

Exploring Opportunities of Adopting Biophilic Cities Concept into Mixed-Use Development Project in Malaysia

K Z M Arof¹, S Ismail², N H Najib³, R C Amat⁴, N H B Ahmad⁵

^{1,2,3,4,5}Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia Kuala Lumpur, Jalan Sultan Yahya Petra 54100 Kuala Lumpur, Malaysia.

Corresponding e-mail: kzahreen@graduate.utm.my

Abstract. Mixed-use development project in urban area emerged to cater the increase of population in the region. Due to rapid urbanisation, many research recommended the engagement of human with nature in cities development, including the mixed-use development project since nature and human are holistically created to complement each other. This is where the United Nation (UN) under its sustainable development programme has established 17 development goals that amongst all cover both sustainable cities and communities. This shows the urgency of having cities that best fit human nature. However, although many mixed-use development projects were constructed with senses of nature, many of these projects are harmful to environment as they are unable to sustain the natural habitat as well as human needs. Hence, there are many attempts to connect human with nature in Malaysia via sustainable cities and green cities concepts although no specific guidelines on these have been established. Recently, emerged the term biophilic cities, a new concept combining sustainable and resilient cities, which are also seen as the panacea to these mixed-use development project issues despite the efforts done via the former concepts of sustainable and green cities alone. Generally, biophilic cities resemble green cities with a few enhanced greener criteria that affiliate human to nature as opposed to green and sustainable cities that merely bring nature to human. Therefore, this paper aims at investigating the elements of biophilic cities that can be adopted for mixed-use development project in Malaysia. Via systematic literature review, this paper listed the criteria of biophilic cities from previous studies, which are then used in designing the questionnaires distributed to 173 construction players in the mixed-use development projects in Malaysia. It is found that biophilic cities encompass four main criteria that are important to be adopted in mixed-use development project in Malaysia, namely “building”, “block”, “street” and “neighbourhood”, with a total of eight design elements. As biophilic cities are closer to human needs and environment whilst able to manage the rapid urbanisation and increased world population that is meant to be tackled by the mixed-use development project, construction players should start to consider adopting the biophilic cities concept in their mixed-use development project in Malaysia.

Keywords: biophilic cities, mixed-used development project, opportunity, Malaysia

1. Introduction

Today, more than half of the world's population lives in cities [1]. By 2050, the urbanisation and population growth are projected to add 2.5 billion people [2]. In fact, Malaysia is ranked among East Asia's most urbanised countries [3], where consequently, Malaysia faces challenges in meeting the needs of urban population and expansion. Due to the needs in tackling the rapid urbanisation and



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population growth that are also in line with the United Nation's (UN) Sustainable Development Goals #11 on Sustainable Cities and Communities, The Eleventh Malaysia Plan 2016-2020 addresses the strategic thrust of "pursuing green growth for sustainability and resilience" [4]. The Malaysian government focuses on strengthening the enabling environment, promoting sustainable consumption and production, conserving natural resources, and strengthening against climate change and natural disaster [5].

In line with Malaysia Plans, policies, frameworks and guidelines are established to support the sustainable development including National Physical Plan (NPP) that addresses integrated and sustainable land use planning to manage environmental sensitive areas, safeguard water resources and conserve prime agricultural areas [6,7]. In governing the climate issues, National Policy on Climate Change (NPCC) is established in enhancing environmental conservation and sustainable use of natural resources as well as integrating climate change responses [8]. The National Green Technology Policy (NGTP) is introduced to establish a conducive green environment in Malaysia with green technology to accelerate the national economy and promote sustainable development under four pillars: energy, environment, economy, and social [9]. In addition, National Urbanisation Policy (NUP) is established in 2006 comprising of 30 policies on planning, developing and managing the urban environment [10]. The aim is to deliberate towns or cities in Malaysia with a vision of harmonious communities and living conditions through sustainable urban development.

Hence, together with these federal-government-centric efforts, the researchers, local governments, developers and consultants have tried to promote a new city concept that best fits to human being and connect with the nature, including two most usable terms to describe eco-friendly cities, namely biophilic cities and green cities. However, in comparison with green cities, the term biophilic cities, which is earlier implemented by Singapore whom has been crowned as the first biophilic city in the South East Asia in 2013 [11] is still alien for many [12], including Malaysia hence causing misconception amongst city planning stakeholders. This is proven as various sustainability efforts done by the government in terms policies, frameworks and guidelines are conflicting from the true concepts as well as isolated and not integrated amongst government ministries and agencies [13].

Therefore, this paper aims to investigate the key elements of the main concept of biophilic cities that can be adopted for the mixed-use development project in Malaysia. An initial discussion on the definitions of biophilia, biophilic cities and green cities is undertaken before the findings of systematic literature review on the design elements of biophilic cities in general are elaborated. After the discussion on research methodology performed throughout this study, this paper discussed in detail the analysis obtained from the questionnaire survey on the criteria of biophilic cities design elements that are specifically suitable for mixed-use development projects as a part of the intention of exploring the opportunities of adopting biophilic cities concept into mixed-use development project in Malaysia.

2. Biophilia, Biophilic Cities and Green Cities

Biophilia is an inherent human inclination to natural systems and processes [14] that urges human to affiliate with other forms of life [1]. Biophilia advanced the idea that the contact with nature plays a fundamental role in human physical and mental well-being [15]. Subsequently, the term biophilic emerged as popularised by Harvard myrmecologist and sociobiologist, E.O. Wilson [16] that was originally rooted from the word biophilia. [1] defines biophilic as the innately emotional affiliation of human beings to other living organisms, hence part of ultimate human nature.

The concept of biophilic that near to human needs and close to nature makes biophilic dramatically popular in city planning. [17] mentioned that biophilic city planning is about redefining the very essence of cities as places of wild and restorative nature. In the perspective of city planning, biophilic is about understanding cities as places that already harbour much nature and places that can become, through bold vision and persistent practice, even greener and richer in the nature they contain [17]. [16] define biophilic cities as cities of abundant nature in close proximity to urbanites that value residents' innate connection and access to nature through opportunities to be outside and to enjoy the multisensory aspects of nature by protecting and promoting nature within the city. Hence, it is

suggested by this paper that biophilic cities are cities that generate natural systems and create an ecosystem for biodiversity outcomes.

“Green cities” are a special case of “sustainable development” for cities [18] that have common green-blue infrastructure, such as city forests, river systems and lakes, parks and gardens, roof and wall greening [19]. [20] define green cities as multifunctional spaces that benefit humans, wildlife and the larger environment. [21] further suggest that green cities promote energy efficiency, renewable energy and green solutions, apply land compactness with mixed land use and social mix practices, and anchor its local development in the principles of green growth and equity. All in all, green cities are one that is characterised by its environmental performance, with the intention of maximising social and economic benefits [21,22].

3. Elements of Biophilic Cities

It is well-accepted that the green infrastructure of a city and region rivers and riparian areas, floodplains and wetlands and large swaths of forested land all provide essential services, that help cities and urban regions respond to and spring back from climatic and natural events. Sustainable development should be highly durable and low energy consumption [23], while cities with large natural wetland systems will be better able to absorb floodwaters from hurricanes and storms. These are all perceived as amongst the design elements of biophilic cities, which are summarised as in Table 1.

Table 1. Design elements of biophilic cities.

Criteria	Design Elements of Biophilic Cities	Criteria	Design Elements of Biophilic Cities
Building	Green rooftops Sky gardens Green atria Rooftop garden Green walls Daylight interior spaces Green courtyards Biomorphic approach Opening window Indoor potting plant	Neighbourhood	Community gardens Neighbourhood parks Pocket parks Green grey fields Green brownfields Urban creeks/riparian areas Urban ecological networks Urban park Green schools City tree canopy City green roof
Block	Clustered housing in green areas Native species yards and spaces Green streets Urban trees Low impact development (LID)	Community	Community forest/orchards/garden Green utility corridors River systems Riparian systems Floodplains
Street	Edible landscaping High degree of permeability Stream daylighting Stream restoration Urban forests Ecology parks Green connection Pavement to park Green street	Region	Regional greenspace systems Greening major transport corridors Sustainability hub Permaculture nursery Organic market
		Environment	Enhance native species ratio Large water area
		Sensory	Aromatic plant Natural sound

Source: Adopted and modified from [16,24–27]

Table 1 partially addresses the detailed understanding of the biophilic design element. The 45 design elements collected from five relevant studies on biophilic cities, namely [16,24–27] are divided into eight criteria, which may assist designers and developers to achieve practical application of biophilic design in the future development. The first criterion of the design element of biophilic cities is “building”, which is related to nine design elements that are integrated onto, into and around buildings within the boundary of the property as conceptually, the building with biophilic design elements involved with environmental features such as air, sunlight, plants etc. Façade greening building with vegetative façade for example at the rooftop garden, sky garden and green atria and green courtyard will reflect the remarkable benefits associated with organic components as insulation sources and foods. Food production offers opportunities to at once reconnect to landscape and nature, but also to provide some foods in times and circumstances where food cost and availability may be difficult [16]. Daylight interior spaces are also important for biophilia to improve morale, comfort, health, and productivity, where these can create interesting architectural forms resembling the life forms encountered in nature yet clearly viewed as an organic material [16].

Human usually express a robust and consistent preference for exterior views of the second and third biophilic cities design elements criteria of “block” and “street” specifically when it contains natural features. Human generally will prefer natural rather than artificial materials although the artificial materials are close to the exact copies of the natural products [14]. The green infrastructure surfaces, such as green street, green connection, open network road surfaces, native species yards and spaces, urban forest, ecology park etc. help to reduce the heat absorption, CO₂ emissions and noise pollutions. The application of Low Impact Development (LID) on the other hand is to preserve, restore and create green space using soils, vegetation and rainwater harvest techniques, where water can be managed in a way that reduces the impact of built areas and stimulates the natural movement of water within an ecosystem or watershed [28]. Green streets, green connection and pavement to park are the public access to be provided and accessible to all city residents, which may provide opportunities for recreation and nature-based experiences that generally have lower technical and engineering design requirements to be constructed.

As for “neighbourhood”, “community” and “region” criteria for biophilic cities design elements, many steps can be taken to lower the temperature of the environment in order to increase environmental and human thermal comfort. By means of the biophilic cities concept such as vegetated green roofs, green schools, community forest, urban creeks and riparian areas, greening major transport corridors etc. will necessitate to naturally cool the surrounding air, diminish dust, reduce the noise pollution and stabilise carbon dioxide concentration in the atmosphere at level no more than 20 percent above [29]. In addition, it is inevitable that under these three criteria of biophilic cities design elements, forests, parks and green spaces are important places for socialising and for forming new friendships. [15] in a study of Zurich conclude that such green areas are important vehicles for social inclusion and for integration of immigrant youth. Meeting and communicating in open spaces can be a platform for breaking up social segregation, and therefore, public places are indispensable for meeting and establishing contacts [15]. Similar conclusions have been reached about community gardens in biophilic cities, and such green areas integrated into living environments often serve as ready spaces for breaking-down barriers of various sorts in urban neighbourhoods and providing opportunities for informal contact and socialisation. Friendship and social interaction provided by direct participation in nature activities can in turn helps to strengthen adaptive capacity within the biophilic cities [16].

Human particularly respond to light, sound, touch, smell and other sensory environmental circumstances. As such for the last two criteria of biophilic cities design elements, namely “environment” and “sensory”, these two highlight the amalgamation of properties found in nature into the built environment and also enhance native species ratio by integrating the culture and ecology particularly prominent ecosystems, such as watersheds and dominant biogeographical features, namely rivers, oceans, mountains etc. As the main aspect of biophilic cities is participation and engagement with nature, under the criteria of “environment” and “sensory”, these may include recreational activities, hiking, bird watching to native plant societies to fungi and food foraging. Connection

between human and nature in biophilic cities can create a positive and protective attitude to the environment. Building and landscapes that has compatible connection with ecosystem and local habitats tend to be highly effective design strategy and preferred in the concept of biophilic cities [30].

4. Methodology

This paper involves systematic literature review on five related studies on biophilic cities design elements for general development projects around the globe. All the 45 design elements are grouped into eight criteria and subsequently translated into questionnaires based on 5-Likert criteria of importance following [30] to suit the scope of biophilic cities concept for mixed-use development project in Malaysia. With the intended sample of 170, these questionnaires have undergone a pilot study on 17 experts (10% of intended sample following [31] of biophilic cities and six Malaysian mixed-use development projects sharing the same characteristics of blending both residential and commercial uses (commercial use on the first floor with residential uses on upper floors) with Cronbach's alpha recorded at 0.975, which shows that the questionnaires are highly reliable and internally consistent [32]

Eventually, the questionnaires are distributed through online survey website to 173 respondents involved in mixed-use development projects in Malaysia to get the opinion-based feedback on the 45 design elements of biophilic cities whether or not they are suitable for the Malaysian mixed-use development projects. Nonetheless, 160 respondents have responded consisting of consultants (74 respondents at 46%), local authorities (54 respondents at 34%) and developers (32 respondents at 34%). All the collected data are then being coded to allow statistical analysis using Statistical Package of Social Sciences (SPSS) software to quantify and identify the criteria ranking based on Relative Importance Index (RII) of the proposed design elements of biophilic cities for the Malaysian mixed-use development projects.

5. Results and Discussion

Table 2 illustrates the criteria ranking of the design elements of biophilic cities for mixed-use development projects in Malaysia obtained via questionnaire survey, which the importance ranking are indicated via tone of colours from darker (most important) to lighter (least important). To select the most important design elements for each of the eight criteria of the design elements of biophilic cities for the Malaysian mixed-use development projects, only Relative Importance Index (RII) recorded more than 80.0 are selected following the suggestion by [33]. For "building" criterion as design element of biophilic cities for mixed-use development projects in Malaysia, only three elements are deemed as important, namely (1) designed with opening window; (2) equipped with green courtyards; and (3) designed with daylight interior spaces. In addition, for the second and third criteria of "block" and "street", only two elements of biophilic cities for mixed-use development projects in Malaysia exceed the threshold value of RII 80.0, namely (1) designed with low impact development (LID); and (2) designed with clustered housing around green areas; as well as (1) designed with ecology parks; and (2) maintained/designed with urban forest, respectively. As for the fourth criterion of design element of biophilic cities for the Malaysian mixed-use development projects, namely "neighbourhood", only one design element is deemed as important that can be adopted in the mixed-use development projects in Malaysia, namely these mixed-use development projects must be designed with community gardens.

However, for the rest of four criteria out of the total eight criteria, none of the design element of biophilic cities are deemed as important to be adopted for the mixed-use development projects in Malaysia. Hence, in general, when all the RII of each criterion are calculated individually, it is found by this paper that only four criteria of the design elements of biophilic cities are claimed as important to be adopted in the Malaysian mixed-use development projects, namely "building", "block", "street" and "neighbourhood", with a total of eight design elements. This result evidently shows that very minimal elements of biophilic cities are deemed as important to be adopted in the mixed-use

development project in Malaysia based on the fact that the understanding on biophilic cities is still lacking and alien to many. Strong emphasise is also given by the respondents on the design elements of typical or conventional mixed-use development projects in Malaysia, which resemble the design elements of green cities, a term that is more publicly accepted and understood by Malaysian construction industry players, namely community garden and daylight interior spaces, rather than biomorphic approach and riparian systems, that are seen as very unfamiliar in the Malaysian context. On the other hand, it is also doable to investigate the elements of biophilic cities already adopted in specific mixed-use development projects in Malaysia in forecasting the way forward of biophilic cities implementation throughout the country.

Table 2. Criteria ranking of the design elements of biophilic cities for mixed-use development projects in Malaysia.

Criteria	Design Elements	RII	RII Rank	Average RII	Average RII Rank	Criteria	Design Elements	RII	RII Rank	Average RII	Average RII Rank			
Building	Opening window	82.63	1	75.58	3	Neighbourhood	Community gardens	80.00	1	73.13	4			
	Green courtyards	80.75	2				City tree canopy	78.38	2					
	Daylight interior spaces	80.63	3				Green schools	75.00	3					
	Green atria	76.88	4				Green grey fields	74.50	4					
	Indoor potting plant	75.38	5				Neighbourhood parks	72.88	5					
	Sky gardens	75.25	6				City green roof	72.25	6					
	Green walls	73.25	7				Urban ecological network	72.13	7					
	Biomorphic approach	72.63	8				Urban park	70.50	8					
	Rooftop garden	71.88	9				Pocket parks	70.38	9					
	Green rooftops	67.38	10				Urban creek/riparian area	69.50	10					
Block	Low impact development (LID)	82.13	1	78.58	1		Community	Green brown fields	68.88			11	75.58	3
	Clustered housing around green areas	81.25	2			Community forest/orchards/garden		77.88	1					
	Green streets	78.25	3			River systems		77.25	2					
	Urban trees	75.75	4			Green utility corridors		76.25	3					
	Native species yards and spaces	75.50	5			Floodplains		74.88	4					
Street	Ecology parks	83.75	1	76.99	2	Region		Riparian systems	71.63	5	71.85	7		
	Urban forests	81.38	2					Organic market	75.38	1				
	Pavement to park	78.63	3					Sustainability hub	74.25	2				
	Green connection	78.00	4					Green transport corridors	71.75	3				
	Edible landscaping	76.38	5					Greenspace systems	71.63	4				
	High degree of permeability	74.50	6					Permaculture nursery	66.25	5				
	Stream restoration	74.13	7				Environ- ment	Large water area	74.38	1			72.76	6
	Stream daylighting	73.63	8					Native species ratio	71.13	2				
	Green street	72.50	9					Sensory	Natural sounds	75.88				
							Aromatic plant		70.00	2				

Yet, subsequently, if all the RII of these 45 design elements of biophilic cities for the Malaysian mixed-use development projects are calculated based on average value under each of the eight criteria as summarised in the last two columns in Table 2, different results are tabulated. In contrast, the top three criteria of biophilic cities for the Malaysian mixed-use development projects are (1) block; (2) street; and (3) building and community. This indicated that the respondents agree that focus should be given more on these three criteria of block, street as well as building and community in the construction of mixed-use development projects adopting the biophilic cities design elements. However, similar to the previous discussion on the RII of each criterion, this paper observes that this agreement is again merely aligned with the criteria of green cities, rather than other criteria that theoretically represent biophilic cities, namely region and sensory.

Nonetheless, although none of these criteria recorded the average RII values of 80.0, these values are deemed acceptable, namely between most important to important, as all is above 70.0. This

indicated that the respondents agree that focus should be given more on these three criteria of block, street as well as building and community in the construction of mixed-use development projects adopting the biophilic cities design elements. However, similar to the previous discussion on the RII of each criterion, this paper observes that this agreement is again merely aligned with the criteria of green cities, rather than other criteria that theoretically represent biophilic cities, namely region and sensory.” These acceptable values provide hopes to the mixed-use development projects in Malaysia that there is great opportunity for the elements of biophilic cities to be adopted in the future. This opportunity can be seen by blending the design elements of the former green cities to the biophilic cities via some improvements or rejuvenations on the existing green cities design elements adopted in the mixed-use development projects in Malaysia.

6. Conclusion

Number of people living in cities increases by day that results bigger size of urbanisation area. Governments, researcher and key players in construction industry have put attempts to offer the best living place for people that suites their human needs. Biophilic cities and green cities concepts are quite similar, yet the findings of this paper suggested that biophilic cities cover more sustainable elements that near to human needs. This paper found that since biophilic cities are still an alien concept to Malaysia, the main criteria for biophilic cities concept in the Malaysian mixed-use development projects should consist of four main criteria: “building”, “block”, “street” and “neighbourhood”, with a total of eight design elements. Hence, construction players that involved in design stage of city planning should consider all these criteria and design elements by prioritising the criteria based on the ranking found in this paper as to fulfill the true biophilic cities concept. For future research, this paper recommends further data collection from the expert focus group interview with subject matter experts (SMEs) on biophilic cities and mixed-use development projects for higher reliability and optimum result. On the other hand, it is also doable to investigate the elements of biophilic cities already adopted in specific mixed-use development projects in Malaysia in forecasting the way forward of biophilic cities implementation throughout the country. The planning concept of the biophilic cities for mixed-use development projects in Malaysia need to adopt clear and pertinent design strategies by ensuring active engagement of all stakeholders in city planning fraternity. The most important mechanism is that biophilic cities must be integrated with the designs that have holistic approach which affiliate human with the nature and ecosystem.

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