AMERICAN JOURNAL OF AGRICULTURAL SCIENCE, ENGINEERING, AND TECHNOLOGY (AJASET)

ISSN: 2158-8104 (ONLINE), 2164-0920 (PRINT)

VOLUME 6 ISSUE 3 (2022)

PUBLISHED BY: E-PALLI, DELAWARE, USA

American Journal of Agricultural Science, Engineering, and Technology (AJASET)

Volume 6 Issue 3, Year 2022
ISSN: 2158-8104 (Online), 2164-0920 (Print)
DOI: https://doi.org/10.54536/ajaset.v6i3.962
https://journals.e-palli.com/home/index.php/ajaset

Discovering the Relationship Between the Accessibility and Covid 19 Using Analytic Hierarchy Process (AHP) Case Study Bukit Bintang, Kuala Lumpur

Ramzi Qwasmi[1*], Alias bin Abdullah[1], Norzailawati Mohd Noor[1], Zainora bt. Asmawi[1]

Article Information

Received: November 16, 2022
Accepted: November 19, 2022
Published: November 22, 2022

Keywords

Accessibility, Analytic Hierarchy Process (AHP), COVID-19, Geographic Information System (GIS)

ABSTRACT

People are more likely to meet and connect when there is a high concentration of amenities within easy travelling distance. In this way, we argue that accessibility is a proxy for various characteristics associated with social interaction and that environments with greater accessibility promote greater social interaction, leading to higher contagion rates for some contagious diseases like COVID-19. Three criteria have been proposed to evaluate availability: Diversity, proximity, and connectivity. The three criteria were analyzed using a geographic information system (GIS). One of the multi-criteria analyses, the Analytic Hierarchy Process (AHP), was used to establish the defensible space zones according to the accessibility criteria. Results were verified by comparing them to cases of covid-19 in the Bukit Bintang area. The zones that reported the most Covid incidences were found to cross over non-defensive (easy to access) zones. Because of this, we can conclude that easier access contributed to the rise in reported cases of COVID.

INTRODUCTION

The ease with which any land-use activity may be accessible from a certain location through a specific transportation system is known as accessibility (Dalvi, 1978). It is a metric that quantifies the relative possibility for contact with a certain urban feature, such as a park (Johnston *et al.*, 1986). Diversity is the geographical arrangement of land use that affects the nature and style of travel. Reduced travel times and increased appeal of walking result from a well-mixed land use that supports and provides a range of services close to a region (Feng *et al.*, 2010). Another benefit of mixed land use is that it may give walkers more visual variation and appeal (Forsyth *et al.*, 2006). Although diversity is a very difficult to quantify quality, it is frequently considered when assessing accessibility and physical activity. Theoretically, a multifunctional environment should shorten travel distances and distances between locations, promoting physical activity as a mode of transportation (Robitaille, 2009). Finally, a high variety of indexes decreased automobile ownership and usage and reduced emissions (Song & Knaap, 2004).

The degree of connection between roads, sideways, pedestrian walkways, and trails is measured by connectivity. Since a well-connected network is projected to offer speedier and more alternative routes, favourably affecting accessibility, high connectivity is anticipated to facilitate transit and travel between sites. The grid design, where streets intersect at right angles and compact rectangular blocks and frequent crossings shape the urban environment, is recognised as the classic high-connectivity network. On the other hand, neighbourhoods with a lot of dead-end streets and few intersections, blocks, and sidewalks are seen to be less suited for walking (Feng *et al.*, 2010). Measures of connectivity are related to the physical layout and construction of transportation infrastructure. Numerous studies on the correlation between various walkability measures and highway connectivity have shown that many of these indicators are positively connected (Tomalty *et al.*, 2009); (Vargo *et al.*, 2012). (Robitaille, 2009). (Pelletier *et al.*, 2009). (Berrigan *et al.*, 2010). The number and variety of places within a certain radius serve as a gauge of a region's closeness. It depends on diversity and density. Greater proximity and directness between points of destinations increase the likelihood that their distance will decrease, hence reducing the need to migrate. It is fair to assume that walking is more likely than driving when there is less than one kilometre between two locations (Vargo *et al.*, 2012). Walking and general physical activity have consistently been linked to proximity to parks, paths, trails, schools, and recreational facilities in several studies (Berke *et al.*, 2007; Tucker *et al.*, 2009; Robitaille, 2009; Lovasi *et al.*, 2008; Curran *et al.*, 2007). Proximity regarding retail establishments is also necessary (Krizek & Johnson, 2007). According to (Krizek & Johnson, 2007), the retail establishment includes the following general categories:

- Retailers of food and drink
- Health and personal care stores
- Apparel and fashion accessories shops
- Hobby, book, and music stores; general merchandise stores that sell sporting goods, hobbies, books, and music.
- Miscellaneous stores (e.g., used merchandise, pet, art, tobacco, etc.)
- Restaurant and bar establishments.

Additionally, it is anticipated that places with high rates

[1] Kulliyyah of Architecture & Environmental Design International Islamic University Malaysia
[*] Crresponding author's e-mail: alqawasmi_malaysia@hotmail.com

of urban walking encourage more people to use public transit. (Frank *et al.*, 2010). As a result, these areas rely less on vehicles being close to public transportation terminals and are often used to assess and test any connections with physically active transportation (Tomalty *et al.*, 2009). (Forsyth *et al.*, 2006). (Frank *et al.*, 2010)). A higher facility density increases the likelihood that people will interact and meet since venues are more accessible. locations with greater accessibility promote higher levels of social interaction and, therefore, higher rates of infectious disease transmission., that accessibility is a proxy for numerous social contact-related qualities.

LITERATURE REVIEW

(Brown *et al.*, 2021) studied the city-level commuting networks and the influence of the epidemic potential of cities. When epidemics did occur, they changed the frequency and geographic dispersion of such outbreaks. They rebuilt commuter mobility networks for Bangkok (Thailand) and Dhaka (Bangladesh), two Asian megacities with 16 and 21 million residents, respectively, using aggregated mobile phone user data. They modelled the dynamics of directly transmitted diseases like SARS-CoV-2 on the commuter networks. The researchers found that different projected epidemic trajectories were caused by differences in network structure between the two cities. Bangkok's commuter system was made up of physically linked modular settlements, and the spread of illness was correlated with distance between locations. In contrast, the geographical distance had less of an effect on the epidemic's propagation in Dhaka since the network there had a less distinct geographic structure. They also found that the predicted behaviours of epidemics differed depending on the local network structure around the outbreak's source.

Using a SIRD Model that considers "lockdown" and "riot," (Zheng *et al.*, 2021) forecast the pandemic patterns of national and state regional administrative units in the United States from July 27, 2020, to January 22, 2021, based on COVID-19 surveillance data and human movement data. The results showed that geographic proximity was a key factor in the epidemic's spread across the United States. There was a strong correlation between the number of COVID-19-positive patients and the number of times locals visited parks during the lockdown. (Chen *et al.*, 2020) explored and modeled the spatial factors of COVID-19 in New York City via the Ordinary Least Squares Regression and Geographically Weighted Regression techniques. According to the findings, there are more COVID-19-positive cases in areas with higher medical density, green space density, mean travel distance, male percentage, and commuting patterns (walking, carpooling, and public transportation). Conversely, areas with higher percentages of White Only and Work from Home (WFH) had lower COVID-19-positive case rates. Additionally, distinct zip code areas or clusters show distinctive connections. Overall, this research shows that reducing travel has a significant impact on postponing the epidemic and that maintaining public cleanliness is essential for disease management in areas with high demand for public transportation.

(Huang *et al.*, 2020) maintain that the relationship between the built environment and the risk of COVID-19 transmission is essential to respond to the pandemic. Using confirmed case data from Hong Kong, they looked at the relationship between the built environment and COVID-19 risk. They calculated the risk of COVID-19 and looked into its geographic patterns at the Tertiary Planning Unit (TPU) level using the dataset's details on the homes and places visited by each case based on Incidence Rate (R1) and Venue Density (R2). Next, they looked at the connections between a variety of built-environment traits (such nodal accessibility and green space density) and COVID-19 risk using the Global Poisson Regression (GPR) and Geographically Weighted Poisson Regression (GWPR) Models. The results show that the risk of COVID-19 seems to be concentrated in certain Hong Kong communities. However, if the incidence rate is taken into account as a risk indicator, the danger of COVID-19 transmission in certain suburban areas may be overestimated. The GPR and GWPR models show a strong and varied relationship between the given built-environment parameters and the likelihood of COVID-19 transmission on a regional scale.

Justification of Site Selection

The third wave of the Covid-19 outbreak had affected Malaysia, according to the health director-general of the Malaysian ministry of health, who said this on October 8, 2020. The six million people moving out of the Klang Valley and Negeri Sembilan also worries the Malaysian Ministry of Health (MOH), who fear that this could result in an increase in COVID-19 cases in the US. The majority of districts in Selangor, Kuala Lumpur, and Putrajaya, according to him, are now COVID-19 red zones, and it would be difficult to impose restrictions on the movement of people in these densely populated areas (Malymail, 2020). The covid-19 cases significantly start increasing being of October 2020 Until the number reached 7995 cases in Kuala Lumpur and 718 cases in Bukit Bintang respectively on February 7, 2021 (MOH, 2021) Figure (1).

Figure 1: Kuala Lumpur cases by districts as of February 7, 2021 (*Source: MOH, 2021*)

By zoning Kuala Lumpur city into subzones and using a covid-19 outbreak data and human movement data, we found that in the same period (RMCO) from December 1, 2020, and January 15, 2021, Bukit Bintang area recorded the most significant number of cases with 3555 cases, in addition, it ranked as the most visited places (Qwasmi *et al.*, 2022) Figure 2

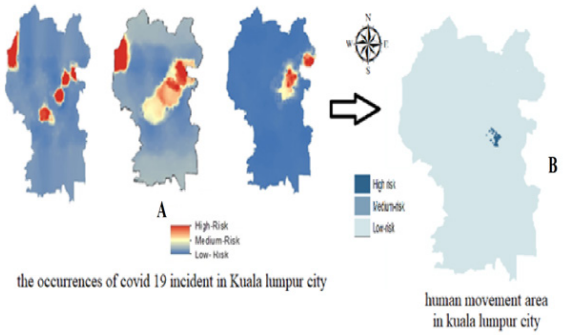

Figure 2: A Kuala Lumpur covid-19 cases using hotspot analysis showing Bukit Bintang area as a red zone; B showing the most visited place using kernel density analysis. places (Qwasmi *et al.*, 2022)

The shopping and entertainment district of Kuala Lumpur, Malaysia, is called Bukit Bintang. Other names for it include Star Hill, which is a direct translation of the Malay name, and Bintang Walk. Included are Jalan Bukit Bintang and the neighbourhood. The area has long been the most significant retail corridor in Kuala Lumpur, and it is home to several iconic shopping centres, outdoor cafés, bars, night markets, food streets, Mamak sellers, and hawker-style eateries. Visitors and locals alike like this area, especially young people. Pudu and Cheras to the south, Bukit Nanas to the north, Kuala Lumpur City Centre (KLCC) to the northeast, Tun Razak Exchange and the Maluri neighbourhood to the east, and Petaling Street (Chinatown) to the west encircle Bukit Bintang (Figure 3).

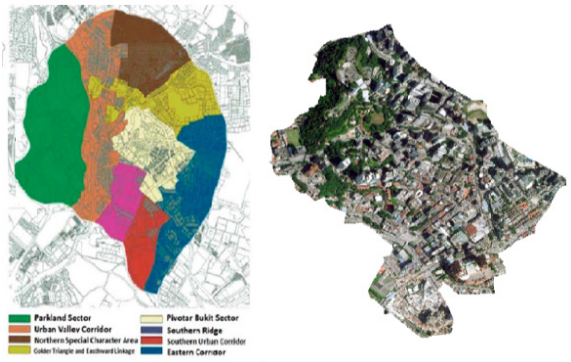

Figure 3: Left City center boundary zones; Right: the study area zone (Bukit Bintang) (Draft Structure Plan Kuala Lumpur, 2020)

RESEARCH METHODOLOGY AND ANALYSIS

The Occurrences of Covid 19 Incident in Bukit Bintang District

The main intention of getting GIS covid-19 cases data was to determine the occurrences of covid 19 incidents in the study area, which recorded the highest number of covid-19 cases in the study area. Covid-19 instances A newspaper article published on the website of the Malaysian ministry of health revealed the distribution of COVID-19 cases in community areas at the COVID-19 National Crisis Preparedness and Response Center (CPRC) Monitoring System from the outbreak's onset until February 2, 2021, Covid-19 cases data from March 28 to April 3, 2021, and April 11 to April 17, 2021. By the desk of the Director-General of Health Malaysia. as showing in Figure 4 and 5.

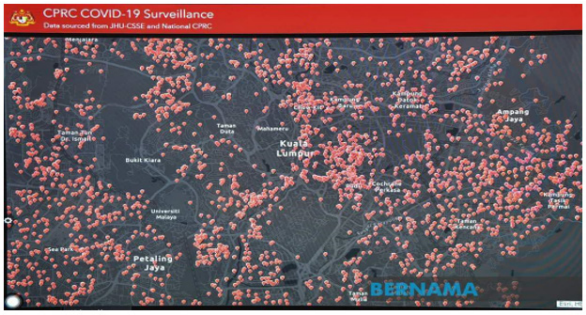

Figure 4: Distribution of COVID-19 cases as of February 5, 2021, Malaysian ministry of health (MOH, 2021)

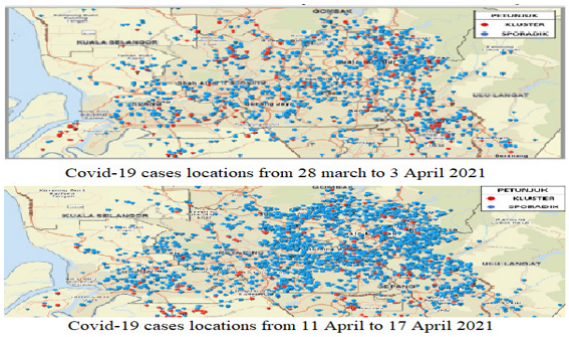

Figure 5: Covid-19 cases data from March 28 to April 3, 2021, and April 11 to April 17, 2021. (Official website of Desk of the Director-General of Health Malaysia).

Produced layers and collected data had to be processed and transformed into the proper format before they could be used for analysis. Data preparation is required since most received data were initially received as pictures and cannot be used right away and because most GIS applications need some raster data to be georeferenced. Georeferencing is the process of giving each raster pixel a set of geographic coordinates. The maps gathered from the Malaysian Ministry of Health (MOH) websites were first georeferenced. The locations were determined via field surveys and were verified on Google Maps by a few easily recognised features of the image.

The image could be "positioned" in the right place in the real world using GIS or mapping tools. The second step involves a method for displaying the globe's curved surface on a flat surface, such a computer screen or piece of paper. Techniques have been developed by

cartographers to "project" places from the earth's curved surface onto a flat surface. These methods were used in this study to reduce the distortion that results from creating a flat map of the spherical globe, Zone 48N in WGS 84/UTM . Third, digitizing was done, converting features on a paper map into digital format. To be suitable for analysis. Where the covid-19 outbreak, points were converted from image to shapefile format, and finally, cleaning and classification of the data by clipping the data for the study area shown in Figure 6.

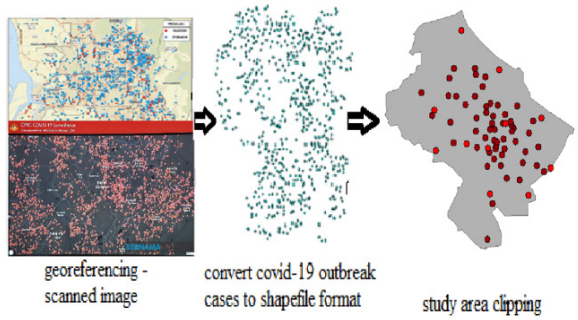

Figure 6: Converting features on a paper map into digital format

The Bukit Bintang area was analyzed to discover the occurrences of covid 19 incidents and to verify the result. The hotspot analysis was used to determine the specific place in Bukit Bintang with the circumstances of covid 19 incident. Two maps were used for this analysis, one related to the period of the beginning of the epidemic until February 5, 2021, and the other one from March 28 until April 17, 2021 (Figure 7)

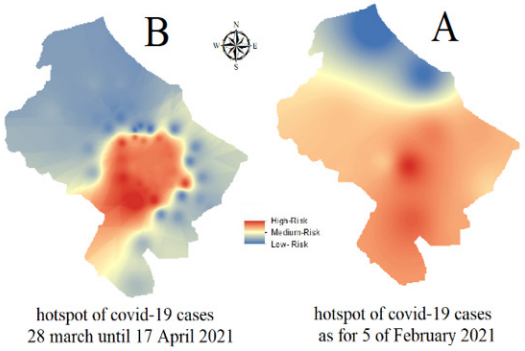

Figure 7: The occurrences of covid 19 incidents in Bukit Bintang area A covid -19 cases from the beginning of the epidemic until the end of February 2021 using a hotspot analysis: B covid -19 cases from March 28 until April 17, 2021, using hotspot analysis

Developing a Defensible Space

In this study, the Analytic Hierarchy Process (AHP) and Multi-Criteria Decision Analysis (MCDA) were used to calculate relative weights, the value of each feature relevant to the defensive space zone, and to build a defensible area based on accessibility. The priority vector is constructed to provide the overall relevance modifier value for each component to be used in GIS calculations after the relative weights have been applied.

The chosen AHP is a more methodical way to assess appropriateness since it breaks the problem down into hierarchical categories and conducts a more thorough study of the components. It could be more clearly understood if you look at their more specific and little shapes or signals. The AHP allows experts and interested parties to participate in providing input. This paradigm enables the incorporation and accommodation of qualitative, quantitative, and information based on expert knowledge. A method for facilitating the consideration of many different elements by decision-makers is multi-criteria decision-making (MCDA). MCDA is used to investigate and contrast a number of, sometimes conflicting aspects in order to get the most accurate result (Ryan & Nimick, 2019).

The requirements for each element were Determined and supported by prior research and survey data, for displaying expert opinions and knowledge as meaningful figures, the values changed to reflect the relative relevance and size of each criteria Finally, the layers/criteria are weighted in relation to the goal that defines the defensive space zones. collect, synthesise, and combine. Figure 8 will create a map of the defended space zones.

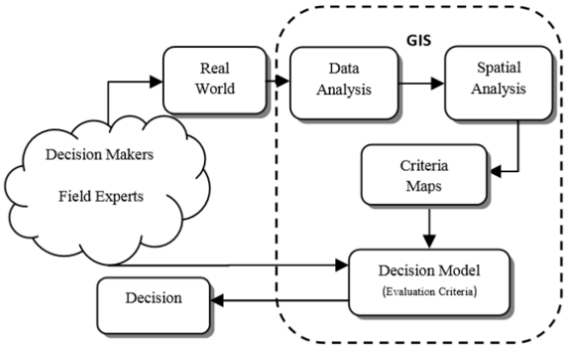

Figure 8: Integrated GIS -MCDA approach.

Preparing the Criteria

the accessibility factor criteria were established according to the accessibility variables, including connectivity, approximately, and diversity. The likelihood of people meeting and interacting socially is thought to increase because to the higher density of amenities and easy access to locations. enhanced COVID-19 contagion as a result.

Connectivity

The initial need of the accessibility element is connectivity.

Figure 9: Bukit Bintang area sidewalk were obtained from (Qwasmi *et al.*, 2022)

The sidewalk centerline vector data from the Bukit Bintang region sidewalk were taken from (Qwasmi *et al.*, 2022) figure, which was used to assess connectivity (9).
This research is counting the number of actual intersections in the sidewalk and excluding pedestrian-inaccessible street crossings on highways. Real junctions were chosen using Arc GIS' Network Analysis feature. The integrate tool is used to combine any crossings that are too close—within 15 meters—and are treated as a single junction. Other research have also recommended a 15 metre gap (Dobesova & Krivk, 2012). Figure 10.

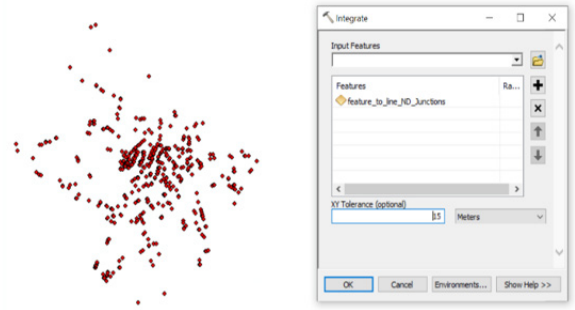

Figure 10: The integration of actual intersection in the study area

A kernel density analysis was done to determine the junctions with the highest frequency. The default result of the kernel density has classified the region into nine zones. According to the premise that easy access to a location enhances the possibility of people meeting and engaging owing to the increased density of facilities, the cells inside zone one is assigned a value of 1. Therefore, a defensible space indicates the smallest number of intersections, which means less connectivity. At the same time, zones nine is given a value of 9, which shows the most significant number of intersections, which means more excellent connectivity and easy access. Increase the chances of individuals meeting and engaging which create an area that cannot be defended; Figure 11.

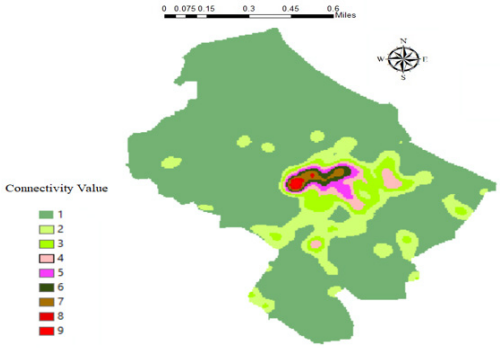

Figure 11: Shows the connectivity area value according to intersection density

The feature of accessibility makes up the second criterion (approximately). The investigation's inclusion of certain locations was decided. The choice is based on the predefined locations. Based on the previous studies (Qwasmi *et al.*, 2022). Based on the significance of the goal, each point relates to a location with a certain value and a buffer distance. The most frequently visited destinations were used to determine the numbers and types of distances. The values show how important each destination class is in relation to the others. Since shopping malls are the most popular walking destinations, according to research on human mobility, having one nearby is four times more important than having a healthcare institution.
To assist in defining a "acceptable walking distance," UN-Habitat organised a series of consultations with national statistical officers, civil society and community groups, experts from various fields, representatives from academia, think tanks, UN agencies, and regional commissions, among other partners. Following these conversations, which took place between 2016 and 2018, it was decided that a walking distance of 400 metres, or about a 5-minute walk, was a realistic and workable standard. A street network-based service area is created around each visiting feature using the 400-meter access threshold. All residents in the service area will have easy access to these visiting features, it is decided.
Due to the small area of the study area, distances have been suggested in this research to be between 100 meters to 500 meters.
Based on the destination and goal of the trip, these are the commonly recognised distances that are thought to be frequently walked. Since they signal a greater possibility of attracting walkers even if they reside at a Facility-Destination Type, the distances also hint at the relative significance of destination types to one another. A service area (buffer) is built around each kind of destination using network analysis. Information about sidewalk centerlines is included in the network analysis. As a result, each sidewalk in the network of Bukit Bintang walkways is represented by a single line. There is no more information on the lane count, kind of road, or existence of street barriers (Figure12).

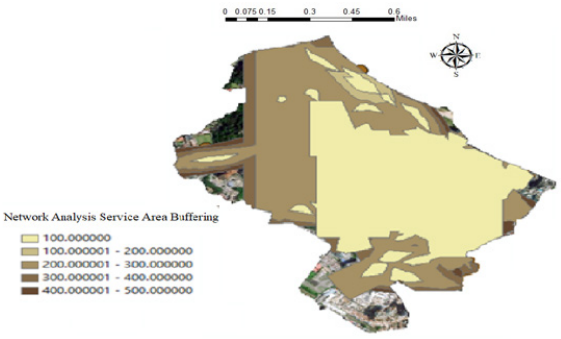

Figure 12: Example of buffers-service areas generated with network analysis

Reclassifying the buffer polygons into four zones and converting them to raster format. In the buffers, each cell is given a number between 1 and 4 depending on how close it is to the services (value 4 means easy to access according to the Proximity factor, which means non-defense zone, while buffers 4 and 5 have a value of 1 that

mean difficult to access according to the proximity which non-defense zone at this step, each destination type corresponds to a layer that contains the newly generated

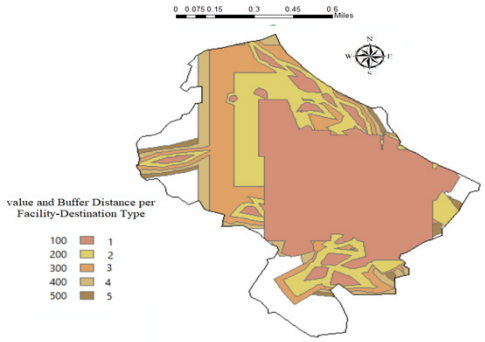

Figure 13: Value and buffer distance per facility-destination type

buffers. (Figure13). Diversity

The third and last criterion of the accessibility factor is the Variety criterion, where the Land Use Mix reflects the amount of diversity of land use types within a region and is an essential part of Urban and Spatial Planning. For instance, the policy of mixed land use is seen as an essential element for enhancing walkability in an urban environment (Mavoa *et al.*, 2018).

There is no clear and standardized approach for assessing the land use variety of a region. Consequently, researchers often evaluate the mixed land use evolution of their study region using a variety of methodologies and data sources. (Bhat & Gossen, 2004) (Song & Knaap, 2004); (Ritsema van Eck & Koomen, 2007); (Manaugh & Kreider, 2013). Each of these methodologies has both good and bad consequences on the evaluation. For example, the interaction approach (Manaugh & Kreider, 2013) assessed a variety of land uses by measuring the length of lines connecting two polygons of complimentary purposes. Thus, if there is a roadway network connecting many land uses (such as a street between residential, commercial, and/or industrial land uses), this region is not termed mixed land use. In contrast, the Entropy technique merely considers the variety of land uses without regard to their closeness (Manaugh & Kreider, 2013).

(Song & Knaap, 2004) analyzed the land use variety of the city of Portland based on residential land use at the zone level. Interestingly, (Arifwidodo, 2012) omitted the mixed land use development factor from the study of the compact development strategy since, according to him, this element is regional. Therefore, a micro-level evaluation cannot be conducted. Nonetheless, the present research investigated mixed land use of the study region based on a pixel size of 10 m and shown that this crucial element may be studied at many scales of analysis.

As previously indicated, the mixed-use of the land area has both beneficial and negative effects on accessibility. Due to the area's diversified land use, a favorable accessibility outcome is anticipated if there is a high degree of land use diversity. If there is a lack of land use diversity, accessibility will be badly harmed. Mixed land use has the ability to accommodate many uses in close proximity, hence reducing travel distances. In this research, the land use map was obtained from the Faculty of Architecture at the Islamic University.

the following five distinct land-use categories are considered: Residential, Commercial, Public and Institutional Facilities, and Open Space. All of these land uses were extracted from the land use map as a distinct layer, and then Euclidean distance studies were conducted for each of them (ArcMap 10). The findings of all proximity maps were normalized on a scale from one to five, with one indicating that the pixel is far (not mixed) and five indicating that it is close (mixed). Next, the standardized maps were combined by a weighted average to display the regions (pixels) that are in close proximity to several land uses. Therefore, this map displays the features of each pixel's mixed land use in the research region. Reclassified as four distinct zones The cells within the zones are assigned a value between 1 and 4 based on the high and low mix land use (Value 4 low mix land indicates defensible space, while value 1 indicates which non-defense zone). At this stage, each destination type corresponds to a layer containing the newly generated buffers.

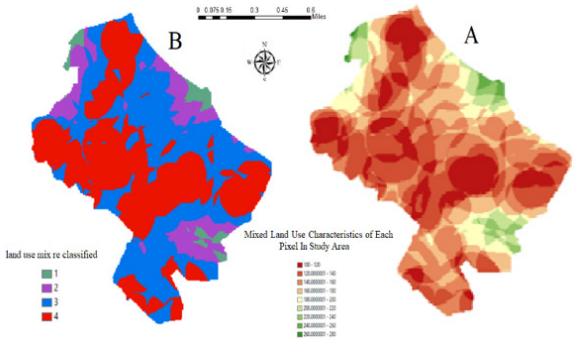

Figure 14: (A) Mixed land use characteristics of each pixel of the study area (B) Reclassification according to the high and low mix land use.

Analytic Hierarchy Process (AHP)

Weighted overlay analysis, which is known as the ArcGIS trademark and the most important and used method in geographic data processing, is used to define the defensible space zone (Bhatta, 2011). Considering all pertinent thematic layers, i.e., the urban fabric, which comprises open space, building design, sidewalk safety (sidewalk width, covid-19 area rate), and sidewalk comfort, all of which are converted to raster format before being classed such that all data layers are unidirectional (Ziaul & Pal, 2017). A strong capability for quantitative modelling is provided by the raster overlay, which combines the pixel or grid cell values from the thematic maps using arithmetic and Boolean operators to create a new value in the composite raster map (numerical analysis) (Bhatta, 2011). Figure 15.

In the study, AHP (Analytic Hierarchy Procedure), a comprehensive approach that integrates factual evidence and the expert-subjective judgement in order to reach a good decision-making process, is used (Şener *et al.*, 2011).

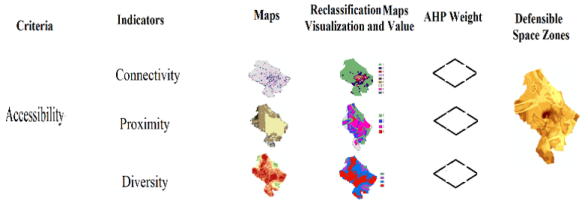

Figure 15: Process diagram of establishing defensible space using Analytic Hierarchy Process (AHP)

As a result, a decision matrix employing 1-9 scale for choice-relevant parameters was created. The rating scale was composed of the following elements: Quite unimportant, extremely unimportant, inconsequential, comparatively unimportant, equally important, pretty important, more important, very important, very important, and very important are all examples of low importance (Saaty, 1980) (Şener *et al.*, 2011) Table 1
The online questionnaire's defensible space factor weight

Table 2: The affected building type after being filtered, verified, and classified based on properties and houses classification in Malaysia

Relative Importance	Definition	Explanation
1	Equeal Importance	Two Activities contribute equeal to objectives
5	Weak Importance	Experiance and judgement slightly one activity over another
5	Strong Importance	Experiance and judgement Strongly one activity over another
7	Demostrated Importance	One activities is strongly favoured and demostrated in practice
9	Absolute Importance	The evidence favouring one activity over another is off highest possible order of affirmation
2,4,6,8	Intermadiat Values	When compromise is needed

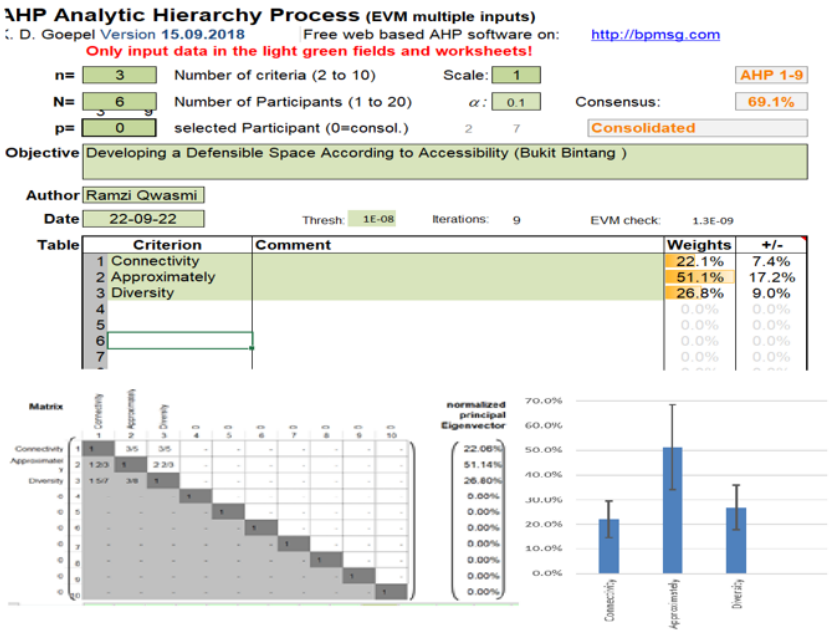

Figure 16: Entering and organizing data using new AHP excel template software

was generated by the new AHP excel template software, which was developed by (Goepel, 2013).
The defensible space theory was used to organise and manage the template, which is illustrated in Figure 16.
There is no minimum sample size necessary for AHP analysis, according to the literature currently in existence on its applications in management and engineering. Sample sizes ranging from four to nine people were employed in several studies (Darko *et al.*, 2019), in our case, the average was considered, which is six expert Participants.
Small sample sizes may be detrimental to the processing of data and contemporaneous interpretation of results, among other aspects of the study. The main advantage of AHP over other MCDM approaches is that it may provide accurate and statistically robust results without the requirement for a large sample size (Doloi, 2008). Some academics claim that using AHP to conduct issue-specific research is subjective. Therefore, using a large sample size is not necessary. Others claim that because AHP is founded on expert evaluations, even the views of a single qualified expert are often representative (Golden *et al.*, 1989). Additionally, using AHP in a study with a large sample size might be counterproductive because "cold-called" experts are likely to give arbitrary responses that could significantly affect the consistency of the assessments (Cheng *et al.*, 2002). It is possible to attribute a significant portion of AHP's appeal in CM to

its capacity to operate on small sample sizes.
The weights assigned to various themed maps and their distinctive qualities were determined by field experience and expert judgement that was standardised using Saaty's AHP method. As advised by the normalization's consistency evaluation, which lessens the bias of the specified weights of the thematic layers (Saaty, 1980). Figure 17.

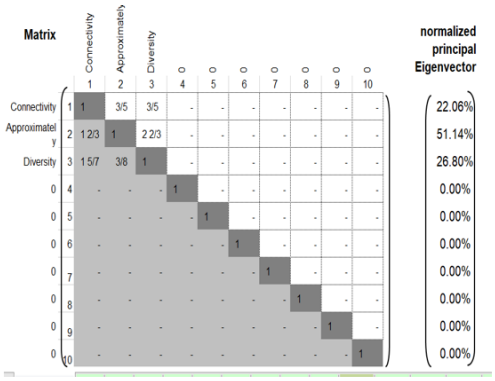

Figure 17: Pairwise comparison matrix by AHP for factors weight

RESULTS

To obtain the overall map which accentuates the defensible space zone according to the accessibility factor, all the indicators (Connectivity, approximately, and diversity) maps are combined and given the weight based on expert assessments using the weights sum up option. The map re-classifies according to the accessibility factor from into 5 zones, as shown in Figure 18.
(AC - Equation 1) is a combination of three suggested indices. According to the suggested technique, the constant Connectivity CO parameters are (corresponding to 22.1), the Level of approximately AP (corresponding to 51.1), and the Level of diversity DV (corresponding to 26.8) accessibility factor (AC) (∑ constant parameters = 1).

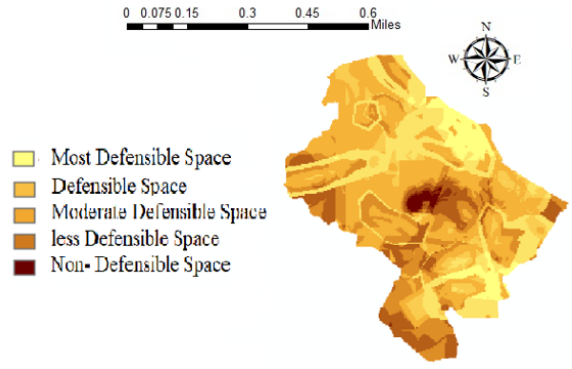

Figure 18: The defensible space map of the accessibility

Equation:
∑ AC = KCO *Z*_ COST + *K*AP *Z*_APST+ *K*DV *Z*_ DVST
k=0
Where
AP: Approximately
CO: Connectivity
DV: Diversity
ST: Study Area
To validate and verify the defensible space zone, The final result was compared to the zones that can be defended, and it was found that the zones that cross the non-defensive areas (easy to access) were found in firstly the

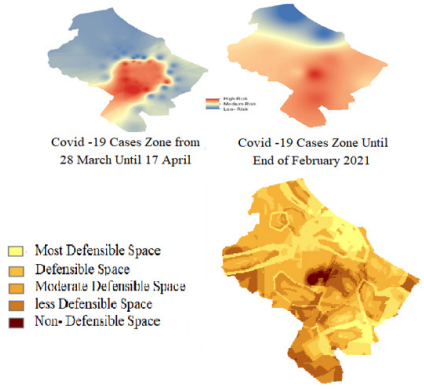

Figure 19: Validation and verify the defensible space zone

zones that recorded the highest cases of Covid during RMCO period while the non-defensible zone appeared as (difficult to access) This confirms the validity of the results, Figure 19

DISCUSSIONS AND RECOMMENDATIONS

In evaluating thousands of public spaces around the world, the studies have found that to be successful, they generally share access, and This matched with the access to green open spaces Where accessibility plays a positive role, While the ease of access played a negative role for the most visited places because they are in fact commercial places such as shopping malls and restaurants that People took it as alternative place due to proximity factor which led to crowded level increases the chance of getting the virus

CONCLUSIONS

In conclusion, this work is important in the area of urban planning because it relates to land management to create a healthy environment free from epidemics. It analyses the planning effectiveness on space as defensible space using GIS tools. The key to any study is the availability of data, which gives researchers the information they need to create clever models and tactics connected to creating a safe zone where people may move about freely during an outbreak to stop it from spreading. Where the distribution of the most significant community services and amenities depends on planning basics and standards in order to prevent fragmented attractions and crowding in any zone, Kuala Lumpur City's Structure Plan and Local Plans must be implemented. The first investigation was conducted in Malaysia's Kuala Lumpur, in the Bukit Bintang district. to establish a Defensible Space in relation to the COVID-19 outbreak based on accessibility utilising the delivery, roughly, and connection criteria.

REFERENCES

Arifwidodo, S. D. (2012). Exploring the effect of compact development policy to urban quality of life in Bandung, Indonesia. *City, Culture and Society, 3*(4), 303–311. https://doi.org/10.1016/J.CCS.2012.11.007

Berke, E. M., Koepsell, T. D., Moudon, A. V., Hoskins, R. E., & Larson, E. B. (2007). Association of the Built Environment With Physical Activity and Obesity in Older Persons. *American Journal of Public Health, 97*(3), 486. https://doi.org/10.2105/AJPH.2006.085837

Berrigan, D., Pickle, L. W., & Dill, J. (2010). Associations between street connectivity and active transportation. *International Journal of Health Geographics, 9*(1), 1–18. https://doi.org/10.1186/1476-072X-9-20/FIGURES/4

Bhat, C. R., & Gossen, R. (2004). A mixed multinomial logit model analysis of weekend recreational episode type choice. *Transportation Research Part B: Methodological, 38*(9), 767–787. https://doi.org/10.1016/J.TRB.2003.10.003

Bhatta, B. (2011). *Remote sensing and GIS* (2nd ed.). Oxford University Press.

Brown, T. S., Engø-Monsen, K., Kiang, M. V., Mahmud, A. S., Maude, R. J., & Buckee, C. O. (2021). The impact of mobility network properties on predicted epidemic dynamics in Dhaka and Bangkok. Epidemics, 35(January), 100441. https://doi.org/10.1016/j.epidem.2021.100441

Chen, Y., Jiao, J., Bai, S., & Lindquist, J. (2020). Modeling the Spatial Factors of COVID-19 in New York City. *SSRN Electronic Journal*. https://doi.org/10.2139/SSRN.3606719

Cheng, E. W. l., li, H., & ho, D. C. k. (2002). Analytic hierarchy process (AHP): A defective tool when used improperly. *Measuring Business Excellence, 6*(4), 33–37. https://doi.org/10.1108/13683040210451697/FULL/PDF

Curran, A. S., Grant, J. G., & Wood, M. (2007). Indicators for Community Action: Built Environment and Community Health. *Journal of Rural and Community Development, 2*, 59–74.

Dalvi, M. Q. (1978). Behavioural Modelling, Accessibility, Mobility and Need: Concepts and Measurement *. In Behavioural Travel Modelling. Routledge. https://doi.org/10.4324/9781003156055-38

Darko, A., Chan, A. P. C., Ameyaw, E. E., Owusu, E. K., Pärn, E., & Edwards, D. J. (2019). Review of application of analytic hierarchy process (AHP) in construction. *International Journal of Construction Management, 19*(5), 436–452. https://doi.org/10.1080/15623599.2018.1452098

Dobesova, Z., & Krivk, T. (2012). *Walkability Index in the Urban Planning: A Case Study in Olomouc City*. Advances in Spatial Planning.

Doloi, H. (2008). Application of AHP in improving construction productivity from a management perspective. *Construction Management and Economics, 26*(8), 841–854. https://doi.org/10.1080/01446190802244789

Draft Structure Plan Kuala Lumpur. (2020). City Hall Kuala Lumpur. Draft Structure Plan Kuala Lumpur.

Feng, J., Glass, T. A., Curriero, F. C., Stewart, W. F., & Schwartz, B. S. (2010). The built environment and obesity: a systematic review of the epidemiologic evidence. *Health & Place, 16*(2), 175–190. https://doi.org/10.1016/J.HEALTHPLACE.2009.09.008

Forsyth, A., Schmitz, K. H., Oakes, M., Zimmerman, J., & Koepp, J. (2006). Standards for Environmental Measurement Using GIS: Toward a Protocol for Protocols. *Journal of Physical Activity & Health, 3*(1), S241–S257. https://doi.org/10.1123/JPAH.3.S1.S241

Frank, L. D., Devlin, A., Johnstone, S., & Van Loon, J. (2010). *Neighbourhood Design, Travel, and Health in Metro Vancouver: Using a walkability index-executive summary*. University of British Columbia.

Goepel, K. D. (2013, June). Implementing the Analytic Hierarchy Process as a Standard Method for Multi-Criteria Decision Making in Corporate Enterprises – a New AHP Excel Template with Multiple Inputs. Proceedings of the International Symposium on the Analytic Hierarchy Process. https://doi.org/10.13033/ISAHP.Y2013.047

Golden, B. L., Wasil, E. A., & Harker, P. T. (1989). The Analytic Hierarchy Process. In *The Analytic Hierarchy Process. Springer Verlag*. https://doi.org/10.1007/978-3-642-50244-6

Huang, J., Kwan, M. P., Kan, Z., Wong, M. S., Kwok, C. Y. T., & Yu, X. (2020). Investigating the Relationship between the Built Environment and Relative Risk of COVID-19 in Hong Kong. *ISPRS International Journal of Geo-Information, 9*(11), 624. https://doi.org/10.3390/IJGI9110624

Johnston, R. J., Gregory, D., Smith, D. M., Haggett, P., & Stoddart, D. R. (1986). The Dictionary of human geography. *Blackwell Reference*.

Krizek, K. J., & Johnson, P. J. (2007). Proximity to Trails and Retail: Effects on Urban Cycling and Walking. *Journal of the American Planning Association , 72*(1), 33–42. https://doi.org/10.1080/01944360608976722

Lovasi, G. S., Moudon, A. V., Pearson, A. L., Hurvitz, P. M., Larson, E. B., Siscovick, D. S., Berke, E. M., Lumley, T., & Psaty, B. M. (2008). Using built environment characteristics to predict walking for exercise. *International Journal of Health Geographics, 7*. https://doi.org/10.1186/1476-072X-7-10

Malymail. (2020). Now facing third wave, Dr Noor Hisham urges Malaysians to stay home as best way to flatten Covid-19 curve | Malay Mail.

Manaugh, K., & Kreider, T. (2013). What is mixed use? Presenting an interaction method for measuring land use mix. *Journal of Transport and Land Use, 6*(1), 63–72. https://doi.org/10.5198/JTLU.V6I1.291

Mavoa, S., Boulangé, C., Eagleson, S., Stewart, J., Badland, H. M., Giles-Corti, B., & Gunn, L. (2018). Identifying appropriate land-use mix measures for use in a

national walkability index. *The Journal of Transportation and Land Use, 11*(1), 681–700.

MOH. (2021). National CPRC COVID-19 Monitoring system. MOH.

Pelletier, A., Paquin, S., Chartr, A., Pelletier, C. A., & Qc, M. (2009, December). Article walk 21 2009-11-07 1 Are all walking audits equivalent? A comparison of three walking audits in a Montreal neighbourhood. CORE.

Qwasmi, R., Abdullah, A. Bin, Asmawi, Z. bt, & Mohd Noor, N. (2022). Impact of Human Mobility of COVID-19 Epidemic in Kuala Lumpur using GIS. *American Journal of Agricultural Science, Engineering, and Technology, 6*(2), 25–36. https://doi.org/10.54536/AJASET.V6I2.441

Ritsema van Eck, J., & Koomen, E. (2007). Characterising urban concentration and land-use diversity in simulations of future land use. *The Annals of Regional Science, 42*(1), 123–140. https://doi.org/10.1007/S00168-007-0141-7

Robitaille, É. (2009). Indicateurs géographiques de l'environnement bâti et de l'environnement des services influant sur l'activité physique, l'alimentation et le poids corporel.

Ryan, S., & Nimick, E. (2019, August). Ellis. Multi-Criteria Decision Analysis and GIS.

Saaty, T. L. (1980). The analytic hierarchy process: planning, priority setting, resource allocation. In Priority Setting. *Resource Allocation, MacGraw-Hill, New York International Book Company* (1st ed.). McGraw-Hill International Book Co.

Şener, Ş., Sener, E., & Karagüzel, R. (2011). Solid waste disposal site selection with GIS and AHP methodology: a case study in Senirkent-Uluborlu (Isparta) Basin, Turkey. *Environmental Monitoring and Assessment, 173*(1–4), 533–554. https://doi.org/10.1007/S10661-010-1403-X

Song, Y., & Knaap, G. J. (2004). Measuring Urban Form: Is Portland Winning the War on Sprawl? *Journal of the American Planning Association, 70*(2), 210–225. https://doi.org/10.1080/01944360408976371

Tomalty, R., Haider, M., & Smart Growth British Columbia. (2009). *BC sprawl report : walkability and health. 57*.

Tucker, P., Irwin, J. D., Gilliland, J., He, M., Larsen, K., & Hess, P. (2009). Environmental influences on physical activity levels in youth. *Health & Place, 15*(1), 357–363. https://doi.org/10.1016/J.HEALTHPLACE.2008.07.001

Vargo, J., Stone, B., & Glanz, K. (2012). Google walkability: a new tool for local planning and public health research? *Journal of Physical Activity & Health, 9*(5), 689–697. https://doi.org/10.1123/JPAH.9.5.689

Zheng, Z., Xie, Z., Qin, Y., Wang, K., Yu, Y., & Fu, P. (2021). Exploring the influence of human mobility factors and spread prediction on early COVID-19 in the USA. *BMC Public Health, 21*(1). https://doi.org/10.1186/S12889-021-10682-3

Ziaul, S., & Pal, S. (2017). Estimating wetland insecurity index for Chatra wetland adjacent English Bazar Municipality of West Bengal. *Spatial Information Research, 25*(6), 813–823. https://doi.org/10.1007/S41324-017-0147-X