CHANGE DETECTION OF GREEN SPACES IN PUTRAJAYA USING REMOTE SENSING TECHNIQUE

MUHAMMAD NABIL ASYRAF BIN AZHAR

FH 2019 17

CHANGE DETECTION OF GREEN SPACES IN PUTRAJAYA USING

REMOTE SENSING TECHNIQUE

MUHAMMAD NABIL ASYRAF BIN AZHAR

A Project Report Submitted in Partial Fulfillment of the Requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry Universiti Putra Malaysia

2019

DEDICATION

For my beloved parents

Azhar Adnan

Azura Saleh

My siblings and Damira Khairi.

To all my best friends,

My team during the data processing periods.

Thank you for your encouragements and supports.

Thank you for everything. May God bless us all.

ABSTRACT

Nowadays, rapid urban expansion has changed the forms of land in most part of the world. In Malaysia, after independence in 1957, the economics and population has dramatically increased. Thus, many forestland have been converted into industrial area to support the economical demand. While in Putrajaya, the administrative capital of Malaysia were also have been affected by the country's rapid growth since the last 17 years when it was first establishment in 19 October 1995 and declared by the Prime Minister Tun Dr Mahathir Mohamad as the Federal Territory in 1st February 2001. In pursuing Malaysian Vision of Wawasan 2020, Putrajaya was planned to be a green city and intelligent city. Hence, there is a need of mapping tool to monitor and acquire information about the green spaces changes. In this study, remote sensing technique was applied for detecting the land cover changes over a time span of 17 years. The objective of this study was to obtain information about the current status of green spaces in Putrajaya by using remote sensing (Landsat 4 and Sentinel 2) data, secondly to compare the changes of green spaces as well as the land cover at two different times (Year 2000 and 2017) and finally to produce a map of land cover types in Putrajaya. The method include making subsets from raw data image, removing noises by using Masking tool, extracting features with supervised classification tool, analyzing NDVI method, image analysis supported by accuracy assessment and ground truth activity. Supervised classification extracted four features which were Vegetation1 (grassland/shrubs), Vegetation2 (forest), Water body and URS which stands for urban rock and soil. Besides, observing NDVI (Normalized difference vegetation index) from unsupervised classification has four features which are from no, low, medium and high vegetation. All the area for each feature is determined for data in all images. Results from this study shows that for the study area of 4638 ha, the land cover changes from year 2000 to 2017 are: (Vegetation 1 +205 ha, Vegetation 2 -715 ha, Water body +153 ha and URS +357 ha). The study shows the effectiveness, accuracy of remote sensing technique in monitoring the land cover change.

ABSTRAK

Pada masa kini, perkembangan bandar yang pesat telah mengubah bentuk tanah di sebahagian besar dunia. Di Malaysia, selepas kemerdekaan pada tahun 1957, ekonomi dan penduduk telah meningkat secara dramatik. Oleh itu, banyak kawasan hutan telah diubah menjadi kawasan perindustrian untuk menyokong permintaan ekonomi. Semasa di Putrajaya, modal pentadbiran Malaysia juga telah terjejas oleh pertumbuhan pesat negara sejak 17 tahun yang lalu apabila ia pertama kali ditubuhkan pada 19 Oktober 1995 dan diisytiharkan oleh perdana menteri Tun Dr Mahathir Mohamad sebagai Wilayah Persekutuan pada 1 Februari 2001. Dalam mengejar Visi Malaysia Wawasan 2020, Putrajaya dirancang untuk menjadi bandar hijau dan bandar pintar. Oleh itu, terdapat keperluan pemetaan alat pemetaan dan mendapatkan maklumat tentang perubahan ruang hijau. Dalam kajian ini, teknik penderiaan jauh digunakan untuk mengesan perubahan litupan tanah sepanjang tempoh 17 tahun. Objektif kajian ini adalah untuk mendapatkan maklumat mengenai status ruang hijau di Putrajaya dengan menggunakan data penderiaan jauh (Landsat 4 dan Sentinel 2), kedua untuk membandingkan perubahan ruang hijau serta litupan tanah pada dua tahun berlainan iaitu tahun 2000 dan 2017 dan akhirnya menghasilkan peta jenis litupan tanah di Putrajaya. Kaedah ini termasuk membuat subset dari imej data mentah, menghilangkan gangguan dengan menggunakan alat Masking, mengekstrak ciri-ciri dengan klasifikasi secara selia, menganalisis NDVI menggunakan kaedah klasifikasi yang diselia, analisis imej yang disokong oleh penilaian ketepatan dan aktiviti pengesahan di lapangan. Klasifikasi secara selia mengekstrak empat ciri iaitu Tumbuhan 1 (padang rumput / semak), Tumbuhan 2 (hutan), Badan air dan URS yang bermaksud tanah dan kawasan bandar. Selain itu, pemerhatian NDVI dari klasifikasi tidak selia mempunyai empat ciri litupan tumbuhan iaitu tiada, sikit, sederhana dan tinggi. Semua ciri litupan ditentukan untuk data dalam semua imej. Hasil daripada kajian ini menunjukkan bahawa untuk kawasan kajian seluas 4638 ha, perubahan tanah dari tahun 2000 hingga 2017 adalah: (Vegetasi 1 +205 ha, Vegetasi 2 -715 ha, Waterbody +153 ha dan URS +357 ha). Kajian ini menunjukkan keberkesanan, ketepatan teknik penderiaan jauh dalam memantau perubahan litupan tanah.

ACKNOWLEDGEMENTS

Alhamdulillah and thank to Allah S.W.T with all His Gracious and His Merciful for giving me the spirit, patience, strength and the ability to accomplish this project successfully. I would like to take the utmost opportunity to express my appreciation especially to my supervisor Lt. Cdr. Assoc. Prof. Gs. Dr. Mohd. Hasmadi Bin Ismail RMNVR, who had contributed so many efforts in guiding and assisting me through the entire project. The encouragement given by the Faculty of Forestry, Universiti Putra Malaysia is gratefully acknowledged. Not to forget many thanks to all my friends who had been my side supporting me in completing this project. Last but not least, my deepest gratitude to my supportive parents and my siblings for constantly praying for my success.

APPROVAL SHEET

I certify that this research project report entitled Change Detection of Green Spaces in Putrajaya Using Remote Sensing Technique has been examined and approved as a partial fulfillment of the requirements for the Degree of Bachelor of Forestry Science in the Faculty of Forestry, Universiti Putra Malaysia.

_____

Lt. Cdr. Assoc. Prof. Gs. Dr. Mohd. Hasmadi Bin Ismail RMNVR
Faculty of Forestry
Universiti Putra Malaysia
(Supervisor)

_____

Prof. Dr. Mohamed Zakaria Bin Hussin
Dean
Faculty of Forestry
Universiti Putra Malaysia

Date: January 2019

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Ha   Hectare

Km   Kilometre

NDVI   Normal Difference Vegetation Index

URS   Urban Rock and Soil

GPS   Global Positioning System

TM   Thematic Mapper

PGC   Putrajaya Green City

USGS   United States Geological Survey

GloVis   Global Visualisation

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Nowadays, rapid urban expansion have changed the forms of land in most part of the world. In Malaysia, after independence in 1957, the economics and population has dramatically increased. Thus, many forestland have been converted into industrial area to support the economical demand. While in Putrajaya, the administrative capital of Malaysia were also have been affected by the country's rapid growth since the last 17 years when it was first declared by the Prime Minister Tun Dr Mahathir Mohamad as the Federal Territory.

In pursuing Malaysia Vision of Wawasan 2020, Putrajaya was planned to be a green city and intelligent city. Thus rapid urbanization and construction begin in early 20th century after its first establishment in 19 October 1995. When human activities led to modifying the landscape and the renewable resources, remote sensing can react very quickly to the rapidly changing environment. In this study, remote sensing technique are applied for detecting the land cover changes over a time span of 17 years.

Many other experimenters who perform research about change detection has affected this study in term of methodology. There are many ways to identify changes of land cover in remote sensing technique. By using different software to analyze these images, variation of analysis could be made. In this research which focusing on the changes of the land cover and the total area of green spaces in Putrajaya, Erdas Imagine software which capable of classifying the characteristic in the images and Arc Map software which capable of mapping and calculating area are used.

1.2 PROBLEM STATEMENT

Nowadays, world is experiencing a global climate change where most countries are having unexpected or abnormal temperature. Rapid urban expansion has had a significant impact on green space structure. Cities have grown rapidly in size and density and in some developing countries its often denominated rapid urban expansion (Turrini and Knop, 2015). Humanity reacted and one of the ways to encounter it is by enhancing the growth of urban green spaces.

While in Malaysia, Putrajaya also known as the Garden City and Intelligent city has shown a fast increasing graph of its population since its establishment in year 1995 and declaration as Federal territory in year 2001. According to Putrajaya Administrative Division, the population has rapidly increased from 12240 people in year 2000 to 72413 people in 2010. This result proved that urbanization currently striking this region. Thus, National Federal Administrative centre has took the challenge into becoming a sustainable low carbon green city in PGC2025 (Bernama, 2017). One of the three goals of Putrajaya Green City 2025 project is to reduce the peak temperature to 2 degree Celsius which correlate with this study that this city needs to be higher percentage of green spaces.

Therefore, this study is crucial in order to show how remote sensing technique be able to obtain the status of green area in Putrajaya as well as the total changes of land cover from year 2000 to 2017.

1.3 OBJECTIVES

The aim of this study was to identify the land cover of Putrajaya using remote sensing technique. The specific objectives were:

I.   To map the status of green spaces of Putrajaya.

II. To analyze and compare the changes of green spaces of Putrajaya from 2000 to 2017.

1.4 HYPOTHESIS

The hypothesis of this research is that urbanization contribute to the decrease of green spaces in an area. Some forestland in Putrajaya has been cleared for other building purposes mainly for the city element such as office buildings or roads, residential areas, parks and artificial lakes. Despite of its administrative authority efforts in Putrajaya Green City PGC2025 project, Putrajaya still be able to maintain 53% of its green spaces although has decreased from 65% in year 2000.

REFFERENCES

Adeniyi, P. O. (1980). Land-use change analysis using sequential aerial photography and computer techniques [Nigeria]. *Photogrammetric Engineering and Remote Sensing*. Anderson, J. R. (1977). Land use and land cover changes. A framework for monitoring. *Journal of Research by the Geological Survey*, *5*, 143-153.

Duvenhorst, J. (1995). Photogrammetry in forestry-Tool for effective Inventory and Planning.

Drusch, M., Del Bello, U., Carlier, S., Colin, O., Fernandez, V., Gascon, F., ... & Meygret, A. (2012). Sentinel-2: ESA's optical high-resolution mission for GMES operational services. *Remote Sensing of Environment*, *120*, 25-36.

Dotzler, S., Hill, J., Buddenbaum, H., & Stoffels, J. (2015). The potential of EnMAP and Sentinel-2 data for detecting drought stress phenomena in deciduous forest communities. *Remote Sensing, 7*(10), 14227-14258.

Gandhi, G. M., Parthiban, S., Thummalu, N., & Christy, A. (2015). NDVI: vegetation change detection using remote sensing and GIS–a case study of Vellore District. *Procedia Computer Science*, *57*, 1199-1210.

Hermosilla, T., Wulder, M. A., White, J. C., Coops, N. C., Hobart, G. W., & Campbell, L. B. (2016). Mass data processing of time series Landsat imagery: pixels to data products for forest monitoring. *International Journal of Digital Earth, 9*(11), 1035-1054.

Immitzer, M., Atzberger, C., & Koukal, T. (2012). Tree species classification with random forest using very high spatial resolution 8-band WorldView-2 satellite data. *Remote Sensing, 4*(9), 2661-2693.

Lambin, E. F. (1996). Change detection at multiple temporal scales: seasonal and annual variations in landscape variables. *Photogrammetric Engineering and Remote Sensing, 62*(8), 931-938.

Lee, A. C. K., Jordan, H. C., & Horsley, J. (2015). Value of urban green spaces in promoting healthy living and wellbeing: prospects for planning. *Risk Management And Healthcare Policy*, *8*, 131.

Li, D. (2010). Remotely sensed images and GIS data fusion for automatic change detection. *International Journal of Image and Data Fusion*, *1*(1), 99-108.

Morancho, A. B. (2003). A hedonic valuation of urban green areas. *Landscape And Urban Planning*, *66*(1), 35-41.

Newton, A. C., Hill, R. A., Echeverría, C., Golicher, D., Rey Benayas, J. M., Cayuela, L., & Hinsley, S. A. (2009). Remote sensing and the future of landscape ecology. *Progress in Physical Geography*, *33*(4), 528-546.

Nor, A. N. M., Corstanje, R., Harris, J. A., & Brewer, T. (2017). Impact of rapid urban expansion on green space structure. *Ecological Indicators*, *81*, 274-284.

Pekel, J. F., Cottam, A., Gorelick, N., & Belward, A. S. (2016). High-resolution mapping of global surface water and its long-term changes. *Nature*, *540*(7633), 418.

Pettorelli, N., Laurance, W. F., O'Brien, T. G., Wegmann, M., Nagendra, H., & Turner, W. (2014). Satellite remote sensing for applied ecologists: opportunities and challenges. *Journal of Applied Ecology*, *51*(4), 839-848.

Skidmore, A. K., Wood, G. B., & Shepherd, K. R. (1987). Remotely sensed digital data in forestry: a review. *Australian Forestry*, *50*(1), 40-53.

WHO (2018). *Urban green spaces*. [online] World Health Organization. Available at: http://www.who.int/sustainable-development/cities/health-risks/urban-green-space/en/ [Accessed 16 Nov. 2018].

Wulder, M. A., Hall, R. J., Coops, N. C., & Franklin, S. E. (2004). High spatial resolution remotely sensed data for ecosystem characterization. *AIBS Bulletin*, *54*(6), 511-521.

Yang, X., Skidmore, A., Melick, D., Zhou, Z., Xu, J. (2007). Towards an efficacious method of using Landsat TM imagery to map forest in complex mountain terrain in Northwest Yunnan, China. *Tropical Ecology*, *48*(2), 227.