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## **Criteria for Sustainable Landscape Maintenance: Addressing Cost Implication**

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### **Abstract**

The upkeep of urban public parks involves tedious maintenance to ensure their functionality, purpose and it involves an immense amount to maintain our public parks. This mixed-methodology research examines the cost-efficiency and strategies to mitigate this issue. The first phase established an experts' verified checklist of maintenance procedures establishing the themes, parameters, and attributes for cost-effective maintenance. Phase two involves Semi-structured Interviews with selected professionals and practitioners focusing on issues related to the current landscape maintenance practice and its operational cost. The study's findings suggest six components that link effective maintenance with cost-efficiency.

**Keywords:** Urban Parks, Maintenance Procedure, Cost-effective, Sustainable Maintenance Process

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### **1.0 Introduction**

Landscape maintenance is the art-keeping the landscape healthy, clean, safe, and attractive when we speak about parks or gardens. For public open space, maintenance is somewhat more complicated considering the vast landscape areas, the limitations of funds, and even the political aspirations of the local authority. The style and intensity of maintenance have a much more significant effect on the cost of upkeep than the organisation or efficiency of carrying it out. The detail or complexity of a site's layout influences its maintenance cost, apart from the type of landscape and its degree of formality. Considering the importance of the public park to the community and how this is a critical link to landscape maintenance, there is a need for a cost-efficiency study that can set forth a strategy that best works to mitigate this issue.

### **1.1 Research Aim and Objectives**

The research revolves around urban sustainable landscape maintenance and the evaluation of cost implications. This research aims to evaluate the cost implication for Malaysian public park maintenance. Hence the research objectives include:

- i. To analyse the existing public park landscape maintenance practice in Malaysia
- ii. To propose and recommend the sustainable and cost-effective public park maintenance practice in Malaysia.

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## 2.0 Literature Review

Urban parks are essential components of everyday life and significantly contribute to users and urban residents for the quality of life of our increasingly urbanised society. The presence of natural assets and their components in the form of greeneries and water elements, and environmental services such as air, wind, and microclimate stabilisation, provide social and psychological services, which are crucial for the comfort and wellbeing of urban dwellers (Chiesura, 2004). The Malaysian Government is fully aware of the importance of greeneries, urban parks, and landscapes in the nation's development, as declared in the 12<sup>th</sup> Malaysia Plan (12MP) second Dimension: Environmental Sustainability focusing on green initiatives and climate change (Economic Planning Unit, 2021). Acting on the awareness, the National Landscape Department (NLD) or Jabatan Landskap Negara (JLN) has intensified their effort and formulated strategies to achieve the Beautiful Garden Nation. The three strategies are:

- **Driving the Nation Towards a Higher Income Economy** – by providing a conducive landscape environment with its own identity to attract local and foreign investments.
- **Ensuring holistic and Sustainable Development** – through effective landscape planning, development, and management.
- **Focusing on the citizen's wellbeing** – by providing adequate landscape spaces for recreation and social interaction among Malaysian multicultural society.

(Source: Jabatan Landskap Negara (JLN), 2011)

Subsequently, the National Landscape Department and the Institute of Landscape Architects Malaysia (ILAM) work collectively to materialise the government's aspiration to build the "Malaysian Beautiful Garden Nation." Many urban parks and gardens have been developed throughout the nation, especially in Malaysian's major cities, to increase urban residents' quality of life and beautify the nation (Ayob, Harun, & Mat Akhir, 2013).

### 2.1 Urban parks and Users' Satisfaction

The aesthetic merit, historical significance, and recreational usefulness of urban parks enhance the attractiveness of an urban park in the eyes of potential users. Natural elements such as trees, water, and greeneries increase the land's value (Ahmad, 2018; Atwa et al., 2019; Kolimenakis et al., 2021; Mansor et al., 2019). Numerous empirical evidence signifies parks and greeneries contribute significantly to the urban residents' happiness and wellbeing (Ayob, 2020; Konijnendijk et al., 2013; Morse, 2000; Saeedi & Dabbagh, 2021). Numerous studies have established the correlations between park design, physical characteristics of urban park elements, and park maintenance with users' satisfaction Shilton, 2021; Chan, Si, & Marafa, 2018; Wheeler, 2009).

In addition, according to Bahriny & Bell (2020), park supervision, quality, and effective maintenance and access control in urban parks also contribute significantly to the feeling of safety, comfort, and satisfaction among users. Nam & Dempsey (2019) iterated that any well-used parks fulfil a certain level of users' satisfaction; thus, they require appropriately scheduled and effective maintenance to maintain the high level of users' satisfaction and safety. Definition of Key Components.

### 2.2 Landscape Maintenance

The upkeeping works to prevent or resist deterioration of a park's initial planning and design is vital to ensure its longevity and achieve its objectives (Liu & Xiao, 2021; Nam & Dempsey, 2019). It is challenging to keep the parks as most of their elements are living things that are constantly changing and evolving (Easton, 2009; Cao, 2021). Shamsuddin (2013) defined *Landscape Maintenance* as part of landscape management that involve the routine works according to daily or weekly operations in caring for green areas, gardens, and parks, which include all scheduled works such as site cleaning, grass cutting, weeding, pruning, fertilising, pest control and the likes.

Landscape maintenance involves the art and craft of landscape up-keeping ensuring a clean and healthy, safe and attractive, of a park, garden, cemetery, institutional ground, and the likes (Fathoni, Latief, & Machfudiyanto, 2020; Ighravwe & Oke, 2019; Atwa, Ibrahim, Saleh, & Murata, 2019; Ayala-Azcárraga, Diaz, & Zambrano, 2019; Easton, 2009; Cao, 2021). This research adopts Shamsuddin's (2013) definition of '*landscape management that involves the routine works according to daily or weekly operations in caring for green areas, gardens, and parks, which include all scheduled works such as site cleaning, grass cutting, weeding, pruning, fertilising, pest control and the likes.*', as it is more suited and relevant to the research and context.

### 2.3 Urban Park – Cost Effective Maintenance

The operation and running of maintenance works involve a considerable chunk of the park's management budget. The current landscape practices and Standard Operation Procedure (SOP) in park maintenance may no longer be efficient as it requires excellent maintenance (R. Ibrahim, 2016; Shilling, 2020; Nam & Dempsey, 2020). The high maintenance cost triggered a financial burden on the states and federal governments, with smaller municipalities badly affected due to their limited maintenance budget.

As a result, proper and scheduled maintenance operations are often neglected or left out, causing significant declines in existing park quality. The rectification of run-down and poorly maintained parks has proven to be more complex and costly (Roziya Ibrahim et al., 2020). In addition to the national economic slowdown due to the current pandemic, budget for the landscape maintenance will continue to shrink (Mansor et al., 2019).

Therefore, there is an imperative need for a paradigm shift to engage in more sustainable and effective landscape maintenance, in our urban parks and other public green and open spaces. Besides being costly, the current maintenance practice of using a substantial amount of chemical fertilisers, pesticides, and fossil fuels for machinery and irrigation is also environmentally detrimental (Roziya Ibrahim et al., 2020).

### 3.0 Methodology

This research applied a mixed-method approach. However, the central study strand remains qualitative despite a questionnaire method used to generate and establish the urban park landscape maintenance checklist.

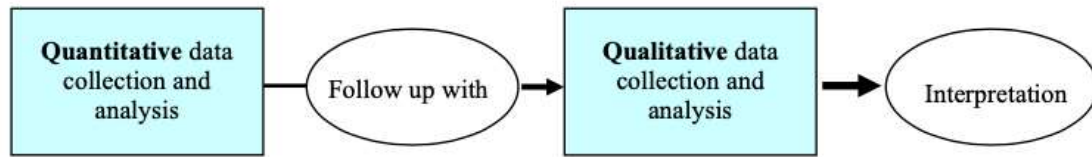


Fig. 1. Creswell and Plano Clark's prototype of the explanatory sequential design adapted for this research.  
(Source: Reproduce illustration from Creswell and Plano Clark, 2011, p. 69).

### 3.1 Research Approach and Phases

This research approach is divided into two phases:

**Phase 1:** Developing parameters for landscape maintenance checklist through literature investigations. A set of questionnaires based on the developed checklist were then distributed to 15 selected experts for ranking. The result was then analysed using the Percentage of Consensus of Agreement Score (PoCoA Score). The final validated checklist included items equivalent to or above the 'Cut-off Point of 80%' (Dawes, 2008; Ayob, 2020). The value of percentage considered as consensus - Percentage of Consensus of Agreement (PoCoA) had been reached was arbitrarily set at either 66.7%, 75%, 80% or 100% agreement amongst respondents (Ayob, 2020; Lau, 2010; Watson, Watson, Ackerman, & Gronvall, 2017). The calculation for Percentage of Consensus of Agreement is done by taking the Accumulated Given Rating by participants and divided by the Total of Maximum Rating [Maximum rating Point (= 10) x Number of Participants (N = 15)] and multiplying by 100.

**Phase 2:** Developing cost-effective landscape maintenance operation through semi-structured interviews with 10 practising professionals. Data gathered were then analysed based on coding and thematic analysis.

The selection of experts for both phases ranges from a wide range of built environment fields with a minimum experience of 15 years in the Malaysian landscape industry, i.e., academics, government sectors (local authority), landscape firms, landscape contractors, and nursery operators among others. The lists of experts were obtained from various gatekeeper's members' databases, i.e. Institute of Landscape Architects Malaysia (ILAM), National Landscape Department (JLN), and Persatuan Arkitek Landskap Awam Malaysia (PALMA).

### 4.0 Result

The results of this research are divided into two categories.

#### 4.1 Phase 1 – Questionnaires and experts' validation on sustainable landscape maintenance.

Ten key criteria associated with sustainable landscape maintenance were identified. Table 1 presents the PoCoA Score analysis of each criterion based on the expert's validation.

Table 1. Experts' validated criteria checklist for Sustainable Landscape Maintenance

NO	CRITERIA FOR SUSTAINABLE LANDSCAPE MAINTENANCE	PoCoA Sco (%)
<b>1.</b>	<b>Plant Strategically</b>	
a.	Applying native species in landscape design.	100
b.	Landscape design should retain as much as possible the existing plants and vegetation.	100
c.	Applying the less-water consumption landscape design (Xeriscaping).	87
d.	Planting selection (through landscape design) should include various heights and habits to enhance the ecological value and biodiversity.	100
e.	Applying hydro zoning (group shrub planting) for effective water consumption.	100
f.	Trees should be the main component of the plant's collection since it requires less maintenance than shrub and ground cover.	80
g.	Applying slow-growing species in the planting scheme for less maintenance.	80
h.	Plant selection should consider the prevailing environmental condition.	87
i.	Utilise the nitrogen-produced plants from the Leguminosae family to improve the infertile soil (symbiosis approach - plants that can provide minerals to other plants).	93
j.	Applying rain garden or bioretention area.	87
k.	Applying bigger size planting holes for areas with low annual rainfall.	83
l.	Consider applying root barriers to control fast root development, especially in the urban landscape.	100
<b>2</b>	<b>Fertilize Organically</b>	
a.	Applying organic fertiliser instead of chemical fertilisers.	100
<b>3.</b>	<b>Soil and Composting</b>	
a.	Use recycling garden disposal materials such as mulching/organic fertilizers (cut grasses/grass clipping & dead leaves. This helps improve the soil texture and reduce the cost of disposal).	100

b.	Use mulching to retain soil moisture. Compost mulching may include dried leaves, grass clipping, branches, crushed stone, shredded bark, sawdust, coconut mulch, etc.	100
c.	Applying soil aeration (for rich, fertile and adequately drained soil).	87
<b>4.</b>	<b>Water Efficiency</b>	
a.	Applying drip irrigation system to reduce overspray towards other plants or structures.	83
b.	Applying a root watering system for high efficiency (enable water, oxygen, and nutrients to bypass compacted soil thus easily reach the tree root system).	80
c.	Creating irrigation zones for an efficient watering system.	83
d.	Utilizing super absorbent polymer (SAP) for improving water use efficiency (growing gel for water retention). This additional water-holding material can be added to planting media- natural fibres and no-toxic gel (during the initial plant growth).	93
e.	Practice rainwater harvesting for effective water source use, especially for watering the plants.	100
<b>5</b>	<b>Pruning and Shearing Strategically</b>	
a.	Pruning is a long-term maintenance strategy and should be executed by trained professionals. Types of pruning may include structural pruning, crown cleaning, crown thinning, crown restoration, etc.	83
b.	Conducting a tree risk assessment for tree safety management.	80
<b>6</b>	<b>Pest and Weed Control</b>	
a.	Using Integrated Pest Management (IPM) for effective/environmentally sensitive approach to pest management.	93
b.	Include the maintenance program for pest and disease control.	87
c.	Perform weeding and loosening the soil.	80
<b>7</b>	<b>Sustainable Hardscape Materials</b>	
a.	Reuse of old building materials in new construction.	93
b.	Applying permeable paving (pervious concrete/asphalt) for effective stormwater runoff filtration and flow.	87
c.	Use energy-saving equipment such as solar energy lighting or a solar water pump system.	100
d.	Use reclaimed materials as part of landscape design (reuse and recycle vegetation, rocks, and soil generated during construction).	93
e.	The use of local materials may promote sustainability and enhance the local character of the place.	100
f.	Ensure quality of materials and workmanship (strictly following design standards and specification).	100
<b>8</b>	<b>Minimizing Fuel Consumption</b>	
a.	Choosing hybrid vehicles and alternative energy sources for landscape maintenance tools and equipment.	80
<b>9</b>	<b>Sustainable Drainage System (SuDS)</b>	
a.	Applying the sustainable drainage system (SuDS) for better surface management and control.	80
<b>10</b>	<b>Sustainable Tools and Equipment</b>	
	Use advanced technology in maintenance such as woodchippers machines to solve the problem of large dumping ground space and support recycling practices.	80

(Source: The Author, 2022; )

#### 4.2 Phase 2 – Semi-structured interview focussing on effective landscape maintenance that links to cost implications.

Discourse related to the critical component and procedure in park maintenance is also highlighted, together with the standard operational maintenance associated with cost reduction. Data gathered during semi-structured interviews with relevant professionals and experts in the fields were coded and analysed for the theme and key components using Nvivo software. Table 2. Detailed the outcome of category 2 result.

**Table 2.** Theme and key components of Effective Landscape Maintenance that links to cost implication

NO	THEME	KEY COMPONENT
1	<b>Park Without Maintenance Is a Waste</b>	a) Sustaining design and function b) Upkeeping for health and safety c) Periodic maintenance
2	<b>The Key Component and Systematic Planning in Park Maintenance</b>	a) The landscape planning and design development phases b) Implementation Phase c) Operational maintenance phase
3	<b>Effective Operational Maintenance to Cost Efficiency</b>	a) Getting a reliable maintenance contractor b) Detailed scope of work for landscape maintenance contracts c) Knowledge competency d) Recycling the landscape waste e) Consistency of the landscape maintenance program f) The application of modern technology for machinery and landscape maintenance tools
4	<b>Technology Vs. Cost Efficiency</b>	a) Efficiency of operation b) Minimise labour c) Prolong maintenance contract

(Source: The Author, 2022)

## 5.0 Discussion

The discourse on the research findings focuses on the theme and key components of Effective Landscape Maintenance that links to cost implication under Category 2. This section presents detailed perceptions and viewpoints of experts.

### 5.1 Park Without Maintenance Is a Waste

Significantly, all experts agreed that a park without maintenance is a waste.

- Sustaining design and function

The landscape is dynamic since it involves living entities that need proper maintenance to survive and sustain. It is 'such a waste' if the substantial investment in the landscape is not maintained correctly since the client has spent significant amount of money on park development. Towards the end, it is not in proper order. Furthermore, Experts also expressed that 'park and maintenance is very synonym and inseparable' since beautiful landscapes are portrayed as landmarks, giving a significant image and identity to a place.

b) *Upkeeping for health and safety*

Poorly maintained landscapes project negative impressions on the visitors. The use of parks will decline due to perceptions that poorly maintained landscapes pose hazards and endanger users, especially children.

c) *Periodic maintenance*

Experts accentuated that poorly maintained trees will incur a higher cost for maintenance in the long run. Thus, scheduled/periodic maintenance is vital in ensuring that all parks (including neighbourhood parks, community parks, or regional parks) can sustain their function and aesthetic appearance and eliminate unnecessary spending.

## 5.2 The Key Component and Systematic Planning in Park Maintenance

The experts agreed that the component and procedure of systematic planning should not be detachable from the cycle of landscape or, specifically, the park development. The finding of this analysis suggested that the key component of an appropriate procedure and systematic planning in park maintenance include:

a) *The landscape planning and design development phases*

All experts highlighted that good landscape maintenance should begin at the preliminary planning and design stage. All designs, selection of materials and sourcing, construction and implementations must consider the sustainability approach and the maintenance operation and procedures. Thus, it ensures the design's practicality and ease of maintenance.

b) *Implementation Phase ease*

During the implementation phase, all technical aspects related to the softscapes should comply with the standard specification outlined by the JLN. It includes planting holes, proper staking/guying technique, root barriers, and other basic procedures for plants to sustain well on site.

c) *Operational maintenance phase*

The final part of the project cycle stands as the significant debate and focus by the experts. As part of the systematic planning, experts have concluded that the critical components during the maintenance period include:

- Knowledge and competency of the workforce involved during the maintenance period.
- The selection of maintenance contractor – adequate experience based on the scope of work and the scope of a given area should be the main criteria for contractor's selection before the tender award.
- The maintenance teams (workforce)
- Checklist and working schedule, including short-term, medium-term, and long-term maintenance activities.
- Adequate tools and equipment, including machinery for maintenance.

## 5.3 Effective Operational Maintenance to Cost Efficiency

Experts are in consensus that cost-saving is not a short-term attempt but a long-term effort and the formulating should begin as early as the landscape planning stage. Parallel to the study's aim to evaluate the cost implication on the Malaysian public park; experts suggested that effective maintenance that is associated with cost efficiency can be obtained by:

a) *Getting a reliable maintenance contractor*

Appointing a reliable maintenance contractor with knowledge and background in landscape maintenance is vital in ensuring that all maintenance cycles can be strategically accomplished, thus attaining good maintenance practice.

b) *Detailed scope of work for landscape maintenance contracts*

Because the landscape is dynamic, a one-year maintenance period is inadequate and insufficient to ensure plants' stability and growth. A more extended maintenance period of three to four years contract is appropriate for better maintenance stability and economically viable investment in modern machinery and tools. It will also improve maintenance operation quality and program.

c) *Knowledge competency*

Experts stress that knowledge competency is vital to attain quality and cost-effective maintenance. Competent and knowledgeable workforces related to plant selection, plant health, and growth can prevent sub-standard, incorrect and inappropriate maintenance practices. Thus, it contributed to effective maintenance and cost-efficiency.

d) *Recycling the landscape waste*

Experts highlighted that landscape waste is not a 'dirty/unusable' waste as it can be reused as a compostable organic item that helps improve the irrigation soil condition of the plant materials. Interestingly, landscape waste helps reduce 25% of fertilizer usage and significantly lowers the landscape maintenance cost.

e) *Consistency of the landscape maintenance program*

The experts agreed that a consistent and periodic maintenance operation could reduce landscape maintenance costs. They also emphasise that periodic maintenance operation has proven to minimise maintenance in the long run and eliminate unnecessary work due to overgrown plant issues that jeopardise the safety of public park users. In addition, overgrowth plants resulted in more workforce, machinery, and time needed to complete the maintenance activities, thus, incurring higher maintenance costs.



f) *The application of modern technology for machinery and landscape maintenance tools*

Most experts highlighted the application of modern technology for landscape maintenance tools and machinery as an essential factor contributing to effective maintenance operation. Advance landscape maintenance and tools technology can effectively reduce human resources, maintenance period, and costs.

#### 5.4 Technology Vs. Cost Efficiency

Most the experts agreed that modern technology employed in operational maintenance practices significantly minimises or saves maintenance costs.

a) *Efficiency of operation*

The efficiency of modern machinery and landscape maintenance tools can assist the landscape operators in expediting their daily, weekly, or monthly maintenance routine, which further results in time-saving and effective maintenance practice.

b) *Minimise labour*

The number of labours involved in the maintenance operation is smaller than the traditional (manual) workforce, resulting in cost reduction.

c) *Prolong maintenance contract*

The current maintenance contract implementation ranges between three to four years and offers a better maintenance opportunity. Landscape contractors can pragmatically invest in modern machinery and tools for maintenance. Ultimately, achieving the quality of the landscape maintenance operation which in line with cost-efficiency.



Fig. 1. Backhoe and lorry were used for landscape waste clean-up due to pruning activity in Seri Iskandar. Less than seven workers were involved in this maintenance operation.

(Source: Photograph by Author in 2021)



Fig. 2. Skylift was used to expedite pruning activities in Bandar Seri Iskandar.

(Source: Photograph by Author in 2021)

#### 6.0 Conclusion & Recommendations

This short study successfully imparts the best practices for effective urban park maintenance in line with cost-effective exercises. This research also developed an innovative Sustainable Landscape Maintenance Checklist to be utilised and benefitted by landscape consultants, contractors, and urban parks managers, among others. In addition, this checklist (refer Table 1) can methodically guide landscape architects, designers, contractors, and municipalities in producing viable landscape projects that are sustainable, maintenance-friendly and cost-efficient. Due to the limited time frame (Grant duration of 3 months), this research has only managed to encompass maintenance issues and practices involving several selected large municipalities such as Dewan Bandaraya Kuala Lumpur (DBKL), Perbadanan Putrajaya (PPJ) and Majlis Bandaraya Ipoh (MBI); and several major developers such as SP Setia and Gamuda Land to

name a few. Thus, the gathered data and developed checklist might need some adjustment before being implemented by smaller municipalities and developers.

In conclusion, this study shows room for improvement in urban parks' standard maintenance operation procedures. The conventional practices were proven ineffective and costly compared to the experts' suggestions and findings from this research. This research has further paved future research direction that potentially investigates recycling park wastes, landscape waste management, and sustainable landscape design with minimum maintenance needs.

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## Paper Contribution to Related Field of Study

This paper contributed significantly to Landscape Architecture, Urban Park Developer and Managers, Park and Amenities Personnel, and the field of sustainable urban development among others.

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