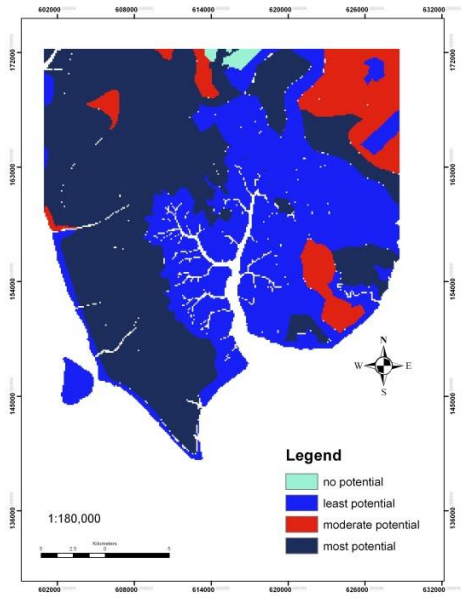

Figure 5: Soil series map after multicriteria analysis.

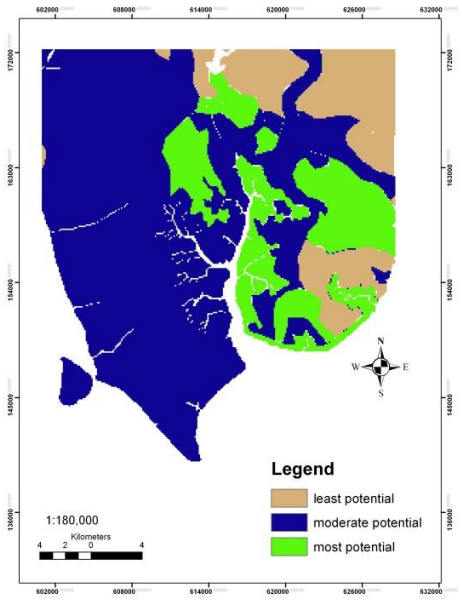

Figure 6: Soils group and hydrology map aftermulticriteria.

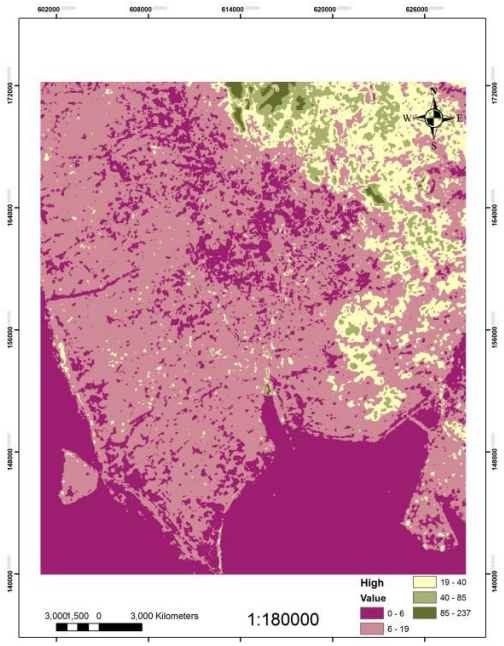

Figure 7: Topographical map after multicriteria analysis.

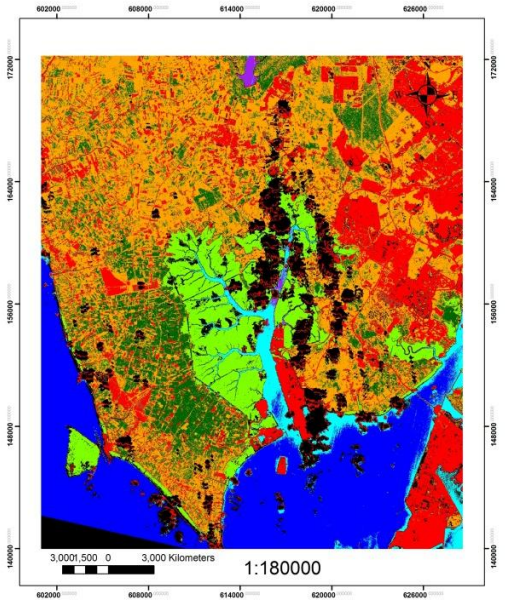

Figure 8: Landuse map classified from SPOT 2010 imagery.

After MCA process, the final result has been generated. The final result shows that the highest score is 255 marks and the lowest was 30 points. If seen in figure 9, the final result shows that the areas with the lowest value is more around at the east area of the map which is the Gelang Patah area meanwhile the district of Pontian have more potential and suitable location for urban forest development. This study also classified the lowest marks for not suitable area that has a value of 185 and below. An area that suitable for urban forest area has the value 186 and above which are an area around Pontian district as refer to final map in figure 9.

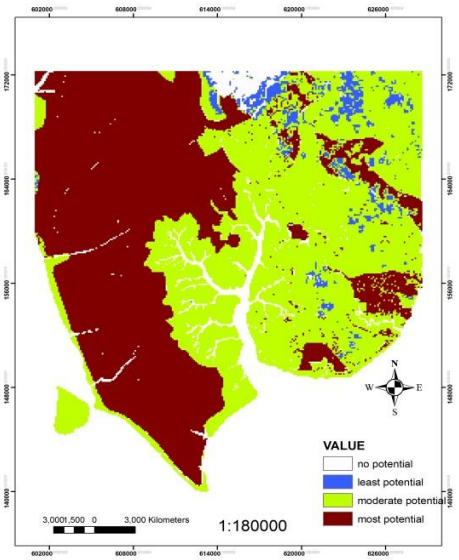

Figure 9: Final result of multicriteria analysis (MCA)

The potential area for urban forestry landscaping site was produced after the classification, digitizing and overlaying the soil series, landuse, soils group and hydrology map, topographical and also slope map. All of the data has been overlay or calculated using spatial analist in arcGIS software. Sites indicating most potential, moderate potential, least moderate potential and no potential were finally mapped as illustrated in figure 9. The most potential area for urban forest landscaping, which was indicted in blue and dark blue color has the higher score range between 210-255 with the fine loamy to moderate soil and with the existence of various natural resources such as forest, plantation and vegetation. The area also have the alluvium soil texture which among the best texture contribution to the urban forest landscaping. The moderately potential area with a score range between 165-210 in light blue and sea green color. For the least and not potential area was mainly focused at the east of the study area which is Gelang Patah area which have score mark below than 165. Actually, along to the north of study area, the slope become higher. This is because of in that particular area there was mountain which is Gunung Pulai area. Contribute from the Gunung Pulai area, the area are appropriate least moderate landscape due to the steepy slope. Below to the score 165 which is indicted to the least and no potential at all which is most located at the Gelang Patah area because the soil is poor with the least of availability of natural resources.

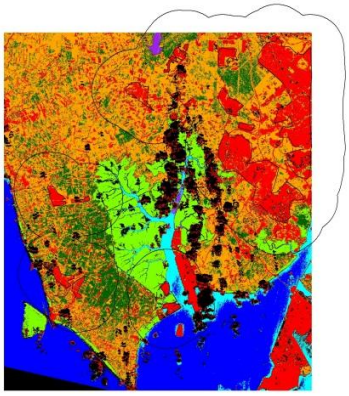

Figure 10: Buffering technique of urban vicinity.

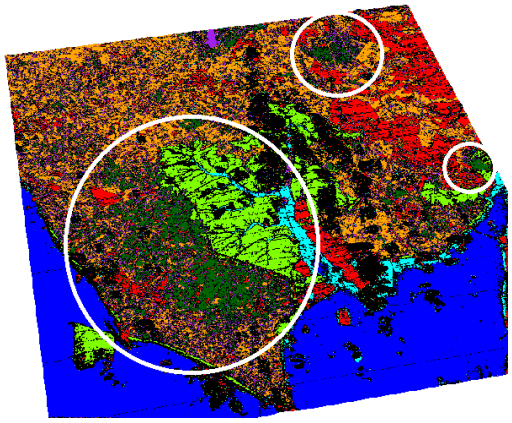

Figure 11: 3D surface view land cover map of southern Johor.

DISCUSSION

Based on this study, as shown in the final map, the area surrounding district Pontian are very suitable for urban forest landscaping. It is because there are still lots of potential for such planning and developement in the southern Johor vicinity. Furthermore, there is still plenty green area in the southern Johor especially district of Pontian that surrounding with suitable soil, gently sloping, availability of natural resources and 'green' vicinity of surrounding areas.

Intergration of remote sensing and GIS technique is a powerfool tool for generating base map in order to identify the potential area for landscape purposes at southern Johor which were Gelang Patah area and also district of Pontian. Supporting information such as soil series, land use 2006, soils group and hydrology map, topographical map and also digital elevation model from aster which is 30m accuration are very useful to aod identification and allocation of potential site for urban forest landscaping. However, both of the objectives which were 1)to identify the parameters and 2) to analyze and map the potential area for urban forest landscaping site were achieved.

CONCLUSSION & RECOMMENDATION

For the contribution in order to provide a detailed and better landscape planning, further and additional information such as meteorological and geological data are important to support the GIS to map the potential landscape area using remote sensed data.

Satellite data also play an important role for better accurcy, thus to obtain better result. Satellite data with higer spatial resolution can produce better results.

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