SPATIAL TEMPORAL OF SCHOOL DROPOUT HOT SPOT: A CASE STUDY OF SARAWAK DISTRICT EDUCATION

Analisis Hot Spot Ruang Masa Keciciran Sekolah: Kajian Kes Sempadan Daerah Pendidikan Negeri Sarawak

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Received: 20 Sept 2022 ; **Revised:** 27 Oct 2022 ; **Accepted:** 25 Nov 2022 ; **Published:** 15 Dec 2022

To cite this article: Chabo, D., Masron, T., Jubit, N., & Yaakub, N. F. (2022). Spatial Temporal of School Dropout Hot Spot: A Case Study of Sarawak District Educatio. *GEOGRAFI*, *10*(2), 56–70. https://doi.org/10.37134/geografi.vol10.2.4.2022

ABSTRACT *The Ministry of Education Malaysia (MOE) has achieved remarkable successes midway between the implementation of education policy for all through the Malaysia Education Development Plan 2013-2025. However, dropout, especially at the secondary school level, relics stagnant as an educational issue in the country. Therefore, this study aims to identify the changes in the spatial pattern of dropout among secondary school students in Sarawak for a study period of six years starting from 2013 to 2018. The spatial methods applied in this study to identify dropout hotspot areas for secondary school students are Getis-Ord Gi* and polygon grid (fishnet). The analysis conducted from 2013 to 2018 revealed that the hotspot areas for secondary school dropouts were intense within the District Education Office of Kuching, Sibu, and Bintulu. In conclusion, the identification of student dropout hot spots based on time and space is very important so that intervention programmes to manage dropout can be implemented based on location. The findings of this study can help stakeholders of secondary school education in Sarawak to emphasis more on the hotspot areas that have been identified.*

Keywords: School dropout, secondary school, hot spot, Getis-Ord Gi* & education

ABSTRAK *Kementerian Pendidikan Malaysia (KPM) telah mencapai kejayaan yang luar biasa dalam pelaksanaan dasar pendidikan untuk semua melalui Pelan Pembangunan Pendidikan Malaysia 2013-2025. Walau bagaimanapun, keciciran murid terutamanya di peringkat sekolah menengah merupakan isu pendidikan di negara ini. Oleh itu, kajian ini bertujuan untuk mengenal pasti perubahan corak keciciran dalam kalangan murid sekolah menengah di Sarawak bagi tempoh pengajian enam tahun bermula 2013 hingga 2018. Kaedah analisis ruangan yang digunakan dalam kajian ini untuk mengenal pasti kawasan hot spot keciciran murid sekolah menengah ialah Getis-Ord Gi* dan grid poligon. Analisis yang dijalankan dari tahun 2013 hingga 2018 menunjukkan bahawa kawasan hot spot bagi keciciran sekolah menengah adalah sekolah di Pejabat Pendidikan Daerah Kuching, Sibu dan Bintulu. Sebagai kesimpulan, pengenalpastian kawasan hot spot keciciran murid berdasarkan tempoh masa dan ruang adalah amat penting supaya program intervensi menangani keciciran dapat dilaksanakan berdasarkan lokasi. Dapatan*

Geografi Vol.10(2),56-70
ISSN 2289-4470 /eISSN 2462-2400

kajian ini dapat membantu pemegang taruh pendidikan sekolah menengah di Sarawak untuk memberi penekanan lebih lanjut mengenai kawasan hot spot yang telah dikenal pasti.

Kata kunci: Keciciran sekolah, sekolah menengah, hot spot, Getis-Ord Gi* & pendidikan.

1. Introduction

School dropout is considered as a global problem as it occurs in all countries (Ajaja, 2012; Kishore & Shaji, 2012; Tas *et al*., 2013). School dropout is a worrying phenomenon because it affects students, families, communities and the nation (Prevatt & Kelly, 2003; Rumberger *et al*., 1990). Furthermore, school dropout is a rampant social phenomenon, particularly at the secondary school level (Bridgeland *et al*., 2006). Not only that, school dropout is also considered to be one of the serious educational, social and cultural worldwide problems (Abotsi *et al*., 2018; Rasmy *et al*., 2017). It does not only affect the local community at the school, district or provincial level but has a long-term negative impact on the social development and economic growth of a country (De Witte & Rogge, 2013; Glennie *et al*., 2013; Ioana *et al*., 2015). In Malaysia, the problem of school dropout does not only affect the aspirations of the Malaysia Education Development Plan 2013-2025 to achieve universal enrolment from preschool to upper secondary level (Form 5) but can also create higher socio-economic development costs in the future.

Most of the previous studies that examined the issue of school dropout have mostly covered on the subject of indigenous accessibility and identifying trends as well as factors of high school dropout. For instance, there are studies conducted in Perak that focused on the dropout factors among secondary school students in Plantation Settlement and the prevention of school dropout among indigenous people using descriptive analysis (Marzuki *et al*., 2014; Mokshein, 2016; Rasmy *et al*., 2017; Md Nor *et al*., 2011; Nagaraj *et al*., 2016).

Although many studies on school dropout have been conducted in Malaysia, but most studies only examine the factors of dropout and measures to prevent dropout. In addition, previous studies have also neglected the spatial element and most studies are only conducted in Peninsular Malaysia. Therefore, the weakness of the research scope makes it incompetent to identify schools that have the highest dropout case clustering rates in the view of spatial context. This is because the negligence of the spatial element makes it difficult to detect the hot spots of school dropouts for urban and rural areas respectively. Moreover, hot spot areas could not be identified using only descriptive analysis.

School dropout studies using GIS applications in Malaysia are still lacking and require more in-depth research, especially in the context of spatial elements. Thus, the study of detecting high risk school dropout location at secondary school in Sarawak can reveal the hot spot area of school dropout in Sarawak according to the administration of the District Education Office by using Geographic Information System (GIS).

2. Literature Review

Some scholars opined that school location is one of the factors that affect student dropout. For example, primary school students in rural Uganda are more likely to experience dropouts compared to students in urban areas (Mike *et al*., 2008). At the upper secondary level as well, student dropouts occur in rural areas in developed countries such as the United States of America (USA) (Suhyun & Jingyo, 2011) and France (Blanchard *et al*., 2011). However, the findings from a study led by Rumbeger and Thomas (2000) show that dropouts are more common in urban schools than in suburban and rural areas.

A study in Nigeria conducted by Ajaja (2012) that focused on school characteristics in influencing school achievement found out that location of school influences student dropout at the upper secondary level. At the university level, Hanewicz (2009) stated that students who live close to the university are less at risk of dropping out and remain to continue their studies as well as successfully complete their studies. On the other hand, Jordan *et al*., (2012) discovered that school dropout rates were similar in urban and rural areas. This is because they opined based on their study areas that family factors are more dominant in determining student dropout. In Malaysia, the level of accessibility of Orang Asli students to educational facilities is one of the factors that cause dropouts (Marzuki *et al*., 2017).

Hashim et al., (2018) study the hot spot schools and the relationship with crime pattern in Mukim Petaling and Klang. This study using multiple ring buffer and location quotient crime to determine the hot spots school that influence distribution of crime. The finding shows that hot spot schools contributing 10% of crime. However, this study focuses on hot spot school that involving in disciplinary problems and the list of hot spot schools is got from Ministry of Education Malaysia.

Jubit et al., (2020) applied Getis Ord Gi* analysis to detect property crime hot spots in Kuchig, Sarawak. This finding shows Getis Ord Gi* is suitable to identify the hot spot with statiscally significant value. Saleh and Balakrishnan (2019) identify hot spots and cold spots of primary education in India by using Getis Ord Gi*. The spatial data include state boundaries of India while non spatial data including population, Education Development Index scores of primary educations from 2005-2015.

3. Methodology

3.1 Spatial and Non-spatial Data

The attribute or non-spatial data for this study is the dropout data of secondary school students in Sarawak from 2013 until 2018. The data was ethically obtained from the Sarawak State Education Department (JPNS). This study involved 190 secondary schools under the administration of 31 district education offices. For spatial data and unit of analysis, this study uses a grid boundary of 10 square kilometres to divide the school catchment area. Figure 1 shows the distribution of secondary schools and district boundaries in Sarawak.

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ISSN 2289-4470 /eISSN 2462-2400

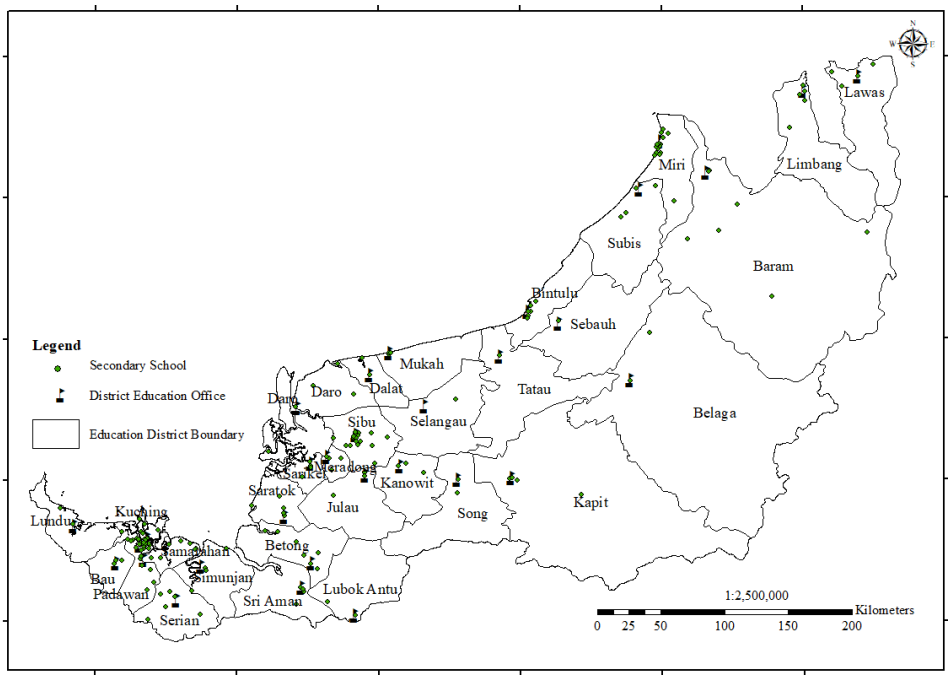

Figure 1. *Area Study*

A spatial hot spot analysis tool on ArcGIS 10.3 known as Getis-Ord Gi* is used to identify the hotspot areas for secondary school dropouts in Sarawak. The hotspot analysis allows the determination of the location of clustering or distribution of student dropouts that is difficult to be determine with simple visualization. Getis-Ord Gi* can also detect spatial clustering areas with similar values around spatial boundaries (Jubit et al., 2020). High level of dropout and low level of dropout that reflect hot spot and cold spot respectively were determined by z-score, p-values and confidence levels for each grid on map. A statistically significant value is when the recorded z-score is positive. The larger the z-score, the higher the clustering density or in other words, hot spots. If the p-value is less than 0.01 and the z score is more than 2.58, then it indicates a hot spot area with a very high value. Meanwhile, the cold spot area is indicated by a negative z -score value. If the value of the z-score is less than -2.58 with a p value of less than 0.01, it indicates that the cold spot area has the lowest value (ESRI, 2020). The significant confidence levels of hot spots and cold spots were determined by three levels, namely 90%, 95%and 99%. Table below shows the connection between z-score, p-value, and confidence level.

Table 1.
Relations between z-score, p-value, and Confidence Level

z-score (Standard Deviations)	p-value (Probability)	Confidence level
< -1.65 or > +1.65	< 0.10	90%
< -1.96 or > +1.96	< 0.05	95%
< -2.58 or > +2.58	< 0.01	99%

4. Findings

Overall, the dropout rate of secondary school students in Sarawak showed a declining trend in six years of study period, except for the year 2016 and 2018. Referring to the statistical record in Figure 2, the highest number of dropouts in 2013 occurred among the secondary schools located in rural areas in Kapit District with a total of 427 people. The second highest dropout was among the secondary schools in the urban areas of Kuching District with a total of 394 people, followed by Bintulu District with 351 students and Sibu District with 263 people.

Although the number of student dropouts decreased in 2014, but Kuching showed an increase of 7.61% that resulted into a total of 424 people. The recorded figure reflects a high value. The number of student dropouts continued to show a decrease of 18.74% in 2015. However, the number of student dropouts in urban areas such as Kuching, Sibu and Bintulu is still high. In addition, the dropout rate in rural areas in Belaga, Daro, and Subis also showed a significant increase. In 2016, student dropout increased by 28.61%, which means an addition of 495 people compared to 1,730 people in 2015. In specific, a significant increase in dropouts occurred in rural districts of Bau, Betong, Julau, Kapit, Meradong, and Saratok.

The number of student dropout in 2017 showed a declining trend of 17.5%, that is from 2,225 to 1,835 students. However, rural districts such as Belaga, Padawan, Sebauh and Simunjan, on the other hand, showed a significant increase. As for urban areas, the number of student dropouts in Kuching showed a high increase of 66.82%, that is from 140 people in 2016 to 422 people in 2017. Student dropouts in 2018 increased again by 6.37% and brought the total dropout to 1,952 students. It was observed that school dropouts are increasing in urban areas, especially in Bintulu and Sibu as well as other rural areas such as Betong, Dalat, Mukah, Padawan, Samarahan and Sarikei. Nevertheless, rural areas such as Bau, Belaga and Tatau showed a drastic decline.

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ISSN 2289-4470 /eISSN 2462-2400

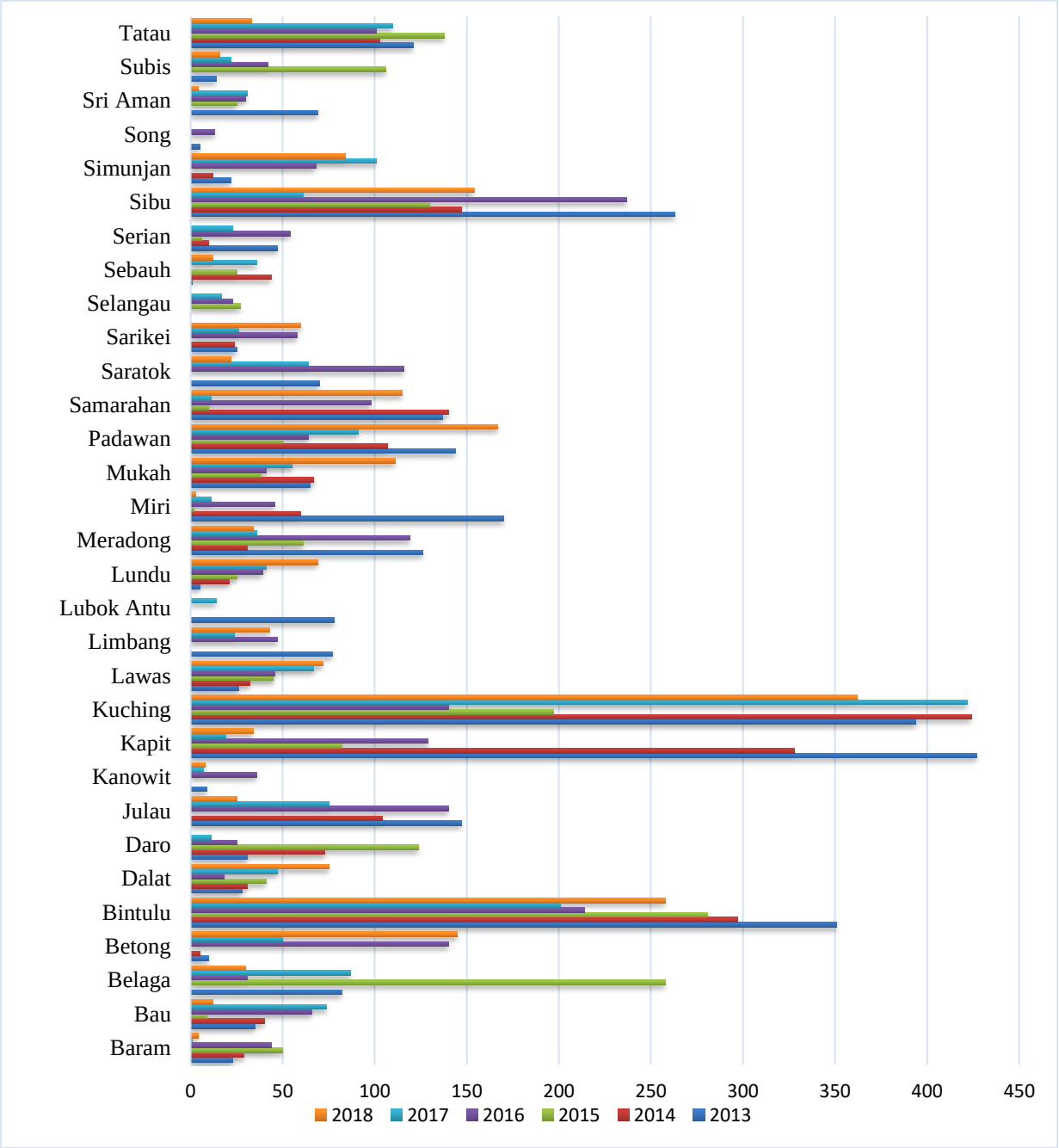

Figure 2. *Graph of Secondary School Dropouts in Sarawak According to the District Education Office from 2013-2018*
Source: Sarawak State Education office

5. Analysis

Figure 3 until Figure 8 geovisualize the areas classified as dropout hot spot in Sarawak from 2013 to 2018. There were 28 grids identified as hot spot areas for high school dropouts under the administration of the Sri Aman, Lubok Antu, Padawan, Bau, Kuching, Julau, Kapit, Meradong, Sibu, Mukah, Tatau, Belaga, Bintulu, Miri and Limbang District Education Office.

Based on the results obtained, the highest z-score value for a grid that has only one school per grid is Grid 463. A school coded as YEE7102 is located in this grid and it has a z-score value of 9.6595 and a p-value of p <0.001. YEE7102 is a school in rural area under the administration of District Education Office of Kapit. Meanwhile, YEA6201 is a school located in Grid 404 and is the second highest hot spot area with a z-score value of 5.968786 and a p-value of p <0.001.

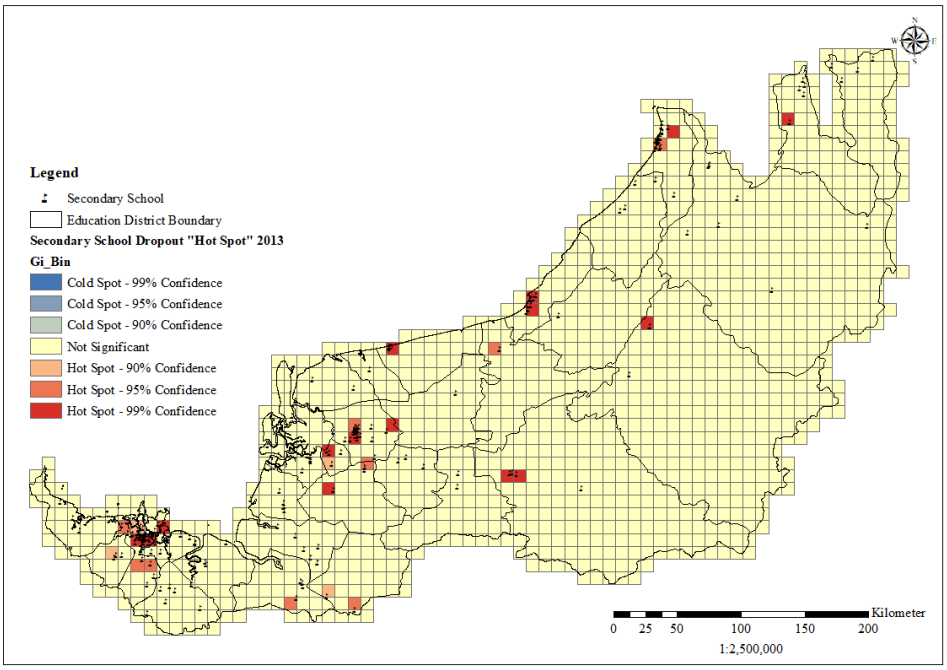

Figure 3. *Hot Spot Area for Student Dropouts in 2013*

Figure 4 shows that the hot spot areas for secondary school dropouts in Sarawak in 2014 was reduced to 27 grids. However, the number of district education office boundaries with hot spots increased to 16. The identified hot spot areas under the administration of District Education Office were Samarahan, Kuching, Julau, Kapit, Meradong, Daro, Sibu, Tatau, Sebauh, Baram, Miri, Bau, Sarikei, Mukah, Bintulu and Padawan.

For rural areas, the highest z-score value for a grid that has only one school in it is Grid 893. A school coded as YEA9201 is located within the grid and it comes with a z-score value of 8.233347 and a p-value of p <0.001. This school is a rural school under the administration of District Education Office of Tatau. Whereas, a school coded as YEE7102 located at Grid 463 is the second highest hotspot area with z-score value of 5.963347 and p-value of p <0.01. For schools located in the city, a school coded as YEA4107 located at Grid 1338 under the administration of District Education Office Miri has the highest z-score value of 4.744759 and p-value p <0.001.

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ISSN 2289-4470 /eISSN 2462-2400

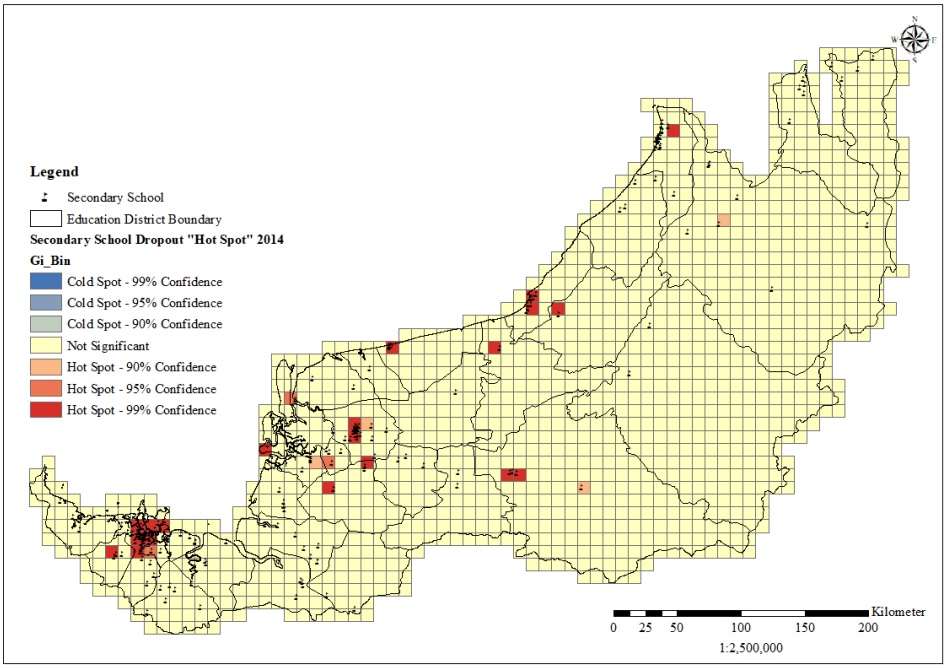

Figure 4. *Hot Spot Area for Student Dropouts in 2014*

Based on Figure 5, a total of 27 grids were categorized as hot spot areas for secondary school dropouts in Sarawak in 2015. The identified hot spots areas are under the administration of 18 District Education Offices namely Padawan, Kuching, Lundu, Kapit, Daro, Sibu, Selangau, Dalat, Tatau, Belaga, Sebauh, Baram, Lawas, Sri Aman, Meradong, Mukah, Bintulu and Subis.

For the grid that has only one school, Grid 971 has the highest z-score value of 17.82071 and p-value p <0.001. The grid has a school coded as YEA7102 in it and it is a rural school under the administration of District Education Office Belaga. Meanwhile, a school coded as YEA9201 that is located in Grid 893 is the second highest hotspot area for rural schools with z-score value of 10.355159 and p-value of <0.001 under the administration of District Education Office Tatau. For the city areas, a school coded as YEA1207 that located in Grid 246 under the administration of District Education Office Kuching has the highest z-score value of 4.744759 and p-value p <0.001.

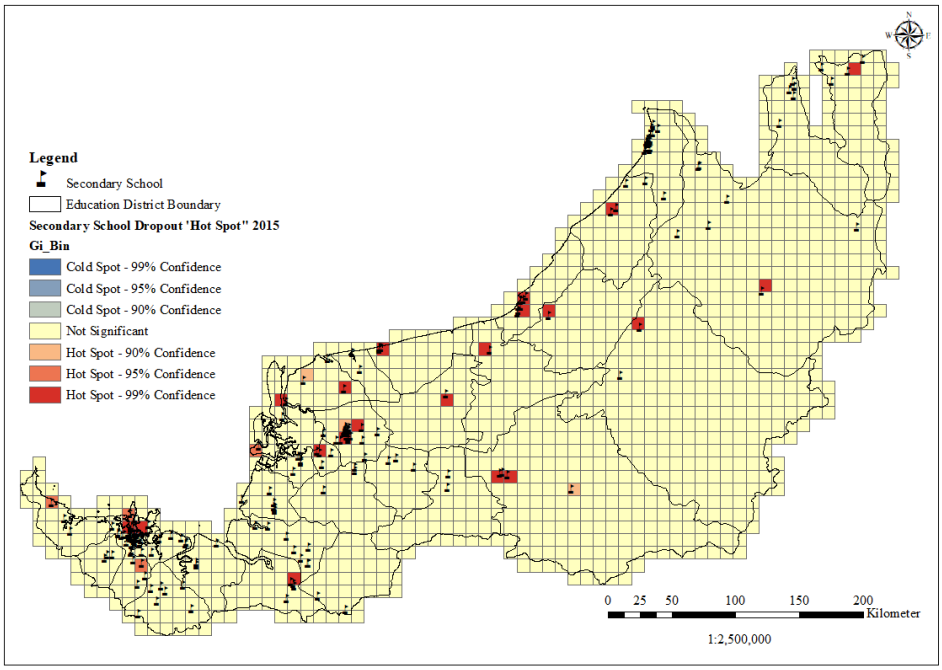

Figure 5. *Hot Spot Area for Student Dropouts in 2015*

Figure 6 proves that the school dropout among the secondary school students in Sarawak for the year 2016 shows an increment in the number of hot spot areas with a total of 41 grids. Spatial analysis shows that the increase in hotspot areas occurs among students located in rural areas. The identified hot spot areas covered 26 District Education Offices of Padawan, Bau, Samarahan, Betong, Kuching, Lundu, Saratok, Julau, Kapit, Kanowit, Sarikei, Sibu, Selangau, Tatau, Belaga, Baram, Lawas, Serian, Sri Aman, Simunjan, Meradong, Bintulu, Subis, Limbang, Mukah and Miri.

Grid 992 under the administration of District Education Office Bintulu has recorded the highest z-score value. The recorded z-score value was 16.01826 with a p-value of p <0.000000. Grid 992 is the location for schools YEA9101, YEA9102, YEA9105 and YEE9103.

Schools under the administration of the Sibu District Education Office have a high number of hot spots that is consisting of Grid 576, Grid 619, Grid 620 and Grid 622. Grid 576 has a z-score value of 11.545402 and a p-value of p <0.000000 and this grid consists of schools coded as YEA3101, YEA3104, YFB3101, YFB3102, YBF3103, YFB3106 and YFB3203. With a Gi_Bin value at level 3 which is a 99%confidence level, the grid has been classified as a high hot spot area.

Grid 893 located within the district boundary of Tatau District Education Office is marked as the highest hot spot area based on the number of schools located in each grid unit. This is because the grid only has one secondary school with a z-score value of 10.586572 and a p-value of p <0.000000.

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ISSN 2289-4470 /eISSN 2462-2400

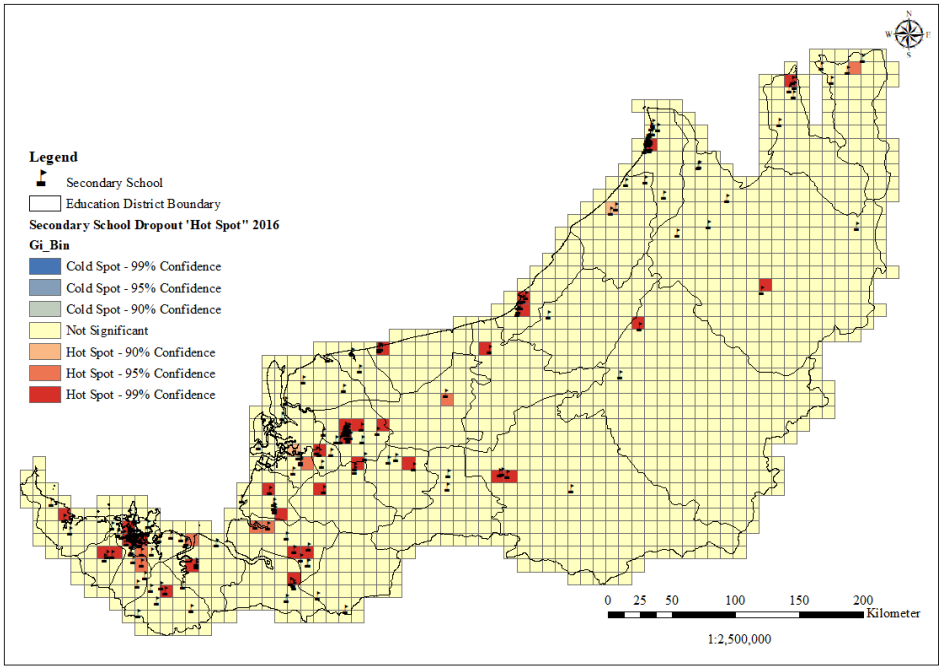

Figure 6. *Hot Spot Area for Student Dropouts in 2016*

Figure 7 verifies that the hot spot area of secondary school dropout in Sarawak for the year 2017 showed a decline by recording a total of 34 grids. The identified hot spots are located within 22 administrative areas of the District Education Office namely Bau, Belaga, Betong, Bintulu, Dalat, Julau, Kapit, Kuching, Lawas, Limbang, Lundu, Meradong, Mukah, Padawan, Saratok, Sarikei, Sebauh, Selangau, Sibu, Simunjan, Sri Aman and Tatau.

The results show that there are 19 grids which are categorized as hot spot areas for student dropouts in rural areas. Grid 893 that is under the administration of District Education Office Tatau has the highest z-score value of 12.609936 and a p-value of p <0.000000.

A school located in rural areas under the administration of the Belaga District Education Office that is coded as YEA7102 in Grid 971 has the highest z-score value of 7.85411 with a p-value of p <0.000000. For schools in urban areas, the school in Grid 246 under the administration of Kuchinh District Education Office has been confirmed as a dropout hot spot area with a z-score value of 4.377346 and a p-value of 0.000012. Grid 190 under the administration of District Education Office Bintulu has the highest z-score value of 15.858965 and p <0.000000. Grid 190 is the location for schools YEA1201, YEA1202, YEA1204, YEE1201, YEE1204, YEE1205, YEE1301, YFB1201.

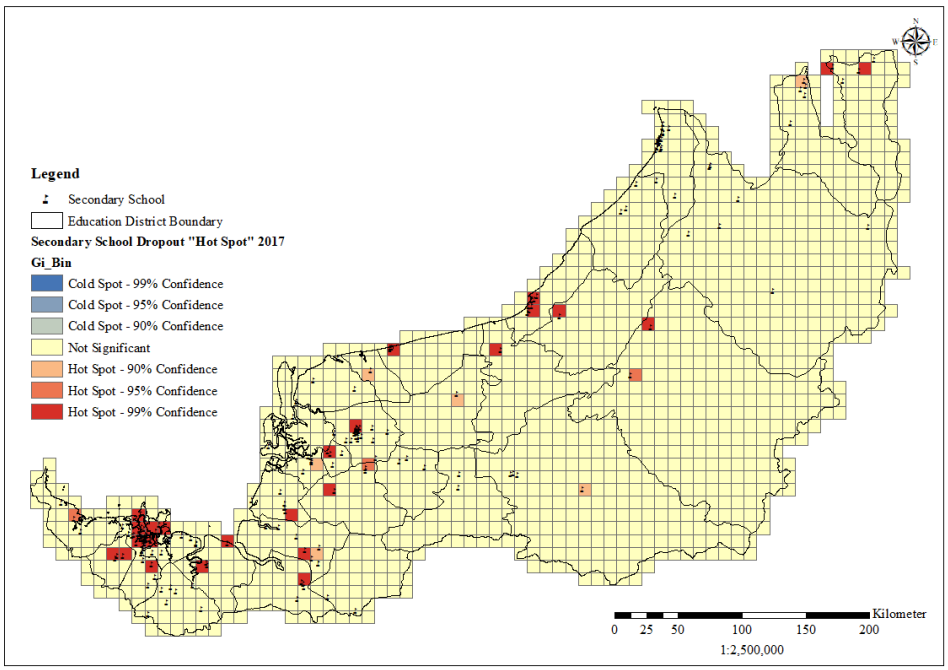

Figure 7. *Hot Spot Area for Students Dropouts in 2017*

The hot spot areas for secondary school dropouts in Sarawak in 2018 showed an increase by recording a total of 37 grids. However, the number of district education office involved was reduced 21 namely Belaga, Betong, Bintangor, Bintulu, Dalat, Julau, Kapit, Kuching, Lawas, Limbang, Lundu, Mukah, Padawan, Samarahan, Saratok, Sarikei, Sebauh, Sibu, Simunjan, Subis and Tatau District Education Office.

Rural areas with one school per grid unit cover the largest number of hotspot area with a total of 23 grids. A school coded as YEE1302 within the Grid 103 under the administration of District Education Office Padawan has the highest z-score value of 18.758991 and p-value of $p<0.000000$. Whereas, for the urban areas with one school per grid, a school coded as YEA1207 in the Grid 246 under the administration of District Education Office Kuching is the only grid identified as a hot spot area with z-score value of 8.071702 and p-value of $p<0.000000$.

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ISSN 2289-4470 /eISSN 2462-2400

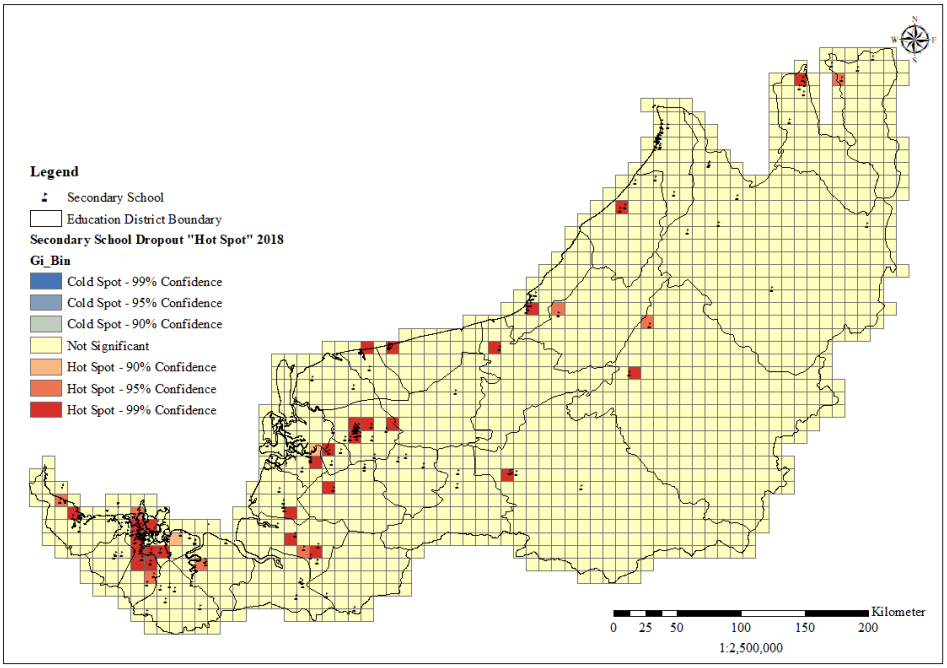

Figure 8. *Hot Spot Area for Student Dropouts in 2018*

6. Discussion

The results of this study found that Getis Ord Gi* analysis helped to detect statistically significant school dropout hot spots among secondary school students in Sarawak. This validity was measured based on the results of the z-score and the p-value. This means that Getis Ord Gi* analysis in this study revealed the location of schools with the highest rate of school dropout clustering in Sarawak.

Thus, the change in the hot spot trends of secondary school dropouts in Sarawak in the spatial context can be identified. This is because Getis Ord Gi* analysis measures high or low clustering densities based on the z -score value and the p -value. Hot spot analysis is particularly important for assessing phenomena that occur on a broader scale and available in limited resources (Harris et al., 2017). The results of the analysis can help the government to organize more effective strategies in reducing dropouts. Previous studies have measured the high risk of dropout based on the number of cases and the rate of cases reported in each school.

If the number of dropout cases is high, then the school is classified as a high-risk school. If the number of dropout cases is low then the school is classified as a low-risk school (Hoeurn, (2021). For this study, the schools identified as most at risk of experiencing school dropout in the period 2013-2018 are located in urban and rural areas in Sarawak. Four schools, namely schools YEA9101, YEA9102, YEA9105 and YEE9103 under the administration of PPD Bintulu were identified as the riskiest areas for 2013, 2014 and 2016. This shows that four schools in Bintulu have the highest clustering rate of school dropout cases in Sarawak. The main factor that contributed to school dropouts was the factor of lack of interest.

These findings are similar to a study conducted by Soares (2015) who found that lack of interest contributed to school dropouts in Monas Gerais, Brazil. Among them is not interested in the subjects taught in school. A study by Buop *et al.* (2018) also found that feeling disinterested contribute to the dropout of primary school students in Kenya, East Africa.

School YEA7102 that is located under the administration of PPD Belaga was identified as a dropout hot spot school in 2015. However, the main factor contributing to the school dropout was not confirmed. In 2017, a total of eight schools under the administration of PPD Kuching namely YEA1201, YEA1202, YEA1204, YEE1201, YEE1204, YEE1205, YEE1301 and YFB1201 were identified as the most at risk of dropping out of secondary school students in Sarawak.

The results showed that the dropout factor was influenced by other factors. In 2018, the school most at risk of dropping out of secondary school students in Sarawak is at YEE 1302, that is a school located in Grid 103 under the administration of PPD Padawan which is largely influenced by other factors. Thus, it is clear that the hot spot areas for secondary school dropouts in Sarawak are constantly changing according to location and year. In addition, this study found that the main factors influencing the dropout hot spot area of school children differed by location.

7. Conclusion

Applying GIS as a spatial-based tool in this study marked a significant step in determining the hot spot areas of student dropout at the secondary school level. Areas that continue to record high levels of dropout hot spots require special attention from all stakeholders. Besides, areas with high school dropout hotspots need further study to link the situation to political factors and socio-economic conditions. The spatial analysis can be used as a first step in building strategic planning to ensure that the objectives of the Malaysia Education Development Plan 2013-2025 are achieved as well as to improve the Education system and next, preserving our first-class human capital.

6. Acknowledgement

The authors sincerely thank every party that contributed to this study, both directly and indirectly

Author Contribution Statement: Danggat Chabo, Tarmiji Masron, Norita Jubit & Nur Faziera Yaakub Conceptualisation, Methodology, Analysis, Data Curation, and Editing.

Conflicts of Interest: The authors declare no conflict of interest.

Data Availability Statement: The authors confirm that the data supporting the findings of this study are available within the article.

Geografi Vol.10(2),56-70
ISSN 2289-4470 /eISSN 2462-2400

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