

A REVIEW ON CRITERIA FOR GREEN INFRASTRUCTURE TO BE ADOPTED BY LOCAL AUTHORITIES

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ABSTRACT

Green infrastructure planning has grown in prominence since it was first discussed in the late 1990's. Since the President's Council on Sustainable Development discussed the concept researchers and academics from across the globe, though predominantly the UK, Western Europe and North America, have won the process. However, green infrastructure is an important trust in National Landscape Policy (NLP). At the moment, Malaysia is moving towards to a developed nation by the year 2020. One thing that must take into accounts are enviromental requirement which is to ensure the planned development. This is to ensure that development does not destroy the heritage and the environment. Therefore, efforts are carried out extensively with concerted efforts by the government. In the Malaysian government efforts to intensify efforts to raise awareness and participation in issues of global warming, green technology is the discourse is often featured. The preservation of green spaces in urban areas can function as recreational and social interaction areas in molding citizens who peaceful, harmonious, unified, and healthy. However, the approach to Green Infrastructure in Malaysia is still at an early stage, but these efforts have actually started to walk among scholars and researchers to disentangle the appropriate method with the situation in Malaysia. The purposes of this paper is to identify the green infrastructure criteria to be adopted by local authorities Malaysia to control and effectively development in Malaysia.

Keywords: Green infrastructure, Criteria, Local authorities, Evaluation.

1. INTRODUCTION

Urbanisation has profound effects on the build-up of a city as well as the quality of life of residents. It is generally recognised that in an urbanisation process, as the population increases, its environment will generate various environmental problems. These problems range from impairment of human health to economic and damage to urban ecosystem. As a result, urban residents increasingly live in a city and town with less balanced ecological system (Mazlina, 2011).

The preservation of green spaces in urban areas can function as recreational and social interaction areas in molding citizens who peaceful, harmonious, unified, and healthy. The

execution of the National Landscape Policy (NLP) requires the collaborative efforts of the Government, private sectors, and all Malaysian to commit for effective green infrastructures, deal with climate change, and showcase our own image and identity to make Malaysia more competitive by attracting the interest of local and foreign investors especially to urban areas (National Landscape Policy, 2011).

The green infrastructure (GI) has been described by MacMohan (2001) that is appearing more and more frequently in land and development discussions across the country and around the world.

Its approach complements other approaches that are taken to planning and managing the natural environment. It is an ecosystems based approach that is guided by landscape considerations and when implemented can lead to biodiversity and ecological framework benefits (Liverpool City Council Planning Department, 2008). Green Infrastructure means different things to different people depending on the context in which it is used.

However, the approach to Green Infrastructure in Malaysia is still at an early stage, but these efforts have actually started to walk among scholars and researchers to disentangle the appropriate method with the situation in Malaysia. In this paper, it is more focused on the review the criteria and evaluation of performance for GI in controlling the policy development by providing development and enforcement of existing development. This is for local authorities which had their Landscape Master Plan, the National Landscape Department does not have indicators and performance assessment methods for measuring and monitoring the implementation. There is still no indicator that used to measure the performance achievement of the implementation of master plans in local authorities and programs that have been planned by the Department of National Landscapes as landscape policy makers. The Department of National Landscapes which using the Landscape Master Plan has been able to provide the standards and specifications in accordance with the international norm to ensure the development of green infrastructure can be developed with quality in every development especially in local authorities (Meor Saadon Sofian Mior Razali, 1997).

2. THE HISTORY OF DEVELOPMENT GREEN INFRASTRUCTURE

The GI is a new term, but it is not a new idea. It has roots in planning and conservation efforts that started 150 years ago. The concept involved from two important precedents: (1) the linking of parks and other green spaces for the benefit of people, and (2) the linking of natural areas to benefit biodiversity and counter habitat fragmentation (Mark *et al.*, 2003).

According to Mell (2010), the term green infrastructure first came to prominence in the UK following the work of the PCSD in the work of the Urban Task Force and the Department for Environment, Transport and the Region's (Department of the Environment Transport and the Regions, 2000) proposals for the Urban Renaissance. The goals were to raise some questions and give some new insights to help others share our appreciation of these areas, and our great concern for the future.

2.1. Issues in Metropolitan Washington

The Metropolitan Washington DC will lose 28 acres of open space every day from 1997 to 2020. Normal metropolitan growth does not provide open space although land is abundant. All the parks, open space and recreation areas are often the residual product of the development process.

An experience reveals that parks, open space and recreation area planning, protection, management and use should emphasize the total green space system, rather than individual isolated parks, natural areas, greenways, trails and recreation areas. This GI approach to parks, open space and recreation areas is a way to recognize land for its ecological, recreational, cultural, economic, and conservation values and functions. It seeks to prevent, rather than ameliorate, the degradation of natural lands, air, water, the countryside, parks, recreation areas, farms and forests. It can be used to clean land, water, and air, replenish the human spirit, and help to sustain and regenerate the economy. According to Sir Thomas More's, Utopia described towns surrounded by country belts, which made a permanent boundary preventing the town from extending over the greenbelt. The first attempt establishes a greenbelt is in Britain. It was to ensure cheap food and to minimize the effects of the plague.

First laid out, a city with 17 park reservations, including the Mall, the President's park and urban squares, circles and triangles distributed throughout the plan's baroque street system. The City of Trees as Washington has been dubbed has been defined as much by its natural values as by its national purpose. The establishing of L'Enfant Plan for the District of Columbia in 1790 came out with the concept of setting aside public reservations for parks. Linked a number of public projects together in a regional design scheme that created the first regional park system in the U.S. Olmsted developed a way to simultaneously accomplish drainage, runoff, health, recreation, beautification, and education projects. The result was a system of large and medium sized parks, smaller landscaped areas with ponds for recreation, and linear parkland for pleasure drives, riding and hiking. The effort eventually described as the "Emerald Necklace" created precedents for the future park system planning.

Later Olmsted, Daniel Burnham, Augustus Saint-Gaudens, and others advised the McMillian Commission on a new set of plans for Washington, DC in 1901-02. The commission had been asked to study and report on a park system for the capital, but before it had finished a comprehensive city plan, with a system of connected parks, was the result Frederick Law Olmsted work on Boston Back Bay Fens in the late 1800's.

In the affecting a continuation from Maine to Georgia was outlined the possibility of combining the various efforts of trail-building. The trail conceived as a backbone on which to build a series of public forests, parks and open ways.

2.2. An Approach of Green Infrastructure

People depended on the land and landscape resources that are the most interested ways they can begin to take steps toward a less destructive state of equilibrium between people and their life

support system. These corridors seen as areas relatively free of human use and impact that would be protected and developed wisely as stated by Phil Lewis.

In taking a green space action against a rapid expansion of the Nation's urban areas and passed Public Law 87-80 the Housing Act of 1961. The Act included Title VII-Open Space Land, which recognized the loss of valuable open space. The purpose of this provision was to assist state and local governments preserve open space land that is essential to proper long-range development and welfare of the Nation's urban areas. In the year of 1961, the US Congress said legislation was different from other important laws, such as the Land & Water Conservation Fund, in that it was linked to an agency dedicated to providing housing and urban development and in response to growth and development pressures.

From an ecological planning and project perspective, articulated a view that science and ecology can help decision-makers understand the consequences of different actions. From an overarching perspective, it was believed that in order to understand a region, watershed or site, one must understand the place, its inhabitants and all of the areas physical, biological and cultural history. From a site-specific perspective, their teams of interdisciplinary planners applied the principles of natural drainage to land development projects. Pioneering some of the first GI development projects in America, McHarg demonstrated in the Woodlands of TX and on Amelia Island in Florida ways to incorporate natural drainage into developments without adversely affecting natural systems (McHarg, 1969).

Traditional approaches to the location of open space in metropolitan areas have preserved many major stream valleys and areas important to natural process, more often open space has been conceived as a residual to a desired development pattern itself. McHarg and others stated that design for open space should start with a pattern of open space and limitations for development based on the maximum preservation of natural processes and amenity. Through community beautification and the Green City Strategy, the Society has led a community-based effort to convert urban vacant land into a neighborhood resource that is a part of a larger system of green space.

Report outlines of framework for a regional green infrastructure system by Beth Benson and Michael Hough in year 1995 includes a hierarchy of green space that recognizes the various types of GI, their functions and design requirements.

The preparation of a habitat conservation plan for San Bruno Mountain, was prepared in 1982 and resulted in a reduced size development project, and protection for living resources. The process was hailed as a way to resolve urban development and endangered species conflicts. As a result, in 1982 the Endangered Species Act was amended to permit the preparation of such plans.

The GI initiative emerged in 1999 from the work of the President's Council for Sustainable Development and the implementation of the Rural and Metropolitan Strategies Task Force in US Forest Service.

3. CONCEPT OF GREEN INFRASTRUCTURE

Benedict and O'Connor (2005) stated since the term GI was first used in planning efforts, the plans have been developed in a variety of ways and have served a variety of purposes. This term has become more widely used in land-use and conservation plans within the last few years. The term GI has multiple meanings as it relates to conservation efforts. Just as gray infrastructure describes the functional support system of urbanized areas, the noun of GI refers to nature's life support system (Benedict and Bjornland, 2002). This term describes all of the natural features of a place – its wetlands and wild lands, parks and open spaces, wildlife habitat and ecological systems.

More conservation planners are beginning to understand the importance of planning for GI. The adjective of GI refers to approach to conserve planning that is landscape scale, driven by a broad-reaching public process, and results in an implementation strategy to protect an ecological network of conservation lands.

One of the factors that distinguish GI plans from other conservation plans is that the primary objective is to identify suitable lands for conservation in the context of current and future developed lands. Its planning can assist the traditional land use planning process, delineating lands for protection before the allocation of lands for new development (MacDonald *et al.*, 2005).

This not only to ensure that the natural systems are very important to urbanization, but it also provides a framework for locating new development. Green infrastructure's comprehensive network design gives conservationists and developers the certainty of knowing which lands are available for development, and which are conservation priorities.

Moreover, conservation efforts are much more effective when they are coordinated with growth management and smart growth efforts.

3.1. Criteria of Green Infrastructure

According to Abrahams (2010), he had summarised the criteria of GI as follow:

- (a) Preserves Ecological Functions/Maintenance of Biodiversity/ Provides Ecosystem Service;
- (b) Environmental quality to improve climate/ water/ noise / aesthetics;
- (c) Biological solutions to technical problems such as stormwater management;
- (d) Cultural identity in awareness of the history/ culture of the city;
- (e) City structure is an important element of urban structure/ urban life;
- (f) Provide areas for recreation & everyday public life such as forests, wetlands, trails, parks, rivers, grasslands, cemeteries, and other open spaces;
- (g) Strategically planned and managed for integration between urban development, nature conservation and public health;
- (h) Maintains integrity of habitats to equal the quality as well as quantity; and
- (i) Preserves lands for marketable goods like food production, forest products.

Randolph (2001) had outlined the four types of local conservation planning efforts. Beginning with parks and recreation planning and arriving at present day green infrastructure planning,

Randolph depicts an increasing complexity in planning efforts, as well as a tendency over the years to incorporate a broader, landscape scale focus. (See table1).

Table-1. Evolving Nature of Local Government Land Conservation in the United States

Period	Type	Conservation Tools	Primary Objectives
<1980	Parks & Recreation Planning	Land acquisition; park planning & management	Active recreation, scenic amenity
1980s	Open Space Planning	Land acquisition & easement; park planning & management	Active recreation, scenic amenity, farmland protection, urban forestry
1990s	Greenways & Open Space Planning	Land acquisition, easement, floodplain zoning, park and greenway planning & management	Active and passive recreation, scenic amenity, farmland protection, urban forestry, urban wildlife
2000	Green Infrastructure	Land acquisition, easement, floodplain management, Smart Growth Management tools, conservation land development, partnerships with landowners, land trusts	Hubs and links for active and passive recreation, scenic amenity, farmland protection, urban forestry, urban wildlife, regional and state ecological systems, integration of conservation and growth management

3.2. Comparison Criteria of Green Infrastructure

Five authors have made the comparison. In order to guide development and respond to changes, GI has been introduced to provide more informed and systematic way of considering priorities in the spatial planning process, and environmental friendly techniques which can be molded to fit into design situations (Davies and Reddie, 2006). Jerke (2008) identifies green infrastructure as one way to conserve natural systems and areas within urban communities.

According to American Society of Landscape Architects (ASLA), green infrastructure has two scales: national or regional level; and urban level. The national or regional level refers to interconnected networks of park systems and wildlife corridors; and the urban level refers to parks and urban forestry, but also to green roofs, walls, and other techniques to reduce energy consumption and storm water runoff. Five contexts and functions of GI [16]:

- (a) Sustainable resource management in land and water resources;
- (b) Biodiversity relating to the importance of connectivity of habitats at a variety of landscape scales;
- (c) Recreation relating to greenways and the use of non-car routes to address public health and quality of life issues; and
- (d) Landscape resources examined from aesthetic, experiential and functional points of view; and Regional development and promotion of overall environmental quality and quality of life.

Benedict and McMohan (2002) summarized seven principles for successful GI initiatives:

Principle 1: To plan and protect interconnected green space systems, successful initiatives can be used as the framework by sharing similar strategies.

Principle 2: Design and plan GI before development. Restoration of natural systems is far more expensive than protecting and preserving existing landscapes. It is essential to identify and protect critical ecological sites and linkages in advance.

Principle 3: Linkage is a key point. The network of different system components is critical to maintain vital ecological processes, services and biodiversity of wildlife populations. It is also required linkages among different agencies, nongovernmental organizations, and the private sector.

Principle 4: Green infrastructure functions across multiple jurisdictions and at different scales, which means green infrastructure systems should connect across urban, suburban, rural and wilderness landscapes and strategically incorporate green space elements and functions at corresponding scales.

Principle 5: Green infrastructure is grounded in sound science and land-use planning theories and practices, with disciplines including conservation biology and landscape ecology, urban and regional planning, and geographic analysis and information systems.

Principle 6: Green infrastructure, as a critical public investment, should be included in the annual budget. Resources should be tapped in state and federal agencies for planning and management activities.

Principle 7: Green infrastructure involves diverse stakeholders, with stakeholders of the initiatives having diverse backgrounds and needs. Successful GI efforts forge alliances and interrelationships among various organizations.

They mentioned the links are connecting the system together and enable GI networks to work; landscape linkages are large protected natural areas that connect existing parks, preserve or natural areas, and provide sufficient space for native plants and animals to flourish while serving as corridors connecting ecosystems and landscapes. Landscape linkages may also provide space for the protection of historic sites and offer opportunities for recreational use. All GI linkages link elements to form landscape systems and enhance the connectivity. To integrate GI elements into the urban development site planning and design (Benedict and McMohan, 2002) summarize the procedure as follows:

- (a) Recognize and address the needs of both people and nature;
- (b) Provide a framework for integrating diverse natural resource and growth management activities in a holistic, ecosystem-based approach;
- (c) Ensure that both green space and development are placed where most needed and most appropriate;
- (d) Identify vital ecological areas and connectivity prior to development;
- (e) Identify opportunities for the restoration and enhancement of functioning systems in already developed areas;
- (f) Enable communities to create a system that is greater than the sum of its parts; and
- (g) Enable conservation and development to be planned in harmony, not in opposition to one another.

Gidding (2005) stated the combination of economic power and planning has built the image of individual space and landmarks, which contribute to the character and space of cities. Open spaces provide places for recreation, social interaction, psychological renewal, and environmental education, and are valuable carbon sinks and wildlife habitats. Because open spaces and natural systems are important to the future of cities, it is critical for communities to plan and develop such spaces and systems as an integral part of the urban fabric. Rethinking and reinvesting in networks of parks and other open spaces is a remedy for long-term urban landscape decline.

There are three key dimensions, which are context, quality, and interaction to plan or to evaluate the open spaces as GI for the functions of conservation, enhancement, linkages, creation and development initiatives, opportunities and proposals (Jerke, 2008).

Table-2. Green Infrastructure Elements and Green Infrastructure Systems

Green Infrastructure System	Green Infrastructure Elements
Open Space Systems	<ul style="list-style-type: none"> ▪ Public spaces ▪ Recreational Parks ▪ Green roofs ▪ Street Trees ▪ Eco-industrial Parks ▪ Public Gardens
Transportation Systems	<ul style="list-style-type: none"> ▪ Green Roads ▪ Porous Pavement ▪ Recreational Pathways (Walking) ▪ Recreational Pathways (Cycling)
Stormwater Management Systems	<ul style="list-style-type: none"> ▪ Water courses ▪ Stormwater swales ▪ Stormwater wetlands (Constructed) ▪ Rain Garden

4. GREEN INFRASTRUCTURE EVALUATION

A MacDonald *et al.* (2005) whom proposed the guidelines or checklists of best practices for developing and evaluating GI plans, stress the multifunctionality of GI. The definition is protecting ecological functions alongside goals for providing benefits to humans, in terms of land use, such as agriculture, forestry and green urban space. This raises an interesting discussion about whether to priorities certain goals and functions of GI. Miller (2008) distinguishes between conservation-with-development approaches and development-with-conservation approaches, where the latter are generally led by developers and priorities the goal of land development, whilst the former tend to be led by conservation organizations and priorities the reduction of development impact on conservation. The secondary functions have been termed co-benefits, for example, urban forests provide the co-benefits of carbon sinks and purifying drinking water alongside climate mitigation functions, such as storm-water and air pollution management (Foster *et al.*, 2011).

Wright (2010) argues that an environmental focus of GI is fundamental is to secure its objectives, which suggests that monitoring should priorities environmental aims. In order to evaluate effectively, there is a need to be clear and genuine about project goals, which requires the creation of definitions, guidelines and standards, as well as reliable statistics on conservation

development. In 2007, the Streamlining European Biodiversity Indicators (SEBI) initiative summarised the properties of efficient indicators of ecosystem resilience. The SEBI initiative in 2010 identified several indicators with specific relevance to GI, such as the fragmentation of natural and semi-natural areas, the fragmentation of river systems, ecosystem coverage and nationally designated protected areas.

Owing to the different elements involved in GI, MacDonald *et al.* (2005) highlight the importance of basic GI design on both science and stakeholder feedback. Similarly, Hostetler *et al.* (2011) propose a systems approach to GI, which involves the views of built environment professionals and residents.

While Angelstam *et al.* (2003) recommended that both natural and social sciences are involved in conservation planning and policy implementation. For example, the assessment is not only the qualities of the habitat and species, but also the qualities of the conservation institutions and management.

This is encompassed by the concept of ecological solidarity, which consists of two main elements, in terms of the dynamics of ecological processes and biodiversity; and the social recognition that humans are part of ecosystem functions. This proposal of evaluation at both a natural and social scale is further supported by research conducted by Mabelis and Maksymiuk (2009) who demonstrate the importance of public participation in the success of green urban policy in their comparative analysis between the Hague and Warsaw.

5. DISCUSSION

Malaysia is moving towards a developed nation by 2020. The environmental requirements should be emphasized to ensure the planned development would not destroy the heritage and the environment itself. Therefore, efforts are carried out extensively with concerted efforts by the government. Among the issues to be addressed is to establish the Ministry of Science and Green Technology. The policy of green technology development has been developed to provide incentives to industry players to invest in the development of green technology.

For local authorities who already had their Landscape Master Plan, the National Landscape Department does not have indicators and performance assessment methods for measuring and monitoring the implementation. There is still no indicator that used to measure the performance achievement of the implementation of master plans in local authorities and programs that have been planned by the National Landscape Department as landscape policy makers. The National Landscape Department which using the Landscape Master Plan has been able to provide the standards and specifications in accordance with the international norm to ensure the development of GI can be developed with quality in every development especially in local authorities. The government is aware of the importance of landscape in the development of our nation. In response to that, the National Landscape Department entrusted with the responsibility of greening the nation and ensuring our landscape is at its best condition. The department has been mandated to lead the nation's efforts in achieving the aspiration of Beautiful Garden Nation, in line with

Malaysia's goal of being a developed nation by 2020. Hence, the quality of Malaysian living environment and socio-economic standards can be protected and alleviated.

6. CONCLUSION

In Malaysia, GI was stated in any urban development involving various land uses such as residential, commercial, industrial and institutional and mix-development areas require at least 10% of open space and recreational areas (TCPD, 2006). Regarding with the National Landscape Policy (2011), GI has existed and it is contained in the national policy landscape in the thrust 3. However, there are many problems in the implementation of GI. Up to now, it is still not fully implemented on several problems such as there is no comprehensive framework of GI. Towards this, researcher will first explore the relevant literature available and subsequently use exploratory study and content analysis to generate the criteria and sub criteria perceived to be important to GI. Based on the issues identified in this study, the important thing is to determine what the appropriate criteria used to measure the performance of GI in Malaysia. The research issues that are addressed in this study are the important evaluation aspects. Performance criteria of GI require inputs from policy maker (National Landscape Department) and implementers (local authorities) and the importance of performance criteria to develop the indicators of GI evaluation need to be clearly identified and understood. Outputs from the research will contribute to the decision model of criteria and sub criteria of GI performance to help the local authorities make decision in terms of important criteria and sub criteria when developing a GI. Finally, a model can be developed as mechanism of evaluation (tools) to measure performance of the implementation of the GI across local authorities in Malaysia.

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