Pertanika J. Soc. Sci. & Hum. 31 (2): 561 - 584 (2023)

PERTANIKA JOURNALS

SOCIAL SCIENCES & HUMANITIES

Journal homepage: http://www.pertanika.upm.edu.my/

Review Article

A Review of Policies and Regulations of Green Infrastructure Establishment in Kuala Lumpur, Malaysia

Owen Thian Seng Yeo[1]*, Mohd Johari Mohd Yusof[1], Sreetheran Maruthaveeran[1], Kei Saito[2] and Junainah Abu Kasim[3]

[1]*Department of Landscape Architecture, Faculty of Design & Architecture, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia*
[2]*Faculty of Urban Life Studies, Tokyo City University, 158-8557, Tokyo, Japan*
[3]*City Planning Department, Kuala Lumpur City Hall, 50350 Kuala Lumpur, Malaysia*

ABSTRACT

Kuala Lumpur (KL), a capital city of Malaysia has experienced significant development that has led to the fragmentation of urban green spaces. Even though green infrastructure (GI) may address the problem of green space fragmentation, there is a notable gap in the extent to which the existing policies and regulations support the development of GI in KL. Hence, a set of policies and regulations pertaining to GI patch and corridor establishment in KL is reviewed in this study. In total, 77 documents related to policies and regulations that might contribute to GI establishment spatially were studied using thematic analysis. Next, the identified GI elements were themed together based on policies and regulations. The outcomes revealed that most policies and regulations focused on patches with 15 categories, followed by corridors (three categories) and components (one category). A typology of Malaysia's GI from the policies and regulations is prescribed in this study. The reported findings may catalyse GI planning and establishment in KL for a more sustainable future.

Keywords: Corridor, green infrastructure, green network, green space, Kuala Lumpur, open space, planning

ARTICLE INFO

Article history:
Received: 22 December 2021
Accepted: 04 October 2022
Published: 05 May 2023

DOI: https://doi.org/10.47836/pjssh.31.2.06

E-mail addresses:
owenyeo@upm.edu.my (Owen Thian Seng Yeo)
m_johari@upm.edu.my (Mohd Johari Mohd Yusof)
sreetheran@upm.edu.my (Sreetheran Maruthaveeran)
saitok@tcu.ac.jp (Kei Saito)
junainahabukasim@dbkl.gov.my (Junainah Abu Kasim)
*Corresponding author

INTRODUCTION

The world population is expected to hit 8.6 billion by 2030, increase to 9.8 billion

ISSN: 0128-7702
e-ISSN: 2231-8534

by 2050, and reach 11.2 billion by 2100 (United Nations, 2017). By 2050, cities are projected to hold around 70% of the world's population. As this massive population uses 90 billion tons of raw materials annually, the destruction of natural ecosystems and green space can cause the loss of biodiversity (United Nations, 2019). Hence, protecting these natural resources, including green spaces, is crucial.

The 3rd National Physical Plan of Malaysia stipulated that the population in Malaysia would reach 33.8 million people in 2020 and exceed 41.5 million in 2040 (Federal Department of Town and Country Planning, 2016). Referring to PLAN Malaysia 2014, 1,251.79 ha of green and open spaces were short in supply across KL (Danjaji & Ariffin, 2017). Kanniah and Ho (2017) asserted that spatial trends in KL were affected by rapid urban growth, while the master planning strategies caused the fragmentation of green space areas to have less connectivity and shape complexity. It stemmed from poor coordination and monitoring of green space conservation in the Kuala Lumpur Structure Plan 2020 (KLSP 2020) (Nor et al., 2017).

As pointed out by Kanniah (2017), Kuala Lumpur City Hall (KLCH) has made several attempts to increase urban green cover in KL by increasing the overall green coverage (from 24% in 2013 to 30% in 2016) when analysed using satellite images. Most green growth was ascribed to tree planting along major expressways, parks, and recreational woods. While the data reflected an improvement in the overall green coverage, KL continues to lose its green cover (public parks and forest reserves) due to population expansion and development pressure. According to Rasli et al. (2019), the inadequate policy has worsened the urban sprawl and the fragmentation of green spaces in KL. As the progress of various urban infrastructures has fragmented forests, implementing urban corridors could lower the impact of urban-induced forest fragmentation (Danjaji & Ariffin, 2017). In addition, KL had no formal green network linking with open spaces (Sreetheran & Adnan, 2007). Yeo et al. (2022b) depicted that Malaysia's policies and regulations focused on green spaces instead of GI, thus contributing to the fragmentation of green spaces. The KLCH developed an impressive policy upon adhering to the national policies for green space planning. Besides, KLCH had outlined detailed guidelines for tactical, operational, and reflexive purposes. Imminently, improvements can be attained by formulating an effective GI policy (Yeo, et al., 2022b).

According to Benedict and McMahon (2006), the idea of GI was initially conceived by Henry David Thoreau and Frederick Law Olmsted in 1850. The phrase "green infrastructure" was first coined in the 1990s in the US and later developed into a tool for development and conservation (Mejía et al., 2015). At present, GI is acknowledged as supporting land use in connection with nature conservation and infrastructure planning. As de la Fuente et al. (2018) claimed, mentioning GI in

Europe's Natura 2000 sites is essential for sustaining a healthy ecosystem and providing exceptional ecosystem services. In the US, GI includes natural processes to enhance water quality and regulate water quantity by restoring the hydrologic function of the urban landscape, controlling stormwater at its source, and eliminating the need for new grey infrastructure (Environmental Protection Agency, 2015). Bartesaghi Koc et al. (2017) stated that the geographical context is essential in defining GI when site-specific variables, the study aims, and country-based factors are weighed in. The definition of GI is provided in the following discussion before moving on to further analyses.

Green Infrastructure as a Solution

Benedict and McMahon (2006) associated GI with an integrated network of natural areas. The corridors serve as a buffer between rapid intervention and growth in the urban setting (Aziz & Rasidi, 2014). The general definition of GI can be interpreted as the strategic network planning of natural, semi-natural, and artificial spaces to conserve the natural ecosystem, providing ecosystem services beneficial to humans in rural and urban areas.

GI preserves and links natural areas to benefit biodiversity, besides addressing habitat fragmentation to protect flora, fauna, natural processes, and ecosystems (Benedict & McMahon, 2006). The multi-functionality of GI reaches the optimum level when the individual elements, such as parks, forests, and green spaces (individuals), are linked (networks) to form a holistic GI (see Figure 1). Various GI elements and their connections form a network that enables organisms to travel and matter to spread (Davies et al., 2006).

The spatial pattern of patches, corridors, and matrix that forms a landscape is critical in determining functional flows and movements in the landscape (Forman, 1995). This network system supports a vital ecological process contributing to a sustainable landscape (Ahern, 1995; Shi & Qin, 2018). Uy and Nakagoshi (2008) asserted that connected green space ecological values are better than solitary green space. Mell et al. (2017) state that some scholars, organisations, and local perceptions influence the definition. This present study only focused on GI that contributes to ecological connectivity. This topic needs further investigation to accurately identify the individual elements and linkages within the local Malaysian context.

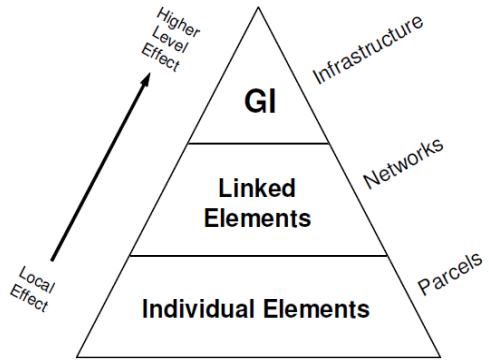

Figure 1. Parcels, network and infrastructure (Source: adapted from Davies et al., 2006)

The research questions formulated for this study are:

1. What are the roles of policies and regulations in the planning and development of GI in KL?

2. What types of patches, corridors, and components contribute to the establishment of GI in KL?

Although Malaysia has policies and regulations governing its green spaces, it is imminent to determine if the implemented green space policies are indeed adequate to maintain and contribute to GI establishment. Subsequently, the study objectives are listed as follows:

1. To understand the roles of policies and regulations in establishing GI in KL
2. To identify the types of patches, corridors, and components that can be part of GI

The next discussion elaborates on the method deployed in this study. Thematic analysis was performed on green space-related policies and regulations that can contribute to GI establishment in KL.

METHODS

Type of Documents

In total, 77 documents from policies, plans, acts, guidelines, and non-government organisation (NGO) plans or reports that contribute to GI establishment were analysed in this study (see Table 1). This study also included the draft report, as GI-related documents were scarce.

Table 1
Type of policies and regulations

Level	Policies and regulations
National	11th Malaysia Plan, National Landscape Policy, National Housing Policy, National Policy on Biological Diversity 2016-2025, National Green Technology Policy 2009, National Agro-Food Policy, National Forestry Policy, National Policy on Climate Change, National Sports Policy, National Tourism Policy 2020-2030, Low Carbon Cities Framework, Green Earth Programme, National Community Programme, Smart City Framework, National Urban Policy 2, National Physical Pan 3, National Urban Community Garden Policy, National Policy on the Environment
Structure & Local Plans	KL Structure Plan 2020, KL City Plan, KL Low Carbon Society Blueprint 2030, Strategic Plan KL 2010-2020, Draft KL Development Control Plan 2008, Draft KL Structure Plan 2040

Table 1 *(Continue)*

Level	Policies and regulations
Guidelines	Urban Stormwater Management Manual for Malaysia, KL Planning Guideline for Building Setback in Landed Housing (Bungalow, Semi detach or Terrace), KL Planning Guideline for Low-Density Housing Development (Bukit Tunku, Taman Duta, Bukit Persekutuan Dan Bukit Damansara), KL Planning Guideline for Submission of Planning Approval Document Digitally, Planning Guideline for Green Neighbourhood, Planning Guideline for Identification of Brownfield Development, Planning Guideline for Healthy Walkable City, Planning Guideline for Community Facilities, Planning Guideline for Theme Park, Planning Guideline for Golf, Planning Guideline For Preservation and Development of Environmental Sensitive Area, Planning Guideline For Housing, Planning Guideline Rooftop Garden, Draft Planning Guideline for Open Space & Recreation, Planning Guideline for Carpark, Planning Guideline for Old Folks Physical, Planning Guideline Erosion and Sediment Control in Malaysia, Landscape Masterplan Manual, National Landscape Guideline, Wayleave for Electricity Supply Line, Planning Guideline for Commercial Area, Planning Guideline for Transport Oriented Development, Planning Guideline for Strata Community Scheme, Planning Guideline for Mix Used (Vertical) in Commercial Zone, Planning Guideline for Infrastructure & Utility, Planning Guideline for Utility Infrastructure, Planning Guideline for Backlane, KL Planning Guideline for Open Space Requirement, KL Shading Tree Management Plan, KL Planning Guideline for Perimeter Planting
Acts	Act 172 Town & Country Planning Act 1976, Act 171 Local Government Act 1976, Act 133, Street, Drainage & Building Act 1976, Act 313 National Forestry Act 1984, Act 716 Wildlife Conservation Act 2010, Act 226 National Park Act 1980, Act 267 Federal Territory (Planning) Act 1982, Act 645 National Heritage Act 2005, Act 418 Water Act 1920, Act 56 National Land Code 1965.
NGOs Plans/Reports	Landscape Architect Agenda, Green Transformation Programme – Think City, MyCrest, Green Building Index

Note. Adapted from "Green Infrastructure Transitional Management Sphere Analysis of Policies and Regulations in Kuala Lumpur, Malaysia" by Yeo et al. (2022b).

Study Flow and Codes

The thematic approach introduced by Braun and Clarke (2006) was deployed to analyse and synthesise the gathered data. Figure 2 illustrates the study flow of this study. In a study by Yeo et al. (2022b), Atlas.ti was applied to identify the transitional management sphere analysis for Malaysia's GI policies and regulations. Therefore, the theoretical thematic analysis was executed in this study using Atlas.ti to code GI.

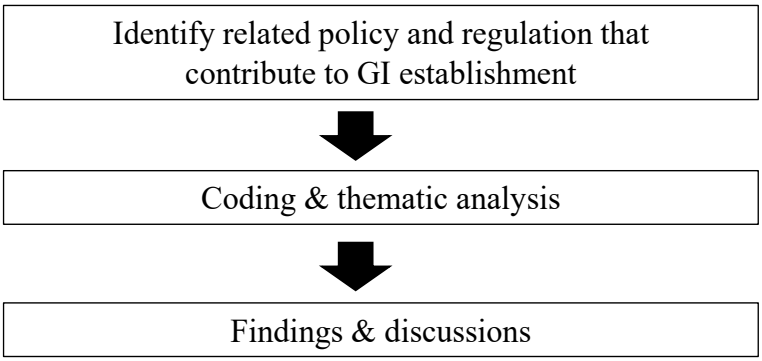

Figure 2. Study flow

Upon referring to Atlas.ti, the code group and concepts for elements are tabulated in Table 2. Saldana (2015) concurred that in a qualitative study, a code refers to a term or a short phrase symbolising a summative, salient, essence-capturing, and evocative attribute to a segment of language-based or visual data. GI elements were categorised into patches, corridors, and components in Atlas.ti to comprehend the GI typology.

Table 2

List of code groups and ideas for elements

Code group	Ideas for elements
Green infrastructure	green infrastructure
Patch—hub/space	any space that shapes like patches, such as a green space, park, or national park
Corridor—network	any linear corridor such as river, pedestrian, railway
Component	single entity in GI, such as a tree, green building, hardscape

While doing so, a constant question determined if the themes and codes are related to telling a compelling story. The results are presented in the following discussion.

RESULTS AND DISCUSSION

GI in Malaysia and Kuala Lumpur

The National Landscape Policy (NLP) describes GI as a network of open spaces, green areas, parks, wetlands, natural habitats, and natural landscapes to preserve ecosystems. This concept conforms to the landscape ecology principle by embedding a patch and a corridor to preserve the ecosystem. Despite the mention of GI in Kuala Lumpur City Plan 2020 (KLCP 2020), the scope emphasises green technology, including sewerage treatment and stormwater management. The GI, which interconnects green spaces, is disregarded in the Malaysian legislation, structure or local plan. Kuala Lumpur Low Carbon Society Blueprint 2030 (KLLCSB 2030), KLSP 2020, KLCP 2020, and Draft KLSP 2040 (Draft KLSP 2040) have been established to link green areas and blue corridors as urban ecological hubs. East London Green Grid Framework can be an example of developing GI for KL (Greater London Authority, 2008). The following discussion elaborates on the types of patches, corridors, and components that could contribute to GI establishment within the context of KL.

Potential GI Patches

A list of GI patches and elements (Table 3) was derived from the study of policies and regulations. A patch refers to a non-linear zone that is relatively homogenous and distinct from its surroundings; it serves multiple purposes, such as animal habitat, aquifer recharge zones, species or nutrient sources, and sinks (Ahern, 2007). The patches identified in the analysed policies and regulations in this study were grouped into 15 categories.

Table 3

Patches and elements

Patch	Landscape element
Open space	national park, regional park, urban park, local park, neighbourhood park, playing field, playground
Forest	protected forest, forest reserved, recreational forest, educational forest, permanent forest reserved, wildlife reserve/habitat, timber production forest, soil protection forest, soil reclamation forest, flood control forest, water catchment forest, virgin jungle reserved forest, amenity forest, research forest, forest for federal purposes
Civic spaces	public park, pocket park, urban plaza/square, urban space/landscape, recreational area/ garden, courtyard, sports facilities, state park, district park, green area/space, green lung, social amenities and facilities
Private	private garden, private land, golf, theme park, palace
Education	arboretum, botanical garden, agriculture theme park, floral garden

Table 3 *(Continue)*

Patch	Lanscape element
ESA	coastal, water catchment, floodplain, wetland, ex-mining land, pond and river, mineral resources & geohazard, landfill, prime food area, wildlife habitat, cultural and natural heritage
Wetland or waterbody	wetland/pond/lake/waterbody/peat, catchment areas, rain garden, detention pond
Green building	green roof, vertical greenery system
Cultural	rural landscape, native right land
Heritage	historic/heritage sites, cultural heritage area, natural heritage, geological heritage
Neighbourhood	green township, green neighbourhood,
Infrastructure, utility facilities reserved	utility reserved area, graveyard, electric station, satellite ground station, planting space, car park, landscape reserve,
Vacant and derelict	infill, brownfield/disturbed land areas, vacant space, landfill
Public institution	school, school field, military camp, marching field, health complex, nursery
Agriculture	edible garden/community farming/ urban farming, agriculture, agriculture park

Open Space. In Malaysia, the Draft Planning Guideline for Open Space and Recreation ascertains the preservation of open spaces in any development under the Act 172 Town and Country Planning Act 1976 implemented by the local government in Peninsular Malaysia. According to Ibrahim et al. (2014), Act 172 enables the local government to have its own set of open space regulations. As a result, the following five approaches to open space policy were deployed by different local authorities: general, ergonomic, land ownership, number of housing areas, and size of the development. Ibrahim et al. (2014) proposed a uniform open space approach to meet the 2 ha of open space target for every 1,000 residents. Table 4 presents the open space hierarchy in KL that differs from the guideline.

Table 4 shows several new open space categories, such as pocket parks and linear green corridors, listed in Draft KLSP 2040. Given the increasing urbanisation scenario in KL, this open space hierarchy should overcome the green space issue. The KLCH also preserves its green area. The NLP and the Economic Transformation Plan (ETP) recommended that 30% of the total land be set aside for government and private agencies to redevelop green areas. However, no further claim or evidence supports this restorative measure. Thus, Act 172 stipulates that KL improve its open space hierarchy accordingly.

Table 4

Comparison of open space hierarchy of KLSP 2020, Draft KLSP 2040 and PLANMalaysia

Hierarchy of open spaces in KLSP 2020 (2004)	Hierarchy of open spaces in Draft KLSP 2040 (2020)	Hierarchy of open spaces by PLANMalaysia (2010)
City park	City park	National park
District park	District park	Federal park
Neighbourhood park	Neighbourhood park	City park
Local park	Local park	Neighbourhood park
Local play area	Local play area	Play field
Sports complex	Sports and Recreation	Playlot
	Pocket park	Recreation garden
	Linear green corridor	

Forest. The tropical forest in Malaysia is one of the oldest and most diverse in biodiversity. These forests are preserved under Act 313, National Forestry Act 1984, Act 645, National Heritage Act 2005, and Act 716 Wildlife Conservation Act 2010. Different types of forests have different functions and characteristics.

As depicted by Kanniah (2017), in Act 313 National Forestry Act 1984, economic progress takes precedence when conflict sparks between economic development and environmental protection. Section 64 (1) of the National Land Code provides the public officials' revocation of reserved and protected public parks and recreational areas. In 2014 and 2016, Kanniah (2017) reported that the Landsat satellite images detected the loss of 23,88 ha and 11 06 ha in Sungai Besi Permanent Forest Reserve and Bukit Gasing Reserve Forest, respectively. Even gazetted property may be transformed into economically beneficial land uses, such as residential, due to development pressure.

The KLSP 2020, the Draft KLSP 2040, and the KLCP 2020 focus on maintaining forests as part of linked green areas to sustain biodiversity. Hence, one may infer that the KLCH does understand the value of the forest and green spaces in terms of ecological and monetary. However, such open spaces and forests are insufficient to establish GI. Hence, the following potential GI elements should be incorporated into GI establishment proactively:

Civic Space. Civic spaces, such as public parks, pocket parks, and plazas, are potential spaces for GI. Civic spaces are public or private areas that are not under the direct authority of the government or conglomerate (Lewinson, 2007). Yusof (2012) suggested city squares, boulevards, waterfront, rivers, and lake embankments as civic spaces for the local context. This present study focused on waterfront and river as corridors. Civic space offers multiple functions. For example, the Beijing Olympic Forest Park

was built for long-term civic and tourist purposes (Wu et al., 2021). In the KLSP 2020 urban space: nodes, plazas, and parks are vital in assigning a city identity, structure, and landscape amenities.

Private Space. In this thematic study, the category of private open space was derived from policies and legislation. Yusof (2012) claimed that private space comprises private residential and recreational areas. To develop private recreational open spaces (i.e., golf and theme park) in Malaysia, developers should abide by 10% of the open space requirement. PLANMalaysia has outlined guidelines for golf courses and theme parks. Eriksson et al. (2015) explained that golf arenas located in the conservation area are governed strictly to protect the biodiversity aspect of that area. Besides adhering to standard guidelines, Malaysia should adopt an ecological policy so that golf or other private areas offer multi-functionality and are ecologically sound. In KLSP 2020, the KLCH ensured that the existing private open spaces and other empty places were adequately landscaped. Tahvonen and Airaksinen (2018) claimed that private garden in low-density housing is part of urban green spaces based on their vegetation and biodiversity potential. Malaysia's residential area is developed in accordance with the 10% open space requirement. However, the private garden is under the control of the house owner. Hence, the question is, "How to integrate private gardens as part of GI in Malaysia?" Tahvonen and Airaksinen (2018) stated that a private garden is difficult to manage, builds on ineffective land use, and may cause a disservice. However, it has intriguing potential for resilience in sustainable cities.

Educational Space. In an effort to let people value nature, green educational space is significant. Schweitzer and Gionfra (2018) listed the benefits of nature-based education that significantly contribute to one's mental and physical well-being. Such education also benefits the community by improving social cohesion and labour productivity, minimising public expenditure on healthcare, and enhancing planetary sustainability. Mat Nazir et al. (2014) posited that botanical garden offers recreational, educational, and tree preservation opportunities. Nature and park activities provide educational and learning opportunities that continue educating the public's sense of ecological awareness, besides cultivating civic pride (Wu et al., 2021). In support of this measure, Draft KLSP 2040 have organised health, educational, entrepreneurship, and other green space activities. Education and awareness play a key role in accelerating the adoption of GI by discarding cognitive blocks (Dhakal & Chevalier, 2017.

Environmentally Sensitive Areas (ESA). Malaysia Environmentally Sensitive Areas (ESA) consist of three ranks based on conservation priorities: ESA Hazards, Life Support System, and Heritage Value. PLANMalaysia outlines nine contexts for ESA: (1) coastal, water catchment, and water source, (2) floodplain, wetland, ex-mining land, (3) pond and river, (4)

mineral resource and geohazard, (5) landfill, (6) food production area, (7) wildlife habitat, (8) permanent reserve forest, as well as (9) natural and cultural heritage. The ESA in Malaysia is a reasonable basis for implementing GI as it blankets a wide range of areas that can be potential GI elements. Ndubisi et al. (1995) disclosed that ESAs and the linked landscape components serve as a vehicle for creating greenway corridors that function first as a conduit for wildlife migration and secondarily as zones for water quality protection. In KLCP 2020, ESA is a valuable natural resource that must be protected and conserved for the sustainability of KL. It was also followed up by Draft KLSP 2040 to supervise development on highlands.

Wetland and Waterbodies. Malaysia's wetlands and water bodies must be protected as some wetlands, such as peat swamps, have unique biodiversity. Stefanakis (2019) elaborated that placing multiple constructed wetlands across a GI network enables treated effluents to create new habitats for irrigation and open space. Wetlands linked to urban ecological corridors help create large-scale multifunctional landscapes that modify the character of urbanised development. It is addressed in KLSP 2020, KLCP 2020, and Draft KLSP 2040. Hence, wetlands should be included in Malaysia's GI. One example is the transformation of an abandoned tin mining lake into the Titiwangsa Public Park by the KL local authorities (Nor Akmar et al., 2011).

Green Building. In light of technology, green buildings apply green roofs and vertical greenery as substitutes in urban areas. Green roofs provide ecosystem services as a larger strategy to develop GI in urban areas (Carter & Fowler, 2008). In Malaysia, the Green Building Index (GBI) was deployed as the green building and town rating system to achieve a sustainable built environment. Nizarudin et al. (2012) listed three components of environmental conservation in the GBI: The first is maintaining existing natural spaces or increasing soft landscaping areas to offer habitat, increase biodiversity, and minimise the heat island effect. The second component is encouraging habitat preservation, restoration, and biological diversity by including native or adapted plants, as well as increasing the open space available on grades or rooftops. The last component is maintaining a high open space-to-development footprint ratio to promote biodiversity and counteract the heat island effect. The GBI should have a specific GI index that contributes holistically to GI. Vertical green density in Draft KLSP 2040 and KLLCSB 2030 can enhance the quality of life in the city while concurrently benefiting the environment by decreasing the effect of urban heat islands and improving air quality to meet KL's Low Carbon City goal. This approach applies to all high-density new construction and redevelopment zones for mixed-use, residential or commercial purposes. PLANMalaysia introduced the Planning Guideline for Green Roof Gardens for green roof construction and planting.

The 10% open space policy established by PLANMalaysia for each development application may be challenging to execute in developed areas. To date, only a few local authorities have approved green roofs. The full potential of green roofs as a GI element is largely untapped.

Cultural Land. Kilbane (2013) states that de facto areas, such as Indigenous Protected Areas, are included in the GI plan. Malay reserve land or *kampung* area is a potential aspect of GI with a wide range of green space. Malaysia's indigenous people lead a unique lifestyle by incorporating the forest element. It is captured in the National Forest Policy and National Policy on Biological Diversity to develop conserved community areas as an integral part of the protected area. As Ubaidillah et al. (2018) explain, the *Tagang* system offers several benefits, such as providing economic income to protect the river's ecology. There is a need to encourage community participation and agreement in this measure. Referring to KLSP 2020 and Draft KLSP 2040, the KLCH ensures the redevelopment of Malay reserve areas and traditional *kampung*, including their unique design features that reflect their historical and traditional character.

Heritage Area. Historical heritage, landmarks, and mature trees, as well as native species in Malaysia, are excellent choices for preservation (Hasan et al., 2016). For example, urban heritage trees were inventoried to identify the species and nature of heritage trees in Bangkok to enhance their GI (Thaiutsa et al., 2008). Act 645 The National Heritage Act 2005 provides more details on elements that can be part of GI. The Greater KL proposed revitalising the Klang River into a heritage and commercial centre. As such, KLCP 2020 encouraged the urban heritage to be expanded as part of the city's urban tourism. As identified by the KLCP 2020, the heritage zone refers to an area of architectural or historic interest and character desirable to preserve or conserve. Therefore, heritage areas can be part of GI in KL upon adhering to proactive policies and actions incorporating green space.

Neighbourhood. According to Marzukhi et al. (2012), green network connections of open space should be linked to each home. According to experts, purchasers are prepared to pay more for a home with excellent environmental characteristics (Tan, 2011). Small-scale or community-scale in GI complements the social and economic functions attributed to strategic scale projects (Jerome, 2017). In the National policy, a guideline on the green neighbourhood was introduced by PLANMalaysia. This situation creates green space inequality, where rich people can afford to own a house with more greenery than the poor. This issue should be addressed by the government carefully. KLSP 2020 and Draft KLSP 2040 emphasise facilities, such as neighbourhood parks, in the neighbourhood area. The GI can be a catalyst for developing a sustainable residential area.

Infrastructure, Utility and Facility Reserve. It is necessary to design residual mobility-related green space for urban

context as part of a more extensive multifunctional GI system, which can link other urban green areas and appropriate open spaces across the city (Dall'Ara et al., 2019). Hence, the utility facilities area can be part of GI. The landfill, for instance, can be part of the open green space, whereas the electric utility line can be part of the corridor. The cemetery is also a ubiquitous GI component in the urban setting. Cemeteries designed as urban woodland can be part of the heritage and biodiversity preservation in urban GI (Kowarik et al., 2016). Undoubtedly, the existing cemeteries contribute significantly to the city's increasing biodiversity, while cemeteries designed with a park idea enhance public health and enjoyment (Alfa & Reza, 2012). Apart from ecological and aesthetic considerations, abandoned places have functional and social significance (Gałecka-Drozda & Raszeja, 2018). Draft KLSP 2040 encourages sharing utility, river, and road reserves for other purposes, such as community gardening, public/pocket parks, playgrounds, as well as pedestrian and bicycle lanes.

Vacant and Derelict Area. In the context of São Bernardo do Campo, Sanches and Pellegrino (2016) found that only 40% of vacant and derelict land had high potential for greening, 40% displayed medium potential, and 20% exerted low potential. In Xuzhou, a coal mine brownfield was checked for GI's potential restoration to assist reclamation quantitatively (Feng et al., 2019). It highlights the pressing need to comprehend vacant and derelict spaces in detail due to the presence of different indicators. Newman et al. (2017) reported that vacant land might link existing ecological patches with a less negative impact on development potential while enhancing ecological service provision. In Draft KLSP 2040, for example, infill development on the vacant or abandoned area is encouraged to promote more investment by turning it into an opportunistic space for GI. A Planning Guideline for Brownfield was prepared by PLANMalaysia that adheres to the National Physical Plan. Draft KLSP 2040 signifies that undeveloped land on government property, government land reserves, and private land should be managed efficiently and productively.

Public Institution Area. According to Iojă et al. (2014), the school field is a part of GI. Other public institutions should also incorporate GI elements to enhance their structural connectivity besides serving as an ecological stepping-stone. In the Draft KLSP 2040, shared school fields can be utilised to improve the quality and diversify the activities of parks and open spaces. Other institutions, such as military camps, marching fields, and health complexes, can incorporate a similar approach.

Agriculture Area. Evaluating edible GI implementation offers city planners and policymakers more practical suggestions for green space protection and management (Russo & Cirella, 2020). The National Agro-Food Policy (NAP 4) Malaysia was established to address issues in local and global markets to guarantee food security and safety via sustainable agriculture

(Dardak, 2015). Therefore, sustainable and productive farms may form part of the connectivity networks (Reza & Abdullah, 2010). The Green Earth Programme, proposed by the Ministry of Housing and Local Government, was executed by the local government to help the local people produce agricultural products for self-consumption or income generation. In 2021, the National Community Garden Policy was initiated for housing areas, abandoned green space, utility reserve areas, community amenities and facilities areas, as well as river reserves. While securing agricultural land in a city is difficult, each minor green space substantially contributes to GI creation. Draft KLSP 2040 and KLLCSB 2030 promote community garden and urban farming collaboration in green space design with local communities.

Summary of Patches. In Draft KLSP 2040, Biodiversity Protection Zone was proposed. This zone encompasses permanent forest, field and recreational land, rivers, and water bodies prioritised in nature-integrated urban development. It can be summarised that GI patches have much potential to contribute to GI as a holistic entity. Furthermore, creativity and proactive measure were applied in creating these policies and regulations. However, there is a need to incorporate other GI corridors and components into the policies and regulations.

Potential GI Corridor

A corridor is a linear stretch of a specific land cover type that differs from its surroundings in content and physical structure (Forman, 1995). Corridor offers a niche, shelter, food, and security for urban wildlife, thus allowing them to thrive and migrate from one patch (green space) to another (Alias et al., 2014). The establishment of corridors is the least acknowledged in the policies reviewed, whereby only the NPP offers a central forest spine to reconnect the scattered forest regions across Peninsular Malaysia (Danjaji & Ariffin, 2017). A continuous network of open spaces was envisioned to connect the main open spaces through a network of smaller open spaces, as well as river and drain reserves (Azwar & Izham, 2009). Modica et al. (2021) identified an ecological network by assessing the structural and functional connectivity in Italy. Table 5 lists the corridors and elements identified from the analysed policies and regulations. This study defines the corridor element as an ecological entity with a linear characteristic.

Blue Corridor. Referring to the Draft KLSP 2040, the blue corridor comprises river reserves, drains, and water bodies (e.g., catchment ponds, natural lakes, and former mining areas). Lake and pond, however, are considered as a patch in this study. The contaminated Klang River demands substantial treatment before being used domestically (Manaff et al., 2020). It calls for remedial efforts for the river. The Act 645 National Heritage Act of 2005 protects and preserves national heritage, including natural heritage and rivers (Latip et al., 2010). Guidelines for rivers, river reserves, and waterfronts were formulated for local governments (Yassin et al., 2011). The initial relationships among hydrology, topography, and geology can unveil the

Table 5

Corridors and elements

Corridor	Element
Blue corridor	river/river reserved, coastal/shoreline, marine ecological corridors, mangrove
Green corridor	green belt, green corridor/linkages, green network/trail, central spine link
Function corridor	ecological linkage/corridors, road median, boulevard, pedestrian network, bicycle network, utility reserved corridor, road/street, railway, back-lane/ side-lane, drainage reserve, heritage trail

blue infrastructure's logical and site-specific distribution (Deak & Bucht, 2011).

The Klang River should be revived as a cultural and economic centre for the Greater KL in ETP. The River of Life (RoL) identified in the Greater KL under the ETP has been projected to convert Klang and Gombak Rivers into dynamic, liveable waterfronts with significant economic value to catalyse the goal of KL towards becoming a sustainable city. The National Sewerage Department, the Department of Irrigation and Drainage, as well as the KLCH, are responsible for the project. Enforcement and further planning are in need to preserve specific locally rare or endangered species, the whole mangrove ecosystem, and the essential ecological services (Jusoff, 2013).

Green and Functional Corridors. The green corridor denotes a physical factor influencing urban wildlife behaviour movement (Aziz & Rasidi, 2014). Developing green corridors is a solution that can overcome the effect of fragmented green space (Danjaji & Ariffin, 2017). As for the functional corridor for humans, it serves socio-cultural purposes. Several elements, including streets in the urban GI, may be embedded and utilised to expand the network (Tudorie et al., 2020). In KLSP 2020, Sreetheran and Adnan (2007) claimed that green networks, which consist of road, utility, river, drainage, and railway reserves, offer sustainable living environments for wildlife. KLLCSB 2030, KLCP 2020, KLSP 2020, and Draft KLSP 2040 proposed a green network plan that included pedestrian, heritage trails, and cycling paths. This green network serves as a functional corridor for humans. Draft KLSP 2040 also proposed the development of park connector networks comprising utility corridors, riverside corridors, back lanes, road and drainage reserves, as well as private development. The proposed ecological corridor is connected via three green landscape corridors comprising linear corridor, eco-stepping stone, and landscape. Such a measure surely contributes to GI establishment. Moreover, KL is eager to apply its resources to optimise GI. Since protecting the corridor protects merely the structural element of ecology, there is a pressing need to comprehend ecological connectivity.

Potential GI Component

The elements in Table 6 were derived from the analysed policies and regulations. The GI elements have the characteristic of singularity and are unfit to be classified as patches or corridors. Some GI elements (e.g., trees) are vital for creating GI. For instance, pedestrian bridges, roundabouts, wildlife crossings, permeable surfaces, swale, and buffers can be embedded in GI establishment and planning.

Table 6

Component and elements

Component	Element
Component	tree/canopy cover, pedestrian bridge, roundabout, wildlife crossing, swale, buffer, perimeter planting, permeable surface

four key components: publicity, tree list, planning permission Standard Operating Procedures (SOPs), and enforcement strategies based on the TPO (Act 172) to ensure the legislation is effectively applied in construction projects.

The 100 million trees planting campaign led by the Ministry of Water, Land and Natural Resources promotes trees, green space, and forest preservation. This campaign aims to plant 100 million trees by 2025 by involving other ministries and departments in Malaysia. This campaign is promoted via a website and application to record tree-planting statistics, donation programmes, and rewards.

The KLCH plans to increase its tree planting efforts from 25,000 to 100,000 trees, according to ETP, focusing on big coverage trees to provide the appearance and feel of green corridors. The KLLCSB 2030 has established a tree inventory, a 15-year tree planting plan, a 'one resident, one tree programme' to instil diversity in the tree population programme, the development of standards for species at specific locations, and the native tree seedlings project. In Draft KLSP 2040, tree coverage is increased across KL, similar to the efforts made in other global cities.

Dall'Ara et al. (2019) claimed that roundabouts are potential GI elements by assigning roundabouts as wildflower areas, rain gardens, urban grooves, and dry gardens. In Ethiopia, designing permeable surfaces and planting green areas with grey structures were executed to protect cities from flooding (Girma et al., 2019). Meanwhile, Tudorie et al. (2020) considered stripes of the green, green roundabout,

The economic worth of the trees may be estimated based on their age, size, species, condition, and function (Mohd Hashim & Hitchmough, 2015). Despite implementing Tree Preservation Order (TPO; Act 172) in Malaysia, problems still emerge. For example, the developer or contractor may reduce development costs by cutting down trees (Mohd Hashim & Hitchmough, 2015). Sukri et al. (2020) proposed a conceptual framework that consists of

and even non-tree greenery (e.g., shrubby or grassy road verges) in their study. In Singapore, the greenway was established by utilising buffer zones adjacent to existing water canals and designing canal banks with ecological restoration and pedestrian paths (Sini, 2019). However, a question continues to linger about integrating all these components into GI in KL. It can be deduced that trees have been the primary focus of most policies and regulations compared to other components. Notably, including other components to achieve a holistic GI is crucial.

GI Elements and Planning Framework

This discussion presents a planning framework for establishing GI in KL to connect the findings discussed in the previous discussion. According to Bartesaghi Koc et al. (2017), the four categories of GI are (a) tree canopy, (b) green open spaces, (c) green roofs, and (d) vertical greenery systems (facades/walls). Nonetheless, these categories have drawbacks in identifying GI patches, corridors, and components in the Malaysian local condition. The Ahern (1995) planning strategy and the local GI patch, corridor, and component were used to define the type of element that enables a more rigorous comparison and systematic presentation of the findings.

Given the different types of typology, the GI elements in a local scenario should be categorised as outlined by Ahern (1995; see Table 7). The framework gathers the required information to assist in the decision-making process so that the GI can be set as a mainstream mechanism of urban infrastructure. The four measures in the planning framework are protective, defensive, offensive, and opportunistic. These measures are tabled with patches, corridors, and components to identify the elements systematically.

The landscape elements derived from the policies and regulations provide opportunities to determine elements that could be used in GI planning, as most policies focused on an individual element for GI space. The policies concentrated on patches above corridors and components. This scenario protects more patches than corridors, thus leading to green space fragmentation. The ecological connectivity part of GI must be strengthened to achieve sustainable landscape planning. Any legislative limitations on open areas, such as setbacks, that prohibit the use of such places for GI should be repealed, while technically feasible GI should be permitted in such areas (Dhakal & Chevalier, 2017). Therefore, this framework is beneficial for future GI establishment and planning.

The integration of GI elements might provide multifunctional GI. Creativity in planning and designing GI is essential as well. For example, a utility reserve corridor as an urban farming area for urban dwellers might require specific guidelines to support the activities and facilities. Hence, future GI studies should remember that each location or study is unique. Future scholars should adequately choose methodologies such as scale, data, and analytical tools (Yeo et al., 2022a).

Table 7

Planning framework for GI in Malaysia

Planning Framework	GI Patch	GI Corridor	GI Components
Protective: provides proactive measures to protect landscape components that are in good condition before they are endangered by change or development	Environmentally Sensitive Areas (Coastal, water catchment, floodplain, wetland, ex-mining land, pond and river, mineral resources & geohazard, landfill, prime food area, wildlife habitat, cultural and natural heritage), permanently reserved forest, wildlife sanctuary, wildlife reserve, national park, natural heritage, national heritage, forest, waterbody	river, central spine link,	tree
Defensive: Attempting to protect landscape features that are under threat from development	open space (national park, federal park, urban park, local park, neighbourhood park, playfield, playlot, recreation garden, detention pond), agriculture, amenities space, reserved land, national heritage, site, private land, education space, neighbourhood, cultural land	road median, boulevard, pedestrian network, bicycle network, road/ street, railway, back-lane/side-lane, drainage reserve, heritage trail	a pedestrian bridge, roundabout, permeable surface, swale, buffer zone
Offensive: Taking corrective or restorative measures to restore abiotic, biological, or cultural functions where they are presently absent	landfill, brownfield/ disturbed land areas	polluted river	wildlife crossing

Table 7 *(Continue)*

Planning Framework	GI Patch	GI Corridor	GI Components
Opportunistic: Recognise the possibility of non-contributing landscape components being handled or organised differently to fulfil particular purposes.	vacant, utility facilities	utility reserved corridor, drainage reserve	green building (roof garden, vertical greenery)

CONCLUSION

This paper's policies and regulations analysis framework unveils the status and sheds light on how policies and regulations can provide GI establishment in Malaysia, especially in KL. The GI typology proposed in this study enables practitioners and policymakers to improve GI establishment by providing basic knowledge on strategically identifying GI elements.

Although the Malaysian government intends to protect the environment, its policies lack GI planning and establishment. The findings indicate that Malaysia's planning policies and regulations are insufficient to protect and establish GI due to their emphasis on patches while disregarding corridor establishment. The GI component must be highlighted, especially when all these components can exert collective effects. Strategically, the GI policy should be included at the national level so that other policies and regulations can adhere to it. Notably, the KLCH is making a great effort to develop structure, local plans, and guidelines that contribute to green spaces and even GI. Further steps should be taken in designing GI as the ecological corridor in KL by analysing the GI structure and its functional connectivity. The KLCH did improve the open space hierarchy in KLSP 2040. However, an urban area like KL faces some obstacles due to land constraints. Therefore, not all the important elements listed in Table 7 could be utilised due to some setbacks.

In conclusion, the findings of GI typology in this study should be incorporated into the GIS and remote sensing spatial planning to establish GI. This method may lead to a more systematic identification of elements for future GI planning to ascertain a better ecology and a sound environment. This study may be enhanced by incorporating upcoming policies and regulations.

ACKNOWLEDGMENT

We acknowledge the help and support of our families and loved ones during the course of this research.

REFERENCES

Ahern, J. (1995). Greenways as a planning strategy. *Landscape and Urban Planning*, *33*(1–3), 131-155. https://doi.org/10.1016/0169-2046(95)02039-V

Ahern, J. (2007). Green infrastructure for cities: The spatial dimension. In V. Novotny & B. Paul (Eds.), *Cities of the future towards integrated sustainable* (pp. 271). IWA Publishing.

Alfa, M., & Reza, M. (2012). Sustainability of urban cemeteries and the transformation of Malay burial practices in Kuala Lumpur metropolitan region. *World Academy of Science, Engineering and Technology*, *71*, 538-558. https://www.waset.org/journals/waset/v71.php

Alias, A., Ali, A. S., & Othman, K. N. (2014). Land development on high land areas: Comparison of process implementation and legislation effectiveness between Malaysia and Hong Kong. *World Journal of Engineering and Technology*, *2*(3), 55-60. https://doi.org/10.4236/wjet.2014.23b009

Aziz, H. A., & Rasidi, M. H. (2014). The role of green corridors for wildlife conservation in urban landscape: A literature review. *IOP Conference Series: Earth and Environmental Science*, *18*(1). https://doi.org/10.1088/1755-1315/18/1/012093

Azwar, D. H., & Izham, G. (2009). The importance of green space: Towards a quality living environment in urban areas. *International Journal of Architectural Research*, *3*(1). 245-262

Bartesaghi Koc, C., Osmond, P., & Peters, A. (2017). Towards a comprehensive green infrastructure typology: A systematic review of approaches, methods and typologies. *Urban Ecosystems*, *20*(1), 15-35. https://doi.org/10.1007/s11252-016-0578-5

Benedict, M. A., & McMahon, E. T. (2006). G*reen Infrastructure: Linking Landscapes and Communities*. (pp. 24). Island Press.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Carter, T., & Fowler, L. (2008). Establishing green roof infrastructure through environmental policy instruments. *Environmental Management*, *42*(1), 151-164. https://doi.org/10.1007/s00267-008-9095-5

Dall'Ara, E., Maino, E., Gatta, G., Torreggiani, D., & Tassinari, P. (2019). Green mobility Infrastructures. A landscape approach for roundabouts' gardens applied to an Italian case study. *Urban Forestry & Urban Greening*, *37*, 109-125. https://doi.org/10.1016/j.ufug.2018.03.011

Danjaji, A. S., & Ariffin, M. (2017). Green infrastructure policy for sustainable urban development. *International Journal of Environment and Sustainable Development*, *16*(2), 112-127. https://doi.org/10.1504/ijesd.2017.10004010

Dardak, R. A. (2015). Transformation of agricultural sector in Malaysia Through agricultural policy. *FFTC Agricultural Policy Database*, *237*, 2–5.

Davies, C., Macfarlane, R., & Roe, M. (2006). *Green infrastructure planning guide*. Urban Environmental Education Review. https://doi.org/10.5822/978-1-61091-693-6_1

de la Fuente, B., Mateo-Sánchez, M. C., Rodríguez, G., Gastón, A., Pérez de Ayala, R., Colomina-Pérez, D., Melero, M., & Saura, S. (2018). Natura 2000 sites, public forests and riparian corridors: The connectivity backbone of forest green infrastructure. *Land Use Policy*, *75*, 429-441. https://doi.org/10.1016/j.landusepol.2018.04.002

Deak, J., & Bucht, E. (2011). Planning for climate change: The role of indigenous blue infrastructure, with a case study in Sweden. *Town Planning Review*, *82*(6), 669-685. https://doi.org/10.3828/tpr.2011.38

Dhakal, K. P., & Chevalier, L. R. (2017). Managing urban stormwater for urban sustainability: Barriers and policy solutions for green infrastructure application. *Journal of Environmental Management*, *203*, 171–181. https://doi.org/10.1016/j.jenvman.2017.07.065

Environmental Protection Agency. (2015). *Green infrastructure opportunities that arise during municipal operations*. Office of Wetlands, Oceans and WatershedsNational Estuary Program. https://www.epa.gov/nep/green-infrastructure-opportunities-arise-during-municipal-operations.

Eriksson, F., Eriksson, T., & Ignatieva, M. (2015). Golf courses as a part of urban green infrastructure: social aspect of golf courses and extensively managed turfgrass areas from Nordic perspective. *52nd World Congress of International Fedration of Landscape Architect*. http://www.sterf.org/Media/Get/2898/golf-courses-as-a-part-of-urban-green-infrastructure-social-aspects.pdf

Federal Department of Town and Country Planning. (2016). *National physical plan 3*. https://myplan.planmalaysia.gov.my/www/admin/uploads_publication/rancangan-fizikal-negara-ke-3-chapter-7-en-31102020.pdf

Feng, S., Hou, W., & Chang, J. (2019). Changing coal mining brownfields into green infrastructure based on ecological potential assessment in Xuzhou, Eastern China. *Sustainability*, *11*(8). 1-13. https://doi.org/10.3390/su11082252

Forman, R. (1995). Some general principles of landscape and regional ecology. *Landscape Ecology*, *10*(3), 133–142. https://doi.org/10.1007/BF00133027

Gałecka-Drozda, A., & Raszeja, E. (2018). Useful wasteland - The potential of undeveloped land in modification of urban green infrastructure based on the city of Poznań. *Miscellanea Geographica*, *22*(4), 225-230. https://doi.org/10.2478/mgrsd-2018-0016

Girma, Y., Terefe, H., Pauleit, S., & Kindu, M. (2019). Urban green infrastructure planning in Ethiopia: The case of emerging towns of Oromia special zone surrounding Finfinne. *Journal of Urban Management*, *8*(1), 75–88. https://doi.org/10.1016/j.jum.2018.09.004

Greater London Authority. (2008). *East London Green Grid Framework*. https://www.queenelizabetholympicpark.co.uk/-/media/lldc/local-plan/local-plan-examination-documents/regional-planning-policy-documents/rp9-spgeastlongreengrid.ashx?la=en

Hasan, R., Othman, N., & Ahmad, R. (2016). Tree Preservation Order and its role in enhancing the quality of life. *Procedia - Social and Behavioral Sciences*, *222*, 493-501. https://doi.org/10.1016/j.sbspro.2016.05.140

Ibrahim, P. H., Dali, M. M., & Yusoff, S. M. (2014). Implementation of open space: The need for uniform policy? *Open House International*, *39*(1), 82-91. https://doi.org/10.5539/jsd.v6n7p16

Iojă, C. I., Grădinaru, S. R., Onose, D. A., Vânău, G. O., & Tudor, A. C. (2014). The potential of school green areas to improve urban green connectivity and multifunctionality. *Urban Forestry and Urban Greening*, *13*(4), 704-713. https://doi.org/10.1016/j.ufug.2014.07.002

Jerome, G. (2017). Defining community-scale green infrastructure. *Landscape Research*, *42*(2), 223-229. https://doi.org/10.1080/01426397.2016.1229463

Jusoff, K. (2013). Malaysian mangrove forests and their significance to the coastal marine environment. *Polish Journal of Environmental Studies*, *22*(4), 979-1005.

Kanniah, K. D. (2017). Quantifying green cover change for sustainable urban planning: A case of Kuala Lumpur, Malaysia. *Urban Forestry and Urban Greening*, *27*, 287–304. https://doi.org/10.1016/j.ufug.2017.08.016

Kanniah, K. D., & Ho, C. S. (2017). Urban forest cover change and sustainability of Malaysian cities. *Chemical Engineering Transactions*, *56*, 673-678. https://doi.org/10.3303/CET1756113

Kilbane, S. (2013). Green infrastructure: Planning a national green network for Australia. *Journal of Landscape Architecture*, *8*(1), 64-73. https://doi.org/10.1080/18626033.2013.798930

Kowarik, I., Buchholz, S., von der Lippe, M., & Seitz, B. (2016). Biodiversity functions of urban cemeteries: Evidence from one of the largest Jewish cemeteries in Europe. *Urban Forestry and Urban Greening*, *19*, 68-78. https://doi.org/10.1016/j.ufug.2016.06.023

Latip, N. S. A., Heath, T., Shamsuddin, S., Liew, M. S., & Vallyutham, K. (2010). The contextual integration and sustainable development of Kuala Lumpur's City Centre waterfront: An

evaluation of the policies, law and guidelines. *International Conference on Sustainable Building and Infrastructure, Part of The World Engineering, Science and Technology Congress (2010)*, 1-7. http://irep.iium.edu.my/3101/

Lewinson, A. S. (2007). Viewing postcolonial Dar es Salaam, Tanzania through civic spaces: A question of class. *African Identities*, *5*(2), 199-215. https://doi.org/10.1080/14725840701403457

Manaff, A. I. N. A., Muhammad, N. S., & Abdullah, J. (2020). Multivariate statistical assessment of Klang River, Selangor, Malaysia. *IOP Conference Series: Earth and Environmental Science*, *476*. https://doi.org/10.1088/1755-1315/476/1/012121

Marzukhi, M. A., Karim, H. A., & Latfi, M. F. (2012). Evaluating the Shah Alam City Council policy and guidelines on the hierarchy of neighborhood open space. *Procedia - Social and Behavioral Sciences*, *36*, 456–465. https://doi.org/10.1016/j.sbspro.2012.03.050

Mat Nazir, N. N., Othman, N., & Nawawi, A. H. (2014). Green infrastructure and its roles in enhancing quality of life. *Procedia - Social and Behavioral Sciences*, *153*, 384-394. https://doi.org/10.1016/j.sbspro.2014.10.071

Mell, I., Allin, S., Reimer, M., & Wilker, J. (2017). Strategic green infrastructure planning in Germany and the UK: A transnational evaluation of the evolution of urban greening policy and practice. *International Planning Studies*, *22*(4), 333-349. https://doi.org/10.1080/13563475.2017.1291334

Mejía, C.V, Shirotova, L., & de Almeida, I. F. M. (2015). Green infrastructure and German landscape planning: A comparison of approaches. *Urbani Izziv*, *26* (supplement), S25–S37. https://doi.org/10.5379/urbani-izziv-en-2015-26-supplement-002

Modica, G., Praticò, S., Laudari, L., Ledda, A., Di Fazio, S., & De Montis, A. (2021). Implementation of multispecies ecological networks at the regional scale: Analysis and multi-temporal assessment. *Journal of Environmental Management*, *289*. https://doi.org/10.1016/j.jenvman.2021.112494

Mohd Hashim, N. H., & Hitchmough, J. D. (2015). The comparisons of perceptions among landscape professionals' on tree retention and legislation article information. *International Academic Research Journal of Social Science*, *1*(2), 164-176.

Ndubisi, F., DeMeo, T., & Ditto, N. D. (1995). Environmentally sensitive areas: A template for developing greenway corridors. *Landscape and Urban Planning*, *33*(1–3), 159-177. https://doi.org/10.1016/0169-2046(94)02016-9

Newman, G. D., Smith, A. L., & Brody, S. D. (2017). Repurposing vacant land through landscape connectivity. *Landscape Journal*, *36*(1), 37-57. https://doi.org/10.3368/lj.36.1.37

Nizarudin, D. N., Mohd Hussain, M. R., & Tukiman, I. (2012). The importance and involvement of landscape architecture in the green building index (GBI) practice. *1st International Conference on Innovation and Technology for Sustainable Built Environment 2012 (ICITSBE 2012)* . https://www.researchgate.net/publication/282657130_THE_IMPORTANCE_AND_INVOLVEMENT_OF_LANDSCAPE_ARCHITECTURE_IN_THE_GREEN_BUILDING_INDEX_GBI_PRACTICE

Nor, A. N. M., Corstanje, R., Harris, J. A., & Brewer, T. (2017). Impact of rapid urban expansion on green space structure. *Ecological Indicators*, *81*, 274–284. https://doi.org/10.1016/j.ecolind.2017.05.031

Nor Akmar, A. A., Konijnendijk, C. C., Sreetheran, M., & Nilsson, K. (2011). Greenspace planning and management in Klang valley, Peninsular Malaysia. *Arboriculture and Urban Forestry*, *37*(3), 99–107. https://doi.org/10.48044/jauf.2011.014

Rasli, F. N., Kanniah, K. D., & Ho, C. S. (2019). Analysis of fragmented green spaces in Kuala Lumpur, Malaysia. *Chemical Engineering Transactions*, *72*, 457–462. https://doi.org/10.3303/CET1972077

Reza, M., & Abdullah, S. A. (2010). Ecological connectivity framework in the state of Selangor,

Peninsular Malaysia : A potential conservation strategy in the rapid changing tropics. *Journal of Ecology and Natural Environment*, *2*, 73–83.

Russo, A., & Cirella, G. T. (2020). Edible green infrastructure for urban regeneration and food security: Case studies from the campania region. *Agriculture*, *10*(8), 1-14. https://doi.org/10.3390/agriculture10080358

Saldana, J. (2015). *The coding manual for qualitative researchers*. SAGE Publications Ltd.

Sanches, P. M., & Pellegrino, P. R. M. (2016). Greening potential of derelict and vacant lands in urban areas. *Urban Forestry and Urban Greening*, *19*, 128-139. https://doi.org/10.1016/j.ufug.2016.07.002

Schweitzer, J.-P., & Gionfra, S. (2018). Nature-based education for resilient cities. In U. M. Azeiteiro, M. Akerman, W. Leal Filho, A. Setti, & L. Brandli (Eds.), *Lifelong learning and education in healthy and sustainable cities* (pp. 355-376). Springer. https://doi.org/10.1007/978-3-319-69474-0_21

Shi, X., & Qin, M. (2018). Research on the optimization of regional green infrastructure network. *Sustainability*, *10*(12). 1-13. https://doi.org/10.3390/su10124649

Sini, R. (2019). Singapore's green infrastructure and biophilic urbanism. In *Singapore's park system master planning*. Springer Singapore.

Sreetheran, M., & Adnan, M. (2007). Green network development of Kuala Lumpur city: From the perspective of Kuala Lumpur Structure Plan. *Journal of Postgraduate Studies in Architecture, Planning and Landscape*, *7*, 38-41.

Stefanakis, A. I. (2019). The role of constructed wetlands as green infrastructure for sustainable urban water management. *Sustainability (Switzerland)*, *11*(24). https://doi.org/10.3390/su11246981

Sukri, N. A. N. M., Ismail, Z., & Ariffin, W. T. W. (2020). Conceptual framework for developing a model of effective tree preservation order (Act 172) implementation in construction projects. *International Journal of Sustainable Construction Engineering and Technology*, *11*(1), 18-30. https://doi.org/10.30880/ijscet.2020.11.01.003

Tahvonen, O., & Airaksinen, M. (2018). Low-density housing in sustainable urban planning – Scaling down to private gardens by using the green infrastructure concept. *Land Use Policy*, *75*, 478-485. https://doi.org/https://doi.org/10.1016/j.landusepol.2018.04.017

Tan, T. (2011). Neighborhood preferences of house buyers: the case of Klang Valley, Malaysia. *International Journal of Housing Markets and Analysis*, *4*(1), 58-69. https://doi.org/10.1108/17538271111111839

Thaiutsa, B., Puangchit, L., Kjelgren, R., & Arunpraparut, W. (2008). Urban green space, street tree and heritage large tree assessment in Bangkok, Thailand. *Urban Forestry and Urban Greening*, *7*(3), 219-229. https://doi.org/10.1016/j.ufug.2008.03.002

Tudorie, C. M., Vallés-Planells, M., Gielen, E., & Galiana, F. (2020). Assessing the performance of urban green infrastructure: The case study of benicalap district, Valencia, Spain. *WIT Transactions on Ecology and the Environment*, *243*, 83-95. https://doi.org/10.2495/UA200081

Ubaidillah, N. Z., Saib, R., Ab-Rahim, R., & Ismail, F. (2018). Tagang system development: the impacts and perception of local communities in Terbat Mawang Village, Sarawak, Malaysia. *International Journal of Academic Research in Business and Social Sciences*, *8*(12), 1203-1222. https://doi.org/10.6007/ijarbss/v8-i12/5192

United Nations. (2017). *World population prospects: The 2017 revision, key findings and advance tables*. https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Jan/un_2017_world_population_prospects-2017_revision_databooklet.pdf

United Nations. (2019). *The future is now: global sustainable development report*. https://

reliefweb.int/report/world/global-sustainable-development-report-2019-future-now-science-achieving-sustainable

Uy, P. D., & Nakagoshi, N. (2008). Application of land suitability analysis and landscape ecology to urban greenspace planning in Hanoi, Vietnam. *Urban Forestry and Urban Greening*, *7*(1), 25-40. https://doi.org/10.1016/j.ufug.2007.09.002

Wu, H., Yang, Y., & Hu, J. (2021). Nurturing nature in a mega-city: A decadal assessment of the Beijing Olympic Forest Park. *Socio-Ecological Practice Research*, *3*(2), 91-108. https://doi.org/10.1007/s42532-021-00076-5

Yassin, A. B., Bond, S., & Mcdonagh, J. (2011). *The effectiveness of the riverfront development guidelines in Malaysia* [Paper presentation]. 17th Pacific Rim Real Estate Society Conference. http://www.prres.net/Papers/Azlina_The_Effectiveness_of_the_Riverfront_Development_Guidelines_in_Malaysia (1).pdf

Yeo, O. T. S., Mohd Yusof, M. J., Maruthaveeran, S., Mohd Shafri, H. Z., Saito, K., & Yeo, L. B. (2022a). ABC of green infrastructure analysis and planning: The basic ideas and methodological guidance based on landscape ecological principle. *Urban Forestry & Urban Greening*, *73*(July), 127600. https://doi.org/10.1016/j.ufug.2022.127600

Yeo, O. T. S., Mohd Yusof, M. J., Maruthaveeran, S., Saito, K., & Abu Kasim, J. (2022b). Green infrastructure transitional management sphere analysis of policies and regulations in Kuala Lumpur, Malaysia. *Planning Malaysia*, *20*(2), 61–73. https://doi.org/10.21837/pm.v20i21.1092

Yusof, M. J. (2012). *True colours of urban green spaces: Identifying and assessing the qualities of green spaces in Kuala Lumpur, Malaysia* [Doctoral dissertation, University of Edinburgh]. https://era.ed.ac.uk/handle/1842/8111