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GREEN INFRASTRUCTURE IN CITIES AND TOWNS IN SOUTHEAST ASIAN COUNTRIES: QUEST FOR RESEARCH

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ABSTRACT

The cities in Southeast Asia are rapidly urbanised. Urbanisation in the region causes urban residents to live in a city with less balanced ecological system. Green infrastructure is known to be a vital indicator for urban environmental sustainability. The green infrastructure is all landscape types comprise of greenery and open spaces. Its network of park, playing field, pocket and incidental green space and neighbourhood space that is linked by tree-lined streets and waterways around and between urban areas provides green lung for cities, hence promotes healthy society through spaces for recreational, social and leisure activities. These are the places where urban residents have access and contact with nature, and interactions with other individuals. This paper explores the roles of green infrastructure in the Southeast Asian cities and towns, and its implications to urban residents' well-being. The green infrastructure acts as an important countermeasure to alleviate negative effects of urbanisation to residents and urban ecological system. A multidisciplinary literature review on urban open space, greenery and urban natural ecosystem was conducted to assess the body of research that highlights green infrastructure in Southeast Asia cities which include Jakarta, Singapore, Kuala Lumpur, Manila and Bangkok. The major themes derived from the findings were categorised into three: (i) quantity of existing green infrastructure, (ii) studies on green infrastructure contributions to well-being of urban residents, and (iii) significant attribute parameters that emerged from the studies. The review has found that even though the concept of green infrastructure may be new for many countries in the region, the areas of research have gained recognition in the urban public health dimension. In other words, the governments of the region must consider urban residents' health derived from green infrastructure to be of important resources for future urban sustainability. There are also challenges especially on green infrastructure's implementation that need to be addressed in city planning and urban design. The findings implicates that accumulation of research can promote public health of Southeast Asian cities that ultimately lead to environmental sustainability.

Keywords: *Green infrastructure; Southeast Asian region; urban residents' well-being*

1.0 Introduction

Rapid process of economic development and urbanisation that took place throughout the Southeast Asian countries had led to a massive migration of people from rural villages to urban and newly growth areas. They become residents that gradually adopted urban cultures and lifestyles. It is projected that urban areas in developing countries will account for nearly 90% of the world population increase (2700 million) between1995 and 2030. By the year 2030, almost 50% of Asians people will live in cities (Kuchelmeister, 2000). For instance, urban population in Malaysia will increase by 78% by 2030 (Nor Akmar *et al.*, 2010).

Urbanisation has profound effects on the build-up of a city as well as the quality of life of residents. It is generally recognised that in an urbanisation process, as the population increases, its environment will generate various environmental problems. These problems range from impairment of human health to economic and damage to urban ecosystem. Air, water pollution, waste generation, intensification of energy consumption, and limited and decline greenspace are among the key problems that are faced in urban areas. As a result, urban residents increasingly live in a city and town with less balanced ecological system.

Healthy urban environment is essential for urban residents' well-being. As such, urban natural environment in the form of urban green infrastructure is a highly valued resource to countermeasure these urban ecosystem deteriorations. Urban 'green infrastructure' or 'greenspace' is used interchangeably in this paper. Urban green infrastructure is all landscape types comprise of greenery and open spaces. Its network consists of parks, open spaces, playing fields, hill forests, pocket spaces, small incidental greenspace and neighbourhood gardens that are linked by tree-lined streets and waterways, around and between urban areas. It serves as an ecological and social function systems in cities and towns. The roles of urban green infrastructure are manifold; ranging from conservation of natural resources to provision of recreations to urban residents. The linkages provide green lung for cities, hence promotes healthy society through spaces for recreational, social and leisure activities. These are the places where urban residents have access and contact with nature, and interactions with other individuals. For example, greenery is important to maintain ecological sustainability and a balanced ecosystem between flora and fauna. Socially, urban nature has a soothing effect on urban residents whereby greenery beautifies, provides a serene environment to the residents thus affecting their well-being.

This paper highlights the impact of urbanisation by focusing on issues and roles of green infrastructure in cities and towns of the South East Asia region. Hence, the contributions of the green infrastructure to urban residents' well-being and challenges faced by cities are identified. The paper asks the following questions:

1) What are the benefits and issues concerning green infrastructure in the Southeast Asian cities and towns?
2) What attributes of the greenspace are important to urban residents and have strongest positive effects to the residents' experience?

3.0 Urban Greenspace Research in South East Asian Countries

Many have increasingly recognised that green infrastructure is vital component that improves the urban ecosystem and quality of life of its inhabitants. The green infrastructure acts as an important countermeasure to alleviate negative effects of urbanisation to residents and urban ecological system. A wide range of benefits as well as issues concerning green infrastructure were studied by various researchers all over the world. This reviews that focused on studies of green infrastructure in Southeast Asian settings were found to add to the knowledge on benefits and challenges of green infrastructure's planning, provision and management of the green infrastructure of the region.

3.1 Issues and Challenges

Green infrastructure consists of predominantly managed parks, gardens, designed greenspace, scattered vegetated pocket and incidental spaces, and semi-natural areas. A large portion of the greenspace such as public parks, neighbourhood open spaces and incidental open spaces are amenity green infrastructure. The rest of greenspace include semi-natural areas such as forest reserves and undeveloped lands in urban areas. A city deserved to be called a 'green city' when it has sufficient greenspace to account for its environmental sustainability (Aldous, 2010). According to Singh *et al.* (2010), cities that are renowned for their adequate greenspace should provide at least 20-30% of greenspace. As well, the United Nation Food and Agriculture Organisation (FAO, 1992) suggested that at least 9m² of greenspace should be provided per inhabitant.

Reviews on green infrastructure in several Southeast Asian countries in Table 1 show the percentage of greenspace. It also summarises the aspects of studies carried out concerning the green infrastructure.

Table 1: Percentage of greenspace and aspects of studies

Cities /Countries	Greenspace /city area (%)	Greenspace(m^2) /inhabitant	Concern of research	Authors
Jakarta	9.6%	0.22	• Lack of greenspace due to competition with other physical developments. • Increases environmental degradation from the lack of greenspace. • Lack of awareness and sense of civic mindedness resulted in uncaring attitude of public.	Sabarini, P. (2009); Pitakasari et al. (2010); Jakarta General Masterplan, 2010); Rustam (not cited); Aldous (2010); Kuchelmeister (2000)
Kuala Lumpur	15.5%	12.9	• Lack of proper planning, implementation management and reinforcement i.e. low standards of maintenance, lack of manpower and budget, • lack of skill, knowledge, expertise and interest. • lack of awareness and sense of civic mindedness.	Mustafa & Osman (1999); Lillian et al. (2002); JPBD (2005, 2006); Yap *et al.* (2007); Streetheran *et al.* (2004; 2006); Gairola and Noresah (2010)
Singapore	46.5%	20	• Overcoming connectivity issue for urban residents' ease of movement and ecosystem benefits. • Park connector was introduced for well-being.	Yuen (1996); Tan (2004); Briffet et al. (2004): Aldous (2010); Tanuwidjaja (2010)
Bangkok Cambodia Manila	39% - -	5 - -	• Lack of greenspace due to competition with other physical developments. • Lack of awareness that greenspace (roads, parks, gardens and water bodies are part of urban heritage (Symann, 2009)	Rustam (not cited); Regional Plan of Area Arrangement (RTRW); Aldous (2010); Fraser (2002); Kuchelmeister (2000).

The reviews found that green infrastructure developments in many Southeast Asian cities face various challenges in terms of provision and demand for green outdoor recreations. It is expected that due to future population pressures, Southeast Asian cities need to increase their provision of green infrastructure in order to achieve environmental sustainability (Aldous, 2010). Whereas, the studies (e.g. JPBD, 2006; Pitakasari *et al.*, 2010) found that almost all cities in the region (except for Singapore) have inadequate and poor quality greespace, which are associated with poor social conditions, economic and environmental deterioration. One of the obvious threats is green infrastructure has to compete with other physical developments (Zaid et al., 2009; Pitakasari *et al.*, 2010). As a result, existing green infrastructure is constantly under risk of land acquisition, changes and modification. It is often being substituted, sacrificed and imposed to make ways for new developments in favour of development that is seen as more financial priority. For example, one major cause of Jakarta's (Indonesia) environmental degradation is the decline of vast green open spaces. According to the Jakarta's masterplan for 1965-1985, 37% of the city areas were dedicated to greenery and provision of greenspace. However, the target of 37% was subsequently reduced to 26% in the masterplan 1985-2005 (Jakarta General Masterplan, 1985-2005) and again to 14% in the Regional Plan of Area Arrangement (RTRW 2000-2010). By 2010, this targeted

proportion fell to 9.6% or 50km2. The greenspace provision was reduced in the planning development because to make way for the demand of areas to meet residential, commercial and industrial needs of the growing population. To make it worse, the existing green infrastructure is damaged due to functional shift from recreational greenspace to commercial areas (e.g. hotels). Hence, the biggest constraint of greenspace provision and planning are the unbalanced urban policy regarding the city's development (Rustam, not cited). Other significant threats that need attention include low level of awareness and participation of the public in the caring for the greenspace in the cities and towns.

In Malaysia, the planning of green infrastructure is heading in the right direction however it lacks proper planning, implementation and reinforcement (Cheang, 2010). Cities such as Kuala Lumpur and Penang face problems in maintaining a clean, green and healthy environment. In addition, the green infrastructure in the cities is getting smaller and smaller (Zaid *et al.*, 2009). As such, not many existing green areas are left where urban residents can enjoy clean air and participating in recreational activities during weekends. The issues concerning management and implementation of urban green infrastructure include low standards of maintenance, lack of manpower and budget, lack of skill, knowledge, expertise and interest, and lack of awareness and sense of civic mindedness (Adnan, 1998; Mohamamed and Kassim, 1999; Mustafa and Osman, 1999). Many urban places end up with sterile open spaces that are either empty or underused. These spaces may become impressive or monumental spaces that will decline over time. In addition, many established existing and greenspace are not valued as assets or heritage, therefore lose their importance to other physical developments. Their provision is either compromised of, largely being ignored or merely treated and included as leftover spaces (JPBD, 2005; 2006). This too happens in the city such as Phnom Penh (Cambodia). Due to increase in real estate and construction business, the public greenspace in the city is put under pressure whereby it becomes freely available land for construction projects (Symann, 2009).

Lack of awareness and sense of civic mindedness resulted in uncaring attitude that treats urban green infrastructure as a luxury instead of a necessary amenity. For example, urban green infrastructure is perceived as mainly associated with beautification of urban landscape, planting of trees and the addition of landscape features for aesthetic values (Sreetheran *et al.*, 2004, 2006). This is one of the reasons that many city governments all over the world have often cut expenditures for development and management of greenspace to make ways for development that is seen as a financial priority (Tyrväinen and Vaananen, 1998; Nor Akmar *et al.*, 2010). For instance, informal communal greenspace is given up on the presume basis that they are costly to manage. Hence, the reluctance of green infrastructure spending may cause urban environment to be consisting primarily of streets, roads and highways rather than of parks and gardens.

On positive note however, Singapore has successfully implemented a park connector system to overcome the issue on provision and connectivity in the country. In 1997, the greenspace in Singapore was 17.8%, however, today the country owns 46.5% of greenspace despite merely 4.6 million of population (Aldous, 2010). The general aim to to nurture greenery and open space in the country into Singapore's garden infrastructure, to cultivate the country as premier horticulture hub and to ignite the community passion for greenery have made the it successfully in achieving the 'Global City in a Garden'. Thus, the national effort in creating the best environment for residents to live, work and play is paying off. This is owing to good political will, careful planning and strict development control of its government (Tanuwidjaja, 2010).

3.2 Well-being Benefits of Green Infrastructure

Urban green areas contribute to the quality of life and affect livability of towns and cities. Researches in the Southeast Asian countries added to the existing body of knowledge on benefits of green infrastructure. The benefits can be categorized into environmental, social, urban residents' health and economics.

City is known to have impact on environment by its need for energy, transport, water, food and raw material supplies and generates large quantities of waste that need to be disposed of. As a result, ecosystem functions are disrupted and natural resources are used faster than they can be replenished (Tzoulas and James, 2003). From ecological perspectives, green infrastructure allows transport, creates wildlife habitats and reserves land for future urban development and countermeasures of the damaged caused by activities in the city. Studies in urban design and environmental planning disciplines showed that green infrastructure improves the quality of urban environment through provision of access to natural habitats, avoidance of damage to the built form, improvements in ambient environmental quality (e.g. Lilian et al., 2002-Malaysia; Tan, 2004-Singapore). In addition, its contributions extend to the conservation and enhancement of urban habitats, cultural heritage and presents opportunities to demonstrate sustainable management practices (e.g. Osman, 2005-Malaysia; Symann, 2009-Cambodia).

Socially, green infrastructure contributes to urban residents' recreational and leisure needs. Many studies (e.g.Yuen, 1996-Singapore; Fraser, 2002-Thailand) have found that green infrastructure contributes largely to the social inclusion of urban residents. This is because the greenspace is free and available to all residents regardless of their gender, age, social and economic backgrounds. Major green infrastructure in a city enables residents to have access to natural environment, and allow interactions and engagements with nature to take place. Hence, there is more

prospect for healthy lifestyles and opportunities for urban residents to come in contact with nature. As such, high quality greenspace is needed to facilitate more social interaction, healthy activity, personal satisfaction, and opportunity for personal development. As a result, it can also attract frequent visits of urban residents, business and wildlife.

The health benefits of green infrastructure are extremely important. The studies found that urban nature would certainly affect physical and psychological well being of urban residents. Recreational green infrastructure, playfields, tree-lined streets, home gardens, neighbourhood gardens, small pockets spaces and other semi-natural areas in urban environments make a significant difference to physical and psychological well-being of residents living in the cities and town. Physically, it presents a setting for residents to engage in healthy outdoor exercise (Tan, 2004; Yap *et al.*, 2007). Psychologically, it allows urban residents to escape from stressful day to day living to a more relaxing environment. Research shows that, views of nature can reduce physiological and indicators of stress, improve mood, decrease aggressive feelings and promote community bonding (Zaid *et al.*, 2009). For example, community participation in greenspace such as gardening and tree care encourage socialising and contribute to stronger social relations.

The economic benefits of urban greenspace derived from the studies (e.g. Aldous, 2010-Southeast Asian region; Briffett *et al.*, 2004-Singapore) can be summarised into: rise in housing values, creation of employment, environmental improvements, attracting business in an area and investment and attracting tourists. Thus, overall green infrastructure plays a fundamental role in achieving societal, community and public well-being goals for urban sustainability.

3.3The Attributes of Green Infrastructure

Growing contemporary evidences support the views that green infrastructure provide a wide range of benefits to urban ecosystems and its residents. The contributing factors for vast benefits derived from green infrastructure experience are due to the attributes of greenspace. Reviews for this paper have classified the attributes into diversity, naturalness, connectivity, good management (e.g. facilities, maintenance, reinforcement). Hence, Table 2 summarises the studies based on the attributes important for an urban green infrastructure.

Diversity means experience of different types of green infrastructure that owns a range of scale, spaces and landscape features. The attribute affords more choices for urban residents to engage in and become familiar with different greenspace and more experiential choice of activities. A variety of greenspace then attract different people at different times for different purposes, thus makes for a

lively environment. For example, Symann (2009) indicated that in Cambodia, daily activities most often take place in public spaces especially along the streets and sidewalks. These are the spaces where temporary and movable foodstalls are located in which urban residents can mingle and socilise. As such, a variety of such places need to be designed with good maintenance and cleanliness to cater such activities.

Table 2: Green infrastructure's attributes

Authors	Concerns of research	Attributes & definitions
Noorazuan and Ruslan (2003); Symann (2009); Lilian et al. (2004); Gairola and Noresah (2010); Fraser (2002)	• Streets are greenspace that is rich in informal activities such as movable food stalls (e.g. in Cambodia, Indonesia, Malaysia) where most activities and social interaction take place. • Various greenspace enhance experiential contacts in urban, allowing more informal activities and exploration, favourite places, and attachment	**Diversity** Urban areas that comprise of different types of green space, greenery, size and the richness of landscape elements.
Yuen (1996); Sreetheran *et al.* (2004; 2006); JPBD (2005; 2006); Lilian *et al.* (2002); Yap *et al.* (2007); Zaid *et al.* (2009)	• As part of ecosystem services to residents' well-being and sustainability of ecosystems. • The significance of greenspace to user's visual aesthetic, preference and experiential contacts with natural scenes. • Human interactions with greenery and natural features restore from stress and produces positive well-being effects.	**Naturalness** Highly natural urban environment consisting of vegetation, water bodies and other landscape features
Yokohari & Amati (2005); Briffet et al. (2004); Tan (2006); Sreetheran *et al.* (2004; 2006)	• Connectivity counters fragmentation and enables continuity of wildlife habitats, greenspace and greenery. • Nearby nature and wayfinding allow outdoor experiences e.g. for play activities and social cohesion. • Physical and visual connections to spaces enable unbroken continuity of experience; allow wayfinding and orientation.	**Accessibility** Opportunity for movement, physically and visually
Zaid *et al.* (2009); Osman (2005); Pitakasari et al. (2010);	• Framework on the urban landscape management in Malaysia is needed for sustainable landscape management • Unused, derelict and decay and unsafe place need more attention.	**Management** Good facilities, maintenance (e.g. cleanliness) and reinforcement

Green infrastructure that is highly natural consisting of vegetation, water bodies and other landscape features reinforces positive responses of urban residents because this environment is similar to a preferred landscape. In urban design and landscape architecture, vegetation and natural scenes such as water are the attributes of visual amenity that residents often value. In environmental psychology, the concept of naturalness has been linked with evolutionary theories of preferences. Evolution-based theories such as Prospect-Refuge (Appleton, 1975) and Landscape Preference (Kaplan and Kaplan, 1989) posit that people responses to natural environment are so strong and consistent that they suggest that humans have evolved instinctive preferences for a certain type of environment consisting of greenery. Biophilia Hypothesis of Wilson (1984) also states the importance of naturalness as man's biological need to affiliate with nature. A study by Lilian *et al.* (2002) identify that the lack of greenery and greenspace has caused urban pollution, heat island, erosion and flood in urban areas in Malaysia. Therefore, the idea of garden

city planning is suitable whereby naturalness quality become the essence of a city. This concept has been adopted to cities in Malaysia such as Petaling Jaya and Putrajaya. It is aspired to overcome the effects of urban environmental degradation by providing as much greenery as possible that connects as a network. For example, 70% of land uses in Putrajaya are reserved for green infrastructure development (e.g. Botanical garden, Taman Putera Perdana, Taman Alam Rimba and wetlands) so that the area can be developed as a city within luscious gardens. Hence, the quality and composition of greenery and greenspace are necessary attributes that may lead to urban sustainability.

Legibility and accessibility are the opportunity for urban residents' movement, wayfinding and orientation. Legibility is greenspace that is distinctive and ordered in an urban environment. Physical accessibility is the ability to move through an urban environment with ease and visual accessibility is the ability to see as residents experience the urban environment (Carmona *et al.*, 2003). In Putrajaya, Yap *et al.* (2007) found that public buildings' ground is vital because it is a green node as well as a landmark that offers livability, aesthetic quality and preserving the greenery, thus improves environmental health mentally and physically for a community.

Places that are well-designed and cared for make residents feel safer and they tend to use the spaces more. Hence, management of greenspace (such as cleanliness of greenspace, ample facilities and good reinforcement) is vital for any country to ensure good quality green infrastructure is provided to users and in turn to be used properly. Nonetheless, many studies found that this is the most difficult aspect to accomplish because it deals with interrelated issues such as lack of manpower, budget, skill, knowledge, expertise, interest, awareness and sense of civic mindedness.

4.0 Conclusion

The concept of green infrastructure may be new for many countries in the region, the areas of research have gained recognition in the urban public health dimension. In other words, the governments of the region must consider urban residents' health derived from green infrastructure to be of important resources for future urban sustainability. There are also challenges especially on green infrastructure's implementation that need to be addressed in city planning and urban design. The findings of the reviews implicate that accumulation of research can

promote public health of Southeast Asian cities that ultimately lead to environmental sustainability.

Current body of knowledge in the Southeast Asian cities and towns recognises that good quality of urban green infrastructure will enhance the amenity of the city and consequently the quality of life of its residents. Various studies supported the literatures on its contribution to environmental, social, social, health and economic, thus to the well-being of residents and urban ecosystem. However, despite the increasing number of studies documenting the benefits of green infrastructure in urban areas, there are many challenges that the cities must face to become sustainable. Hence, much research is needed to overcome these challenges. Among others are:

1) Cities should aim for an adequate provision of green infrastructure to encourage urban sustainability. Hence, research on identifying an adequate amount of greenspace per capita is needed to sustain urban environmental degradation.

2) Countries in South East Asia are actively encouraging tree-planting campaigns to preserve a green environment in dense cities. Hence, research is needed to explore the results and contributions of the existing 'greening' strategy by the cities. For example, study could be carried out on the effects of implementation of "One Tree, One Malaysia" campaign in Malaysia whereby the government aims to plant 26 million trees by 2014.

3) To study whether the existence of green infrastructure in a city can nurture a community's attitude that appreciates nature and conservation of greenspace. This is because urban residents play their important part in making the provision and conservation of greenspace to be successful.

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