UNIVERSITI PUTRA MALAYSIA

APPLICATIONS OF REMOTE SENSING AND GIS FOR DENGUE EPIDEMIC SURVEILLANCE IN PETALING JAYA, MALAYSIA

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BY

MIOR MOHD HADAFI BIN AHMAD ZAHAWIR

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirements for the Degree of Master of Science

AUGUST 2008

DEDICATION

To Allah S.W.T. and His Messenger Muhammad S.A.W.

To my father, my mother and all my family members, to my beloved wife Najwa Jamri and my daughters Marsya Huda, Maryam 'Audah and Munirah Afiqah for support and understanding of my work.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirements for the degree of Master of Science.

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By

Mior Mohd Hadafi bin Ahmad Zahawir

FEBRUARY 2009

Chairman: Associate Professor Dr. Abdul Rahman bin Ramli, PhD

Faculty: Computer System and Communication Engineering

Remote sensing and GIS data was used in dengue epidemic mapping. The work focused on three main applications. First, mapping the dengue epidemic incident location by analysing the cases which have relationship between one another, like cases occurring in 200 meter range from the first case and time period in one to two weeks. Secondly, application for landuse, where landuse information was extracted from high resolution satellite image, Ikonos. Dengue cases occurred in any landuse will be observed where the epidemic was influenced by landuse factors. Thirdly, the dengue cases occurred will be observed whether it was influenced by climate factors such as rainfall and temperature, including temperature and vegetation indices, obtained from medium resolution satellite images. These data was then analysed using statistical method. Although the results can show the spot area of dengue cases occurrence, the dengue cases risk index in area based on landuse and other factor in that area will also be shown. Results from statistical analysis will show the model development and verification, whether

it can be accepted or not. The main conclusion of this work will show the levels of remote sensing and GIS technology used, which can help in dengue epidemic monitoring in Malaysia.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains.

APLIKASI PENDERIAAN JAUH DAN SISTEM MAKLUMAT GEOGRAFI BAGI PENGAWALAN WABAK DENGGI DI PETALING JAYA, MALAYSIA

Oleh

Mior Mohd Hadafi bin Ahmad Zahawir

FEBRUARI 2009

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Data remote sensing dan GIS digunakan dalam pemetaan wabak denggi. Kerja-kerja ini difokuskan kepada tiga aplikasi utama. Pertama, memetakan lokasi kejadian wabak denggi dengan menganalisa kes-kes yang mempunyai pertalian antara satu sama lain, iaitu kes yang berlaku dalam jarak 200 meter dari kes sebelumnya dan dalam jarak masa antara seminggu hingga dua minggu. Kedua, aplikasi bagi faktor guna tanah di mana pemetaan guna tanah dilakukan dengan menggunakan image satelit beresolusi tinggi iaitu Ikonos. Kes denggi yang berlaku dalam mana-mana kawasan gunatanah akan dilihat samada wabak tersebut dipengaruhi oleh faktor guna tanah tersebut. Ketiga, Kes denggi yang berlaku akan dilihat samada dipengaruhi oleh faktor cuaca seperti hujan dan suhu termasuk suhu dan indek tumbuh-tumbuhan yang diperolehi dari satelit beresolusi sederhana. Data-data ini kemudiannya dianalisa menggunakan kaedah statistik. Keputusan kajian disamping menunjukkan kawasan-kawasan spot berlakunya kes denggi, akan juga menunjukkan index risiko kes denggi dalam kawasan tersebut

berdasarkan faktor guna tanah dan faktor kawasan itu sendiri. Keputusan dari analisa statistik pula akan menunjukkan pembangunan model berlakunya kes denggi dalam tahun-tahun kajian, seterusnya model tersebut akan dibuat pengesahan samada ianya boleh diterima atau sebaliknya. Kesimpulan utama yang dapat dibuat akan menunjukkan setakat mana teknologi remote sensing dan GIS yang digunakan dapat membantu usaha-usaha pemantauan wabak denggi di Malaysia.

ACKNOWLEDGEMENTS

All praise to Allah S.W.T. the Most Gracious and Most Merciful for giving me the strength, health and self-confidence to complete my study. My greatest pleasure and salaam to the great Prophet Muhammad S.A.W.

First of all, I would like to express my gratitude to my supervisor, Assoc. Prof. Dr. Abdul Rahman Ramli, Prof. Dr. Shattri Mansor, and Assoc. Prof. Dr. Abdul Rashid Mohamed Shariff for their sincere, frank advice, constructive criticism, patience and guidance throughout this research. My appreciation is also extended to Dr. Ahmad Rodzi Mahmud, Dr. Shamsul Azhar Shah, Mr. Ibrahim Selamat and Dr. Laili Nordin for their guidance and support throughout the stages of my study.

My special appreciation to Malaysian Centre for Remote Sensing (MACRES) for providing the satellite images (Landsat 7 ETM+ and Ikonos) and dengue cases data for my study area.

Special thanks also to University Putra Malaysia (UPM) for the financial support at the beginning of my study. Finally, I wish to convey my special thanks to my parent, Hj. Ahmad Zahawir Saaia and Allahyarhamah Pn. Asmah Abdul Wahab, all my brothers and sisters, my beloved wife Najwa Jamri, my daughters Marsya Huda, Maryam ‘Audah and Munirah Afiqah for their contribution and support toward the success of this study. Last but not least, all my friends, who contributed to my study, May Allah bless all of you.

I certify that a Thesis Examination Committee has met on 13 August 2008 to conduct the final examination of Mior Mohd Hadafi Bin Ahmad Zahawir on his thesis entitled “Application of Remote Sensing and GIS for Dengue Epidemic Surveillance in Petaling Jaya, Malaysia” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 march 1998. The Committee recommends that the student be awarded the Master of Science.

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I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

MIOR MOHD HADAFI BIN AHMAD ZAHAWIR

Date: 31 October 2008

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LIST OF ABBREVIATION

ADB	Asian Development Bank
CDC	Centre for Disease Control
CHAART	Centre for Health of Aerospace Related Technologies
DBMS	Database Management System
DID	Department of Irrigation and Drainage
DOE	Department of Environment
ESRI	Environmental System Research Institute
ETM	Enhance Thematic Mapper
GIS	Geographical Information System
GPS	Global Positioning System
IMR	Institute for Medical Research
JRI	Joint Research Interchange
JUPEM	Jabatan Ukur dan Pemetaan Malayisa
KLIA	Kuala Lumpur International Airport
LST	Land Surface Temperature
MACRES	Malaysian Centre for Remote Sensing
MARDI	Malaysian Agriculture Research and Development Institute
MOH	Ministry of Health
MBPJ	Majlis Bandaraya Petaling Jaya
MPOB	Malaysian Palm Oil Board
RFLP	Restriction-Fragment Length Polymorphism
SQL	Sequel Query language
WHO	World Health Organization

Locality Name:

PJS	Petaling Jaya Selatan
SS	Subang Selatan
SKA	Sungai Kayu Ara
PJU	Petaling Jaya Utara
SEK	Seksyen
KL	Kampung Lindungan
KD	Kota Damansara

CHAPTER 1

INTRODUCTION

1.1 Introduction

Remote sensing when intelligently incorporated with Geographic Information System (GIS) has been identified as being a potential enabling technology to be use in the public health sector. This technology is transforming the way we describe and study the earth. However, being somewhat new to Malaysia, and the lack of knowledge in this technology among the Malaysian society, much effort is required to train the relevant personnel to efficiently utilised and apply remote sensing and the related technologies for the well being of the nation, especially in this case, the public health sector. Albeit the many effort and research that has been done to familiarize with the technology, little action has been taken to implement the application of this technology in the public health sector. Application of remote sensing technology in the public health sector to many people appears to be rather impractical. The common question being, how much can this technology assist the public health sector to monitor, analyze, or predict the many possible health hazards? Thus far, the development of Remote Sensing and the related technologies in the country has been made to many advantages in the

various sectors such as the military, agriculture, geology, and etc. Now numerous introductory efforts have been carried out to use remote sensing and its related technologies in the public health sector.

1.2 Justification

Remote sensing is an important source of information for GIS systems. It is used in various applications like mapping of soil, vegetation, crop monitoring, forestry, environmental issues etc. Maynard (2002) found that many of the environmental factors connected to the public health issues are observable through remote sensing such as air and water quality, thermal, ultraviolet, pollutant and pathogen transport as well as deposition via the atmosphere, ocean, ice and rivers. Combining remote sensing and GIS technologies, may give near real time access to data on temperature, vegetation indices, deforestation and etc. In addition, with the precise geographic location of water bodies, population centres, building, roads, canals, and other infrastructure (WHO, 2002), these technologies are potentially useful for infectious disease surveillance and control for many types of vector borne diseases. The technology will be highly applicable to meet the demands of an outbreak investigation, prompt location of cases, condition of the location, and quick mapping of the epidemic's outbreak area. Thus, the application of remote sensing for health studies can increase the capability and accuracy in its monitoring, surveillance and risk mapping of areas of particular vector-borne disease. In most of these studies remote sensing data were used to