The spatial distribution of "hotspot schools" and the relationship with crime pattern in Mukim Petaling and Klang

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Abstract. The Ministry of Education has announced a list of 402 hotspot schools in August 2017, and it has raised concerns among many parents and school community about the safety of school students. Hotspot schools is a school that has been identified with misconduct, discipline, and drug. The objective of this paper is to determine the type of different hotspot schools which influence the spatial distribution of crime types at the intra-urban scale. This study employed the GIS tool "multiple ring buffer" and the " location quotient crime" (LQC) as the main methods. By using LQC index, the results reveal that there is 4 hotspot schools within buffer ring from 0 to 500 meters have a high crime attraction with LQC above 3.0 and 8 hotspot schools that below LQC of 0.5 which have strong detraction or lowest problem of crime distribution in the study area. This result also shows that crime distribution in 35 hotspot schools produced LQC equal to 0.1, meaning that hotspot schools in study area contributing only 10% of the overall total of crime in Mukim Petaling and Klang. The importance of spatial distribution with proximity analysis provides useful information for encouraging school and law enforcement agencies to promote safety zone area for school.

1. Introduction

The 'Hotspot schools' disclosure by the Ministry of Education Malaysia on April 25, 2017 has attracted attention of many parties and was deliberately discussed in the social media. Director-General of Education, Tan Sri Dr Khair Mohamad Yusof said that 402 primary and secondary schools were identified as hotspot schools involving misconduct and disciplinary problems. He explained that the location of the school within the crime-risk area was one of the factors that putting the school in the category of hot spots based on the information stipulated in the Ministry of Education Disciplinary Discipline System (SSDM) [1]. According to the Minister of Education, Datuk Seri Mahdzir Khalid, Hotspot schools is a school with disciplinary issues, drug abuse, crime and other problems such as very low attendance levels. The disclosure of the list of 402 hotspot schools has raised concern among parents who have their children studying at the school [2]. In order take prompt action and strategic plan to address the existing issues, this paper aims to answer the following questions: What type of spatial distribution of a crime zone that influence the hotspot schools? Are there crime patterns among these school within the buffer zone of crime? How many crime patterns distribution surrounding certain buffer zoning that attract the hotspot school as a crime generator or attractor? To answer these questions, GIS was used as a tool to clarify further these issues.

To identify the spatial distribution of crime by type within hot spot school, buffer zone and location quotient crime (LQC) as a basic spatial analysis were used to understand. The spatial distribution of crime in a city depends on its spatial pattern, land use, transport system, and street network. Crimes

usually are pulled by attractors and generators. Some crime locations are crime generators; others are crime attractors [3,4]. Harries [5] states that a buffer is a zone around an object, such as a school or intersection, that has some investigative or analytical significance. Buffering tools in GIS make this purpose a relatively simple task. Analysis of crime incidents in the buffer zones can help to determine how many crimes occur within the set distance of the zone around the hotspot schools. Paulsen and Robinson [6] mention that buffer zone is an important part of spatial analysis because its competence in answering everyday question concerning crime incident locations and patterns.

2. Methodology

The study adopts crime pattern theory, which has been proposed by Brantingham and Brantingham. The crime pattern theory is now the pillar of environmental criminology together with rational choice and routine activities theory [7], by introducing new concepts as mentioned by Dutkowska and Leitner [8].

2.1 Study area, datasets and background study

This study focuses on Mukim Petaling and Klang, in the state of Selangor. Justification for the study area is due to the highest hotspot schools in Selangor from 402 hotspot schools list. The report indicates that Selangor has the highest with 76 (19%) hotspots school and from that 35 (46%) hotspot schools are within Mukim Petaling and Klang which are covered by 43 police station boundary area as shown in Figure 1. Data set used is crime data index containing a set of x, y coordinates from police department and portal web i-selamat.my in the period of 2013 until 2015. The list of report for 402 hotspot schools are based on 2013 data and therefore this study uses crime data started from 2013.

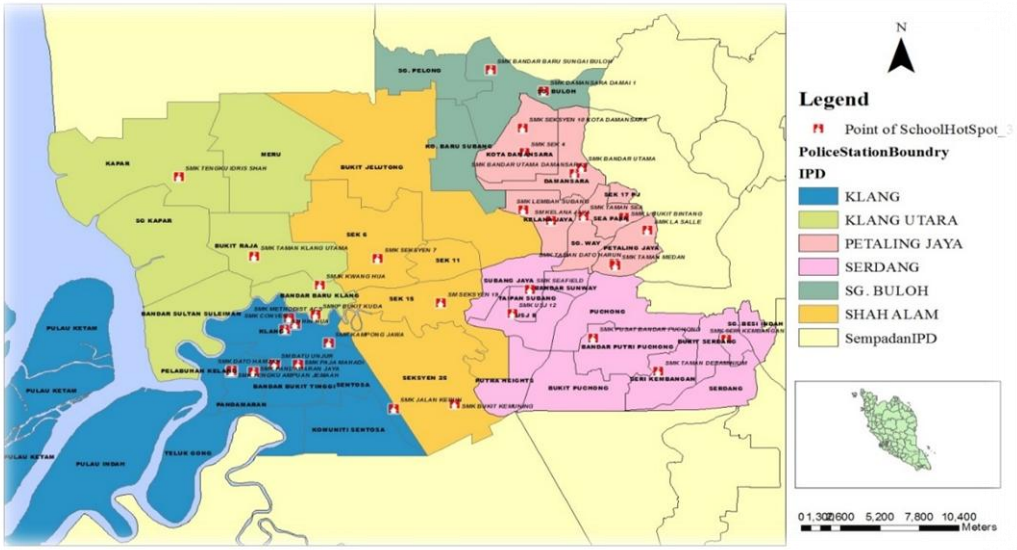


Figure 1. Mukim Petaling and Klang base map showing 35 hotspot schools with police station boundary

Distance and route are key factors to determine school and crime pattern distributions. Brantingham and Brantingham [9] found that routes of travel to and from school tend to be more predictable than the commutes of adults as this produce opportunities for offending when victims and offender's cross paths. Gottfredson and Gottfredson [10] stated that schools located in communities with high crime rates are more likely to experience crime than the schools that located in a safer community.

2.2 Buffering zone as a basic spatial analysis on hotspot schools

The methodology employed is Distance Buffer Zones and created around each of the 35 hotspot schools. Distance buffer zones are zones created inside the hotspot schools range from 0 to 500

meters. The multiple ring buffers created were 0 to 100, 101 to 200, 201 to 300, 301 to 400 meters and 401 to 500 meters. This distance zones are standard which has been mentioned in the Public Facilities Planning Guidelines 2013 amendments by Ministry of Urban Wellbeing, Housing and Local Government [11]. The justification for using five distance buffer zones are: distance range 0 to100 meter is within the area of school, while distance 101 to 200 meters zone is near the school of boundary, distance between 201to 300 meter usually school bus stop and outside parking, distance 301 to 400 meter is residential housing and distance 401 to 500 meter is a business area (shopping, entertainment, shop etc.). Therefore, buffer crime zone by hotspot schools use this standard guideline to determine how many crimes and the type of it occur within this set range of distance zone. The study found 2 hotspot schools sharing same location in multiple ring buffers, namely SMK Taman Medan and SMK Taman Dato Harun, SMK Tengku Ampuan Jemaah and SMK Dato Hamzah. Therefore, only 33 hotspot schools are conduct for analysis in this study.

2.3 Location Quotient Crime (LQC) as a basic count on crime and alternative to crime rates

The advantage of an LQC in crime analysis is there is no need to obtain the number of targets as it is necessary in calculating a crime rate [12]. This study employed a methodology which is similar to Dutkowska and Leitner as originality by Brantingham and Brantingham. The following formula was used:

$$\mathrm{LQm}C_i^k = \frac{\frac{NmC_i^k}{A_i^k}}{\frac{NmC^k}{A^k}} \quad (1)$$

where

$\mathrm{LQm}C_i^k$ is the LQC for crime type m for distance zone i and hotspot school k;

NmC_i^k is the number of events for crime type m within distance zone i from hotspot school k;

A_i^k is the area of distance zone i from hotspot school k;

NmC^k is the number of events for crime type m within the potential influence range of hotspot school k (distance zone 0–500 meter);

A^k is the area of the hotspot school k with the potential influence range of distance zones (0–500 m);

I is six distance zones: i = 1–5 (0–100, 101-200, 201-300, 301-400 and 401–500 meter);

K defines the 33 hotspots school (k = 1–33); and

M defines the number of crimes in total and the fourteen crime index types (m = 1–14).

At a specific distance zones from a hotspot schools, the result of the LQC can be defined as follows: (a) if the LQC is 1, then the crime patterns density in a particular zone is similar to the hotspot schools potential influence range; (b) if the LQC is larger than 1, then the crime patterns density in a particular zone is higher than in the hotspot schools potential influence range; and (c) if the LQC is smaller than 1, then the crime patterns density in the particular zone is lower than in the hotspot schools influence range. This study classifies the values of the LQC into five classes according to its strength (Table 1) as introduce by Dutkowska and Leitner. To improve the readability of all result tables, each class has been assigned to a specific color code.

Table 1. Classification of the LQC based on the school hotspot influence and direction on crime.

LQC	Color Class	Strength and direction influence of crime index
>3.0		Strong attraction (Very Hotspot)
3.0–1.1		Attraction (Hotspot)
1.0		Lack or balance of influence (Medium)
0.9–0.5		Detraction (Cold spot)
<0.5		Strong detraction (Very cold spot)

Source: Dutkowska and Leitner

2.4 Crime Data

Crime data used is from the period year of 2010 to 2016 from Royal Malaysia Police by district police. Type of crime data for analysis is from ten types of crime index which is theft, snatch theft, motorcycle theft, car theft, van/lorry/heavy machine theft, house break-in night, house break-in day, and from violent crime is gang robbery without fire arm, robbery without fire arm and assault. Hotspot schools list is provided by Bernama and New Street Times Newspaper. ArcGIS 10.3 software and main tool is Buffer for Proximity Analysis are used. Land use data such as housing and business (year 2010-2013) area is provided by Local District Council (Shah Alam, Klang and Petaling Jaya).

2.5 Workflow of Analysis

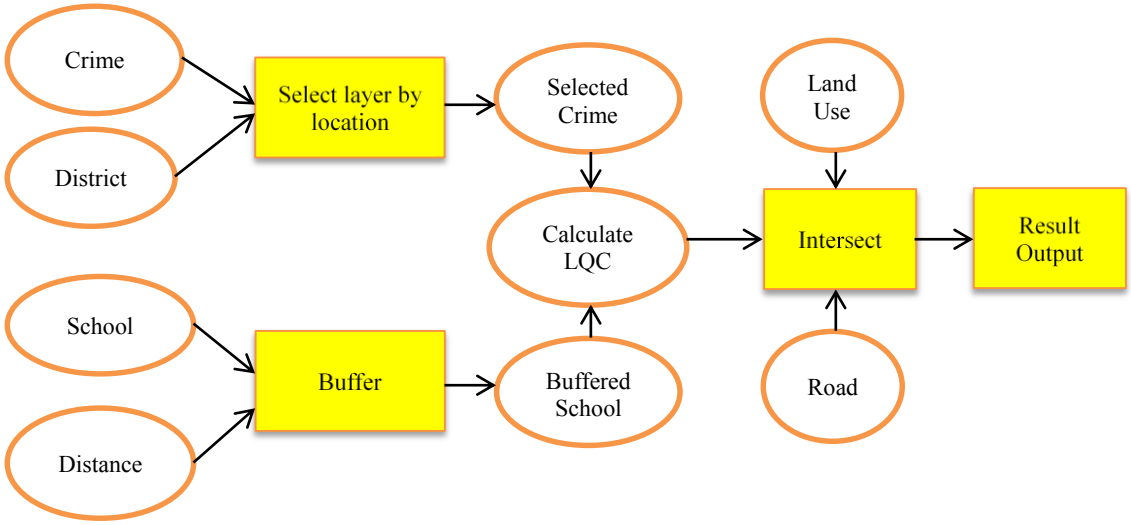


Figure 2. Workflow of Analysis

Figure 2 shows workflow of analysis used in this study. The first step is select layer by location and conduct for crime data layer with district police use to define affected school. The output of buffered zone schools with crime LQC will identify the areas that meet all criteria result for visual strength and direction influence by zones to show the strong attraction (hotspot) and strong detraction (cold spot) of crime pattern.

3. Results and Discussion

3.1 Crime pattern in Mukim Petaling and Klang

As shown in Figure 3, crime distribution in 33 hotspot schools produce LQC equal to 0.1, that means hotspot schools in a study area contributing only 10% from overall total crime in Mukim Petaling and Klang. SMK Tengku Idris Shah in Kapar, Klang shows highest LQC of 5.1 which is a strong crime attraction. Second highest is SMK Taman Medan in Petaling Jaya that has LQC of 3.5, followed by SMK Pusat Bandar Puchong which has LQC of 3.3 and SMK Batu Unjur in Bandar Bukit Tinggi, Klang which has LQC of 3.2. This is based on the crimes occur in the distance zone of 0 to 500 meters from school. These four schools are the highest hotspot among 35 hotspot schools. From this table also, there are 8 hotspot schools that below LQC of 0.5, this means there is a strong detraction or has lowest problems of crime distribution. SMK Jalan Kebun, Klang has the lowest LQC of 0.1, followed by SMK Seksyen 10 Kota Damansara that has LQC of 0.2. Most of hotspot schools in this classification share total LQC of 0.3. This 8 hotspot schools which has LQC value below 1.00, this means the relative proportion of that crime is below then normal crime pattern in comparison with a larger study area. For LQC equal to 1.00, there are 4 hotspot schools, namely; SMK Bandar Utama

Damansara 2, SMK Damansara Damai 1, SMJK Kwang Hua and SMK Methodist ACS in Klang, this shows has a proportional mix with 14 crime indexes for the whole study area.

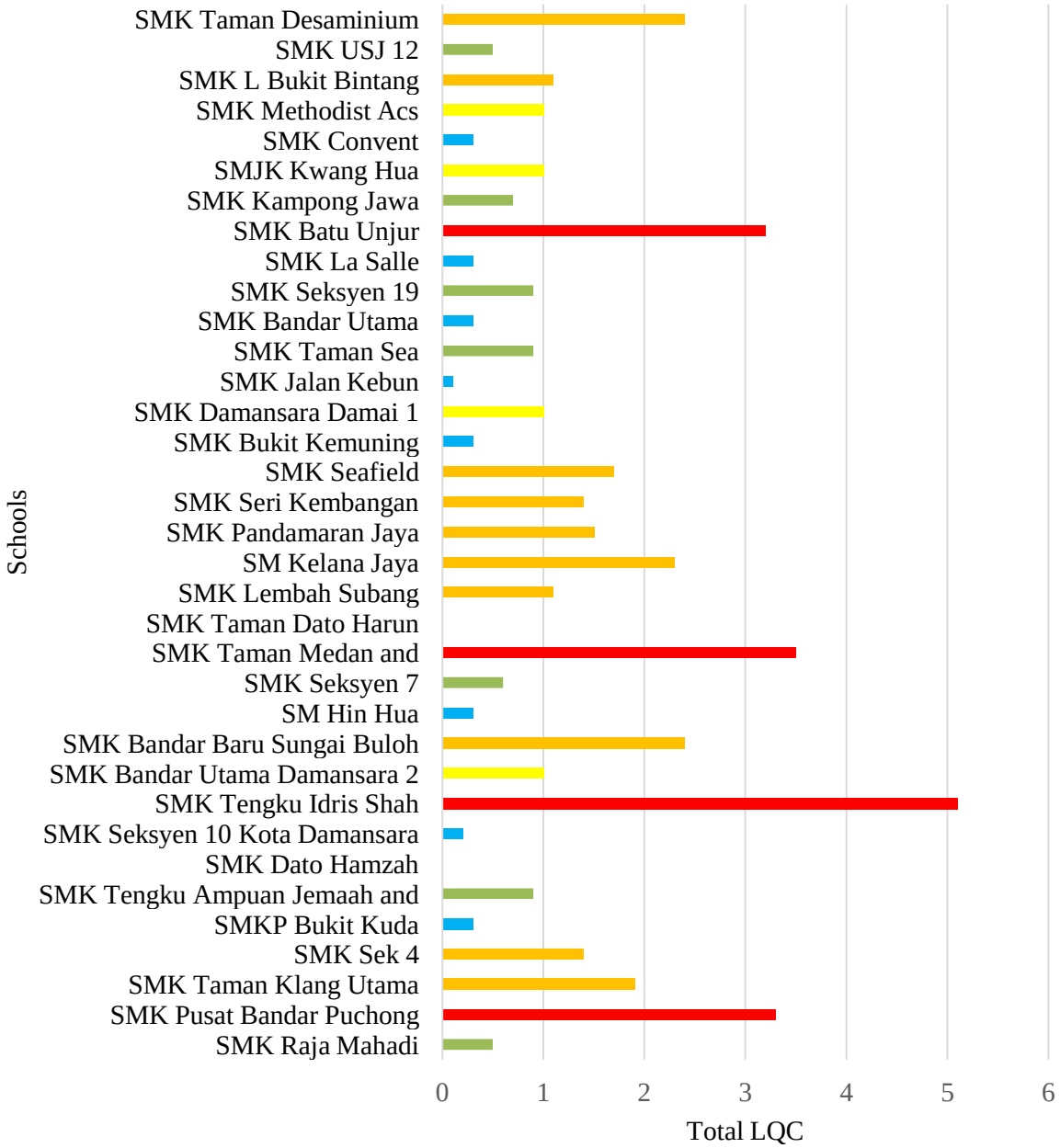


Figure 3. LQC of total crime index by hotspot schools

3.2 Crime pattern within buffer zone of hotspot schools

Figure 4 shows crime distribution of 33 hotspot schools buffer zone within 0 to 500 meters divided into five classes. The most crime occur within buffer zones 0 to 100 meter involving SMK Tengku Idris Shah (LQC of 4.9), SMK Taman Desaminium (LQC of 3.7) and SMK Batu Unjur (LQC of 3.1). Within buffer zone 101 to 200 meter, SMK Tengku Idris Shah, SMK Seafield, SMK Batu Unjur and SMK Taman Desaminium has LQC above 3.0. There are 4 hotspot schools within buffer zone 201 to 300 meter has LQC above 3.0, namely; SMK Taman Medan, SMK Tengku Idris Shah, SMK Pusat Bandar Puchong and SMK Bandar Baru Sungai Buloh and their hotspot schools within buffer zone 401 to 500 meters has LQC above 3.0, namely; SMK Tengku Idris Shah, SMK Batu Unjur and SMK

Pusat Bandar Puchong. This pattern shows that crime distribution within the range of 0 to 500 meters is proportional to the size of buffer zone.

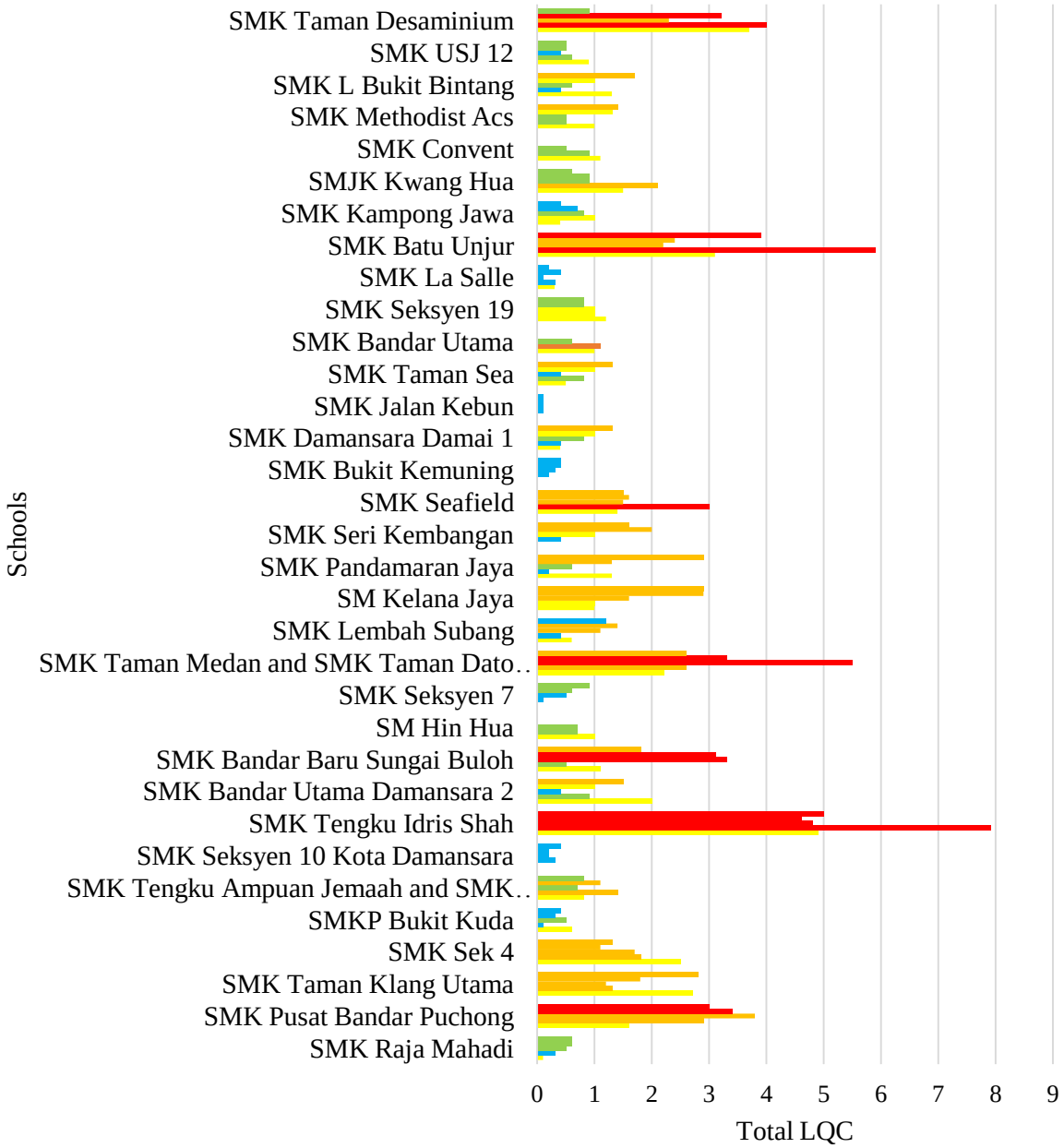
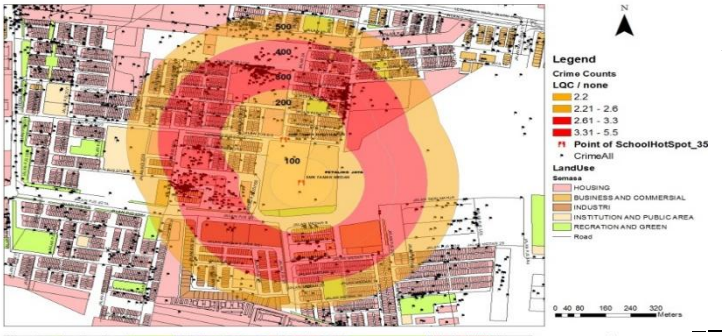


Figure 4. LQC of total crimes by buffer zone

3.3 Crime pattern within buffer zone map (0 to 500 meter) by LQC

Table 2, buffer zone map shows that SMK Tengku Idris Shah, Kapar is the first rank in Mukim Petaling and Klang which crimes affect housing, business and industrial areas within 0-500 meter from school. SMK Taman Medan, Petaling which the second rank also shows the attraction crime zone within 300 to 400 meters from school. These two schools were established more than 20 years with the surrounding old development land use. SMK Pusat Bandar Puchong, the third rank shows crime affected are housing and business areas where there are no industrial area and land use development surrounding 0 to 500 meters are below 20 years and crime attraction within 300 to 500 meters from school.

Table 2. LQC by buffer zone map

Rank	School Name	Buffer Zone Map	Land Use Affected
1	SMK Tengku Idris Shah, Kapar.		1. Housing 2. Business 3. Industrial
2	SMK Taman Medan, Petaling Jaya.		1. Housing 2. Business 3. Industrial
3	SMK Pusat Bandar Puchong.		1. Housing 2. Business

3.4 Correlation between hotspot schools and crime index

To determine whether a correlation existed between the hotspot schools and crime index, this study carried statistical test using Spearman's rank correlation coefficient to measure the association and strength of relationship variable with ranked data. Spearman's rank correlation coefficient uses because data does not meet the assumptions to hold normality distributed by Pearson's correlation coefficient. The null and alternative hypothesis are;

H_0: There is no correlation between hotspot schools and crime index.

H_1: There is correlation between hotspot schools and crime index.

Spearman's Rank are calculate using the formula below (2), where n is the number of samples in each category. After choosing the level of significance, ***α=0.05 (p=0.044) two tailed test***, $r$eject H_0 if r falls in critical region; otherwise, H_0 cannot be rejected and accepted H_1.

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} \tag{2}$$

$$1 - \frac{6(3853)}{33[33^2-1]} = 0.35612 \tag{3}$$

The Spearman's rank-order correlation was calculated to determine the relationship between 33 hotspot schools and crime index. Result found, there was a weak, positive correlation between hotspot

schools and crime index, which was statistically significant (r_s= .35612, p = .044). As shows, r_s 0.35612 > 0.44, therefore H_0 rejected at 0.05 confidence level.

3.5 Discussion Finding

Based on Figure 3 and 4, crime pattern is influenced by the buffer zones distance (0 to 500 meter). The LQC hotspot schools shows, there are four schools have strong attraction (very hotspot) to crime index, namely;

1) SMK Tengku Idris Shah, Kapar, Klang.
2) SMK Taman Medan and SMK Taman Dato Harun, Petaling Jaya.
3) SMK Pusat Bandar Puchong.
4) SMK Batu Unjur, Bandar Bukit Tinggi, Klang.

These schools have LQC above 3.0 means crime pattern above normal trend and must be priority in strategies for reducing crime index. The LQC hotspot schools also shows, there are eight schools have strong detraction (very cold spot) to crime index, namely;

1) SMK Jalan Kebun, Taman Sentosa, Klang.
2) SMK Seksyen 10 Kota Damansara, Petaling Jaya.
3) SMKP Bukit Kuda, Bandar Baru Klang.
4) SM Hin Hua, Klang Selatan.
5) SMK Bukit Kemuning, Sek. 25 Shah Alam.
6) SMK Bandar Utama, Damansara, Petaling Jaya.
7) SMK La Salle, Petaling Jaya.
8) SMK Convent, Klang.

These schools have LQC below 0.5 means crime pattern from normal trend. The result from Table 2 shows, that hotspot schools are surrounding by housing, business and industrial development. Crime distribution in 33 hotspot schools produce LQC equal to 0.1, that means hotspot schools in a study area contributing only 10% from overall total crime in Mukim Petaling and Klang. This study also found, that there is weak positive correlation relationship between hotspot schools and crime index at 95% confidence level.

4. Conclusion

This study has identified the relationship spatial distribution pattern using spatial analysis of hotspot schools and crime index in the Mukim Petaling and Klang, Selangor Malaysia. This study used multiple ring buffer (proximity analysis), location quotient crime (LQC) and Spearman's correlation is significant to identify the spatial distribution pattern. The main recommendation is the Free Crime School Zone by 500 meters and this study able to provide effective tools of interpreting hotspot schools performance results statistically by high and low crime index density for provide the Ministry of Education Malaysia and Royal Malaysia Police to plan strategic implementation for preventing crime such as crime prevention through environmental designs (CPTED) and Safe City Programs.

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