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Spatial data utilization for location pattern analysis

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Abstract

Retail industry growth in Indonesia is considered significant and will continue, related to Indonesian lifestyle changes. One of the important things to consider is location determination. The complexity of the location determination problem for the development of a business requires a comprehensive decision support system, using relevant data and appropriate technology so that it can accommodate a variety of data formats and information. This paper described the spatial pattern analysis approach to discover patterns of fast food restaurants. ArcGIS Spatial Autocorrelation (Moran's I) tool was used to find evidence that the fast food restaurant distribution in Jakarta, as the biggest city in Indonesia, has a clustered pattern and were not the result of random chance. The clustered pattern was investigated using Kernel Density Estimation (KDE) to identify the clustered area of fast food restaurant.

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Keywords: Spatial data; GIS; cluster; fast food restaurant

1. Introduction

Food and beverage industry in Indonesia grew significantly. It becoming one of the key drivers in 2015 which includes huge investment in the long term [1] and the highest investment value [2]. It has become one of the favorite industry for many banks in Indonesia in the disbursement of loans in 2016 as it is considered as a promising sector (addition to infrastructure sector) [3]. This information was in accordance with performance reports submitted by the Ministry of Industry in 2015 [2], that in 2015 food and beverage industry sector grew 7.54%, the second highest in the non-oil manufacturing sector (with an average growth of 5.04%).

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Indonesian food consumption pattern has been changed, especially in the large city. This phenomenon has been affected by the shift of social demography status [4], as well as increased the income of Indonesian people [5] which also automatically increase the purchasing power of people, including the purchasing power of consumers in the food service outlets [6]. The Industrial Ministry of Indonesia explains that Trade, Hotel, and Restaurant sector has 14% contribution to Gross Domestic Product (GDP) [7] and the growth rate of GDP for this sector at constant prices in percent was 5.03 in 2016 [8]. Food service subsector was projected to have 9.1% growth in 2013-2017 [9].

This article is focused on spatial data utilization for location pattern analysis, by using Geographical Information System. Geographical information has involved with retail business processes including facilities management and market analysis, to understand the growth possibilities [10]. The ability of GIS to compile and analyze spatial data provides an overview of the company, including opportunities and challenges. These abilities are important not only for corporate sustainability but also for the surrounding environment.

2. Spatial Data Utilization

In the early days of the development of geographic information systems, Clarke [11] has been reviewing changes in the methodology used for location study, as well as to emphasize the importance of considering modeling procedures were adequate to be able to investigate the company's growth strategy. Many organizations are committed to assessing retail locations more deeply than traditional method (assisted with a checklist). It is creating job opportunities in the field of geography. An important thing to consider in location determination are the methods or approaches or tools for the decision-making process. To obtain the best decision that can support the company's growth, the methods or approaches or tools should have the ability to accommodate the variety of necessary data for the consideration. There is much evidence from research results about the capability of Geographic Information System as a methods or approaches or tools to compile a variety of data types, including spatial and attribute data. Therefore it can be a comprehensive media to manage, visualize, analyze, and communicate a study, including the decision about location determination [12, 13]. Retail location analysis is an important part of the retail outlet location selection, that can be made through Geographic Information System, combining with spatial statistics [13, 14]; integer programming model [15]; Multi-Criteria Decision Making (MCDM) [16-19].

2.1. Spatial data analysis

The spatial information has been powerful tools to gain a comprehensive analysis, both to understand the behavior and for a specific purpose, such as for determining the location. Johnston [20] conclude that there were two fundamental questions of geographical research, such as “(1) Are there relationships between phenomena in various locations?”, and “(2) are places different in terms of the phenomena present there?”.

The early development of GIS at the late 1960s was mostly in North America, USA, and the United Kingdom, but in accordance with the change of the ownership of data, the spread of GIS implementation in the world are more prevail [21]. Anselin [22] has formulated various ideas include spatial analysis and social sciences. He has concluded that the development of theoretical and empirical studies in social sciences have been increased the interest in spatial analysis, thus interaction between theory, data analysis, and computation is required. The further study has emphasized the use of spatial analysis approach with multi-disciplinary interactions. But the growth of knowledge is hampered by the unavailability of data and the lack of a support system for the application of advanced spatial analysis for the social sciences [23].

Gregory and Healey [24] introduced the history of GIS and critically evaluate how it would affect the historical practice of geography. Generally, it happens three changes, (1) GIS software more affordable and easier to use, (2) meta data are increasingly used, (3) even though the capabilities of GIS software for visualizing spatial data and spatiotemporal growing, but in conceptual and modeling operation of GIS has slowed, particularly due to the inconsistency of data availability. But now researchers have a higher opportunity to obtain spatial data, provided by national or international organizations. For example, land use data obtained from “Geospasial untuk Negeri” (http://tanahair.indonesia.go.id/), an Indonesian official website that provides geospatial data. Additional data are obtained from OpenStreetMap Indonesia (http://openstreetmap.id/data-openstreetmap-indonesia/), a collaborative project to create a free editable map of the world or other crowdsourcing such as google map