UNIVERSITI TEKNOLOGI MARA

ASSESSING GREEN SPACE COOLING EFFECTS ON THE TROPICAL URBAN MICROCLIMATE

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ABSTRACT

Urban Heat Island (UHI) is a phenomenon where the temperature distribution in the urban areas is significantly warmer than the surrounding suburban areas. One of the main causes of UHI is the replacement of natural surfaces by built surfaces through urbanisation. Trees and vegetation play vital roles to mitigate the UHI effects, especially by regulating high temperature in saturated urban areas and their surroundings. This study evaluated the effects of land use/land cover on the surface temperature of an urban area, especially in a hot and humid tropical climate like Malaysia. The objectives were to determine the surface temperature distribution within the different land covers, to analyse the vegetation growth impact on land surface temperature, to determine the temperature distribution within parks, to quantify the green space cooling effect intensity, and to analyse the surface temperature distribution of different land covers within 24 hours. The study areas were mainly located within the Petaling Districts, Selangor Darul Ehsan. For a more detailed study to quantify the green spaces cooling effects, Shah Alam Lake Garden (Shah Alam), Bandaran Kelana Park (Kelana Jaya) and Subang Ria Recreational Park (Subang Jaya) were selected as the test sites. Land use/land cover, vegetation, and surface temperature distribution maps were derived from Landsat 5 Thematic Mapper (TM) image of 1991, 1999 and 2009. Other satellite data used in this study were Landsat 8 Operational Land Imager (OLI) and Landsat 8 OLI/Thermal Infrared Sensor (OLI/TIRS) images of 2013 and 2014. Mono-window algorithm was used to generate temperature distribution maps of the study areas. Land cover classification and land cover profile of the selected study areas were generated in the digital image processing software. Geographical Information System (GIS) was used to generate the land surface temperature (LST) map, measure the LST of selected points within specified buffer zones, perform overlay, and buffer operations. The green space cooling effect intensity and the relationship between intensity and proximity from green space boundary were later determined. Major findings of this research indicated surface temperature within built-up areas was highest, followed by cleared land, mixed vegetation, water bodies, and vegetated areas. Within a park, the temperature can be significantly different, depending on the park profile (land cover). Vegetated areas, especially areas with matured trees, help to reduce the surface temperature of the surrounding. Findings from this research had also found that the cooling effect intensity of the surrounding urban areas largely depends on the green space density profile and the distance from the park boundary. Parks can influence the temperature of the surrounding area up to 350m from the park boundary. The introduction of green areas or parks in urban areas can be considered as a good initiative to replace the loss of natural greenery and can potentially reduce the effects of UHI. In future, a more detailed study should be carried out to identify which tree species can significantly reduce the surface temperature within an urban area.

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CHAPTER ONE
INTRODUCTION

1.1 Background

Urbanisation has become a dominant demographic trend of land use/land cover changes in the world. Rapid urbanisation growth has caused the built-up surfaces to increase, hence reduces the vegetated areas. The changes in land use include loss of forest lands, crop lands, as well as increased of barren lands and impermeable surfaces such as buildings, concretes, pavements, and asphalt (Kumar et al., 2012). However, urbanisation is an inevitable activity that needs to be implemented to accommodate the increasing population in urban areas. Due to economic demands, the urban populations are rapidly increasing in size and complexity because more and more people are leaving rural areas and migrate to urban areas. The increasing number and extent of cities, residential areas, and industrial complexes symbolise the movement of people from rural to urban areas.

The transformation of natural physical to built-up surfaces has caused environmental degradation (Uttara et al., 2012 and Omar, 2009). Due to urbanisation processes, the dramatic land use/land cover changes have altered the climatic characteristic of urban spaces (Elsayed, 2006). Urbanisation also brings adverse impacts to the urban residents such as increase of air pollution, unpredictable weather events, and flash floods. A study conducted by Ooka (2007) identified urban development as the cause of regional climate changes which result in urban climate impacts including urban heat island (UHI). The UHI phenomenon can be witnessed in many major cities throughout the world. UHI occurs when air and surface temperature are hotter than their rural surroundings (Gartland, 2008 and Oke, 1972).

The UHI process is when a large amount of heat, generated from the built-up surfaces, traps the incoming solar radiation during the day and then re-radiates it at night. The warmth air during the night time causes the temperature in the urban areas remains warmer than the sub-urban areas. The anthropogenic heat released from vehicles, power plants, air conditioners and other heat sources is the major contributor to the formation of UHI (Memon et al., 2008 and Solecki et al., 2004). Numerous studies related to the UHI phenomenon and behaviours in tropical countries