UNIVERSITI PUTRA MALAYSIA

LAND SUITABILITY FOR RICE GROWING IN THE KLANG VALLEY USING GEOGRAPHICAL INFORMATION SYSTEM AND ANALYTICAL HIERARCHY PROCESS FOR URBAN FOOD SECURITY

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By

SHAMSUL B. ABU BAKAR

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

September 2007

UPM

DEDICATION

To my parents, Abu Bakar Md Sap and Siti Zabedah Embi this thesis is dedicated to both of you. My beloved wife, Noora Shafei and son, Muhammad Nabeel Aiman, both of you are my greatest encouragement. Deepest thanks to my supervisors, Professor Dr Mustafa Kamal Mohd Shariff, Associate Professor Dr Ahmad Rodzi Mahmud and Dr Siva K. Balasundram for all the valuable guidance's and supports.

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

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Chairman: **Professor Mustafa Kamal Mohd Shariff, PhD**

Faculty: **Design and Architecture**

Klang Valley is the most rapidly growing region in terms of physical and economic development in Malaysia. It has a population of 4.07 million people, accounting for nearly 17.5 % of the total national population. Thus, a large amount of constant food supply is required to meet the population's demand. However, the current situation is that Klang Valley is heavily dependent on external sources of food supply. In the event of emergencies such as natural or man-made disasters, Klang Valley will face a high risk of disruption in food supply. The aim of this study is to identify and analyze potential rice cultivation areas as urban food reservoir within the highly urbanized Klang Valley.

By using Geographical Information System (GIS) and Analytical Hierarchy Process (AHP), a land suitability analysis for rice cultivation was carried out in this study area. To construct a rice suitability model, expert evaluation on criteria such as soil series, rainfall, topography, groundwater and strategic agriculture distances were evaluated based on weightage ranking. Those weightage were obtained by using a Pairwise Comparison Method and then converted into spatial values using ArcGIS 9 weighted overlay process.

Results indicated several areas within the Klang Valley having strategic potentials for rice growing. These areas are classified into three major classes - highly suitable, suitable and moderately suitable. The percentage of highly suitable area is 3504.35 ha (8.82 %), suitable areas 18793.28 ha (47.34 %) and moderately suitable areas 17403.02 ha (43.84%). The total areas suitable for rice growing is 39700.65 ha (14%) from the total size of Klang Valley.

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

KESESUAIAN TANAH UNTUK PENANAMAN PADI DI LEMBAH KLANG MENGGUNAKAN SISTEM MAKLUMAT GEOGRAFI DAN PROSES ANALATIKAL HIERAKI UNTUK KESELAMATAN MAKANAN BANDAR

Oleh

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September 2007

Pengerusi: **Profesor Mustafa Kamal Mohd Sharif, PhD**

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Lembah Klang adalah merupakan kawasan perbandaran yang paling membangun dari segi fizikal dan juga ekonomi di Malaysia. Ia mempunyai populasi lebih dari 4.07 juta, iaitu 17.5% dari jumlah keseluruhan penduduk nasional. Oleh itu, keperluan makanan yang berterusan adalah amat diperlukan untuk memenuhi keperluan dan permintaan penduduk. Walaubagaimanapun, pada masa sekarang Lembah Klang amat bergantung dengan bekalan makanan yang dihasilkan di luar kawasan sempadan. Sekiranya berlaku kecemasan samada bencana alam ataupun akibat dari aktiviti manusia, Lembah Klang akan mengalami risiko utama kekurangan bekalan makanan yang amat tinggi. Tujuan kajian ini dilakukan adalah untuk menganalisis dan mengenalpasti kawasan yang sesuai untuk penanaman padi supaya ianya boleh dijadikan sebagai ‘empangan’ makanan di sekitar kawasan perbandaran di Lembah Klang

Dengan mengunakan Sistem Maklumat Geografi dan juga Proses Analatikal Hieraki, analisis kesesuaian tanah untuk penanaman padi telah dilakukan di kawasan ini. Untuk membina model kesesuian, penilaian pakar terhadap siri tanah, hujan, topografi, air bawah tanah dan kedudukan strategik kawasan pertanian dilakukan menggunakan kaedah pemberat. Pemberat kriteria ini didapati melalui Kaedah Perbandingan 'Pairwise' dan kemudianya diubah kepada nilai spatial menggunakan perisian Proses Pemberatan Lapisan ArcGis 9.

Keputusan menunjukan bahawa terdapat beberapa kawasan di Lembah Klang yang di kenal pasti mempunyai potensi strategik sebagai kawasan penanaman padi. Kawasan ini dibahagikan kepada tiga bahagian yang utama - 'paling sesuai', 'sesuai' dan 'sedikit sesuai'. Peratusan keseluruhan keluasan untuk kawasan yang 'paling sesuai' adalah sebanyak 8.82% (3504.35 ha.), 'sesuai' sebanyak 47.34% (18793.28 ha.) dan 'sedikit sesuai' sebanyak 43.84% (17403.02 ha.). Jumlah keseluruhan kawasan yang sesuai untuk penanaman padi ini adalah 39700 ha. iaitu 14% dari jumlah keluasan kawasan yang terdapat di Lembah Klang.

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I certify that an Examination Committee has met on 4th September 2007 to conduct the final examination of Shamsul bin Abu Bakar on his Master of Science thesis entitled "Land Suitability for Rice Growing in the Klang Valley Using Geographical Information System and Analytical Hierarchy Process for Urban Food Security" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the degree of Master of Science.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations in 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.

_____

SHAMSUL ABU BAKAR

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LIST OF ABBREVIATIONS

AHP	Analytical Hierarchy Process
CR	Consistency Ratio
DOA	Department of Agriculture
DID	Department of Irrigation and Drainage
MMD	Malaysian Meteorological Deparment
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agriculture Organization Statistis
GIS	Geographical Information System
GPS	Global Positioning System
GDP	Gross Domestic Products
IADP	Integrated Agricultural Development Project
IRRI	International Rice Research Institute
KADA	Kemubu Agricultural Development Authority
LUPAS	Land Use Planning and Analysis System
LST	Linear Scale Transformation
MADA	Muda Agricultural Development Authority
MARDI	Malaysia Agricultural Research and Development Institute
MCDM	Multi Criteria Decision Analysis
MADM	Multi Attribute Decision Making
MCDA	Multi Criteria Decision Analysis
MODM	Multi Objective Decision Making
NPP	National Physical Plan

NAI	Nutrient Availability Index
NAP3	Third National Agricultural Policy
PCM	Pairwise Comparison Methods
PA	Precision Agriculture
PAA	Prime Agricultural Areas
RS	Remote Sensing
WLC	Weighted Linear Combination

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The process of urban expansion or urban sprawl towards land uses have become one of the major issues for concern in the world. Urban areas are known as the centers of all activities including commerce, industry, settlement, culture and institutional uses. Urban areas continue to expand in size and taking over land for other uses, mainly agriculture areas (Fazal, 2001). According to Brabec and Smith (2002) urban sprawl is caused mainly by the continued out migration of residents from city centers into relatively inexpensive and lower density land housing in the urban fringes. This phenomenon has already placed a tremendous pressure on farmland resources. To meet the needs of the increasing urban population, land within urban periphery and rural areas are currently being converted into housing, shopping and retail, civic institution, business park and roadways.

Rapid encroachment by urban development causes tremendous lost of open spaces, green areas and also give impacts to the surrounding environment such as pollution and climate changes. The speed of urban growth and “land-use change” raised many problems such as inadequate infrastructure, increased population and employment pressure, overcrowding, slum communities arising from low-income groups, food insecurity and environmental degradation (Thapa et al, 2004).

Urban sprawl is often perceived as a negative urban phenomenon with costs including un-sightly development as well impacts on social and economics values. In most cases, agriculture land and rural areas located within urban periphery are facing greater loss in term of land use conversion into non-agricultural uses. Brabec and Smith (2002) added that the scenario of agriculture fragmentations in the urban fringe not only contribute to the loss of traditional farming economic base but also to the character and visual quality of the rural communities. Fragmentation of agricultural land by urban sprawl also affects not only the agricultural production capacity of the land but also its rural scenic quality.

The decline land suitable for agriculture not only affect the production of commercial crops such as rubber and oil palm but also the production of the food commodities such as rice, vegetables and fruits that are vital for high populated urban areas. According to Kuminoff et al., (2000) large-scale farmland conversions that reduce the production of certain commodities could affect local and even international food market. Argenti (2000) added that continous urban growth will contribute greater implications for future urban food security. This issues was raised in the State of California, United States where it produce most of its own food and would faces shortage if its existing farmland were to be developed for urban use. Based on the arguments, it is necessary for urban areas to have a sufficient amount of land that can be use as food crop production areas. In the event of emergencies such as natural disasters and wars, every community should be able to produce or supply at least a third of the food required by its residents (Mann, 2003).

The Malaysian National Physical Plan (2005) specified that assessment of land for urban uses require the consideration of two factors. First, demand for land generated by the increase in urban population and secondly an assessment of lands that could made available for urban uses without jeopardizing the integrity of key land uses considered essential as food supply, agricultural production purposes or which are subject to environmental constraints.

1.2 Problem Statement

Klang Valley is the most rapidly growing region in terms of physical and economical development in Malaysia. It has a population of 4.07 million, accounting to nearly 17.5 % of the total national population and is still growing at a rate of 2.4% annually. To sustain such a large population, Government has to fulfill demands for infrastructure and other physical development that would involve tremendous new land usage. Such physical development contributes to urban sprawl. In most cases, the process of urban sprawl causes losses towards other land uses especially land for agriculture. The intrusion of urban land uses into agriculture land or potentially suitable agriculture land creates agriculture land fragmentations. Planners and the relevant authorities often fail to see the importance of agriculture land as a crucial medium for raw and fresh food production within the urban periphery. Ironically, urban centers are wholly dependent on outsourced food consumption. With rice as a staple food item that feeds the Malaysian populations, land suitability analysis for rice cultivation is becoming essential for Klang Valley. This knowledge will contribute towards increasing Klang Valley's food security in time of war and natural disasters.