

PPGIS mapping of Landscape Values and Development Preferences in the Greater Kuala Lumpur

Abstract

Unplanned and poorly managed urbanisation can give rise to pollution, inequity, impacts on ecosystem services and reduced liveability. The objective of this study is to identify, map and compare residents' landscape values and development preferences using Public Participatory GIS to provide place-specific recommendations for urban planning in Kuala Lumpur. The study compares a range of landscape values and development preferences to assess conflict and compatibility. Landscape values represent valued landscape typologies such as aesthetic and spiritual locations, while development preferences represent participants' preference on whether a location should be developed or conserved. A conceptual model of compatibility and conflict is used to consider the relationship between development preferences and landscape values in two dimensions. Conflict emerges in areas where there is disagreement between landscape values and development preference such in areas recognized for its biodiversity and identified for development. Using a web-based PPGIS social survey, 249 respondents were surveyed across Greater Kuala Lumpur. Our mapping found most of the locations identified were in Kuala Lumpur, Petaling Jaya, Shah Alam, Klang and Kajang. Landscape values which support conservation were generally found in areas with compatible development preferences. The results suggest the participants identified locations for pro-environmental development which were compatible with landscape values, mainly in the forested areas surrounding Kuala Lumpur city; but there were also areas of conflict, mainly inside Kuala Lumpur city regarding pro-development preferences and landscape values. The results of this study potentially provide a pathway forward for supporting urban development that is sustainable and also accounts for community interests.

1. Introduction

The world is becoming more urbanized, with more than half of the world's population in urban areas in 2011 and an estimated 70% of the world's total population by 2050 is expected to be in urban areas (Giap and Aw, 2014). The United Nations (2011) projects that the Asian regions will have half of its population living in urban areas by 2020. With the increasing concentration of urbanisation, there is also a growing need for focus on the quality of living in cities. The measurement and characterisation of liveability has assisted in policy-making, framing appropriate policies for urban development, as it has been used in literature to equate with sustainable development to indicate a highly liveable city (Sassen, 1991; Glaeser, 2011). The concept of liveability has been broadly defined with close relations to environmental quality, quality of life and sustainability (van Kamp *et al.*, 2003). Van Kamp (2003) stated that there are many ways to conceptualise liveability but very little consensus about which framework to employ, with each author using the same term, but carrying a different meaning, giving content to the concepts of liveability. For the purpose of this research, we will relate liveability to social, economic and physical aspects which are, in part, a property of environmental quality and have important impacts on health and wellbeing (Camagni, Capello and Nijkamp, 1998; Newman, 1999).

In Malaysia, rapid urbanisation has caused losses and degradation to physical environments that are important contributions to liveability (Shamsuddin, Hussin and Abu, 2013). With the growth of Malaysia's metropolitan capital, Kuala Lumpur (KL) and surrounding municipalities, the need for an effective public participation approach to urban planning increases due to the possible controversial compromises that could occur, such as intensifying development by sacrificing open spaces which could lead to potential land-use conflict (Brown and Raymond, 2014). Although multiple qualitative studies have been conducted to understand and highlight possible conflict, there are relatively few studies in Malaysia that have mapped the potential for conflict spatially. Characterising the spatial dimensions of environmental quality, such as sustainability, biodiversity, cultural ecosystem services and green planning can be done through the application of Public Participatory GIS (PPGIS) (van Kamp *et al.*, 2003; Brown and Raymond, 2014; Kashef, 2016).

PPGIS uses geographic information systems to map spatial attributes of landscapes identified by participants (Brown, 2012). Spatial attributes are place-based values such as landscape preferences, development preferences, urban park values, ecosystem services and other special places which vary according to the purpose and location of the PPGIS study (Brown, 2006; Brown and Raymond, 2007; Brown and Weber, 2011, 2012). Using PPGIS, participants identify areas on a map (web or paper based) and label them according to a study-specific landscape typology of values (Brown, 2012). In cities, landscape values associated with cultural ecosystem services (such as aesthetic inspiration and sense of place) are often identified in areas such as urban parks, hiking locations and community forests (Ives *et al.*, 2017; Zolkafli, Liu and Brown, 2017). PPGIS maps of landscape values have been used to evaluate socio-ecological and ecosystem service hotspots (Brown and Weber, 2011; Ives *et al.*, 2017), assess priority areas for conservation (Brown and Weber, 2012; Lechner, Brown and Raymond, 2015), compare biological values with PPGIS derived landscape values and development preferences (Brown and Raymond, 2014; Ives *et al.*, 2014) and capture human-nature connections associated with urban green space (Ives *et al.*, 2017).

For planning urban landscapes, mapping and then comparing between different types of landscape values and preferences for development allows for a quantitative spatially explicit characterization of locations where land use conflict and compatibility may occur (Brown, 2012; Brown and Raymond, 2014). Development preferences represent participants' perceptions on whether a location should be developed, such as for residential and industrial development, or alternatively whether an area should be conserved, such as for green spaces and forests (Brown, 2012; Brown and Raymond, 2014; Lechner, Brown and Raymond, 2015). These preferences serve as a useful proxy for assessing social values as they classify areas of acceptable and unacceptable types of development perceived by different groups (Brown and Raymond, 2014). PPGIS studies of development preferences have examined tourism development preferences and conflicts (Brown and Weber, 2013), assessed residential development policies (Nielsen-Pincus *et al.*, 2010) and linked forest management preferences with landscape values to understand interactions between social values and conflict (Brown and Donovan, 2013; Brown and Raymond, 2014).

The relationship between landscape values and development preferences can be described by the potential of conflict or compatibility through a conceptual model of compatibility and conflict (Brown and Raymond, 2014). This study has adapted Brown and Raymond's model to consider the spatial attributes more appropriately (Fig.1). The model proposes that the situation with the highest potential for conflict emerges in areas of high landscape value and development preference disagreement (Young *et al.*, 2005; Brown and Raymond, 2014). The horizontal axis represents the level of conflict from low to high conflict potential, which is dependent on the landscape values and is adapted from Brown's model where it was representing place importance. The vertical axis is representing the degree of land-use preference from agreement to disagreement of the land-use which is dependent on the development preferences. For example, areas identified as having high biological values and also high industrial development preference. The situation with highest compatibility (lowest potential for conflict) occurs in areas with high landscape values and development preference agreement (Brown and Raymond, 2014). As another example, areas identified as having high natural wilderness values and preference for establishment of a conservation area. This conceptual model provides a robust basis for land use conflict assessment to support urban planning.

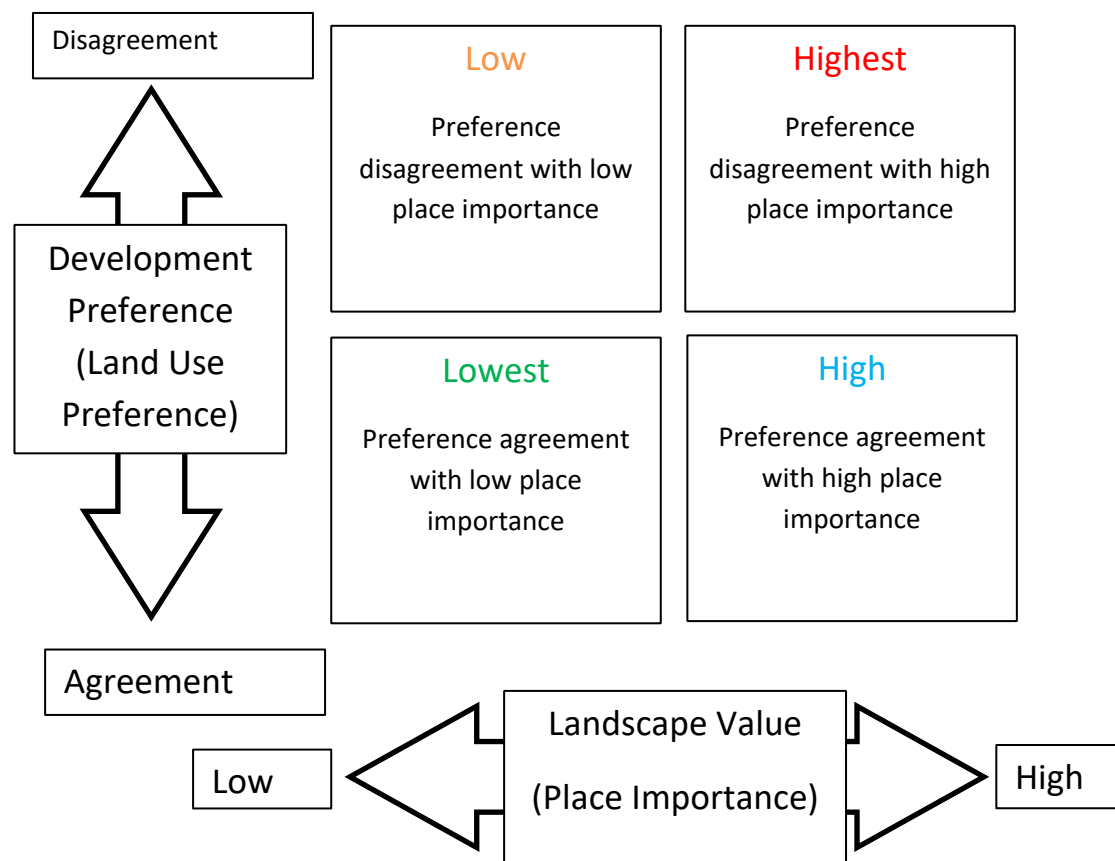


Figure 1. Conceptual model showing the conflict and compatibility relationship between landscape values and development preferences adapted from Brown and Raymond (2014).

Unplanned and poorly managed urbanization can give rise to pollution, inequity, impacts on ecosystem services and reduced liveability. The objective of this study is to identify, map and compare residents' landscape values and development preferences using Public Participatory GIS to provide place-specific recommendations for urban planning in Kuala Lumpur. The study compares different types of landscape values and development preferences to assess conflict and compatibility. The results of this study potentially provide a pathway forward for supporting urban development that is sustainable and also accounts for community interests. It also identifies areas where development should be prevented in order to conserve landscape values. We conclude the study by discussing the significance of the areas of possible conflict visualized on the map, and how such methods could be applied across the region to support a more community involved development plan.

2. Methods

2.1. Study Area

This study takes place in the Klang Valley, the local name for the internationally recognized city of Kuala Lumpur or the Greater Kuala Lumpur metropolitan area within the state of Selangor, Malaysia. The conurbation of the Klang Valley includes five districts: Gombak, Klang, Petaling, Sepang, and Hulu Langat; and two Federal Territories: Putrajaya and Kuala Lumpur (Chan and Tuong, 2017). It is located within latitudes of 2° 35' N to 3° 23' N and longitudes 101° 17' E to 101° 58' E on the west coast of Peninsular Malaysia (Figure 2). The study area covers approximately 3234 km². In the 1980s, the industrial estates in the city attracted many rural communities to work particularly in the electronics manufacturing industry (Abdullah, 2012). New towns such as Shah Alam, Puchong, Bangi, and Subang Jaya expanded rapidly away from the main city centre in the 1990's (Abdullah, 2012). This has made the Klang Valley one of the most developed, populated and fastest growing regions in Malaysia (Chan and Tuong, 2017). Urbanisation resulted in the loss of formerly natural landscapes of covered by lowland and hill dipterocarp forests and agricultural areas including oil palm and rubber (Tsai, Yaacob and Jeyaraj, 2001). Only several patches of forest remain intact. The Klang Valley is surrounded by relatively mountainous topography which connects to the central spine of Peninsular Malaysia, the Titiwangsa mountain range, in the North East to East of the conurbation.

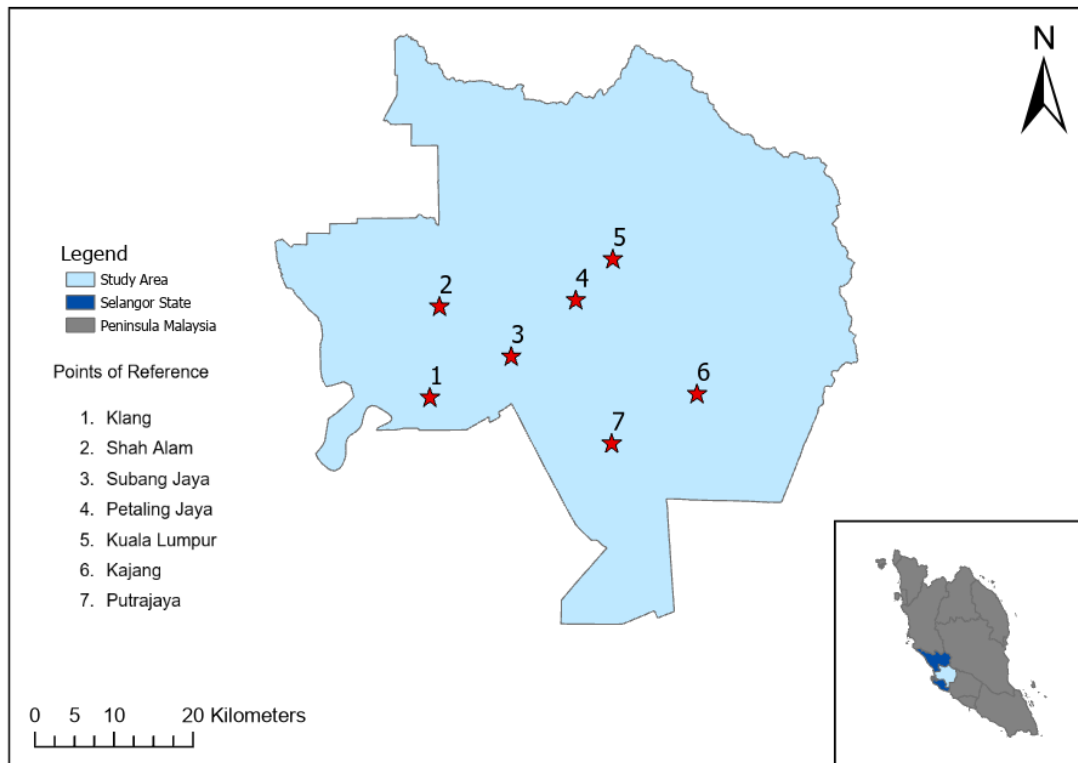


Figure 2 Map of the study area and the Peninsula of Malaysia.

2.2. Landscape Values and Development Preferences

Landscape values and development preferences were collected using a web-based survey application that included three parts: Public Participatory GIS (PPGIS), demographics and some text-based survey questions to evaluate general, non-spatial development preferences and record respondent socio-demographics (Brown and Weber, 2012).

The online survey was set up on a free website that supported the nature of this survey, www.zooniverse.org. However, a large amount of recoding and adaptation of the web-based interface were needed in order for the spatially explicit survey to be conducted on this platform to create similar functionality such as web-mapping and PPGIS web surveying platforms such as Maptionnaire and ArcGIS Online. The survey included an introductory page to inform the purpose of research, research team and contacts, and whether participants needed to learn more about the research. For the PPGIS part of the survey, descriptions for each landscape value and development

preference were provided. For example, the location of aesthetic values was elicited with the following sentence “I value this place for its attractive scenery, sights, smells or sounds.” (refer to Table 1 for full list of descriptions) (Brown and Reed, 2012).

Table 1. The landscape values and development preferences and their categorized class and support development or environment

Attribute	Description	Class	Support development of environment	Comments of Categorization
Landscape Values				
Aesthetic/Scenic	I value this place for its attractive scenery, sights, smells or sounds.	Environmental	Environmental	Attractive sceneries, sights, smells and sounds are related to well-preserved environments.
Economic	I value this place for its economic benefits such as agriculture, tourism, or commercial activity.	Economy	Development	Economic benefits generate more development in an area.
Recreation	I value this place because it provides outdoor recreation opportunities.	Human Relevance	Environmental	Locations for outdoor recreation are defined by how well the environment around it is preserved.
Life sustaining	I value this place because it helps produce, preserve, and renew air, soil, and water.	Environmental	Environmental	A well-managed environment can help produce, preserve and renew air, soil and water.
Learning/Scientific	I value this place because we can use them to learn about the environment.	Environmental	Environmental	To learn about the environment, it must be conserved and managed properly.
Biological	I value this place because it provides for a variety of wildlife, aquatic life, plants or other living organisms.	Environmental	Environmental	The variety of wildlife, aquatic life, plants and other living organisms can only thrive within a good environment.
Spiritual	I value this place because it is spiritually special to me.	Human Relevance	Not Categorized	Spiritual values are related to both the environment and development values, hence it was not categorized.
Intrinsic	I value this place for its own sake, no matter what I or others think about them or whether it is actually used.	Human Relevance	Not Categorized	Intrinsic values varies from one individual to another.
Historic	I value this place because it has natural and human history.	Human Relevance	Not Categorized	Historic locations are valuable and are related to both the environment and development values.

Therapeutic/Health	I value this place because it make people feel better, physically and/or mentally.	Human Relevance	Not Categorized	Locations are valued differently for different individuals as some prefer well-preserved environments, while others prefer well-developed ones.
Cultural significance	I value this place because they allow people to continue to pass down wisdom and knowledge of traditions and way of life of ancestors.	Human Relevance	Not Categorized	The valued locations are for the cause of traditions rather than for environmental or development significance.
Wilderness	I value this place because it contains natural forests.	Environmental	Environmental	Natural forests are the key indicator of a well-preserved environment.
Development Preferences				
Tourism	Tourism development could conditionally occur with a good plan.	Tourism	Not Categorized	Tourism can be beneficial to both the environment and development growth.
High density of development	High density development could conditionally occur with a good plan.	Residential	Development	Development focused on a primary location with the most benefits.
Low density of development	Low density development could conditionally occur with a good plan.	Residential	Development	Development focused on wide spreading to occupy more unused land.
Green development	Green development could conditionally occur with a good plan.	Environmental	Environmental	Environmental driven development, focused on preserving and conserving the environment while developing.
Industrial development	Industrial development could conditionally occur with a good plan.	Industrial/Commercial	Development	Development areas focused on only commercial-type developments such as factories and production plants.
Conservation	Conservation should occur, where future development should be prohibited.	Environmental	Environmental	Areas that are completely prohibited from development and must be preserved and conserved, such as National Parks and Protected Areas.

Parklands/open space	Park lands and open spaces should occur, where future development should be prohibited.	Environmental	Environmental	Areas or spaces that are planned by the developers for various outdoor or environment related recreation, such as green spaces.
Urban multifunctional development	Multifunctional development (i.e. SOHOs, Office Apartments, Workspaces, Event spaces) could conditionally occur with a good plan.	Industrial/Commercial	Development	High-rise buildings that serve multiple purposes in a single building.
Retail development	Retail services development (i.e. shopping malls, convenience stores and grocery shops) could conditionally occur with a good plan.	Industrial/Commercial	Development	A location for all retail services in order to sustain the community occupied in nearby areas.

PPGIS mapping was used to represent the landscape values and development preferences (Brown, 2012). Participants were requested to mark point locations on a digital map describing for 12 landscape values and 9 development preferences. Table 1 describes the range of landscape values and development preferences that were mapped in this study. The 12 landscape values included aesthetic, economic, recreation, life sustaining, learning/scientific, biologically valuable, spiritual, intrinsic, historic, therapeutic/health, cultural significance and wilderness (Brown, 2012; Brown and Raymond, 2014; Ives *et al.*, 2014). While the development preferences were tourism, high density of development, low density of development, green development, industrial development, conservation, parklands/open space, urban multifunctional development and retail development (Brown, 2012; Ives *et al.*, 2014). The participants could place as many or as few dots on the map as they liked. The values' typology was based on previous work by (Brown and Raymond, 2007, 2014) with the addition of green development, urban multifunctional development and retail development as these development themes emerged consistently across the study area.

To understand the broader urban planning and sustainability context for the PPGIS survey the survey also included: (i) broader-scoped non-spatial questions around development preferences, and (ii) demographics questions to better capture respondents' profiles. The survey was created in Bahasa Malaysia and English. The original survey was piloted to ensure the feasibility of the appropriate and assess any issues with the survey questions and the web-based interface such as where respondents found certain elements of the survey too difficult or complicated to be answered. The Bahasa Malaysia version was also proofread and checked by a panel of Bahasa Malaysia speakers to ensure the accuracy of the survey compared to the English version.

The survey was distributed as an internet survey and also face-to-face. The web-based survey was distributed via online communities and forums such as Reddit and Facebook groups which are region specific, as the survey was targeted to collect responses from current residents in the Klang Valley. The web-based survey was shared in web groups such as the r/KualaLumpur subreddit thread and Kota Damansara Community Forest Facebook group, with the help of the Admins and members to spread the survey link by word.

After the distribution of the web survey, a number of study participants were also recruited through purposive sampling. Various locations within the Klang Valley ranging from Shah Alam to Kuala Lumpur were visited to recruit participants. Locations such as cafes and restaurants were visited as the availability of a tables provided for a space for respondents to participate in the survey. The respondents were required to complete the survey using a laptop or mobile device. The participants would be approached and explained the purpose of study after verbal consent. The respondents would then access the web survey through a laptop or tablet provided or their own mobile. Upon accessing the web survey, the respondent viewed a consent page and acknowledged to participate in the survey after understanding the purpose. The web survey included a tutorial page guiding the respondent on the mapping questions and then respondents proceeded with identifying the landscape values and development preferences on the map, text-based questions about the Klang Valley and demographic questions.

2.3. Landscape Values and Development Preferences Surface Generation

To identify the landscape values and development preferences, point values were interpolated to create a separate surface for each value using kernel density estimation ('hotspot') analysis (Brown and Weber, 2012; Brown and Raymond, 2014). A total of 2108 points in landscape values ($n = 12$) and 3033 points in development preferences ($n = 9$) were derived from the social survey used to generate 21 standardized kernel density maps using 1000 m grid cell size and 6000 m search radius (Brown and Weber, 2012). Kernel density estimation (Rosenblatt, 1956; Parzen, 1962) involves fitting a smooth curved surface with a 'grid' over each point in a selected search radius used to produce a circular area – the 'kernel'. The densest grid cells are known as 'hotspots' and empirical PPGIS research (Nielsen-Pincus *et al.*, 2010) suggests that landscape values tend to cluster between 3km to 6km (Brown and Weber, 2012).

2.4. Compatibility versus conflict

The spatial attributes were aggregated into categories that were relevant to either as supporting development or environmental conservation in order to map compatibility versus conflict. The aggregated values for each class of landscape values and development preferences were generated based on how compatible they are in relation to development (Table 1). For example, a place identified for aesthetic and scenic value is considered pro-environmental while industrial development to support development (Table 1). Certain categories were considered neutral and was given the value of 0, as they will not contribute to positive environmental or development situations.

The compatibility score equation is derived with the following equation:

$$\text{Abs} [(Development\ Pro - Development\ Negative) \times (Development\ Pro + Development\ Negative)]$$

Equation 1 Compatibility versus conflict score equation.

where 'Abs' represent an absolute value (removing the signs of negative values), with a higher value representing higher risk of conflict, while a lower value representing lower risks of conflict (i.e. compatibility). The equation was derived from a GIS function for calculating absolutes amongst two overlaying layers of data on the map in order to express the differences of both those layers visually. This equation was adapted from Brown and Raymond (2014).

3. Results

3.1. Characteristics of the Respondents

The total response to our survey was 249 completed questionnaires. 59.4% of the respondents were male and 39.4% were female, while 1.2% identified as 'Others'. The age group of the respondents matches 2010 census data (as per available from Department of Statistic Malaysia Online) and there is sufficient variability in the dataset to explore the values and preferences of the public. A majority of the respondents were also formally educated, with only 5 respondents of

lower-secondary level of education. Most of the respondents are also employed, with 9.2% in the Public Sector, 59% in the Private Sector and 5.6% being self-employed, while 16.9% were students.

Table 2 The demographics of the surveyed participants.

Characteristics of respondents	Frequency	Percentage
Gender		
Male	148	59.4
Female	98	39.4
Others	3	1.2
Age		
18-27	129	52.0
28-37	49	19.8
38-47	29	11.7
48-57	32	12.9
58-67	9	3.6
>67	0	0.0
Highest education level		
No formal education	0	0.0
Primary (UPSR)	0	0.0
Lower Secondary (PMR)	5	2.0
Upper Secondary (SPM)	29	11.6
Pre-University (STPM/Matriculation/A-Levels/Foundation)	12	4.8
Certificate/Diploma	40	16.1
Bachelor's Degree	122	49.0
Postgraduate (Masters/PhD)	37	14.9
Others	4	1.6
Job status		0.0
Public Sector	23	9.2
Private Sector	147	59.0
Self-employed	14	5.6
Student	42	16.9
Housewife	4	1.6
Unemployed	13	5.2
Retired / Pensioner	6	2.4
Monthly income		0.0
No income	69	27.7
less than RM 1,000	10	4.0
RM 1,000 to RM 3,099	65	26.1
RM 3,100 to RM 5,099	42	16.9
RM 5,100 to RM 10,099	24	9.6
RM 10,100 to RM 20,099	32	12.9
RM 20,100 and above	7	2.8

3.2. PPGIS

3.2.1. Graph of Landscape Values and Development Preferences PPGIS Points

A total of 2,108 landscape value points were available for analysis. For development preferences, there were 954 mapped preferences for urban development, and 1,171 preferences to environmental development. The highest number of recorded points for landscape values were for Economic value at 275 responses, while for development preferences it was for Conservation at 416 responses.

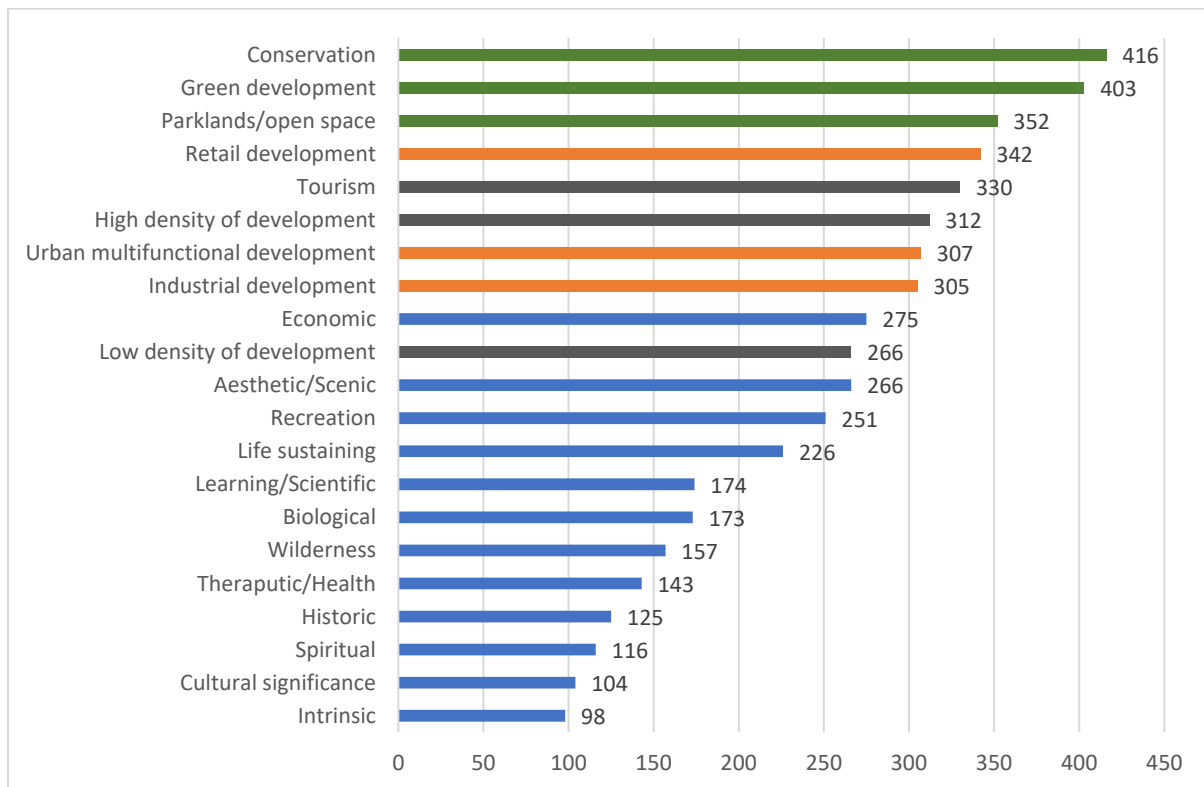


Figure 3 The total number of points for each spatial attribute placed by respondents in the survey map. Green bars represent the Environmental Development attributes; Orange bars represent Urban Development; Grey bars represent regular Development Preferences; while Blue bars represent the spatial attributes from Landscape Values.

3.2.2. Map of Landscape Values and Development Preferences PPGIS Points

All 2,108 landscape value points and 3,033 development preferences points were mapped onto a map of the Klang Valley to visualize the responses recorded.

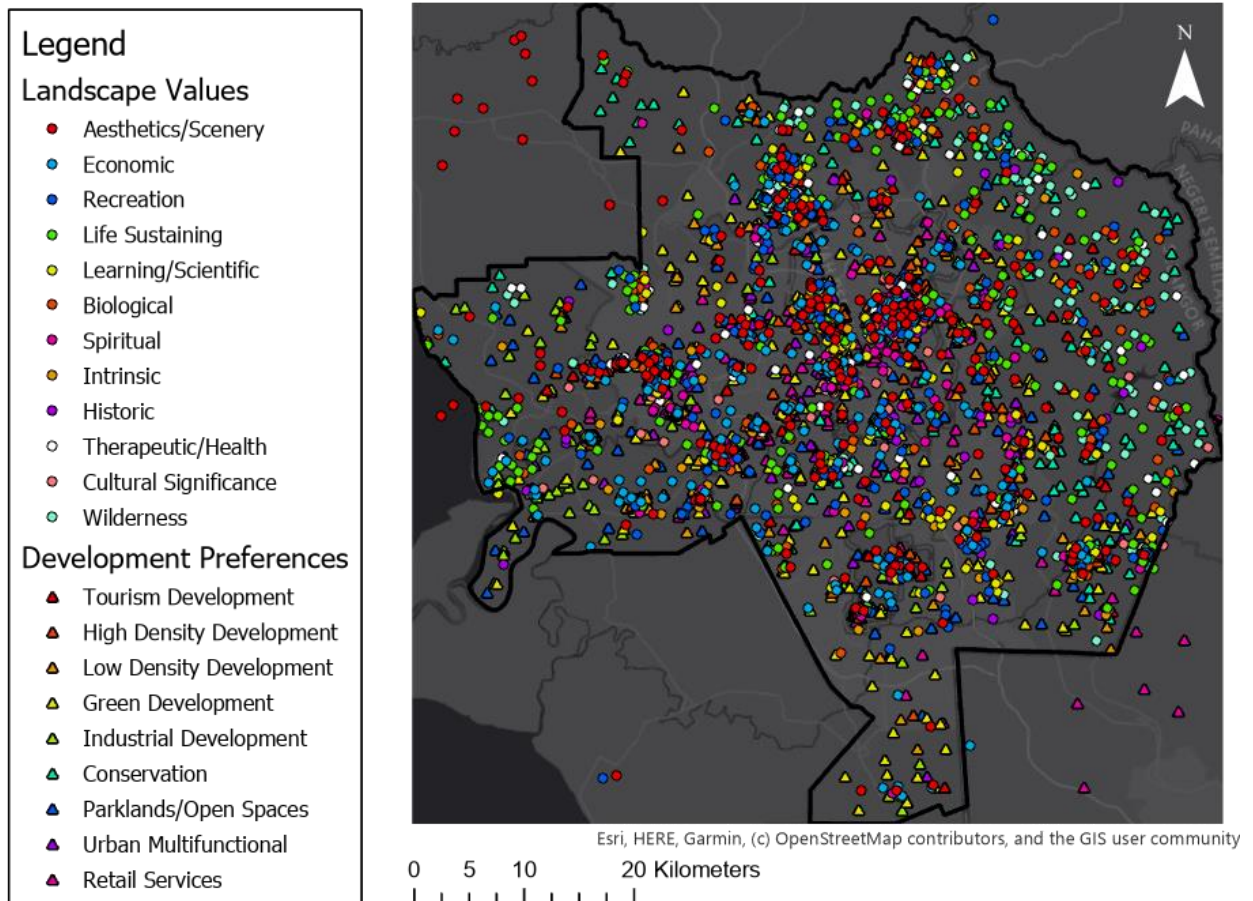
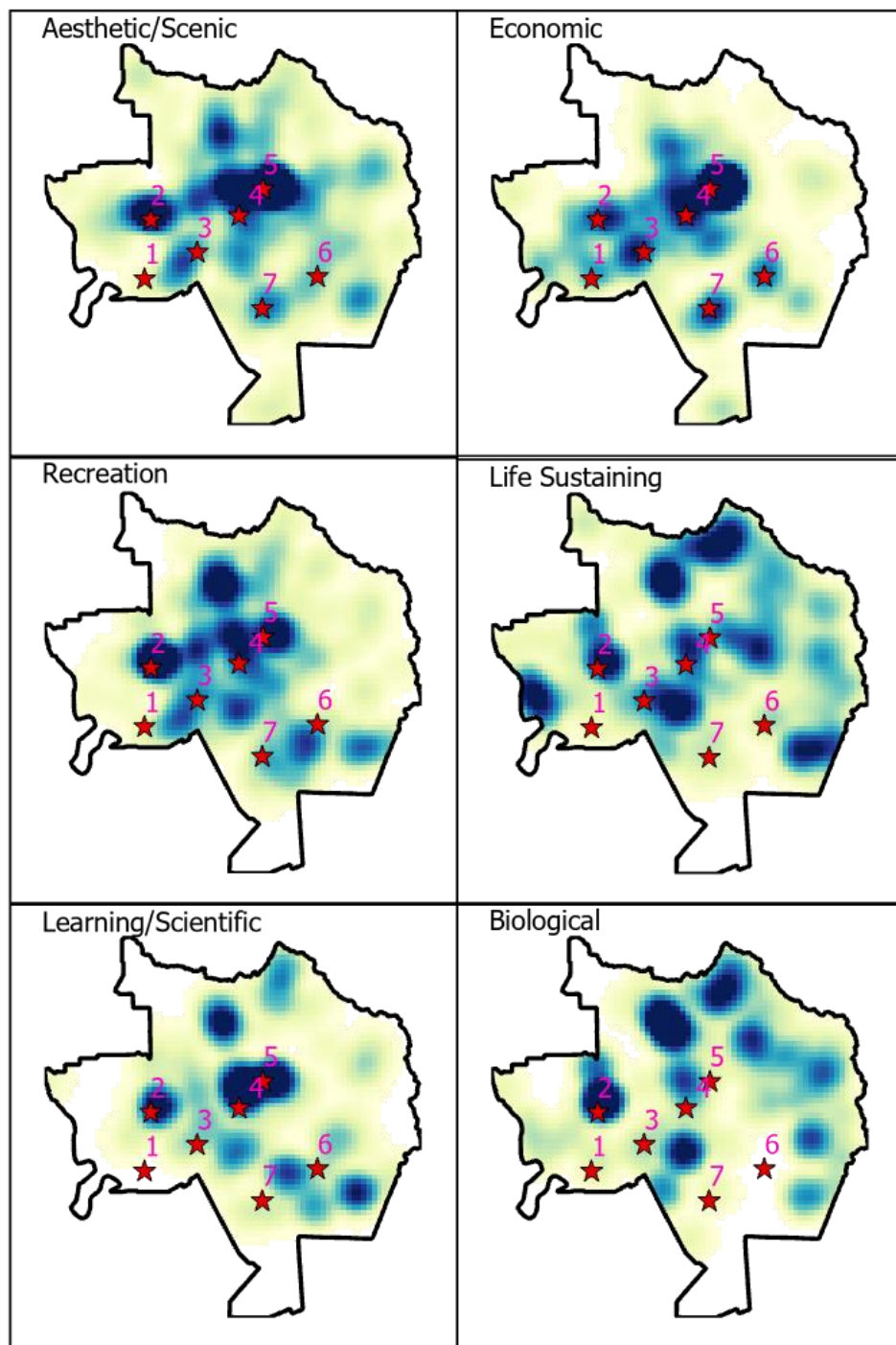


Figure 4. Map of all landscape values and development preferences identified by the respondents.

3.2.3. Hotspot analysis

The panels of hotspot maps display all the locations that the respondents identified for their respective landscape values and development preferences from the web-based PPGIS survey (Figure 6, 7, 8 and 9). The darker areas on the map represents the more points identified in a particular area. Most of the areas identified with the PPGIS points were found in Sha Alam, Peraling Jaya and Kuala Lumpur (Points 2, 4 and 5 respectively in figure 6, 7, 8 and 9). They were densely mapped for attributes including aesthetics, economic benefits, recreation, learning and scientific knowledge and all the development preferences except industrial and conservation. Kuala Lumpur (Point 5) was had the highest density of historical and cultural significance points, while Klang (Point 1) and Sha Alam (Point 2) were densely mapped for industrial development (Figure 7 and 8). Other significant areas mapped were the eastern side of the Klang Valley and north of Petaling Jaya (Point 4), which is the Selayang area. Both areas were mapped for biological importance, wilderness and conservation, with Selayang also being identified for life sustenance (Figure 6 and 7). Finally, areas mapped for green development, parklands and open spaces were also notably similar as the areas are the major cities of the Klang Valley (Figure 9).



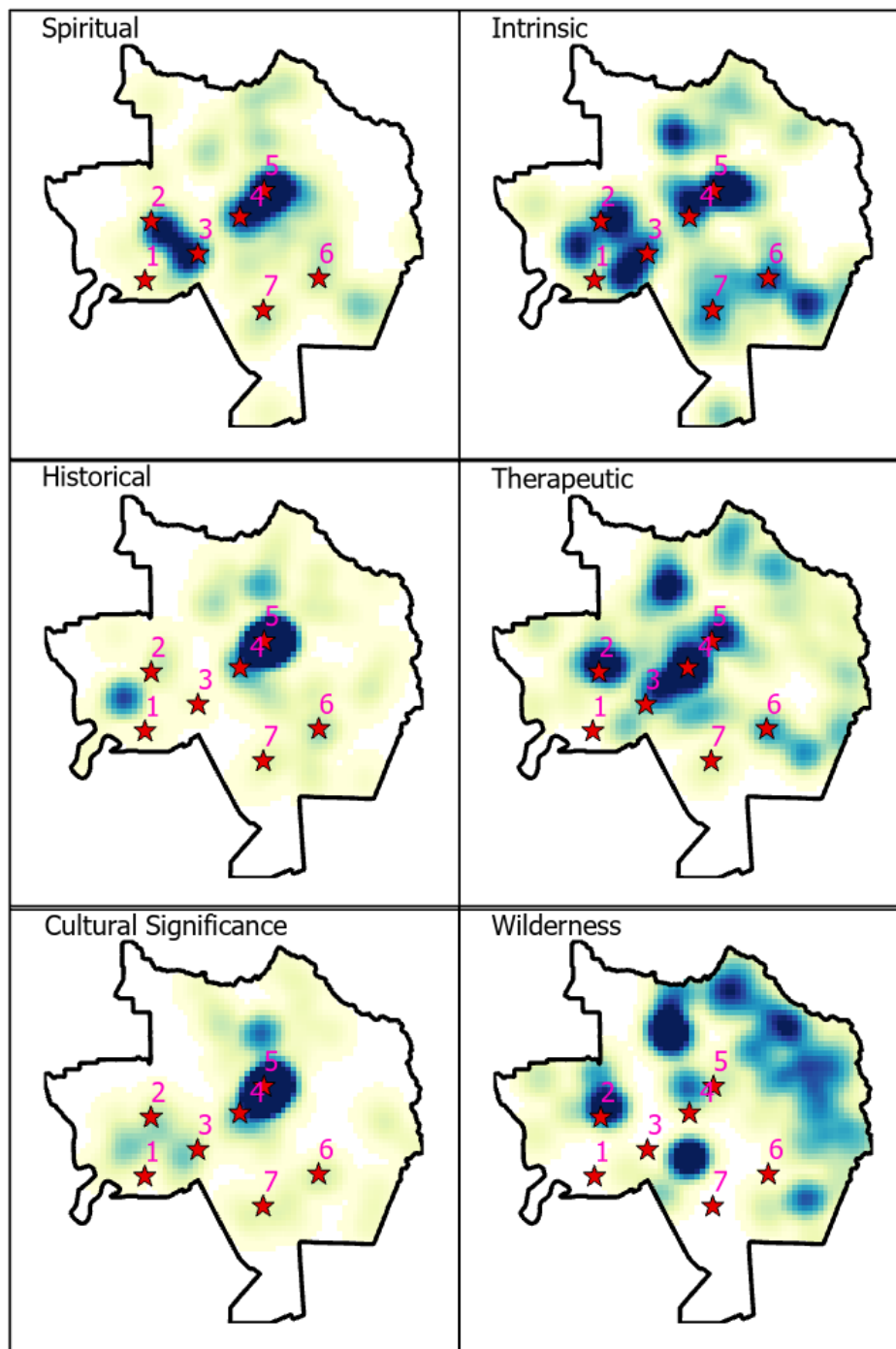
Points of Reference

1. Klang
2. Shah Alam
3. Subang Jaya
4. Petaling Jaya
5. Kuala Lumpur
6. Kajang
7. Putrajaya

0 15 30 60 Kilometers



Figure 5. Landscape values mapped with PPGIS based on 249 respondents.



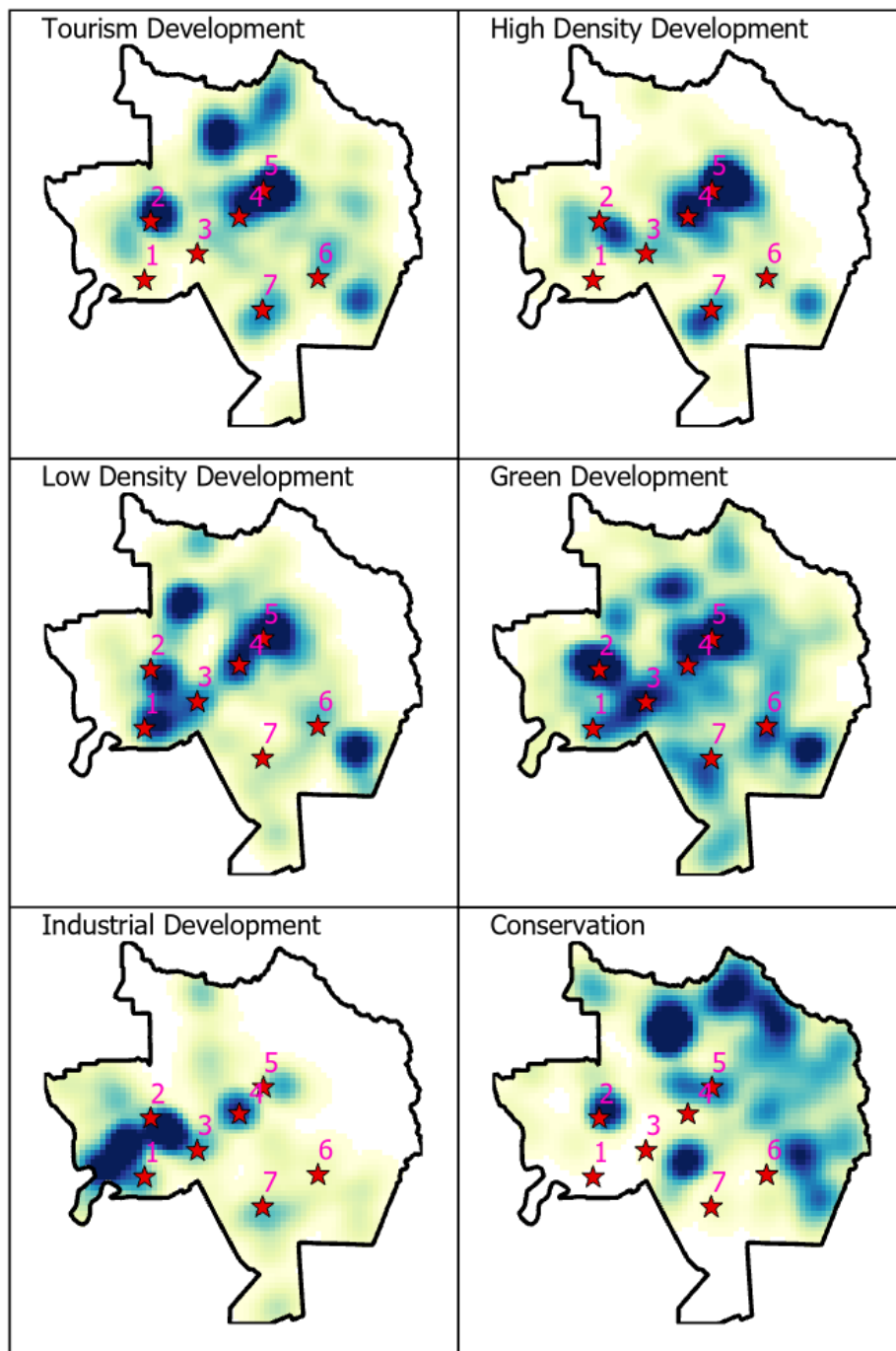
Points of Reference

1. Klang
2. Shah Alam
3. Subang Jaya
4. Petaling Jaya
5. Kuala Lumpur
6. Kajang
7. Putrajaya

0 15 30 60 Kilometers



Figure 6. Maps showing the landscape values mapped with PPGIS based on 249 respondents



Points of Reference

1. Klang
2. Shah Alam
3. Subang Jaya
4. Petaling Jaya
5. Kuala Lumpur
6. Kajang
7. Putrajaya

0 15 30 60 Kilometers



Figure 7. Development preferences mapped with PPGIS based on 249 respondents.

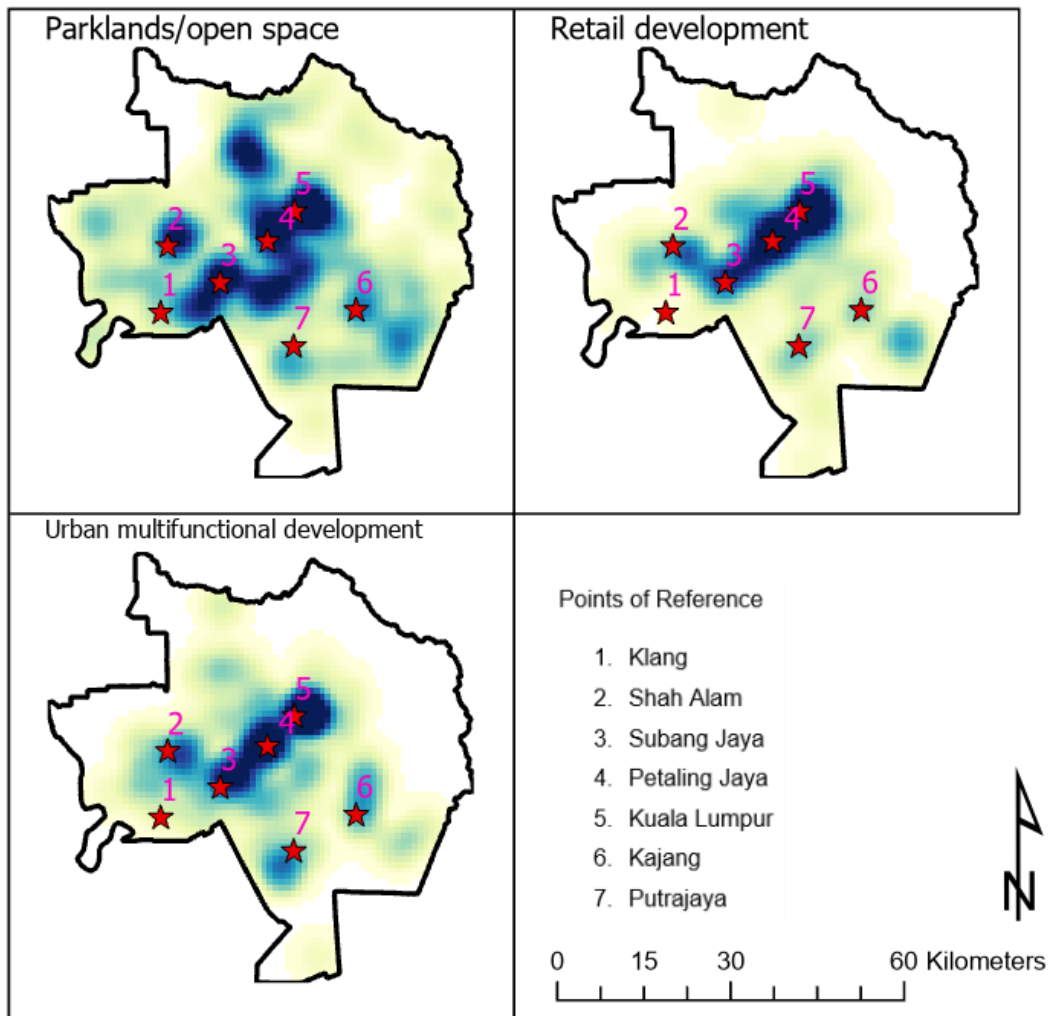


Figure 8. Development preferences mapped with PPGIS based on 249 respondents.

3.2.4. Landscape Values and Development Preferences Compatibility

After deriving the values using the compatibility score equation (Figure 3), the results are visualized on the map as an overlay. The highest values represent the greatest amount of conflict where there are high development negative and development positive values in an area. Areas of low or no conflicts are the lowest values and contains the lowest amount of development negative values. As expected from the hotspot maps, Shah Alam (Point 2) and Kuala Lumpur (Point 5) are areas of high conflict, with Petaling Jaya (Point 4) not far from them in terms of values. The area north of Petaling Jaya (Selayang) also shows high conflict. Areas that have conflict but at lower values are also seen in the location south of Point 4

being the Puchong area and the location southeast of Point 6 identifying as Semenyih.

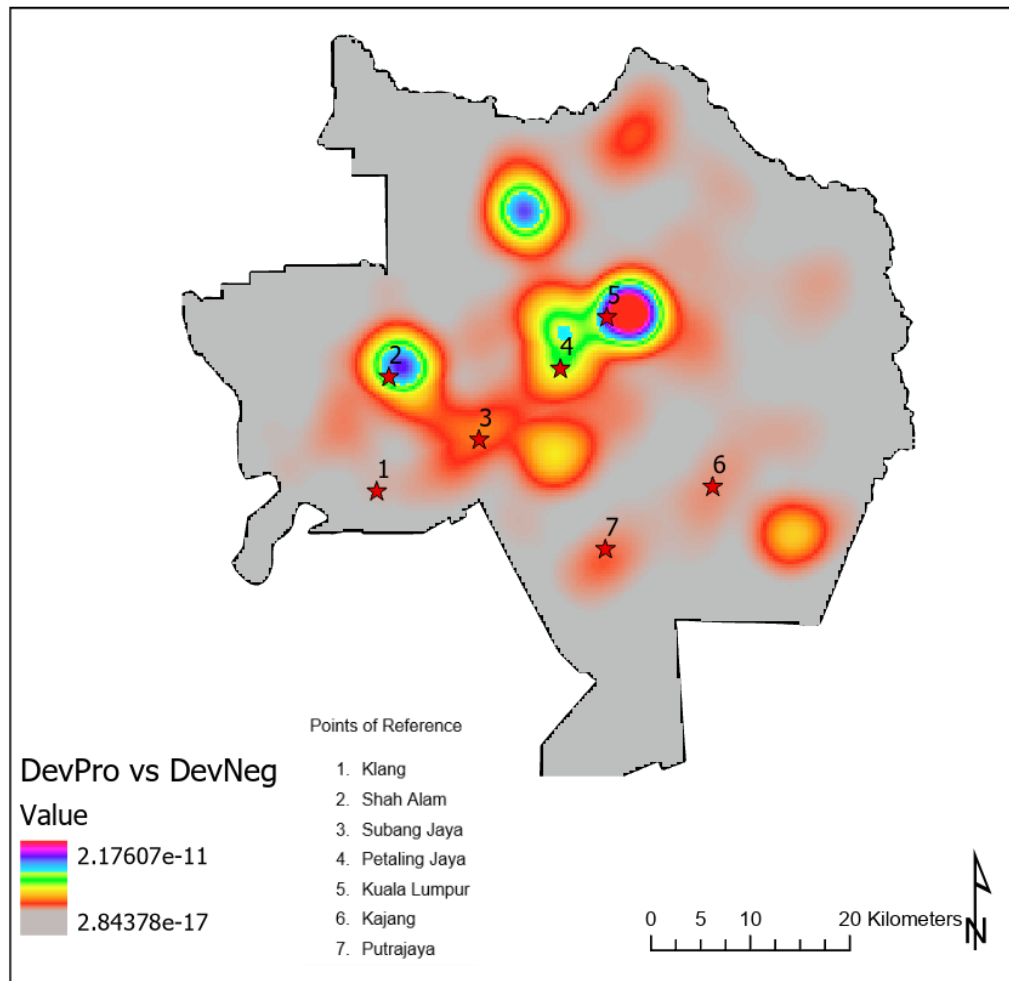


Figure 9. The map of the landscape compatibility, showing the overlay between development negative values against development positive values. The areas of most conflict are shown in bright magenta; the areas of least conflict are shown in red; areas in grey represent very little conflict.

4. Discussion

The study has identified various areas of conflict; some were within expectations while there were other notable findings. Firstly, Kuala Lumpur (Point 5) was expected to be an area of significance and was identified as an important place for landscape values and development preferences by the high point density, probably due to the inevitable and continual development. One of the notable findings included Klang and Shah Alam (Points 1 and 2) being mapped as having a high density of industrial development preference. The area is known for its industrial

development and having future industrial development in the area would align with the preferences of the community. However, the compatibility assessment shows conflict in Shah Alam (Point 2), which could be due to the area being related to its green and clean development concepts. The Shah Alam Botanical Gardens could also be a major reason for opposing of industrial development in the area, as it serves as one of the largest green and open space for the people in that and neighbouring cities. The same can be also be deduced for Puchong (south of Point 4) and Semenyih (southeast of Point 6) with a wide array of recreational forests surrounding the area, such as the Kota Damansara Community Forest Reserve, the Bukit Gasing Recreational Forest, Broga Hill and the Ayer Hitam Forest Reserve all being frequented places for recreation and nature by the community.

Development that is unprecedented or threatens the preservation of these locations are likely to lead to strong community responses that could lead to serious conflict. Another notable finding is in Selayang, where the Forest Research Institute Malaysia (FRIM) is located. The Bukit Lagong Recreational Forest is an important place for FRIM and the community nearby, serving as an area of biological importance, life sustenance, recreation and even tourism. This area is very similar to the areas on the eastern side of the study area, also identified for conservation in the hotspot maps (Figure 8) composed largely of forest landscapes.

From the hotspot maps we could see that Kuala Lumpur had a high density of points for the majority of the landscape values. This could be due to the status of Kuala Lumpur being both the economic centre of the state and country, and also a historical and cultural hotspot (Abdullah, 2012). Additionally, the hotspot map for Parklands and Open Spaces development preferences were clustered around Kuala Lumpur and its surrounding area. This could indicate that the community desires more green spaces in heavily urbanized areas.

This study has provided a visualisation of publicly identified places of value and their development preferences (Figure 5). Through the visualisation. with the use of hotspot maps (Figures 6 to 9), the conflict and compatibility of these values against the development preferences were also displayed (Figure 10). The landscape values identified represents the most important areas in the region, where the respondents expressed degrees of attachment to the place. Due to this place

attachment that the participants identify, there may be an unseen dependency on these places, resulting in less likelihood of the agreement to land use changes that negatively affect these areas (Brown and Raymond, 2007). Although the general population accepts the continual development and land-use change passively for the better, there could be conditions that lead to strong behavioural response either to protect or exploit the landscape (Brown and Weber, 2012). Referencing the demographic data collected in Table 2, all participants received some form of education and only a total of 13.6% of the respondents had an education level below Pre-University (college), this could be a major factor in influencing the pro-environmental responses as education levels can affect environmental awareness (Shobeiri, Omidvar and Prahallada, 2005). The results are not an absolute measure to predict an individual's preference to a specifically proposed land use (Rollero and De Piccoli, 2010; Brown and Reed, 2012). However, it does provide a general importance ranking of what different landscape qualities the people perceive as valued or important.

The identification of conflict and compatibility between landscape values and development preferences may be useful for town planners and politicians alike to allocate necessary resources to resolve these conflicts or plan and develop the area more efficient and wisely. However, the actual predictability of the conflict does not rely merely on just landscape values and development preferences. A more community-based and psychometric approach to measure the intensity and weight of said development preference against landscape values would be valuable (Brown and Reed, 2012). Hence, a measurement and analysis of landscape values and development preferences seem ideally suited to assist public land planning and management. Additionally, PPGIS results tend to be viewed with bias as the participants are inclined towards individuals familiar and experienced with the study area. Although this is a consistent comment that is difficult to defend, the bias could be considered a positive bias, as participants with better knowledge of the area results in better accuracy of the identified locations for their landscape values or development preferences (Brown and Reed, 2012; Brown, Reed and Raymond, 2020). Even if the results could potentially be underrepresented, the results from PPGIS are still preferred due to the social inclusion as that is a key interest for government agencies and town planners (Brown, 2012).

The identification of these place values can potentially result in a linkage between the social acceptance of liveability and land use planning for development that are both environmentally driven and urban focused. PPGIS has also been promoted by academics who realize its true potential in expanding public participation and developing decision support systems for stakeholders. Despite that, the adaptation of this technology is still slow and sees a lack of commitment even with the legal requirement of public consultation for development of public lands. Although with the lack of implementation, landscape values research will remain as an interesting but underutilized method of development planning. Majority of the decision making for development have been influenced by research that are non-spatially explicit, PPGIS mapping will potentially provide a more comprehensive analysis utility since the place values are represented spatially and can prove to be much more influential (Brown, Reed and Raymond, 2020). Further, the agreement to spatially mapped place values as evidence by roles of power will be an important integration towards a more meaningful public inclusion in liveable and sustainable land use planning (Raymond *et al.*, 2014). Hence the need to publish more of these approaches to entice the stakeholders to consider overcoming their conservatism towards public participation and consultation.

4.1. Study Limitations

The non-willingness of the population to participate in the survey has caused an extended response gathering period. Respondents online were slow to provide their responses and respondents that were chosen at random for the face-to-face survey were very conservative and many people approached were unwilling to participate. An approach to possibly improve the response rate would be to organize a workshop to gather responses on the computer en masse, however the quality of the responses may not be as high.

A second limitation is that the results may not fully indicate the place values identified over time. Landscape values are relative values that links personal importance and perceived qualities, changes in either priority will plausibly change the identification of certain landscape values. There is currently still no research on how landscape values change (Brown and Weber, 2012). A social-psychological approach to investigating how an individual perceives landscape value could potentially be conducted in relation to their demographics, exploring the dimensions of person and place.

5. Conclusion

This study has provided insight into the Klang Valley's community landscape values and development preferences. The results showed that community development preferences align with the land-use proposed, and also showed an environmental awareness with the identification of locations for pro-environmental attributes found in wilderness areas on the outskirts of Klang valley. In these areas conservation should be encouraged. As undeveloped land continues to decrease due to the ever-expanding development, there is a need for public participation in land-use and planning to ensure that the communities affected by the developments remain highly liveable.

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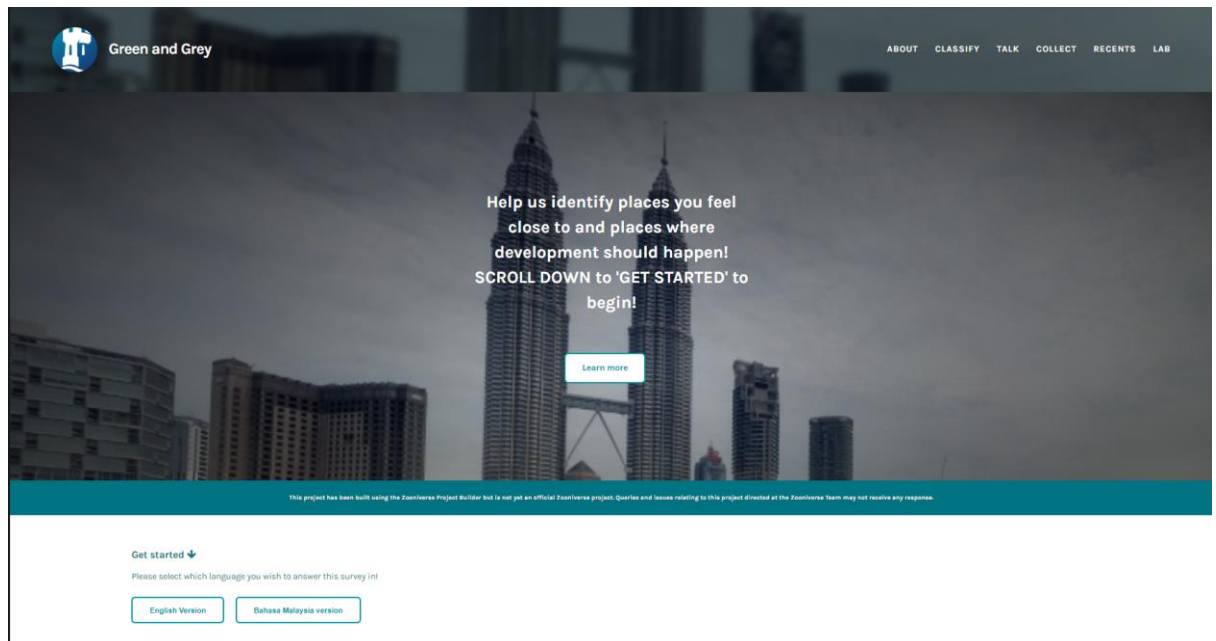
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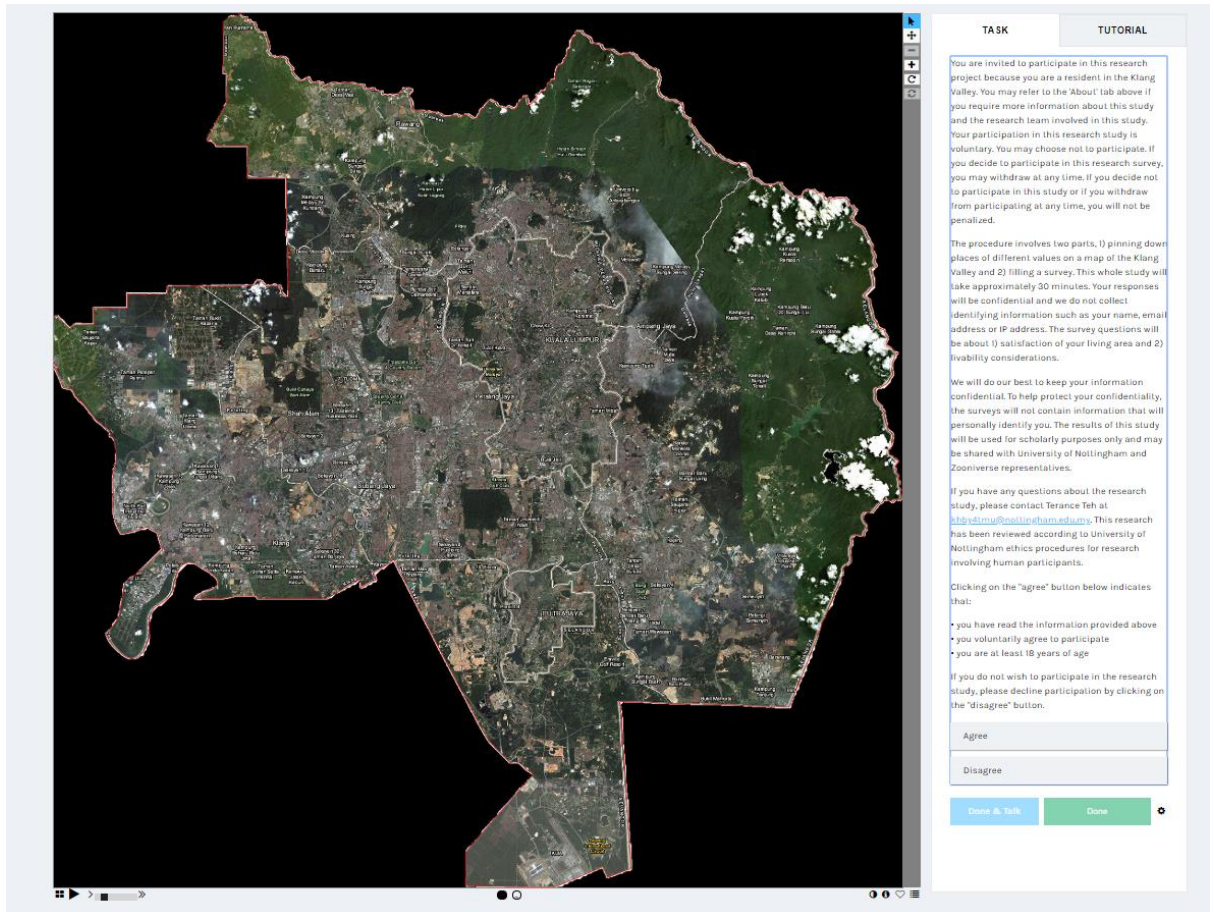
7. Appendix

7.1. Web Survey Interface

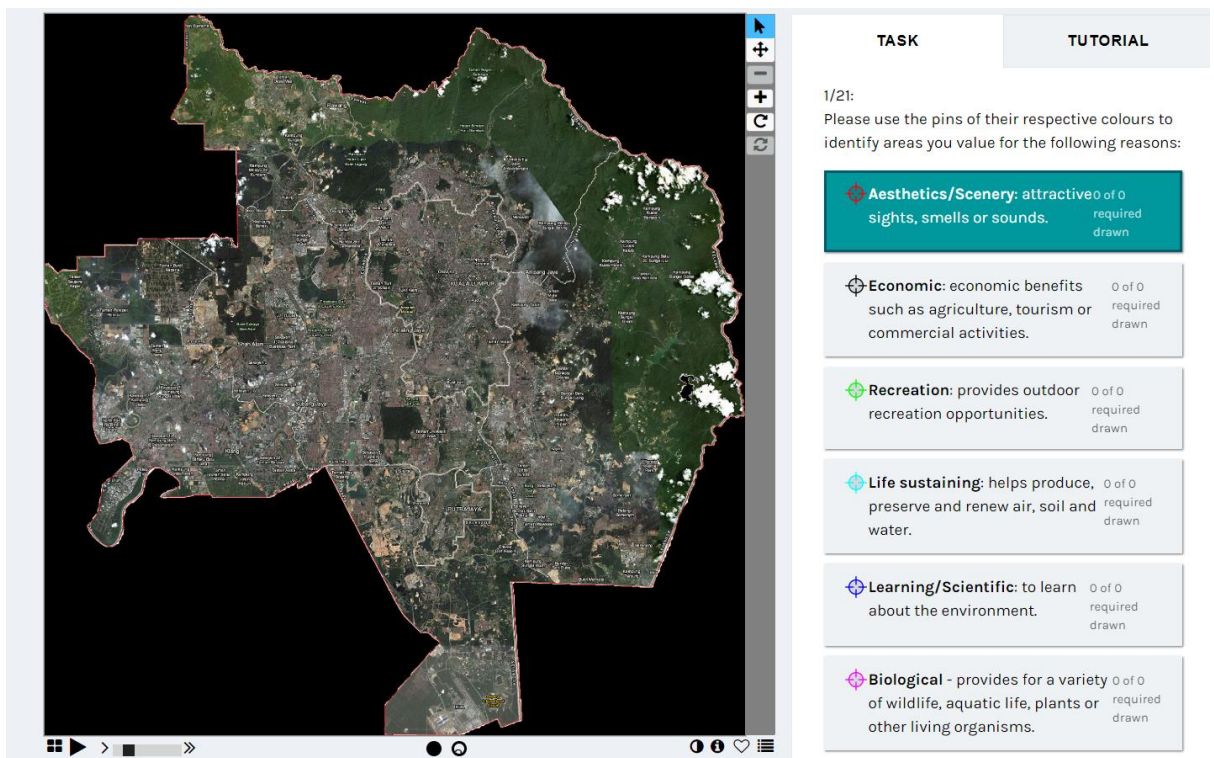
1. Front page



2. Consent page



3. Mapping page



4. Questionnaires

TASK	TUTORIAL
Now you'll be asked some general questions to allow us to better represent your characteristics as a participant in this study. 5/21: Kuala Lumpur should be one of the top 20 most livable cities in the world. Strongly Disagree Disagree Neutral Agree Strongly Agree	
Back	Done & Talk Done ⚙️

5. Demographics

11/21:
Age (in YEARS)

Back

Next →

⚙️

12/21:
Ethnicity

NEED SOME HELP WITH THIS TASK?

Back

Next →

⚙️

13/21:
Which city are you currently living in?
(i.e. Kajang, Shah Alam, Cheras, KL)

Back

Next →

⚙️

7.2. Survey Questionnaire

1. Questionnaire

1. Which of the items shown below would you say are the most important FACTORS in making somewhere a good place to live? Just pick out the FIVE letters of the most important things to you.
Access to nature
Activities for teenagers
Affordable decent housing
Clean streets
Community activities
Cultural facilities
Education provision
Facilities for young children
Health services
Job prospects
The level of pollution
The level of traffic
Parks and open spaces
Public transport
Good community relations
The level of crime
Road and pavement repairs
Shopping facilities
Sports and leisure facilities
Wage levels & local cost of living
Trees

Other

Questions 2 to 5 are responded with LIKERT scale responses, with the ranges being:

Strongly Disagree Disagree Neutral Agree Strongly Agree

2. There is sufficient amount of green and open spaces in the urban areas where I live and work.

3. Development should be a balance between urbanisation, nature and national heritage.

4. Kuala Lumpur should be a 'Tropical Garden City'.

5. Kuala Lumpur should be one of the top 20 most livable cities in the world.

2. Demographics

What is your gender?

Which year were you born?/How old are you?

Which city are you currently living in?

How long have you lived there?

What is your ethnicity?

What is your highest education level?

What is your current job status?

What is your monthly income?

How many people do you live with?

What type of residential properties do you live in? Select all that apply.

Are you a member or involved in a nature club or society? (i.e. Malaysian Nature Society, community hiking groups, outdoor clubs, etc)

3. Mapping questions (in Bahasa Malaysia)

For Landscape Values:

Sila gunakan pin warna masing-masing untuk mengenal pasti kawasan yang bernilai kepada anda yang berkaitan sebab-sebab berikut:

Estetik/Pemandangan	Saya menghargai tempat ini kerana pemandangan, bau dan/atau bunyinya yang menarik.
Ekonomi	Saya menghargai tempat ini untuk manfaat ekonominya, seperti pertanian, pelancongan ataupun aktiviti komersial.
Rekreasi	Saya menghargai tempat ini kerana ia menyediakan peluang untuk melakukan aktiviti-aktiviti rekreasi luar.
Pengekalan kehidupan	Saya menghargai tempat ini kerana ia membantu menghasilkan, memelihara, dan memperbaharui udara, tanah, dan air.
Pembelajaran/Sains	Saya menghargai tempat ini kerana kita boleh menggunakannya untuk belajar tentang alam sekitar.
Biologi	Saya menghargai tempat ini kerana ia menyediakan sumber untuk pelbagai hidupan liar, hidupan akuatik, atau organisma hidup yang lain.
Rohani	Saya menghargai tempat ini kerana ia istimewa dari segi rohani.
Intrinsik	Taman ini bernilai oleh kerana kepentingannya sendiri, tidak kira apa pendapat saya atau orang lain tentangnya atau sama ada ia digunakan.
Bersejarah	Saya menghargai tempat ini kerana ia mempunyai sejarah semula jadi dan/atau manusia.
Kesihatan	Saya menghargai tempat ini kerana ia menyihatkan orang secara fizikal dan/atau mental.
Budaya	Saya menghargai tempat ini kerana ia membolehkan generasi akan datang untuk mengetahui dan merasainya sebagaimana ia sekarang.
Liar (mempunyai hutan semula jadi)	Saya menghargai tempat ini kerana ia masih liar (mempunyai hutan semula jadi)

For Development Preferences:

Sila gunakan pin warna masing-masing untuk mengenal pasti kawasan yang berkaitan dengan kriteria berikut:

Kemajuan pelancongan boleh berlaku secara bersyarat dengan pelan yang baik.
Pembangunan ketumpatan tinggi boleh berlaku secara bersyarat dengan pelan yang baik.
Pembangunan ketumpatan rendah boleh berlaku secara bersyarat dengan pelan yang baik.
Pembangunan Hijau boleh berlaku secara kondusif dengan pelan yang baik.

Kemajuan perindustrian boleh berlaku secara bersyarat dengan pelan yang baik.
Pemuliharaan alam sekitar di kawasan ini perlu dilaksanakan manakala pembangunan harus dilarang.
Taman-taman dan ruang terbuka perlu dilaksanakan manakala pembangunan perlu dilarang.
Pembangunan pelbagai fungsi (contohnya SOHOs, Pangsapuri Pejabat, Ruang Kerja, ruang acara) boleh berlaku secara bersyarat dengan pelan yang baik.
Pembangunan perkhidmatan runcit (iaitu pusat membeli-belah, kedai serbaneka dan kedai runcit) boleh berlaku secara bersyarat dengan pelan yang baik.

4. Questionnaire (in Bahasa Malaysia)

1. Pada pendapat anda, antara perkara yang ditunjukkan di bawah, FAKTOR yang manakah penting demi memperbaiki tempat hidup? Hanya pilih LIMA perkara yang paling penting untuk anda.
Akses kepada alam semulajadi
Aktiviti untuk remaja
Perumahan yang berpatutan
Jalan-jalan yang bersih
Aktiviti komuniti
Kemudahan kebudayaan
Peruntukan pendidikan
Kemudahan untuk kanak-kanak
Perkhidmatan kesihatan
Prospek pekerjaan
Tahap pencemaran
Tahap trafik
Taman dan ruang terbuka

Pengangkutan awam
Perhubungan masyarakat yang baik
Tahap jenayah
Pembaikan jalan dan jalan kaki
Kemudahan membeli-belah
Kemudahan sukan dan riadah
Tahap gaji & kos sara hidup tempatan
Pokok
Lain-lain

Questions 2 to 5 are responded with LIKERT scale responses, with the ranges being:

Sangat Tidak Bersetuju Tidak Bersetuju Neutral Setuju Sangat Bersetuju

2. Terdapat kawasan hijau dan ruang terbuka yang mencukupi di tempat tinggal dan bekerja saya.

3. Pembangunan haruslah seimbangan antara pembangunan, alam sekitar dan warisan negara.

4. Kuala Lumpur sepatutnya bertaraf 'Tropical Garden City'

5. Kuala Lumpur seharusnya menjadi salah satu bandar daripada 20 bandar teratas yang paling diidamkan untuk didiami dalam dunia.

5. Demographics (in Bahasa Malaysia)

Jantina

Umur

Di bandar manakah anda sedang tinggal?

Berapa lamakah anda telah tinggal di bandar tersebut?

Bangsa

Tahap pendidikan tertinggi?

Status pekerjaan

Pendapatan bulanan

Berapakah orang tinggal bersama anda?

Apakah jenis harta kediaman yang anda miliki? Pilih yang berkaitan

Adakah anda merupakan ahli atau terlibat dalam kelab dan persatuan alam sekitar? (cth: Malaysian Nature Society, kumpulan mendaki, kelab aktiviti luar, dan lain-lain)
