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City compactness assessment based on Multi-criteria decision making and Bayes theorem

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Abstract In recent decades, compact urban development and smart cities are recognized as most sustainable urban form in an effort to protect natural environment and decrease air and water pollution. Therefore, evaluation of existing compactness and sustainability of an area is an essential task before the real development takes place. There are few studies regarding city compactness assessment and most of them have considered only a few aspects of compact development analysis. This paper, analyzed urban sustainability of Kajang city (Malaysia) through a comprehensive city compactness assessment using Geographical Information System and latest remote sensing technology. Mixed land use development, urban density and intensity were the main indicators of the analysis. Finally multicriteria decision-making and Bayes theorem was applied for overall compactness assessment. The results classified the zones of the Kajang city in the range of least to most compact zones with the compactness. These promising results can help local government to improve the compactness of least compact zones to make Kajang city more sustainable. Furthermore, the results revealed that efficient public transportation and proper community facilities are the key factors to achieve sustainable urban development.

Keywords: Sustainable urban development; Compact city assessment; Remote sensing; GIS; Bayes theorem

1. Introduction

Unplanned urban growth and sprawl development create many environmental, economic and social problems. However, based on urban sustainability point of view, replacing the productive forest and agricultural lands by manmade structures is the main environmental consequences of these growths. According to the ultimate goal of sustainable development, current human activities cannot endanger the next generation's ability to meet their own needs by degradation and destroying the natural environment (Brundtland 1987, Frame 2008, Kropp and Lein 2012). In the context of urban areas,

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developer and scientists have been concentrating on the effect of urban form and shape on urban sustainability. Regarding this theory, compact development, smart city and Transit Oriented Development (TOD) are strongly recognized as the most sustainable urban forms (Livingstone and Rogers 2003).

It has been proven by numerous studies that urban sprawl and unorganized horizontal city expansion are not sustainable because of high carbon emission, traffic congestion, agricultural and forest destruction, higher infrastructural provision costs, public health problems and so on (Carruthers and Ulfarsson 2002, Burchell and Mukherji 2003, Gu et al. 2012). In contrast, compact and organized urban development have various social, economical and environmental advantages (Crewe and Forsyth 2011), such as less car dependency, less carbon emission, containment of rural areas development, encourage walking and cycling behavior, reuse of existing available lands and facilities etc. (Jenks et al. 1996, Ding 2004, Lin and Yang 2006).

An important step in compact development analysis for a specific urban area is to evaluate the existing compactness in order to realize the current situations before any decision-making takes place. In this regard, there is no standard and consistent evaluation methodology exists in the literature, and each study has defined different zoning manner and criteria to evaluate city compactness. For instance, Turskis et al. (2006) and Zagorskas et al. (2007) in their researches considered only social parameters such as population density, population distribution condition, transportation facilities and etc. However, Turskis et al. (2006) divided the study area into 1 km square zones and Zagorskas et al. (2007) divided into cells according to the similarity of character. Burton (2002) utilized social information as well as built up density and mixed landuse development to evaluate the compactness of twenty-five English cities in the UK. Thingh et al (2001) and Xia Li and Anthony Yeh (2000) considered only physical distribution of the manmade structures especially buildings (development cluster in the area of study to evaluate city compactness). Their assessment was based on average comparison between the perimeter of each developed cluster and that of circle that has the same area. In addition, they used another complicated method based on entropy concept, which is related to the concentration and distribution manner of features in the area of study. Both techniques showed similar results regarding city compactness.

Generally, conventional urban data collection is cost and time consuming. In recent decades, coupling of Geographic Information System (GIS) and Remote Sensing (RS) have been widely used to solve these problems. There are numerous researches about application of GIS and RS on urban issues (Abdullahi et al. 2013, Hamedianfar and Shafri 2013). This study analyzed urban sustainability of Kajang city in Malaysia through urban compactness assessment. Unlike other recent studies, a comprehensive set of compactness indicators were defined and utilized for evaluation of city compactness, which embrace various aspects of urban areas (such as physical, planning, environmental and social aspects). These indicators are urban density (population, built up and residential density), mixed landuse development and urban intensity. To define these indicators, several parameters such as population, landuse/land cover, road network, community facilities and other information regarding city planning were included in the analysis. For the final judgment and assessment of compactness, an integration of

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MCDM and Bayes theorem were utilized. Integration of GIS-based applications with remote sensing, MCDM and statistical approaches for urban sustainability, resulted in a comprehensive and updated interpretation of local situation and provide a proper perspective for future urban pattern.

1.1. Study area

Kajang city is located 21 kilometers from Kuala Lumpur, the capital city of Malaysia (Figure 1). This city covers 60-km^2 area with 250,000 populations. Although there are many available empty lands in the central parts, however, due to its proximity to three main cities of Malaysia, Kajang city in recent years encountered various horizontal expansions. For this reason, this paper tries to evaluate urban compactness and sustainability of Kajang city as an input for further compact development analysis in order to keep this region more sustainable.

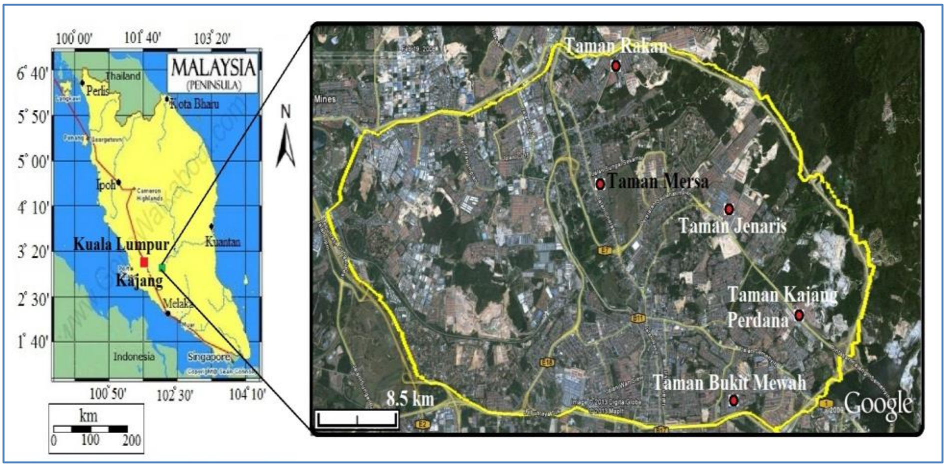

Figure 1. Kajang city location

2. Materials and methods

City compactness is evaluated through self-sufficiency and independency from outside forces (Burton 2002). It also can be defined as; a measure to evaluate the traveling behavior of residences of a community to meet their daily requirements such as working, shopping, entertaining and etc. As mentioned before, there are no standard methods available for city compactness evaluation. However, statistical analysis is the main approach of these studies to calculate the city compactness. Because generally urban areas are evaluated in terms of zonal or district level, the first step regarding this analysis should be the zoning manner of the study area. In this paper, to evaluate the city compactness of Kajang city, a predefined zoning of districts were utilized, which have been defined by local planning authority (Figure 2). The overall workflow of this study is shown in Figure 3.

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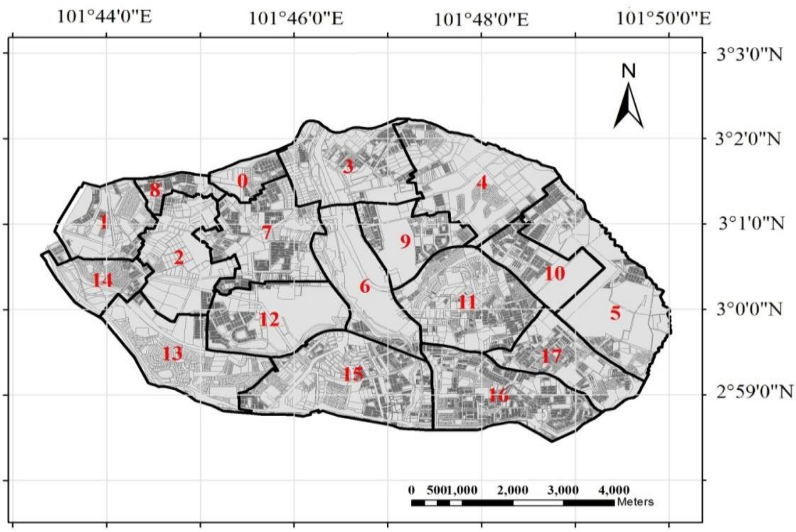

Figure 2. Zoning map of Kajang city

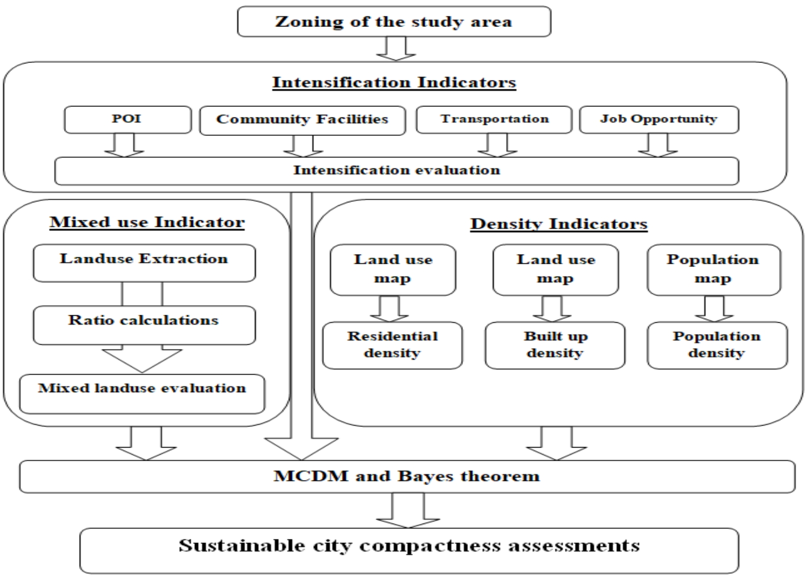

Figure 3. Overall methodology of city compactness analysis

Several urban thematic information of Kajang city was utilized to define the compactness indicators. These layers are listed as follow;

- Population map; to create population density map, which is one of the most important factors for compact development and city compactness assessment
- Land use/land cover map (2008):

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i. to extract various landuse types (residential, commercial, industrial and etc.)
ii. to extract the location of community facilities (health, educational, POI)
iii. to extract the location of job opportunity (commercial, institutional, industrial)
iv. to extract the location of existing parks and open spaces as recreational facilities
v. to create residential density map
vi. to evaluate mixed landuse development

- Public transportation facilities map such as train and bus stations

3.1. Density indicators

One of the most common interpretations of compact city is the density of urban areas. In the case of urban sustainability, higher density is preferred, due to its vitality, creativity and increasing walking, and cycling behavior. The concept of density has been divided into several perspectives such as population density (gross density), built up density (net density), housing density, neighborhood density and etc. In this research, density was assessed in three aspects; population, housing and built up density of the Kajang city. According to the literature, one of the most effective way to measure the density is to calculate the plot ratio i.e. total amount of floor space to the site area (Burton 2002). However, the point is what figures or values are implicated for the most sustainable urban form. Various values can be used to define an optimum density based on the current situation of the study area and objectives of the research. For instance, Earth environmental scientists believe that to achieve urban sustainability residential densities of 225 to 300 are preferred (Burton 2002). However, most of the urban scientists evaluate the density according to the local area characteristics. Therefore, because there is a strong agreement on higher density rather than low density, in this research zones with higher density regarding all aspects were assigned as more compact and sustainable than other zones.

In addition, this point should be noted that, there is difference between urban density and urban intensity, which is more related to crowd and livability of an area. Urban intensity evaluation will be explained in next sections.

Population density usually is the main concern of the researchers regarding urban density analysis. However, certain arguments relate more the density to built up form. Especially in case of environmental conservation, it is the built up areas that destroys agricultural and forest lands. Higher built up and residential density, not only have benefit for land savings, but also decrease energy consumption as well as increase affordable housing (Burton 2002).

Each zone was evaluated according to the population, built up and residential density. Population density was calculated according to the most commonly used way of density measurement i.e. persons per hectare. However, open spaces such as parks and recreation grounds and etc. are subtracted from area of each zone. Therefore, only built up area was included in the measurements. Because a zone with a high building density in a large open space may appear to have low density on the basis of gross density (Sherlock 1990). Same concept was applied for built up and residential density measurement. Open spaces and non-residential land uses were excluded from area of each zone and density of residential units was calculated based on remaining area of each zone. Finally, the output maps were standardized from zero to one, with zero as least compact and one as most compact zone.

3.2. Mixed development indicators

Providing several land use types in an area decreases car dependency and encourage walking and cycling behavior. Therefore, it is important to develop an area with a well balance of residential and non-residential land uses to achieve urban sustainability. Mixed land use development can be divided into horizontal and/or vertical mixed. Horizontal mixed land use refers to multiple land use in an individual development in the neighborhood, and vertical mixed land use development refers to multiple land use in a single multi storey building. However, because this research is about urban neighborhoods planning therefore, horizontal mixed land use development was the main concern for evaluation.

There is not consistent and standard methodology to evaluate landuse diversity of an area. Therefore, usually researchers assessed mixed landuse development of their study area based on various approaches and data availability (Bhat and Gossen 2004, Song and Knaap 2004, Van Eck and Koomen 2008, Manaugh and Kreider 2013). Each of these approaches has its own positive and negative effects on the assessment. For instance, interaction method (Manaugh and Kreider 2013) evaluated mixture of land uses by measuring length of lines between two connected polygons of complementary uses. In this manner, if there is a street network between several different land uses (such as street between residential, commercial and/or industrial), this area is not considered as mixed land use. On the other hand, Entropy method, only takes into account of the diversity of land uses, without considering of their proximity (Manaugh and Kreider 2013). Song and Knaap (2004), assessed the land use diversity of Portland city based on only residential landuse on zonal scale. Interestingly, Arifwidodo (2012) removed mixed land use development factor from the analysis of compact development policy, because he stated that this factor is at the regional level. Therefore, cannot be evaluated in a micro-level analysis. However, the current study analyzed mixed land use of Kajang city based on 10 m pixel size and proved that this important factor can be evaluated in various scale of analysis. Five main land use types were included in the analysis;

- Residential
- Community facilities and institutional
- Commercial
- Open spaces and Recreations and
- Industrial

All these land uses were extracted from land use map as a separate layer and then proximity analyses were performed for each of them using Euclidean distance tool (ArcMap 10). The results of all proximity maps were standardized in the range one to five (one means the pixel is far and five means pixel is near to corresponding land use type). Next, all the standardized maps were aggregated by an equal weight in order to illustrate the areas (pixels) which have proximity to more number of land uses. Therefore,

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this map is showing the mixed land use characteristics of each pixel of the study area. However, because all the analysis of this research was based on zonal scale, mixed land use value of each zone was computed based on their comprised pixels. At the end, each zone was standardized in the range of zero to one based on the land use diversity characteristics.

3.3. Intensity indicators

According to city compactness definition (self-dependency from outside), city intensification is the main parameter determining the degree of compactness of an urban area. In fact, city intensification can be defined as a process to make an urban area more compact and sustainable. This process can be done through increase in population density, development and land use diversity (Burton 2002). For instance, some of these processes are listed as follow;

- Promoting public transportation facilities
- Increase population density especially around public transportation nodes
- Reusing abandon industrial and commercial buildings for residential purposes
- Redevelopment of abandon land within the city (brown field revitalization)
- Development of different land use types in close proximity (Horizontal and vertical mixed land use)
- Centralization of facilities

However, because urban density and mixed land use development were already evaluated in the previous sections, this section has emphasized on community facilities development.

Proper accessibility and availability of various required community facilities such as health, educational and shopping centers to the residential and working areas encourage the local residences to have less dependency on their own private vehicles. In addition, proximity of these facilities can make the daily trips shorter. Especial attention should be paid for city centers and residential area, because most of the people is working and living in these areas. City intensification has other advantages also such as green land conservation, city centers revitalization and economic sustainability. For instance, in Western Europe the main interest of local governments is to increase the capability of existing development to serve more population instead of constructing entirely new developments (Barrett 1996). Therefore, this task can be implemented by improving urban intensity and local infrastructure.

To evaluate the intensity and activeness of each zone of Kajang city, availability, proximity, quality and quantity of each type of community facilities (such as health, educational, public transportation, point of interests, open space and recreational facilities as well as job opportunity) were assessed with respect to characteristics of local residence of corresponding zone.

Population data was included with detail information about age, gender, ethnic, religion and race of each zone. Therefore, required facilities for each zone were evaluated based on local population and characteristics of corresponding zone i.e. ratio of population and required facilities (De Chiara 2001). For instance, educational facilities were evaluated by considering availability and proximity of kindergarten, primary and secondary schools with respect to number of children and youths in various ages. Health facilities were assessed according to availability of clinics, general hospitals, specialized hospitals and welfare center with respect to population especially number of elderly of each zone. Number and type of place of worship for each zone were evaluated according to number of people belongs to each religion.

Availability and proximity of public transportation stations, shopping malls and recreational facilities were assessed with respect to population and location of living and working places.

Finally, each zone was standardized in the range of zero to one based on the intensity assessment.

3.4. Multicriteria decision-making and Bayes theorem

Each aspect of compactness indicator assigned a comparable and standard value to each of eighteen zone of Kajang city. After these evaluations, the last step was to aggregate the layers and evaluate the overall compactness of Kajang city. This process was started by calculating the weights of the three main compactness indicators. In the next level, weights were measured for the factors related to each indicator. Most of the previous studies evaluated overall compactness using weighting system based on expert knowledge. Public opinion also is another solution based on local interviews or surveys. However, Burton (2002) for simplicity, assigned equal weights to all of the compactness indicators. In this research, in order to perform a comprehensive and satisfactory evaluation, weights were extracted and calculated from the literature related to the city compactness assessment, as well as using local expert knowledge (Table 1). These weights were one of the input values for Bayes rule calculations.

Table 1. Weighting of each compactness indicator and corresponding factors by expert knowledge

Indicators	Weights	Factors	Weights
Density	0.3	Population	0.13
		Built up	0.12
		Residential	0.12
Mixed use	0.4	Mixed use	0.14
Intensification	0.3	POI	0.08
		Job Opportunity	0.08
		Health	0.05
		Education	0.08
		Transportation	0.12
		Recreation	0.08

In the next and final step, compactness of each zone was assessed by Bayes rule or Bayes-Laplace principle (Arrow et al. 1948). This method involves an updating of prior probabilities through the ‘weighted evidence’ provided by predefined factors (Maria de Almeida et al. 2003, Hong et al. 2013). This theorem has several applications regarding urban area such as evaluation of city compactness (Turskis et al. 2006), modeling

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development and estimation of urban landuse dynamics (Maria de Almeida et al. 2003), assessing urban uncertainty simulations (Ševčíková et al. 2007), and etc.
To find the actual compactness value for each zone (based on value of compactness indicators and weights of indicators) criterion of optimality method were applied. This criterion refers K_i to Bayes rule. The rationale behind this method is, if the parameters of efficiency q_i are not equivalent, but the weights of these parameters are known, by using the equation 1 (average success criterion of the decision made), the value or ranking of the alternatives can be computed (Turskis et al. 2006);

$$K_i = \{\boldsymbol{vi} \left| \mathbf{max}\, \boldsymbol{i} \left[\frac{1}{n} \sum_{j=1}^{n} \boldsymbol{qi}\, .\, \boldsymbol{xij} \right] \right| \} \quad (2)$$

where, v_i is alternative, x_{ij} normalized attribute value of j-th parameter for i-th variant. Most of the time "$\sum_{j=1}^{n} qi$" assume as equal to one in order to remove the greatest weighted sum of parameters value. Usually, in the literature, Ki called as a miscellaneous. In this method, to get the final weights or ranking of parameters, the input value of alternative should be numerical and comparable. To calculate value of "normalized decision-making matrix", equation 2 and 3 where utilized based on SAW method (Zavadskas et al. 2007);

$$b_{ij} = \frac{aij - \min aij}{\max aij - \min aij} \quad (3)$$

when; preferable value $a_{ij} = \min a_{ij}$

$$b_{ij} = \frac{\max aij - aij}{\max aij - \min aij} \quad (4)$$

when preferable $a_{ij} = \max a_{ij}$

4. Results and discussion

The compactness of each zone based on density and mixed development indicators are given in Figure 4 and 5.

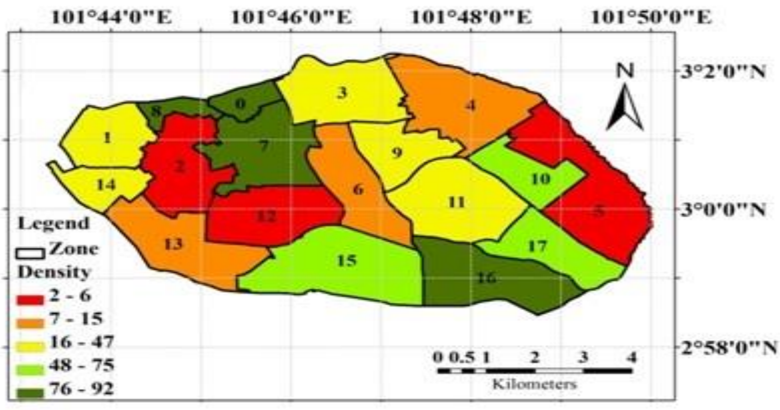

Figure 4. City compactness based on density indicators

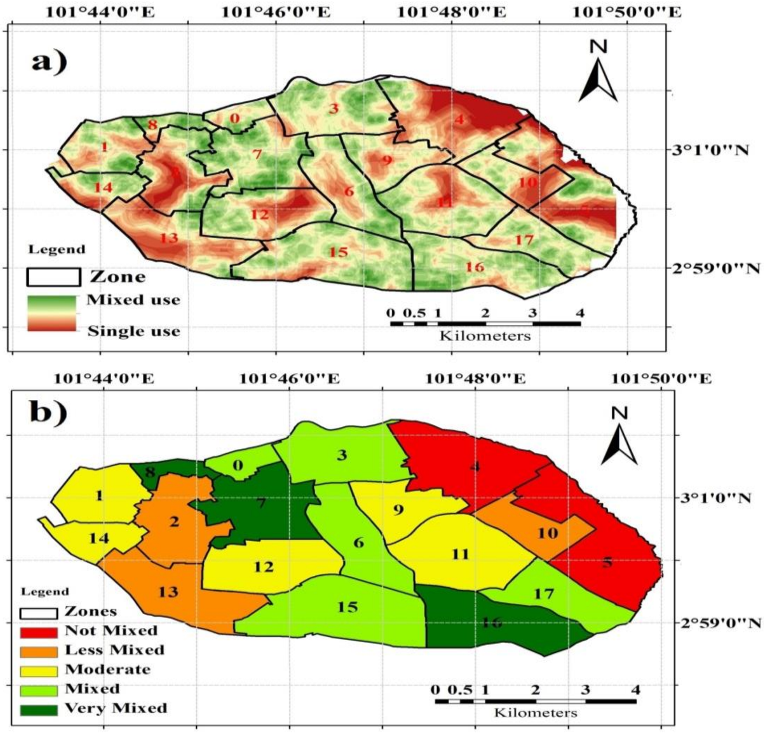

Figure 5. Landuse diversity of Kajang city; a) Pixel based, b) Zonal based

All three compactness indicators were applied on 18 zones of Kajang city, Malaysia. Tables 2 has shown calculations regarding integration of these three indicators. The normalized decision-making matrix and final K_i results (compactness value) were calculated using Bayes theorem. The column d1, d2, d3 and so on, are the main factors of compactness indicators, as given in Table 1. As it is shown in this Table 2, in the column d1 (educational facilities) the value of 0.03 is the maximum and zero is the minimum value. Therefore, value of 0.03 indicates the zones with best provision condition of educational facilities according the population living in these zones. For instance, zone number eight (north west of Kajang city) with 334, 285, 341 and 565 number of children and youths at age of 0-4, 5-9, 10-14 and 15-19 respectively, has not any kinds of educational facilities to serve these population. Interestingly, neighborhood zones like zone number zero, one and two also have same condition. In contrast, zone number 6, 11, 15 and 16 due to proximity to city center have several kindergartens, primary and high schools. In case of health facilities (d2), zone number 11 has the most developed zone with two general hospitals, one clinic and one welfare center to serve the population and elderly of this neighborhood. Public transportation facilities (d3) are developed well in mixed land use areas with higher residential density. For instance, in zones number 2, 13, 4 and 5, which are mainly occupied by single landuse no train or even bus station can be seen. Same conditions are happened for recreational facilities (d4), i.e. no recreational facilities are provided for single landuse areas such as zone 2,

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13, 4 and 5. In contrast, zones number 2 and 13 are assigned as more compact because of availability of job opportunities (d6).
In fact, in case of city intensity indicators (d1-d6), not much correlation among values can be seen. The reason is high degree of compactness regarding educational facilities does not necessarily indicates high level of provision of health or recreational facilities for a neighborhood. In contrast, relative consistency can be observed regarding density indicators for each individual zone. On the other hand, high population density can have implication for high built up or high residential density. For instance, zones number 15, 16 and 17 have high degree of compactness regarding all three density indicators and in contrast, zones number 2, 14, 4 and 5 have low degree of compactness regarding density indicators.

Table 2. Decision making matrix for evaluation of Kajang city compactness

Bayes Rule

Normalized decision making matrix											
Zone	**d1**	**d2**	**d3**	**d4**	**d5**	**d6**	**d7**	**d8**	**d9**	**d10**	**Ki**	**Rank**
0	0	0	0.00975	0.039	0.03	0.036	0.009	0.054	0.024	0.048	**0.00951**	**10**
1	0.015	0.01125	0	0.0195	0.03	0.036	0	0.027	0.012	0.032	**0.00663**	**13**
2	0.0075	0.00375	0	0.00975	0.015	0.036	0.009	0	0	0.016	**0.00273**	**18**
3	0.03	0.0075	0.039	0.039	0.0225	0.027	0.036	0.027	0.024	0.048	**0.01268**	**3**
4	0.03	0.00375	0.00975	0.00975	0	0	0.018	0.0135	0	0	**0.00309**	**17**
5	0.03	0	0	0.00975	0	0.018	0.009	0	0	0	**0.00532**	**15**
6	0.0225	0.01125	0.039	0.039	0.03	0.027	0.036	0.027	0.012	0.048	**0.01041**	**8**
7	0.03	0	0.00975	0.02925	0.0225	0.036	0.009	0.0405	0.024	0.064	**0.01083**	**7**
8	0	0	0	0.039	0.03	0.036	0	0.0405	0.048	0.064	**0.01303**	**2**
9	0.03	0.00375	0.039	0.02925	0.0225	0	0.036	0.027	0.048	0.032	**0.0114**	**5**
10	0.0225	0.015	0	0.02925	0.0225	0	0.027	0.054	0.024	0.016	**0.00907**	**11**
11	0.03	0.015	0.0195	0.039	0.03	0.009	0.036	0.027	0.036	0.032	**0.01116**	**6**
12	0.0225	0	0.00975	0.00975	0.0075	0.036	0.018	0	0.012	0.032	**0.00725**	**12**
13	0.015	0	0	0	0.015	0.027	0.009	0.0135	0.012	0.016	**0.00555**	**14**
14	0.0075	0.015	0	0	0.03	0.036	0	0.027	0	0.032	**0.0041**	**16**
15	0.03	0.00375	0.02925	0.039	0.03	0.036	0.036	0.0405	0.048	0.048	**0.01467**	**1**
16	0.0225	0.01125	0.02925	0.039	0.03	0.009	0.027	0.054	0.036	0.064	**0.01239**	**4**
17	0.03	0	0.00975	0.02925	0.03	0.018	0.027	0.0405	0.024	0.048	**0.01033**	**9**

Interestingly, mixed land use indicator showed correlation among contiguous zones. As it is shown in Figure 5, eastern zones (4, 5 and 10) have very low mixed land use, western zones (1, 2, 13 and 14) have moderate mixed land use and central north and central south (0, 3, 7, 8 and/or 15, 16 and 17) have high degree of mixed land use development. The reason is eastern part of the city is mostly occupied by forest and agricultural fields. Therefore, not much urban development (such as community facilities, transportation facilities, residential and commercial buildings) can be expected in these areas. On the other hand, zones number 2 and 13, are mostly occupied by industrial buildings. Generally, industrial land use avoids construction of residential buildings at a close

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proximity to this land use. Consequently, due to lack of housing area, no other facilities and commercial buildings are provided in these zones. Therefore, these parts evaluated as moderate mixed land use. In contrast, central zones (city center and generally, wherever residential is the dominated land use), are developed in mixed land use manner. As mentioned previously, mixed land use evaluation at the initial stage was evaluated for each pixel and then the result was computed for each zone of Kajang city. Figure 5 demonstrates both maps pixel-based and zonal based of mixed land use evaluation.

Finally, the integration results of all three compactness indicators were calculated in column K_i (Table 2), and illustrated in Figure 6 as final city compactness assessment of all eighteen zones of Kajang city. The Ki value was calculated based on the weights assigned to each parameter (Table 1). In overall, built up density value (d9) has highest impact on final city compactness value (Ki) of Kajang city. This judgment was achieved by regression analysis using IDRISI selva software. The value of correlation coefficient (r) of built up density was 0.85 and this value was followed by 0.82 and 0.77 for intensity and mixed landuse development indicators respectively. This result reveals that the most important compactness indicator is built up density indicator. However, providing proper facilities in suitable locations for local residence in a mixed development area also is a significant task for a compact development.

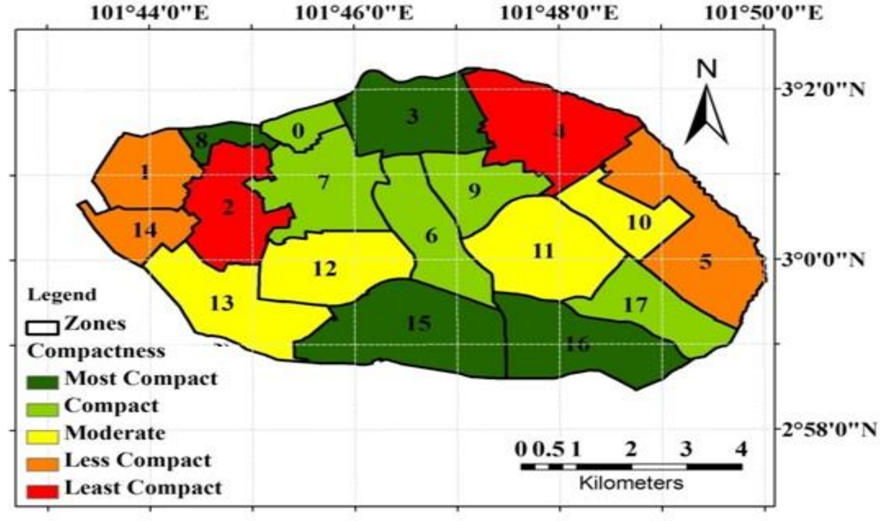

Figure 6. Urban compactness assessment of eighteen zones of Kajang city;

In general, as it is shown in figure 6, eastern and western zones are assigned as less compact, due to lower density, development in single land use manner and lack of community facilities. In contrast, central zones are more compact due higher density, higher land use diversity and distribution of several community facilities.

Local government by considering these results can propose new development plans, especially for least compact zones. However, the proposed plan should be according to the characteristics of corresponding zones. For instance, zone number 0, 1 and 2, should be provided by proper community facilities and commercial land uses. By providing

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these facilities in these zones, not only mixed land use characteristic but also intensification of these zones will be improved.

5. Conclusion

Compact development has several advantages in terms of social and environmental perspectives. One of the main positive environmental effects of these kinds of development is to protect natural and green environments. This essential objective can be achieved through high-density urban development instead of horizontal and low density development. Other benefits of compact developments such as land use diversity and higher intensification also have significant effects on quality of life of the local residences. Hence, to develop an urban area in a compact manner or to improve the compactness of the existing urban areas, the essential task is to measure the existing compactness, in order to have proper knowledge from existing condition. Furthermore, city compactness assessment can help local planning organizations to have comprehensive view during planning new urban developments. However, urban compactness is particularly difficult to assess. Defining dedicated indicators provides useful approach to assess urban compactness in various aspects. This research by considering several aspects of urban area such as density, planning and landuse diversity attempted to investigate city compactness to evaluate sustainability of Kajang city, Malaysia. These indicators were involved not only physical characteristics of the city (like built up density) but also the livability and living behavior of the local residences (such as shopping and traveling behavior). However, measurement and integration of these indicators are an essential task in these kinds of analysis. Multicriteria decision-making methods are the most common approaches to deal with these multidisciplinary problems. These approaches by prioritize and weighting the important factors help decision makers to solve complex problems. Integration of MCDM methods with GIS environment as well as remote sensing data collection provides useful tool to deal with complex geospatial problems such as urban and or natural environmental issues.

Final output maps demonstrated the evaluation of Kajang city zones in the range of least to most compact zone. Least compact zones implicated the areas with lack of proper facilities (Public transportation or community facilities), low density or single land use development. Local government can improve city compactness of these areas by providing required facilities, and increase urban density, to make Kajang city more sustainable. In contrast, compact zones illustrated the areas with proper design and planning regarding various sustainable urban perspectives. However, these areas also can be made more compact and sustainable through close investigations by improving the deficiencies and social problems if any.

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