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Modification of Urban Temperature in Hot-Humid Climate through Landscape Design Approach: A review

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Abstract

This paper discusses a conceptual review of local and micro scale approaches that incorporate the principles of sustainable landscape design as mitigating strategies to improve urban thermal comfort in a warm and humid climate. The modification of urban temperature through landscape approach can be achieved by incorporating sustainable landscape design practices via the interplay of natural vegetation in the hot-humid tropics. The findings of this paper is hoped to guide the practitioners in landscape architecture, policy makers and urban designers to incorporate sustainable landscape design approach towards improving outdoor thermal comfort; thus providing a better quality of life.

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Keywords: Landscape design principles; outdoor thermal comfort; urban heat island; hot-humid climate

1. Introduction

The issues on urban heating and thermal discomfort due to the occurrence of Urban Heat Island (UHI) phenomenon in hot-humid climate has received tremendous attention among climatologists and urban

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designers recently. Due to this phenomenon, urban dwellers experienced intense urban heating that caused thermal discomfort to do activities both in outdoor and indoor environment.

As a region that are close to the equator, the hot-humid climate generally experiencing averagely a uniform temperature, high humidity and low wind velocity all year round. Furthermore, hot-humid tropics also received a high intensity of solar radiation due to the long hours of daytime sunshine duration. These features make it as the biggest challenge for practitioners in urban planning and design to integrate climate-responsive elements into design in order to adapt the changing climate and providing outdoor thermal comfort.

Notwithstanding the fact that UHI effects can be mitigated through proper design approach, however, poor design in current urban landscape of hot-humid tropics has been established to be one of the contributing factors that lead to outdoor thermal discomfort. The existing urban designs of this region often oversee the local climatic needs due to misinterpretation on the conceptual of urbanism in western countries (Corbella and Magalhaães, 2008; Tso, 1996), thus making it insensitive to our climate and result in gin the rise of urban temperature.

At the age of global warming and climate change, prudent task should be taken in improving current urban climatic condition to safeguard sustainability of urban ecosystems in the future. The knowledge of landscape architecture can be widely utilised to provide design solution to improve many environmental setbacks. Due to its ability to interact between built and natural elements; as well as an interdisciplinary profession, hence, landscape architects have a huge potential to modify the effects of extreme climatic conditions (Brown, 2011) through adoption of environmentally-responsive design that incorporate bioclimatic aspects to outdoor environments. In this paper, we concisely describe a holistic approach on landscape principles considering the needs for both at regional and micro scale; in the context of humid tropics. This paper attempts to deduce from literature review of selected journals on climate modification through urban and landscape design approaches. Therefore, the emphasis is made on method used by previous researchers.

2. Effects Of Urban Heat Island (UHI) To The Urban Landscape Of Hot-Humid Climate

A large body of literature observed that the occurrence of UHI phenomenon has resulted undesirable effects to the urban climate and degrade the living quality. Unlike several temperate countries where UHI effect is somehow demonstrated as thermal benefit during the winter season (Grimmond et al., 2010; Gartland, 2008:15; Givoni, 1998:256; Papparelli et al., 1996), the hot-humid climate is on the contrary. As a region that experienced warm and humid climate all year round with various climatic variability, plus the influence of urban design factors; the daytime UHI always exacerbates outdoor thermal discomfort for hot-humid climate. Few tropical studies have shown that generally daytime UHI is more pronounced than nocturnal UHI (Jusuf et al., 2007; Taha, 1997). This is because, due to high solar absorption in daytime with combination of urban thermo physical characteristics (Taha, 1997), building structures and urban impervious surfaces tend to store heat (Gartland, 2008: 15-16) where it has increased the urban temperature. However, despite the thermal discomfort cause by heat island effects, the natural landscape of hot-humid tropics that surrounded by the abundance of tropical rainforest should be utilised to offer shading and evaporative cooling towards providing thermal advantage (Grimmond et al., 2010). It is observed that some of the tropical trees like *Messuaferrea* (Ironwood tree) and *Hurracepitans* (Indonesian Umbrella Tree) can attenuate solar radiation almost 92.55% and 79% respectively (Shahidan et al., 2010), thus lowering ground surface temperature by reducing the amount of terrestrial radiation underneath the canopy. Hence, these natural features provide opportunities for planners and landscape architects to manipulate the use of native vegetation as urban climate regulator in the design for both at local and micro scale.

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