
Sustainable planning through landscaping for pollution mitigation

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Abstract: As Malaysia leapfrogs into being a developed country by the year 2020, the rapid urbanisation and industrial activities are at present increasingly taking place and these may in a long run contribute to significant impact on the environment. Urbanisation although seems as an improvement and proof for an economically strong country, the price that needs to be paid often escalates than the expected to overcome the imbalance of nature. The broad intention of this research is to highlight on the landscaping elements implemented area and the total green to urban development ratio featuring the three case studies, namely Golden Triangle in Kuala Lumpur, Partial Territory of City Centre, Petaling Jaya and Core Island of Putrajaya, all of which are located within the Klang Valley area. Requirements for types of trees or vegetation are part of the mitigation plan and its explains the physical characteristics of the green areas.

Keywords: sustainable planning; pollution mitigation plan; landscaping elements; authorities' requirements; total green to urban development ratio.

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1 Introduction

Urban design draws together the many strands of place-making-environmental responsibility, social equity and economic viability, for example – into the creation of places and beauty and distinct identity (English Partnership – The Housing Corporation; 1998). Urban design is derived but transcends related matters such as planning and transportation policy, architectural design, development economics, landscape and engineering. It draws these and other strands together. In summary, urban design is about creating a vision for an area and then deploying the skills and resources to realise that vision.

A quality landscape and a sense of urbanism can and should go hand in hand. The landscape, development block and movement framework are the three main design elements off an urban project of any scale. Forestry belts can be incorporated into urban areas as part of the landscape structure or as a temporary use for sites awaiting longer-term development (Sashua-Bar, L. 1998). The main issue deriving from the rapid development progress is the sufficiency of the green area to mitigate environmental issues such as air quality within the urban area. Looking at the increasing rate of pollutants coming from the vehicles as well as the air quality which is considered only as moderate, an immediate plan should be implemented before the environment within the city becomes worst.

Global environmental issues have its impact, particularly on developed countries. Kuala Lumpur as such, is a capital city of Malaysia and at present, the rapid urbanisation process within the vicinity has affected the environmental quality. More and more high-rise developments are taking place and less green areas are available in the Klang Valley area. This, in fact can be evidently seen. However, sensing the imbalance of the environment and the threats to the population, the authorities and other state governments are fast preparing new guidelines and regulations; endorsed as a draft structure plan (Department of Statistic, 2003). Environmental policies are being constantly renewed. The emphasis changes because of the realisation that environmental

considerations should be able to control pollution as well as aiming to create more comfortable, pleasant and stimulating surroundings (KLCH, 2003). The same situation is also faced by other states in Malaysia.

Standards on matters such as air quality, water quality and industrial emissions are being determined at a national level. Based on the standards, all states in Malaysia are able to exercise a more direct control over matters on landscape and city as well as carrying out mitigation plans to control the pollution, thus, balancing up the environment quality of the city centre. The draft structure plan which is prepared by the authorities departments has described that implementing a well-balance landscape is the main preventive plan (KLCH, 2003).

2 Environmental impact on the urban areas

2.1 Overview of air pollution within the Klang valley

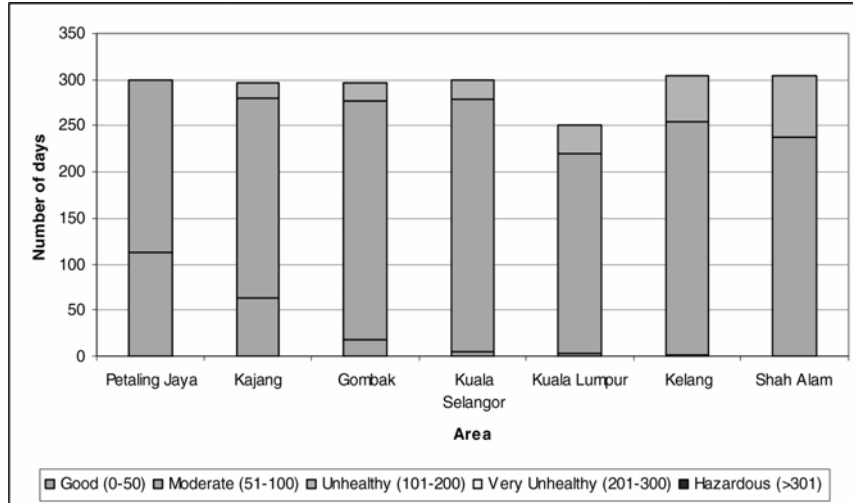
The main approach that will be implemented by the Kuala Lumpur City Hall within the next 16 years will be focused on landscaping aspect as the mitigation approach. As described in the KL Structure Plan, the approach when implemented will transform the city centre area into more comfortable, pleasant and stimulating surroundings which definitely fits the vision and the population (KLCH, 2003). However, from geographical and development point of view, the Klang Valley area is more prone to serious air pollution compared to other parts of the country (Department of Environment, 2002). The main sources of air pollution within the city area are open burning, emission from motor vehicles and construction work, together with a minor contribution from industrial areas located in the fringe of the city (Department of Environment, 2002). Figure 1 illustrates the low air quality results based on the quality monitoring results taken at some locations located within the Klang Valley area. The contamination of air pollutants such as lead concentration in the Kuala Lumpur city is definitely high due to the increasing rate of motor vehicles (see Figure 2). With population more than 1 million people, the Klang Valley area faces high possibility of environmental quality degradation.

2.2 Regulatory approach

Having a balanced nature is becoming important in which instillation of equilibrium landscape within the urban area becomes one of the reputable topics these days. This can be seen from the many guidelines that are being endorsed and regulated by the authorities for instance the Environmental Impact Assessment (EIA), particularly to ensure that the urbanisation process which degrades the environmental quality will be successfully controlled (Paoletto, G. 2003). However, these are more related to the environmental and pollution controls. Detailed requirements for landscape programme and plan are developed by local authorities (MPPJ-Garis Panduan Perlaksanaan, 2003).

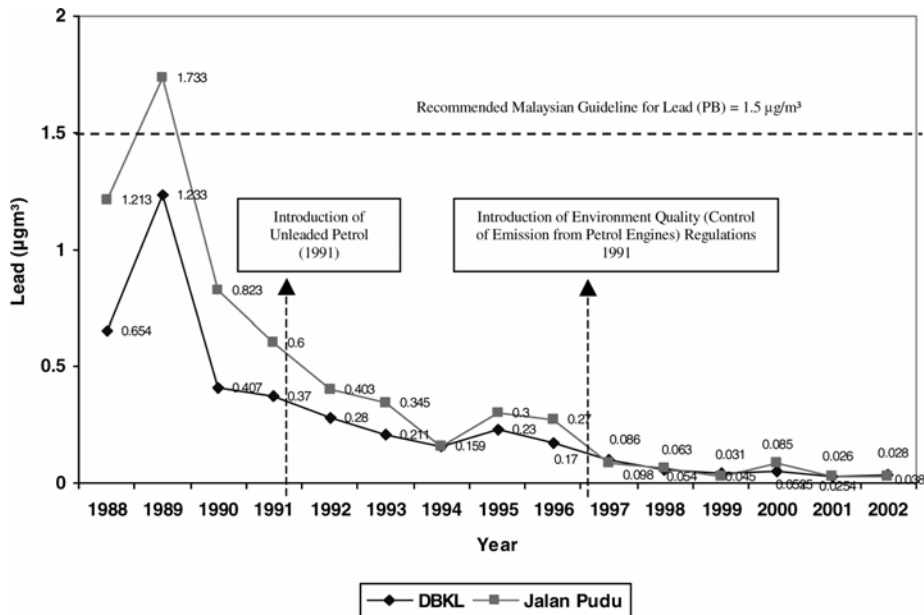
The Kuala Lumpur City Hall, for instance has prepared the Draft Structure Plan Kuala Lumpur 2020 in which one of the main focuses of the structure plan is to implement a more stable environment (KLCH, 2003). The same action plans are also taken by Petaling Jaya Municipal Council (MPPJ) and Putrajaya Council as well as other states in order to outline the basic requirements and landscape policy in order to guide the landscaping programme (MPPJ-Peta Cadangan and Penyertaan Bertulis, 2003).

Figure 1 Air quality in the Klang Valley, 2002



Source: Department of environment (2002).

Figure 2 Ambient lead concentration in the Klang Valley, 2002



Source: Department of Environment (2002).

Precedent research as indicated in the Draft Structure Plan Kuala Lumpur 2020 has indicated that the existing planning guidelines are not comprehensive enough to gauge the impact of development projects on ecology and heritage areas which are considered as environmentally sensitive areas. Guidelines do not stipulate adequate buffer zones between residential areas and potential pollution sources (KLCH, 2003).

2.3 Forms of green areas

Landscaping element is part of the development contents in all states in Malaysia. Landscaping may come in many elements or characteristics (Kumagai, K. 2004). Within the Kuala Lumpur city itself, there are three forest reserves. Other than this, the green areas in the form of golf courses, parks and tree-line roadside are other significant examples of landscape within the urban areas. The landscaping elements in Malaysia can be summarised as more of which are functioning for beautification purpose rather than mitigating the environmental issue.

3 Sustainable urban design and climate

Landscaping is part of the sustainable approach to urban planning and design undertaken with the main purpose to retain or improve the environmental quality. There are two concepts of sustainability. The first concept of sustainability is to exemplify principles of conservation, that is, to survive. The second concept of sustainability is bioregionalism or the concept that all life is on a community basis, that future technology must function within bioregional patterns and scales.

The relationship of urban design and climatic factors can be referred to the following discussions.

- 1 *What city climates do to people:* one of the most issues spoken by most people is to provide a sustainable urban design and climate for people all over the world (Sashua-Bar, L. 1998). In South East Asia as example, climates are quite warm (tropical) but somehow the warming of the urban heat island effect can have adverse effects on health, on energy use and even it seems, on people's behaviour. During hot weather, the city's warmer nights can delay overnight recovery from heat stress. Urban warming affects the city's energy use, reducing the demand for winter space-heating, but increasing for the energy needed for cooling. At times, flash floods caused by greater run off from the city's paved surfaces, result in big financial losses and can be life-threatening.
- 2 *Climate zones for urban design:* since the aim of climate-sensitive urban design is to provide the most comfortable thermal environment possible, the definition of climate zones for urban designers obviously has to be done by considering the climate variables which affect human comfort. These variables are temperature, humidity or water vapour content of the air, heat radiated from the sun and from our surroundings and wind speed. Whether we feel too hot, too cold or 'just right', depends on the combined effect of these five quantities. The heat radiated from the surroundings (terrestrial radiation) and the wind speed can vary considerably over small distances. For simplicity, only temperature and water vapour content of the air (humidity) have been used in the criteria for defining the climate zones.
- 3 *What has climate got to do with urban design?:* climate is only one aspect of planning, yet it can provide answers which are not available any other way. To some extent, cities 'create their own climate'. Studies show that when a landscape of plants and soil gives way to one of the bricks and concrete, the local climate changes along with the scenery. Understanding how this happens

can help us to take control of the process. We can design subdivisions so as to create the best possible urban microclimate (Tietenberg, T. 2003). The result:

- a a more comfortable environment
 - b less energy needed for indoor comfort
 - c money saved
 - d emissions of greenhouse gases reduced.
- 4 *What cities do to local climate:* there is considerable concern about the possibility of world climate change due to the enhance of the greenhouse effect. Scientists have predicted global temperature rises of between 1 and 3.5 degrees Celsius by the year 2100. Yet temperature rises of about the same size have already occurred in some big cities. Particularly at night, cities are usually warmer than their rural surroundings, because of heat stored in bricks and concrete and trapped between close-packed buildings-the so-called urban heat island effect. City wind speeds are lighter, on average and vary from place to place. Wind 'tunnels' and 'hot-spots' occur where winds are channelled down city streets or wash down the faces of tall buildings. By contrast, streets running perpendicular to the wind direction are sheltered, to the extent that pollutants may not disperse. As the city grows, the climate changes intensify.

The discussions above prove that there is a fundamental link between a city's climate and the energy consumed within the urban area for heating and cooling (Sashua-Bar, L. 1998). This explains the reason on why landscape becomes part of the urban planning (i.e.) as an extension for sustainability purpose. Below are some of the advantages of green areas within the urban areas:

- In a hot dry climate, sun protection is essential to provide shade and to minimise the sun glare radiated from the sun. Glare and reflected heat from pale surfaces can be reduced by shading from vegetation. Trees are nature's own evaporative coolers, perfect for the dry climate, if water supply permits.
- The active vehicular movement within the urban areas often contribute to poor air quality. Trees are planted to filter blowing dust from the air (i.e.) minimise air pollution.
- Achieving thermal comfort is important in a warm humid climate. Streets and buildings are oriented to receive natural ventilation. A mix of trees and green areas promote ventilation. However, vegetation must not impede air movement (i.e.) trees with branches far from the ground, such as palms, would be ideal.
- Malaysian climatic condition results in heavy rainfall, so permeable surfaces are needed, to reduce urban stormwater run-off and erosion. Trees and/or vegetation often functions to minimise these impact.
- Trees also provide wind protection during the monsoon season. This can be achieved by designing a tree shelter belts perpendicular to the prevailing wind.

4 Case studies

This study is based on three urban areas, namely, Golden Triangle, Partial Territory of City Centre, Petaling Jaya and Core Island of Putrajaya. The reason why those areas were selected was due to the fact that these areas are those confirmed as urban areas.

Another reason why the selected areas do not cover bigger scale cities or urban areas and segmented to a small scale is to present a centrally focused research, thus enabling research to be done in a short period as it could be easily covered within a day. Table 1 given the detailed background of the urban areas.

Table 1 Detailed background of case study areas

	<i>Items</i>	<i>Case Study 1</i>	<i>Case Study 2</i>	<i>Case Study 3</i>
1	Area/District	Kuala Lumpur	Petaling Jaya	Putrajaya
2	Overall size	243.65 km ²	97.2 km ²	45.81 km ²
3	Area selected	Golden triangle	Partial territory of city centre, Petaling Jaya	Core island
4	Sections	–	Section 52, partial of Sections 14 and 8	Precinct 2, 3, 4 and 18
5	Size of studied areas	200,000.0 m ²	1,578,400.0 m ²	5,869,520.0 m ²
6	Land use			
a.	Major land used	Business and commercial	Business and commercial (Section 52)	Public/Civic and cultural amenities (Precincts 2, 3, 4)
b.	Other components	Residential (High rise condominiums)	Residential (Sections 8 and 14)	Residential (Precinct 18)
7.	Built development percentage	90%	93%	77%

Source: Author's research.

5 Results and Findings

5.1 Landscape and Green Areas

Table 2 summarises the landscape and green areas included within the studied areas. Three aspects were summarised in this table specifically to provide the overview on the types, characteristics and the number of main parks with particular concern on the types of park which are marked as *g(i)*–*g(iv)*. The reason is to emphasise on the major parks that are more functional as an environmental mitigation plan.

With reference to Table 2, it can be concluded that the Core Island, Putrajaya turns out to be the most effective landscape development compared to other two areas selected as case studies. The high number of parks with relation to higher size scale range within the areas confirmed that the landscape plan is directly associated with the intention of minimising as well as mitigating the environmental impact. This proves that careful planning has been practised and environmental impacts are highly being considered during the planning stage, prior to the development implementation stage.

Table 2 Detailed background of case study areas

	<i>Items</i>	<i>Case study 1 golden triangle</i>	<i>Case study 2 partial territory of city centre, petaling jaya</i>	<i>Case study 3 core island</i>
1	Types			
a.	Greenway	–	–	√
b.	Waterway	–	–	–
c.	Meadow	–	–	–
d.	Woodlands/Natural reserves	–	–	–
e.	Playing field	√	√	√
f.	Allotments	–	–	–
g.	Park			
i.	Regional parks and open spaces	–	–	√
ii.	Metropolitan Park	–	–	√
iii.	District Park	–	–	√
iv.	Local Park	√	–	√
v.	Small Local Park & Open Spaces	√	√	√
vi.	Linear Open Spaces	√	√	√
vii.	Urban Forestry	–	–	√
h.	Green - Square	–	–	√
i.	Plaza	√	√	√
j.	Communal garden	√	√	√
k.	Private garden	√	√	√
l.	Playground	√	√	√
m.	Courtyard	√	√	√
n.	Atrium	–	–	–
o.	Creative park life	–	–	√
2	Number of main park	1	–	More than 20
3	Characteristics			
i.	Streetscape and Avenue	√	√	√
ii.	Reserved green area (for transmission line/LRT)	–	√	–
iii.	Sunken mall/urban plaza	√	√	√
iv.	Park	√	√	√
v.	Playing field	√	√	√
vi.	Communal garden	√	√	√
vii.	Boulevard	–	–	√
viii.	Greenways	–	–	√

Source: Author's research.

The characteristic of the green area which is marked as 'three' summarises the overall characteristics of green area that are implemented within the studied areas. Generally, streetscape with tree lined avenues is the most common landscape feature. Elevated garden is commonly found within the Golden Triangle due to land constraint, which as a results foresee more and more condominiums taking place and replacing the housing terrace.

Details of the types and characteristics of green areas within the studied areas are summarised in Table 3.

Table 3 Types of green area and the locations

	<i>Types</i>	<i>Characteristics</i>	<i>Locations</i>
A	Golden Triangle, Kuala Lumpur		
1.	Local park	Public park	KLCC Park
2.	Playing field	Football field	Football field
3.	Communal garden	Residential, commercial, office blocks	Within the area
4.	Roadside landscape	Streets and roads perimeter	Within the area
B	Partial territory of city centre, Petaling Jaya		
1.	Roadside landscape and avenue	Streets and road perimeter	Within the perimeter of studied area
2.	LRT/Transmission Line Reserve Areas	Green area acting as reserved area	Section 52
3.	Sunken mall/urban plaza	Small green areas located in front of business and commercial buildings	Within the perimeter of the studied area
C	Core area, Putrajaya (see below)		

Source: Author's research.

For Putrajaya, the hierarchy of parks within the Green Continuum follow on from the three categories as set out in the Putrajaya Masterplan and Urban Design Guidelines, that of the Metropolitan, Urban and City Park. Figure 4.6 illustrates the landscape plans for the Core Island, Putrajaya. The types and characteristics of the green areas are described as follows:

- 1 *Metropolitan Parks (Taman Puncak)*: the existing vegetated ridges and hills remain as the largest tracts of open space and forms the main components of the desired green lung. Serving the city and greater population, their overall form relates to the natural topography, ensuring their existing vegetation and profiles are conserved as Natural Landmarks. Forestry management regimes will be utilised to regenerate mixed lowland forest species. Activities to draw use are to be mainly passive, but with activities and amenities related the natural environment for example, Arboretum, Hiking, Walking and Nature Trails and adventure play grounds. The Metropolitan Park is located within the studied area as follows:
 - a *Taman Metropolitan Wawasan*, northwest of the Core Area in Precinct 2. Amenities included Walking and Nature Trails, Park Reserve and Information Centre.

- b *Taman Metropolitan Banjaran*, south of Taman Puncak Wawasan and east of the Boulevard, Precinct 3. Amenities such as an Arboretum, hiking and biking trails and Park Reserve.
 - c *Taman Metropolitan Puteri*, west of the boulevard between Dataran Rakyat and Dataran Khazanah, Precinct 4. Generally Parkland Reserve, with sports courts and pitches at fringes to cater for both residents and workers. Status open to reassessment as the immediate vicinity develops and may absorb more development in the future.
 - d *Taman Metropolitan Pancarona*, is located in Precinct 18. Low key park reserve with amenities seen to include outdoor low impact sports such as hiking and walking, with earth environmental art sculptures.
- 2 *Urban Parks (Taman)*: medium size open spaces which have a well-defined shape in-relation to the urban setting generally bridge the waterfront, the Boulevard and Taman Puncak (Metropolitan Parks). They serve the local district as the focal points to the immediate area. They provide amenities which are determined by their immediate land use and therefore have distinctive individual characters.
 - a *Waterfront parks* and related open spaces as follows:
 - i Formal stately gardens, Precinct 2
 - ii Wawasan water garden, Precinct 2
 - iii Persisir warisan, Precinct 2
 - iv Contemplation gardens, precinct 3
 - v Canal walk, Precinct 3
 - vi Sanctuary haven, Precinct 4
 - vii Orchard park, Precinct 4
 - viii Taman rakyat, Precinct 4
 - ix Lake front park, Precinct 4
 - x Taman khazanah and quay, Precinct 4
 - xi Riparian park and beach, Precinct 18
 - a *Taman Budaya dan Seni*, a series of courtyards within Precinct 3 complex, designed with Islamic sensibilities including water features and parterre garden.
 - b *Taman Inang*, adjacent and east of Dataran Khazanah, Precinct 4. A park with seating within shady cool gardens to cater for lunchtime and evening crowds.
 - c *Taman Budi*, a linear park running 1 km underside the proposed elevated rail line, Precinct 3. Amenities include cycling and jogging trails, weekend markets, informal sports pitches, playgrounds and gardens.
- 3 *Boulevards*
 - a *Boulevard North*, formal Boulevard for parades and temporary outdoor exhibitions, running south of Precinct 1.
 - b *Boulevard South*, semi-formal green open space as relief from the built-up surrounds.

4 *Datarans*

- a Dataran Wawasan
- b Dataran Putrajaya
- c Dataran Rakyat
- d Dataran Khazanah.

5 *City Parks and Halaman*: smallest in the hierarchy of public open spaces and serving the immediate area, city parks are essentially resting places and meeting points spatially defined by buildings and accommodated within land use areas outside the open space provision.

City parks adopt a variety of forms including Pocket Parks, Courtyards, Atriums, Bazaars and outdoor cafes which are critical for providing variety in the open space typology. They will include public art works and/or water features to further enrich the city fabric.

Squares and Plazas in front of the buildings along the lateral axis beautify the landmarks and buildings. As subdatarans, they are linked by covered arcades. Just as important a feature as a halaman fronting a headman's house is to a village, so is the subdataran to the building it faces. Thus the treatment of Squares and Plazas would be as seen in the same light – both formal and public.

6 *Greenways (Zone Hijau)*: including streets, heavily vegetated trees zones and Buffer Zones that incorporate footpaths and cycle tracks, they are critical in bridging the open spaces within the Green Continuum. Amenities to be allowed may include fitness stations and jogging trails.5.2 *Total green to development area ratio*

Table 4 summarises the size of development area as well as the green area with the main concern on determining the total green to development area ratio. The sizes for total development area and green area are stated for each studied area. Percentage of the green area for each case study is also given in the following table.

Table 4 Total green to development area ratio

<i>Items</i>	<i>Case study 1 golden triangle, Kuala Lumpur</i>	<i>Case study 2 partial territory of city centre, Petaling Jaya</i>	<i>Case study 3 core area – section 2, 3, 4 and 18, Putrajaya</i>
1 Total development area	200,000.0 m ²	1,578,400.0 m ²	5,869,520.0 m ²
2 Total size of green area	20,000.0 m ²	94,704.0 m ²	1,347,762.2 m ²
3 Percentage of green area to development area	10%	6%	23%
4 Ratio	1: 10.00	1: 16.67	1: 4.35

Source: Author's research.

Percentage of green to development area for each case study was given by the authorities. The green to development area ratio therefore was calculated based on the given green area percentage. Comparatively, the Partial Territory of City Centre, Petaling

Jaya is the lowest green to development area ratio (1 : 16.67) while Core Island, Putrajaya provides the highest ratio (1 : 4.35). The Golden Triangle area provides the green to development ratio as per the standard requirement imposed in Malaysia.

Overall, it can be generally concluded that the Putrajaya Council has successfully implemented the landscape programme with regards to the environmental impact, which is proven from the calculated ratio. As for the Golden Triangle area, although CHKL achieves the targeted ratio, taking the environmental impact and current condition within the area as well as the types and characteristics of the green areas, the percentage and the ratio are considered as not sufficient. As a result to this, the landscape programme implemented can be considered as not taking deep considerations on the actual condition of the environment within the Golden Triangle area.

5.3 Adequacy of green areas to district/area size ratio

The findings derived from this question are summarised as the following description:

- 1 All developments within the Putrajaya are compulsorily need to be complied with the Urban Design Guidelines which are the basic guidelines prepared for Putrajaya Development. As a result to this, environmental control can be practiced and mitigation plan can be carried out effectively through landscaping programme.
- 2 Landscape guidelines and requirements are not following annual readings on the Air Pollution Index as well as any environmental standards. However, the occurrence of haze annually within the Klang Valley area has raised concerns on the landscape planning especially within the Kuala Lumpur area and therefore the Landscape Department of CHKL is working out on stricter guidelines to ensure that landscape plays a major part in balancing the air pollution within the area.
- 3 Involvement of the Federal Government covers only general guidelines and therefore detailed guidelines/requirements are requiring further initiative by the State or local authorities to plan and implement them.

The current practice in Malaysia confirms enforcement of a 10% of green area from the overall development percentage. This explains on why each new development was required to comply with the authorities' requirements by allocating at least 10% of green areas from the overall plinth area. With reference to Table 4, only Putrajaya allocates the green area up to 38%, which is more than the required standard (10%). It is noted that the standard requirement for the allocation of green area is only 10% but the vast difference of the green area percentage in Putrajaya was due to the development planning as specified in the Urban Design Guidelines.

5.4 Effectiveness of existing landscape in controlling the air pollution threats

Based on the findings, it can be summarised that only Putrajaya is above the par level of the 10% of green area to total development percentage, confirming the effectiveness of the landscaping plan within the area in controlling the air pollution threats. This could be related that the Putrajaya area is a modern and well-planned township which is developed in accordance to an integrated development concept that blends well with the existing environment.

It is known that Petaling Jaya area is the first satellite township within the Klang Valley and therefore the planning requirement was too backdated and as the area now is densely populated and congested, actions are taken by the authority to rectify the problems. Although the Golden Triangle area is the most highly populated and congested area, continuous landscaping implementation in achieving a balance environment is being carried out. In addition to this, KLCC Park is the main landscape in this area and functions as the main contributing source in balancing the surrounding environment.

6 Conclusion

The sustainable urban design and climate issue stated here is only part of the ideas and programme done by environmental designers in order to provide a healthy and sustainable living for people all around the world. Topics on sustainable architecture are variable and very wide – energy conservation, pollution, natural building material such as earth and straw-bale, solar energy and lots more are part of the programme of sustainable architecture. Designers and architects as well as other people should be aware of the changes on earth as this will help us to understand more on sustainable living or sustainable architecture.

The findings of the analysis conducted confirms that only Core Island of Putrajaya exceeds the standard requirements for landscape compared to the Partial Territory of City Centre, Petaling Jaya and the Golden Triangle, Kuala Lumpur. However, comparatively, the green area in Golden Triangle still fulfils the requirement compared to the studied area for Petaling Jaya. In terms of implementation of landscaping work programmes, it can be concluded that the Putrajaya Council is far ahead of implementing effective landscape programme specific to mitigate the environmental impacts compared to other two case study areas. However, it should be noted down that Putrajaya is a new developed area and at present state, the area is not highly populated or dense and the environmental impacts are not as intense as what occurred in Petaling Jaya and Golden Triangle.

Currently, Putrajaya Council practises no specific requirements on landscape guidelines in ensuring that the physical characteristics of the surrounding area and the environmental implications. Generally, it can be concluded that not much effort has been taken to ensure that a balance environment is achieved. The integrated landscape concept is merely a general concept; an elaborated programme on these initiatives has to be collaborated between the public and private sectors.

It is recommended that a research on mitigation plan through landscaping programme to be undertaken on other municipalities. It is also necessary to provide a detailed landscape plan and programme before executing excessive development as part of the urbanisation process.

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