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Sustainable Residential Landscape and Practices in Klang Valley

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ABSTRACT

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The concept of sustainable development is now being used as a paradigm in the housing development all over the world. In the case of the Klang Valley (encompassing Kuala Lumpur and its conurbations), one of the area in Malaysia that has a high economic growth and social development, led to increase population and large-scale residential development. Thus, the residential landscape is the main concern because it can create a comfortable residential environment and improve the quality of life to the residents. The developers are willing to invest large amounts of money in residential landscape development. The aim of this paper is to investigating sustainable landscape practices applied for residential estates in the Klang Valley in an effort to creating sustainable residential landscape. The study is divided into two parts. The first part is to identify the principles of sustainable residential landscapes based on literature review on aspects of sustainable human settlements and sustainable landscape in ecological dimension. The second part is to evaluation and comparison of sustainability for two cases of residential estates which has claimed itself as practice of sustainable landscape in the housing markets. Studies revealed that only residential area of outstanding achieved sustainable landscape and exhibited many positive approaches are used in creating a good ecological environment. Therefore, these findings suggest for creating and enhancing a sustainable residential landscape or more ecological environment while improve a high quality of life for the residents, it requires compliance all of sustainable landscape practices which is start during design phase to acceptance phase.

Keywords: Sustainability, sustainable residential landscape practices, evaluation and comparison

INTRODUCTION

'Sustainable' is a term widely used starting in 1987 after the Brundtland report published (United Nations 1993). In short, it is an approach to produce a development action that may be taken at the global and local level on aspects of preservation and conservation of natural resources for present and future generations. In the context of landscape architecture, the term 'sustainable' has actually been so long used since the 1960's. This is evident from the book "Design with Nature" (1969) by landscape architects, Ian L. McHarg. He wrote that the different scale greenery system may bring a comfortable living environment and healthy micro-climate to the whole world. His writings have been an important source of reference material by the landscape architects and other professional fields such as engineering, architecture, geology, and planners in their efforts to implement the concept of sustainability development especially in within human settlement (Carew-Reid et al. 2013).

LITERATURE REVIEW

Generally, sustainability can be divided into two concepts: technological sustainability and ecological sustainability (Orr 1992). In the context of human settlement habitat, the application of ecological sustainability is very important because this concept is perpetually maintaining the carrying capacity of surrounding ecosystem (Thayer 1994). If development activities exceed this capacity, it

will cause the negative impacts on environment such as an increase of urban heat island (Adeb Qaid et al. 2016; Connor et al. 2013; Herzele & Wiedemann, 2013), pollution of water, air, and noise (Hammer et al. 2014; Moughtin & Shirley, 2005; Jiangou 2006), an increase in surface runoff due to *the addition of paved surface* (Li et al. 2013) and the loss of biodiversity (Sushinsky 2013; Pickett et al. 2001; Li et al. 2013). The net effect is to deterioration of the quality of life of human communities especially in urban community areas (Grahn & Stigsdotter 2011; Jansson et al., 2013). Today the building consumes up to 1/3 of the world's resources, emit 40% of the global greenhouse gasses, use up 12% of its freshwater, and generate 40% of its solid waste (greenpages 2011). However, people have realized this matter and aspect of preservation and conservation on environmental particularly in the human settlement is very important. They start desire for finding residential areas which would provide a high coverage of green spaces and attractive landscape as an act of 'back to nature'. This environment can affect many aspects of the quality of life such as well-being and comfort. Effect of this trend, developers seem to 'competing' each other to attract more buyers to purchase their residential projects with to claim itself based on the concept of sustainable residential landscape. This marketing strategy is a good effort because it can restore the natural landscape to the residential community.

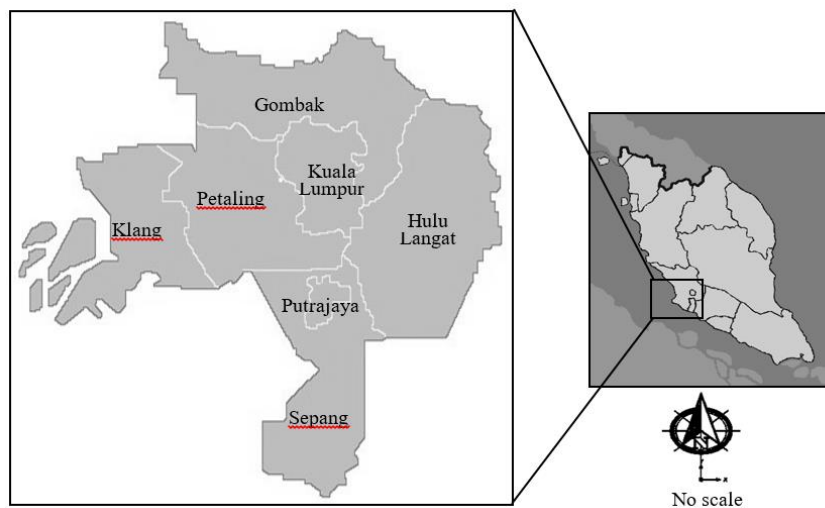
However, in the context of current landscape architecture in the residential area, landscape practice is contrary to the practice of sustainable landscape architecture. The practice is dominated by man-made landscape than a natural landscape. The man-made landscape does not have the natural cycle, maximum use of exotic species, requires the use of large amounts of water, increase cost including maintenance, pesticides, chemical fertilizers and labour (Hough 1984). Without realizing human has changed the structure and function of landscape as a significant source in their lives to the liability burden that requires a lot of financial allocations (Lyle 1999). The lawn area for example is one of the man-made landscape that requires a lot of expense liabilities. Lawn mowing in half an hour per gas power is equal to the amount of pollution generated from the car driven as far as 265 kilometres (Brandum 1994). The type of this landscape not only involves high energy consumption but has little value ecosystems and no function to humans or the environment (Wilson 2010). This occurred because there is a lack of detailed instructions particularly for residential landscape works of large residential estates. It requires understanding and formulates several principles of sustainability that can be identified from the literature review on aspects of sustainable human settlements and sustainable landscaping.

PROBLEMS FROM PRACTICE IN KLANG VALLEY

Klang Valley which is located on the central west coast of Peninsular Malaysia officially has no clear boundary region. However, this area is considered to include the Federal Territory of Kuala Lumpur, Federal Territory of Putra Jaya and its neighbourhood regions are mainly located in the Petaling Selangor (Shah Alam, Petaling Jaya and Subang Jaya), Klang, Gombak (Selayang), Hulu Langat (Ampang Jaya and Kajang) and parts of Sepang (Figure 1) (Majlis Bandaraya Shah Alam 2007). From the 1970's to the 1988's, the total coverage area of natural landscape in the Klang Valley is wide of 23 787.8314 ha because of urbanization under the control. However, in the period between 1988 and 1998, the Klang Valley had begun to decline an eco-urban environment by experiencing the loss of green space of 79 574.2313 ha (BKWPLK 2001). The areas of forest and other natural vegetation were to be converted into residential development, industry, recreation zones, institution and commercial. The increase in population density from 3983.8 million in 2000 to 5627.4 million for the year 2010 is seen as the main factors that influence these changes in land use (Katiman Rostam et al. 2010). At the same time, because of the high population density, traffic jams and poor air quality in the urban residential, an urban community began to realize the importance of landscape preservation and restoration of the environment, thus causing on trends of settlement planning in the Klang Valley has changed.

Now, the community has shifted their preference residential areas to one that promotes quality of life, comfort and welfare. Therefore, to meet the needs of this trend, the developer has changed from that of conventional design to the concept of sustainable residential environment (the era of the

mid 1990's to the 2000's and beyond) (Ahmad Sanusi 2005). This includes the exploiting innovative landscape design (preservation of natural topography, sustainable open space network and optimum the layout) and changing lifestyle choices (open space network neighbourhood living and 'cul-de-sac' versus grid-iron-road pattern). The property sector is no longer seen as providing shelter to the urban population but has evolved into a highly profitable economic sector for the developer. More particularly luxury residential developed in various places based on the concept of sustainability practices. Generally, sustainable residential development will continue to be emphasis between policy makers and pioneers built the environment of the 21st century and beyond (Liu 2001; Jiu 2001).



Source: MBSA, 2007

Figure 1: Location of Klang Valley and its neighbourhood region

Even with the concept of sustainable landscape with emphasis on large green spaces, most residential landscape suffers in a low biodiversity. This is because focused on the aesthetic aspects that promote non-indigenous plants and a high coverage of turf areas. The concept of "how it looks" rather than "how it functions" has dominated the current residential planning and design (Mustafa Kamal & Shamsul 2006). In addition, it also experiencing the high of runoff, the use of porous material, high energy and high resource consumption including labour input, watering, pruning, fertilizing and pest control. These problems are becoming more and more exacerbated by the development process involves a site is reclaimed land, cutting hills and deforestation as well as not consider continuity with the nearest land use. Indirectly, it shows that the current philosophy of landscape design is contrary to the practice of sustainable landscape architecture.

This situation occurs because Malaysia does not have a specific landscape framework to guide related to the application of sustainable landscape architecture into the planning and design of the residential environment. Although at present, there is a number of the framework have been developed from other countries such as the Sustainable Site Initiatives (SITES) and Canada Mortgage and Housing Corporation for assessing landscape sustainability in residential areas but it cannot be directly used due to the factors of differences in climate, geography and sustainability agenda. Until now, the instruments used in relating with planning and designing residential landscapes are only in the form of guidelines such as National Landscape Guidelines and Planning Guidelines for Housing. Both these guidelines focus on policies and standards in general and not specific to creating sustainable landscapes. Eventually this creates a problem which saw more developers will continue to apply the concept in the development of urban residential landscape for attracting consumers. As a result, the concept of sustainable landscape planning and design carried out in the urban residence landscape is not in the sense based on the principles of the sustainable landscape.

METHODOLOGY

Data set

The selection of two case study* sites was based on the following criteria, namely, the housing projects which is adapting sustainable landscape practices in landscape planning and design developed starting in the mid-1990s and has won several awards for their efforts and commitment to providing quality landscaping to inhabitants. Both the locations of case study are in the Klang Valley, which case study 1 in Kajang district and Shah Alam district is for case study 2.

Data evaluation and comparison

In this study, a comparison of two housing projects is not intended to look for deficiencies or weaknesses in their planning and design instead of to identify approaches to priority and is often practiced producing an integrated landscape design with nature (landscape sustainability) in context of the urban landscape. Hence, this could be a reference or a guide towards the practice of sustainable residential landscape, particularly in the Klang Valley. This two-case study site is to evaluate and compare of their sustainability for which has claimed itself as the practice of sustainable landscape in the housing markets using thirteen principles (parameter) of the sustainable residential landscape. These principles of sustainable residential landscapes based on the empirical study which is from literature review on aspects of sustainable human settlements in urban areas by focusing on ecology dimensions (e.g. green spaces, plants, air and water quality, habitats, etc.). This includes the theory of sustainable urban development and communities, sustainable development, sustainable neighbourhoods, sustainable planning, and building sites and sustainable landscape. The findings related to sustainability theoretical research, there are thirteen principles (parameters) of sustainable residential landscape identified are:

1. Consideration of the ecological environment

Consider the design stage of ecological development which to avoid any development on the biogenic environment such as habitat area, watershed, agricultural or forest reserve. Thus, it will be able to maintain and enhance a healthy settlement which is filled with natural resources. This parameter should be a condition of 'prerequisite' for the applicability as it can create the level of impact and implementation of high sustainable residential landscape in the future.

2. Creating or continuity of green space

This including parks, pocket parks, privacy courtyard, landscape reserves, water bodies and urban forest. In the residential estate in surrounded by rapid urbanization, apart for the 'environmental services', the planning and design of a patch of green space that connects between interior or exterior sites by corridors or green belt are also important in improving health and enhancing well-being residents and their interaction with the environment.

3. Protection or increasing of biodiversity

Protection or increasing of biodiversity and creating of aquatic or terrestrial biotope in the micro eco-environment (urban residential) can be implemented without disrupting the habitat patches of vegetation and wildlife communities. Patches of habitat in the composition, large size and ensure the continuity between the internal filling the community with a patch near the corridors of habitat will be able to produce harmony, and the parameters of healthy life in urban areas.

4. The relationship between landscape and building

This relationship includes building layout, the location and orientation according to the wind, the sun, hydrology, soils, topography, water bodies and vegetation patches need to be implemented during the early stages of planning and design of residential gardens. As well as the parameters that consider to the ecological environment aspect, it not only helps creating a healthy settlement space, harmony and not conflict with the natural environment but also significantly protect natural assets.

5. Applying indigenous plants

The use of local or indigenous plants, adapt to local climate or 'drought-resistant plants' and controlling or removing exotic plants not only sustain the virgin environment, natural setting and offers good bio-diversity models to learn from it but effectively with need no maintenance costs, fertilizing, use labour, money save and increase soil fertility.

6. Preservation trees

Preservation and conservation of trees species by selecting from shading species, shady canopy and dense texture can lower the ambient temperature by several degrees and lead to comfort and cheerful to the residents. In addition, tree placement also creates a positive influence on personality which connects residents and expressed their responsibilities towards the environment.

7. Use of Hedges

The use of hedges not only function to control the wind, noise, and filter suspended particles, but it could be a boundary marker and as ecological corridors in maintaining continuity of habitat networks for wildlife such as birds, butterflies, insects and so on. Use widely of this parameter in residential environment can create equilibrium with the environment and avoid the visual environment dominated by manmade.

8. Landscape water efficiency

Landscape water efficiency can be applied through rainwater collection systems that used for landscape irrigation, recycled water through the rooting system of aquatic plants and 'xeriscape' approach. Residential estates in urban areas especially in the Klang Valley which is experiencing rapid population and indirectly water use is non-efficiency, thus, this parameters practice is very significant in an effort toward water savings.

9. Landscape energy efficiency

Landscape energy efficiency can be applied using the species of shade trees, placed large trees in strategic places close to the house to shade the west facing room from the late afternoon sun but in such a way that natural lights is not kept out the house, the use of elements of trellis, pergola, and green wall, and the water body areas, green roofs and courtyard. Use of this widely approach in the urban residential, which are regularly exposed to the effects of the urban heat island not only can reduce the energy costs in the long term but at the same time create a healthy residential environment.

10. Storm water management design

This design uses bio-retention plants, bio-swale plants or bio-infiltration. It is an approach of managing the runoff of water treatment, filtration and infiltration of water into the soil naturally. Although this approach has not been widely used in Malaysia because of limited information about its effectiveness, but it should be introduced and encouraged its use especially in the urban residential. Stormwater management design has diverse functions such as able to limit runoff, prevent erosion, flooding, water pollution, prevent damage habitat aquatic and can also reduce the cost of infrastructure installation.

11. Green innovation

Characteristics of green innovation and green technologies is method to reduce heat with using solar photovoltaic panels, the materials 'zero' ozone (ODP) or porous materials with natural colours such as concrete pavements, asphalt, biobrick and so on. However, this parameter is more suitable for the type of low-rise housing such as detached, semi-detached, terrace or apartment (not more than five or six floors). This parameter is very potential to be expanded and promoted its use in the creating of environmentally sustainable residential.

12. Applying of 3'R' practices

Applying of three 'R practices' of the landscape on site amenity structures during site clearing activities, use composting and use of local natural materials is an efficient way to reduce the environmental impact resulting from the manufacture and disposal of materials. It is also popular used

practice in the construction of residential projects in Malaysia at present because it able to reduce the cost of construction and landscape maintenance.

13. Landscape maintenance efficiency

Landscape maintenance efficiency through mulching or composting, biological control, IPM, drip irrigation, micro-jet sprinkler and rain sensor or the infrared sensor are combination of pest management techniques and conservation of water resources more effective, economical and more environmentally friendly. Although this parameter is still not widely used in residential of Klang Valley but it should be encouraged to enable help to create a healthy environment to the residents.

RESULTS AND DISCUSSIONS

Consideration of the ecological environment

Case study 1

The site of case study 1 has been developed from a former rubber plantation area of Kelton Estate which covered with a rich variety of flora and fauna resources. During the development process, it is not practice of conventional construction, otherwise focuses on the preservation and conservation of the natural landscape of the site which nearly 70% are retained including the existing species habitat, terrains, trees and wetlands. Besides fulfilling recreational needs, the wetlands also provide a diversity of habitats for frogs, toads, iguanas and tortoises. Thus the residential has shown a high level of performance in ensuring continued to growth of ecological in human settlement.

Case study 2

This residential shows excellent effort in attempt to apply sustainable practices by not choosing a site that has a high landscape of natural habitat areas and natural resources instead to take the site 'brown field' and has existing infrastructure. However, the residential is still not showing sufficient natural landscaping because the site factors and limitations of the design concept. Use of forest trees, natural landscape design may help improve the landscape in this area.

Creating or continuity of green space

Case study 1

Case study 1 has 25% green space which is exceeded the requirement of 10% by the national greenery-rate standard. Although the residential development has a high coverage of green space around the edge of the site, but its border separated with outer areas by 3 m high brick-faced perimeter wall intended to protect the security and privacy. This leads to prevents from spreading and the transition ecotone. However, the residential is committed to planning and designing this space to ensure it is integrated and coherent with the natural landscape. Linkages' in the development are provided by roads, avenues, pedestrian walkways and trails. Conservation of biogenic components include patches of natural landscape, the diversity of native plant, a combination of trees and shrubs, topography and the water bodies as well as a comfortable outdoor space is a major focus in the design of it green space. This ensures that the structure of green space not only to the importance of decoration, but can function in providing ecosystem services to residents

Case study 2

As case study 1, case 2 has no green space design continuity with the external space due to barrier enclosures and lack nearest green land availability. In total, the provision of 9% green spaces is slightly short of the requirement of 10 % of the total acreage. Not only is the actual provision less than 10% requirement, the concept of residential landscape more towards the 'artificial' from the create of the natural landscape. Overall residential landscape design that dominated by turf grass, lack the composition of variety plant, mostly decorative features and not focus to creating of space (structure) and function of the landscape has led to suffer of low ecological communities living.

Protection or increasing of biodiversity

Case study 1

Case study 1 has a patch of primer high biotope which combined with the composition of the existing layers of plants and they are left to expanding. The use of local water bodies with aquatic plants in Clubhouse Area is to create more ecological environment and thus can enhance biodiversity

Case study 2

Meanwhile case study 2 is more emphasis on the visual landscape design and there are no efforts to maintain or improve the existence of biological diversity in this residential.



Figure 2: A patch of primer high biotope which combined with the composition of the existing layers of shrub plants in case study 1 (left) and in case study 2 (right) more emphasis on the visual landscape design which use a combination of exotic shrubs.

The relationship between landscape and building

Case study 1

This case still uses the practice of land levelling but it as possible to maximised the conservation of the sanctuary with minimum change to the undulating land, conservation of water bodies, enhance indigenous vegetation communities and fauna habitat. The building structures have been architecturally planned and designed according to environmental characteristics that follow the direction of the wind, facing north-south, cluster layout and the barrier height of the building not more than three levels to ensure that the visual direction of the natural landscape setting is not block.

Case study 2

Even though the site of case study 2 is from quarry sites with scarce natural vegetation but it is reclaimed to create pretty landscape with the natural topography of undulating and sloping flat, soil recovery and consider the site surrounding landscape. However, restructuring the landscaping is not based on the selection of the native plants species in which the use of more exotic species.

Applying indigenous plants

Case study 1

The approach of case 1 that conserve and enhance of native trees and shrubs species, not only to save on maintenance costs (including energy, materials and labour), but significantly help improve the reliability of biodiversity and resilience of life and thus create in diversity of wildlife for the benefit of the functions of residents and the environment.

Case study 2

Even though at case 2 has the implementation effort of planting tree species but it is more focused on exotic species. Similarly, the lack of composition of planting shrubs and use more exotic species. This parameter is among the most important in the create effort of landscaping that has structure and function to humans, the environment and it able to show the unique character of a residential park.

Preservation trees

Case study 1

Preservation of trees in case study 1 is high due to the advantages of the original site covered by trees or mature forest. The residential site is from a former rubber plantation where a total of 3000 species of rubber trees (*Hevea brasiliensis*) is retained. Apart from the rubber tree, the residential is also maintained and replanted about 70% other species of forest trees and palms such as Trumpet Tree (*Tabebuia pallida*), Fistail Palm (*Caryota mitis*), Pokok Cucur Atap (*Baeckia fructocosa*), Fern Tree (*Cyathea latebrosa*) and Crinum spp.

Case study 2

Case study 2 also committed to preserve and improve of trees even though it implementation effort at moderate level. This may be due to significant public awareness about the value of trees that can provide various functions. More over in any development project, the developer must comply with under the Town and Country Planning Act 1978 which requires the maintenance of all trees over 80 cm in diameter.



Figure 3: Preserving of mature trees in residential areas in case study 1 (left) and using a combination of native plant species diversity in case study 2 (right).

Use of Hedges

Case study 1

The use of hedges at case study 1 not only acts as enclosures but at the same time are used for wildlife movement from one patch to another patch, and thus enhance their colony dispersion. Furthermore, the use of this approach can create a more harmonious living environment and integrated with the environment. The residential also use mature trees planted along the road and within dense planting to create an external space ambient moisture, help to absorb the amount of suspended particles in the air and produce oxygen.

Case study 2

As in case 1, the majority of enclosures in case study 2 also use the hedges that can not only create a greener home environment and avoid the domination of man-made elements but to facilitate the movement of wildlife habitat.



Figure 4: The mature trees planted along the road in cases study 1 (left) and in case study 2 uses exotic plants as hedges (right).

Landscape water efficiency

Case study 1

Do not use it

Case study 2

Do not use it

Landscape energy efficiency

Case study 1

Case study 1 practice the use of water elements through the construction of two ponds in which one of them built in the middle of the site (use as recreational centre for residents). Impact of diversity of planting trees and dense forest canopy with combined in clusters planting near the building structures were increase cold ambient environment in this residential area.

Case study 2

Case study 2 should be able to reduce the hot micro-climates environment because it has a lake in the middle of the residential sites. But due to the selection of tree species that are not give shading and lack of planting shrubs in clusters near the home structure cause the environment is still hot. Obviously the residential landscape dominated for please residents on visual level, symbols and decorations.

Storm water management design

Case study 1

Not applicable

Case study 2

Not applicable

Green innovation

Case study 1

Using a combination of porous materials from concrete pavement-related ('permeable interlocking concrete pavement') in almost all pedestrian circulation areas and grass-crete in courtyard could indirectly reduce the heat of the environment temperature.

Case study 2

Using a combination of porous materials from concrete pavement-related ('permeable interlocking Concrete Pavement '), limestone tiles, and 'grass-crete' in almost all pedestrian circulation areas and pocket sites to reduce the heat of the environment temperature.

Applying of 3'R' practices

Case study 1

The use of local natural materials is also practiced in case study 1. Most of the landscape amenities such as gazebo, benches, bridges and trellis dominated by non-stained timbers were not treated with anti-fungal solution. It aims to protect the environment. However, efforts to use natural materials to the landscape elements in the green spaces or courtyard are only for a part of the area.

Case study 2

Approach 3'R' at a high level. In case study 2, it can accumulate a total of seven million tons of granite rocks in which development activities were partially sold and partially re-used. Rocks are then used to stabilize slopes waterways, drainage channels, high walls and build the soil various landscape amenities.

Landscape maintenance efficiency

Case study 1

To help control moisture loss through evaporation from soil surface and to increase the organic content of the soil, they used coconut peat, and shredded bark as organic mulching and dry grass. However, the application of this method is not whole and only a number of areas.

Case study 2

Do not practice it

CONCLUSIONS

From evaluation and comparison of two case studies in the Klang Valley residential area, the study found some of the principles of sustainable landscape that has been practiced in order to create a more sustainable residential area. This includes consideration of ecological environment, a high coverage of green spaces, relationship between landscape and building and maximizing the use of the trees species. However, there are principles of sustainable landscape as practiced at a low level or simply not practiced such as the use of indigenous plant species, increase biodiversity, landscape energy efficiency, landscape water efficiency, low maintenance, recycling material, green innovations and storm water management. The concept of sustainable landscaping as claimed by the developer to attract buyers, in fact, use only partially principles of sustainable landscaping in residential areas. They are more focused on the provision of a huge green area, while other principles of sustainable landscape are negligible. Therefore, the level of implementation sustainable residential landscape principles in two case studies in the Klang Valley has achieved medium progress. In order to achieve greater success in the future residential landscape development, there are three things to note. Firstly, consider aspects about the energy input, labour input and waste output. The second is to protect and enhance indigenous or local plant species because the species is not only able to save costs but increase the biodiversity and lead to a natural eco-model of residential environment. Thirdly is ensure that planning and design landscape in natural setting because through this way, they can bring people to near the environment and thus strengthen the interaction between people and landscape. Toward a more sustainable residential environment, sustainable landscape concept should be studied and applied thoroughly from the design phase to acceptance phase.

**The name of case study sites may not be published because the author is committed to keep all project-related information (client name, project name, etc.) as confidential.*

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