MAPPING SHORELINE CHANGES DUE LAND RECLAMATION USING LANDSAT TM DATA

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Specially dedicated to *Mak* and *Bapak*,

I really miss both of you.

Al-Fatihah.

To my siblings, Ruziana Sekon, Ruziani Sekon and Saadiah Sekon, thank you for the love and warmest support.

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ABSTRACT

Remote sensing sources very useful to capture continuous, repeatedly and recently data. Change detection technique using various type of satellite images in Remote Sensing have been using frequently and continuously previously. Edge change detection used is very sensitive to detect linear feature such as shoreline. Mapping shoreline changes due to only coastal reclamation for urban development purposes are using edge change detection technique in Envi 5.0 software and ArcGIS 10.2 for develop the databases. In order to mapping this changes, images pre-processing, filtering option until feature extraction stage will been used. Geographical Information System (GIS) as a tool for data input either spatial or attribute, data management, data display and manipulation. Therefore, both Remote Sensing and GIS known as a powerful approach to gather new information from primer to secondary data. New information will be tested by statistical of filtering and feature extraction technique and accuracy of Ground Control (GC) distortions. This testing will be produced very accurate of coastal changes area and shoreline changes due to coastal reclamation for urban development purposes.

ABSTRAK

Kaedah pengumpulan data menggunakan Remote Sensing sangat berguna bagi mendapatkan data yang berterusan, berulang dan terkini. Pendekatan yang digunapakai untuk mengesan perubahan menggunakan pelbagai jenis imej satelit dalam Remote Sensing sebelum ini sememangnya sering digunakan secara berpanjangan. Mengesan perubahan kawasan pinggir atau tepian pantai merupakan satu kaedah yang sangat sensitif terhadap kajian untuk mengesan garisan pantai. Teknik ini juga sesuai untuk memetakan perubahan garisan pantai yang berlaku disebabkan faktor penambakan tanah pinggir pantai untuk tujuan pembangunan bandar baru, menggunakan perisian ENVI 5.2 untuk memproses imej Landsat TM 7 dan perisian ArcGIS 10.2 untuk membangunkan pangkalan data. Bagi memetakan perubahan ini, fasa pra-pemprosesan imej, pilihan teknik untuk tujuan penapisan imej sehingga penguraian data dalam imej Landsat TM 7 akan digunakan dalam kajian ini. Manakala, Sistem Maklumat Geografi (GIS) pula berfungsi sebagai alat untuk mengumpul data spatial dan attribut, menguruskan data, memaparkan data dan memanipulasi data. Maka, samaada Remote Sensing atau GIS, kedua-duanya amat penting untuk mengumpul data baru daripada data utama menjadi data sekunder. Data baru ini akan di uji ketepatannya menggunakan kaedah statistik penyaringan, statistik penguraian data dan ujian ketepatan berdasarkan selisih yang dibenarkan dalam dua belas (12) titik kawalan di bumi yang telah dipilih. Ujian ini seterusnya akan menghasilkan ketepatan yang tinggi dalam proses memetakan perubahan kawasan pinggir pantai dan perubahan garisan pantai kesan daripada aktiviti penambakan bertujuan untuk pembangunan bandar baru.

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LIST OF ABBREVIATIONS

AIRSAR	-	Airborne Synthetic Aperture Radar
AOI	-	Area of Interest
CVA	-	Change Vector Length
CW	-	Continuous Wave
DN	-	Digital Unique
DSAS	-	Digital Shoreline Analysis System
DTC	-	Decision Tree Classifier
ENVI	-	Environment for Visualizing Images
EPR	-	Electron Spin Resonance
ER	-	Entity Relationship
ERDAS	-	Earth Resources Data Analysis System
FELCRA	-	Federal Land Consolidation and Rehabilitation Authority
GC	-	Ground Control
GCP	-	Ground Control Point
GIS	-	Geographic Information System
GPS	-	Global Positioning System
HTHW	-	High Tide High Water
HWM	-	Highest Water Mark
ICZM	-	Integrated Coastal Zone Management
ISMP	-	Integrated Shoreline Management Program
ISODATA	-	Iterative Self-Organizing Data Analysis Technique
LANDSAT	-	Land Remote-Sensing Satellite
LANDSAT TM	-	Landsat Thematic Mapper
LIDAR	-	Light Detection and Ranging

LRR	-	Long-Range Requirement
LU/LC	-	Land Use and Land Cover
MHW	-	Mean High Water
MHTW	-	Mean High Tight Water
MLC	-	Maximum Likelihood Classification
MLLW	-	Mean Lower Low Water Line
MLTWM	-	Mean Low Tight Water Mark
MLW	-	Mean Low Water
MODIS	-	Moderate-Resolution Imaging Spectroradiometer
MRSO	-	Malaysian Rectified Skew Orthomorphic
MSL	-	Mean Sea Level
MTL	-	Mean Tide Level
NDVI	-	Normalized Difference Vegetation Index
NIR	-	Near Infra-Red
NN	-	Neutral Network
NOAA	-	National Oceanic and Atmospheric Administration
PIXEL	-	Picture Element
RE	-	Remote Sensing
RISDA	-	Rubber Industry Smallholders' Development Authority
RMSE	-	Root Mean Square Error
SPOT	-	Satellites Pour Observation De La Terre or Earth-Observing Satellite
SPOT VGT	-	Satellites Pour Observation De La Terre or Earth-Observing Satellite for Vegetation
VGT	-	Vegetation
WLR	-	Weapons Locating Radar

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Shoreline known as a country international measurement border determination. Shoreline changes phenomenon probably occurred by land reclamation project for urban development purposes, erosion, water pollution and nature disasters. Monitoring of these changes is crucial to mapped for research and development and management activities of inland and shoreline. It is important to preserved because country area is considered by land and oceans surrounding. Due to the Johor Straits has a length and wide shoreline, requires high technology mapping equipment means by consistency, frequency of observations and more systematic way of map production.

Shoreline changes mapping for the cities near to the coastal area need a regular monitoring in order to ensure the continuity of the human ecosystem. There are a lot of example city that have a development located along to the costal. Transportation, food and environmental ecology system proof that in ten major of world cities such as Tokyo in Japan, Mexico City in Mexico, Mumbai in India and Sáo Paulo in Brazil also located along the coastal. Since Malaysia is also surrounded by the ocean, starting 1990 combination of

some government agency being responsible to identify and mapping the cause of the shoreline changes for planning and further action. For urban planning and economics, changes mapping must be made at least two to three years. While surveillance activities and research sufficient four to five years.

High technology mapping data collecting equipment with more consistency, frequency of observations and more systematic way of map production are needed in term of shoreline changes mapping purposes. IKONOS, Quick Bird, Worldview AVHRR, MODIS and SPOT VGT are example of advanced spatial resolution images which be able to apply into landuse and landcover (LU/LC) changes detection with more accurate, consistently and good local and global monitoring purposes. (Muhammad Iqbal Rosli et al., (2015), Bashir Rokni Deilami et.al,.(2015). As regarded in www.geogallers.com, land reclamation changes in inland the coastal plain has been intensively farmed for paddy in the past and now are mainly focused for market gardens and small holdings of oil palm using Landsat images. Recent studies have shown, there have been various land development authorities that are active in Kuala Pontian area, FELCRA and RISDA included.

This study focuses exclusively on shoreline land reclamation changes in Johor Straits using remotely sensed data between several time period. The expected output from satellite image processing steps and Google Map is a map used to applied to produced map contains characteristics identification include roads network and several landuse types such as agriculture, settlements, coastal development area and urban area. In this study, shoreline reclamation changes mapping will develop within Geographical Information System (GIS) capacity. Spatial analysis term such as overlay approach will be chosen for measure and identify the areas where effected by land reclamation that lead to shoreline changes.

1.2 Problem Statement

Present satellites discrete signal in a limited number of broadbands will generated by traditional multispectral satellite-flown instruments, such as Landsat, SPOT and eccentric. In the other part, hyperspectral and multispectral high capable to cover large areas of interest and provide very accurate spatial information. Shoreline extraction can be derived from visibly discernible coastal features which mean by using true or false color imagery and using the digital image-processing. But somehow, the pixel resolution and high cost of data are generally limited both spatially and temporally.

Many papers and previous research have focused on coastal and shoreline changes mapping and analysis within satellite image and GIS integration such as detecting change at the local dimension of land use or land cover, to solve many coastal erosion problems by providing a means for generating information, regular monitoring and analysis to predict and visualize future scenarios, analyze and measure historic coastal patterns along several beach experiment and detecting shoreline extraction from images with a new algorithm. But there are no papers focus on shoreline reclamation changes mapping. Many small villages along coastal line are being impacted by shoreline land reclamation issues and need to be assessed continuously. Perhaps, the shoreline change detection affected by land reclamation method used in this study can be useful for the government and private agencies to monitor and assess area affected by land reclamation especially for decision support making purposes.

1.3 Aim and Objectives of Study

The aim of this study is to determine and map shoreline changes due to coastal reclamation in Johor Straits and it related changes in range of ten (10) years which is 1996, 2006 and 2016 using Landsat TM satellite data. The following are the specific objectives of this study:

i. To examine and analyse selected linear feature extraction techniques for shoreline mapping using Landsat TM data set;
ii. To examine the resultant of accuracy of shoreline details extracted from Landsat TM data set, and,
ii. To detect shoreline changes due to reclamation at medium resolution data (Landsat TM).

1.4 Study Question

Research questions are as follows:

1. How to identify the characteristics of shoreline change due to land reclamation from multi- temporal Landsat TM data?
2. Does spectral bands have inherent properties in identifying shoreline changes?
3. How to maintain geometrically constant shoreline in area of less available features for Ground Control Point (GCP)?
4. What is the best robust method for rapid integration of shoreline extracted from Remote Sensing data into corresponding GIS spatial database?

1.5. Scope of Study

The main bench mark to achieve all objectives in this study is to figure out the characteristics of change detection from multi- temporal Landsat TM data capabilities. Using shoreline change detection manipulation, mapping accuracy will determine. Then, this multi – temporal Landsat TM characteristics within the high accuracy of scale and shoreline location will meet shoreline changes due to reclamation.

For extract the characteristics of multi – temporal Landsat TM for 1996, 2006 and 2016, image processing using ENVI 5.2 will been used and for digitizing one use ArcGIS

10.2 version. Other than digitize, ArcGIS 10.2 also utilized for the data attribute input, data manipulation (geodatabase development) until data analysis (overlay). The accuracy assessment of this study will be measured using Root Mean Square Error (RMSE) below 0.5m. This RMSE can be guide the suitable location for the establishment of Ground Control Point (GCP's) selected. Attribute accuracy using Google Earth Map in recent year (2016).

1.6 Study Area

The study area concentrates on mapping and assessed location of shoreline land reclamation changes along Country Garden, Danga Bay to RNF, Tanjung Puteri, part of Johor Straits. Country Garden is located in the south-central part of Iskandar Malaysia, Danga Bay, Johor Baharu first and largest mixed residential-commercial development. It stretches along a 25km scenic waterfront facing the Straits of Johor and covers an area of approximately 450-acre or 22.26 hectare. Country Garden, Danga Bay, Johor Baharu located in Latitude 1° 28' 30" North and Longitude 103° 43' 26.4" East. RNF Tanjung Puteri Latitude 1° 27' 36.91" North and Longitude 103° 46' 12.82" East. RNF Tanjung Puteri also residential-commercial development covers an area of approximately 157 acre. Since 2010, both Country Garden, Danga Bay and RNF Tanjung Puteri using GDM 2000 (Johor) coordinate system replace with Malaysian Rectified Skew Ortomorphic (MRSO) in previously.

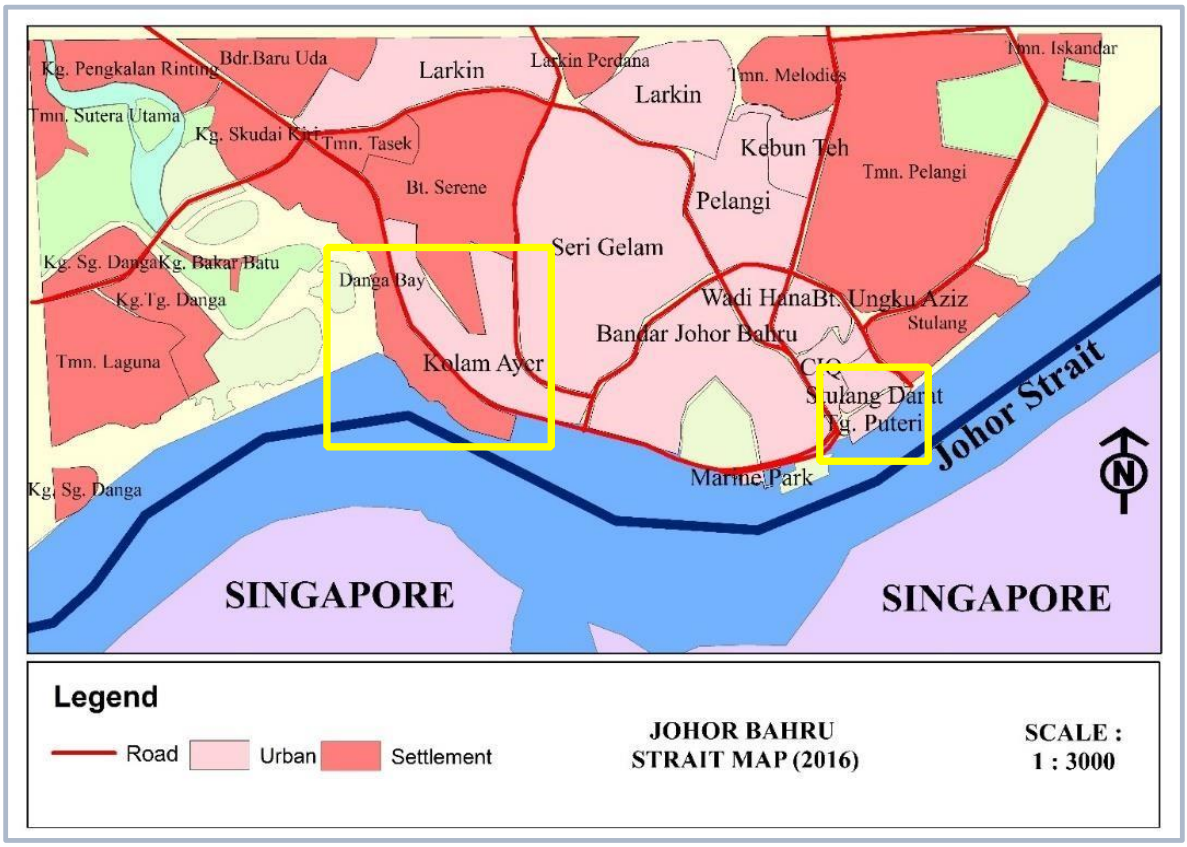

Figure 1.1: Country Garden, Danga Bay and RNF Tg. Puteri, Johor Straits boundary

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