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ORIGINAL

Spacial patterns of the commercial activity in the city of Portoviejo, province of Manabí (2017-2022)

Patrones espaciales de la actividad comercial en la ciudad de Portoviejo, provincia de Manabí (2017-2022)

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ABSTRACT

The objective of this article is to conduct an exploratory analysis of the spatial patterns of commercial activity in the city of Portoviejo, highlighting the importance of the degree of dispersion and concentration within the urban area. This analysis uses information available in the GAD Portoviejo database, which allows us to determine the exact location of commercial activities in the city. ArcGIS 10.3 was used to conduct this analysis. The results reveal a strong pattern of concentration in the central area of the urban space. This work contributes to a better understanding of creative urban areas and provides a source of information for the formulation of public policies aimed at the creation of innovative, knowledge-based sectors.

Keywords: Trade; Concentration; Dispersion; Spatial Distribution; Zoning.

RESUMEN

El objetivo del presente artículo es realizar un análisis exploratorio de los patrones espaciales de la actividad comercial en la ciudad de Portoviejo, resaltando la importancia de la forma de sus grados dispersión y concentración en el área urbana de Portoviejo, utilizando la información disponible en la base de datos del GAD Portoviejo que permite conocer la localización exacta de las actividades comerciales ubicadas en esta ciudad. Se ha utilizado el programa ArcGIS 10.3 para realizar este análisis. Los resultados permiten identificar un fuerte patrón de concentración en la zona central del espacio urbano. Este trabajo contribuye a un mejor entendimiento de las zonas urbanas creativas y constituye una fuente de información para la formulación de políticas públicas dirigidas a la creación de sectores innovadores basados en el conocimiento.

Palabras clave: Comercio; Concentración; Dispersión; Distribución Espaciales; Zonificación.

INTRODUCTION

Portoviejo is the capital of the province of Manabí, considered a medium-sized city with approximately 321 800 inhabitants, representing around 20 % of the province's total population. The city was severely affected by an earthquake measuring 7,8 on the Richter scale in 2016. This caused significant damage to the city's production and housing structures.(1)

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Its main economic functions are transportation, commerce, public administration, and construction. The urban center of Portoviejo served as the provincial commercial center of Manabí and as a hub for commercial transactions between other cantons. A census conducted after the earthquake in Portoviejo found that the city center was a ghost town. Few houses and businesses occupied the area. Most of the buildings were offices, warehouses, medical clinics, and public and private sector offices.[2] The study also concluded that some forty buildings collapsed in the center of Portoviejo as a result of the earthquake on April 16, 2016.[3]

As a result of the earthquake that affected Portoviejo, the Municipal Shopping Center, the Wholesale Market, and Market No. 1 suffered significant damage. Consequently, trade in Portoviejo, which depended heavily on its infrastructure, ultimately failed due to the loss of Market No. 1's power generator and other resources. Obsolete port facilities, inoperable infrastructure, and lack of regulation proved detrimental to Portoviejo's trade. This static state showed that the local government had poorly planned the region's businesses. The challenges presented by these deficits made it clear that reviving trade in Manabita would be difficult.[3]

The earthquake that occurred on April 16 was the trigger for the creation of these urban centers. Trade has always been a very important and dynamic activity in Portoviejo, so when the areas where these businesses operated were destroyed, they had to move elsewhere, especially to the outskirts of the larger urban center. This change would have happened in the city soon anyway, but the earthquake accelerated it. However, other problems followed, such as chaos and congestion, as seen with the businesses on the streets of Alajuela. Therefore, it is recommended that these merchants eventually be relocated to a remodeled center that will invite old and new users of the center to return and alleviate congestion in the post-earthquake city center.[4]

The establishment of the organization of tertiary economic activities strongly influenced international land use planning and cities, which set the tone in parts of urban development, manifesting themselves as builders of the transformation of urban architectural spaces into public sites. The impact of the implementation of tertiary economic activities in a city can be clearly seen in how its territory is organized at different urban scales, from the global to the local, and this impact begins to affect the different urban elements of the city.

Large corporations and real estate developments play a key role in the remodeling of cities through the creation of new office buildings and shopping centers;[5] with material support and specific physical locations (infrastructure and buildings determined by their function), material flows of people, goods, capital, and vehicles, whose logic is established by the structural relationships between the elements they support and determined by the capital pattern.[5]

Therefore, specialized centers without recognizable urban quality and character are due to the implementation of anti-urban streets. Their creation is based on the correlation between connectivity and centrality, despite their different parameters from traditional cities. Traditional cities have a single street connecting the center with the infrastructure. In smaller towns and cities, this street serves as a conduit for higher classifications within the city hierarchy. It is also a benchmark of community identity and homogeneity in terms of connection, proximity, and concentration of activities.[6]

One of the most notable characteristics of the spatial distribution of economic activities is their heterogeneity, and their system tends to aggregate and concentrate. The processes of integration and economic growth have central characteristics in their spatial dimension; they are heterogeneous processes and have become one of the main concerns of politicians, geographers, and economists, who have identified the role of these processes in spatial configuration.[7]

The tendency toward domestic concentration of economic activity has been recognized since at least the classic work of Alfred Marshall.[8] This spatial behavior is not accidental, but is due to the various advantages that companies obtain when they agglomerate in the area, often referred to as agglomeration economies.[9,10,11] The nature, scope, and origin of agglomeration economies are varied[12] and may even be due to natural advantages. For example, in city center spaces, traditional business centers may be related to accessibility to other areas.[13,14,15]

Spatial pattern analysis allows us to know what type of distribution the data we are going to represent exhibits, since this positioning information provides us with additional information to know whether the values are dispersed or whether, on the contrary, they are concentrated in certain areas.

In general, this type of pattern analysis is best performed on point layers, although it can also be performed on other types of geometry and/or entities, such as polygon or raster layers.[16]

Spatial patterns provide benefits to the businesses concentrated there, in addition to the fact that they are mostly found in the densest urban areas. Therefore, this research seeks to address the following general objective: 1) Analyze the spatial patterns of commercial activity in the city of Portoviejo, using geographic information systems, to determine the degree of dispersion and concentration.

The statistical tool used was Moran's I index, which is briefly described in the following chapter. To analyze this statistic and to create the maps included in this work, we used two software programs: GeoDa and ArcGIS. Both are geographic information systems. The first, GeoDa, focuses mainly on Exploratory Spatial Data Analysis (ESDA), while the second has a more general orientation, although the latest versions incorporate basic ESDA

techniques.

METHOD

The data used for this research comes from the Decentralized Autonomous Municipal Government of the Canton of Portoviejo (GAD Portoviejo), which consists of georeferenced information on commercial activities registered in the urban limits of Portoviejo with their respective geographic coordinates. Cartographic information in shape format was also used. The urban area was defined by its high concentration of commercial activities.

The data filtering procedure consisted of selecting the cartographic information from GAD Portoviejo. Subsequently, the database of commercial activities located within the urban limits of Portoviejo was filtered. Once the database of commercial activities and the cartographic database had been filtered, ArcGIS 10.3 software was used to model spatial relationships through a continuous space and visualize spatial clusters hierarchically, as well as to determine the degree of concentration of commercial activities.

Initially, our approach will be to study spatial patterns with the help of ArcGIS 10.3 software. The main objective of this analysis is to determine the distribution of the data we intend to investigate. Specifically, our goal is to identify whether the data is scattered or whether the values are predominantly concentrated in particular regions.

Regardless of the type of spatial pattern analysis we perform with ArcGIS 10.3, we will be provided with the same set of parameters in all of these analyses. We will always start from a null hypothesis that states that the entity or entity values are randomly distributed.

- P-value: this is a probability. If this value is small, it means that the probability of the null hypothesis being true is very small, and we can reject it.
- Z-value: this indicates the standard deviation. In general, if this value is very small (close to 0), we will not have enough statistical evidence to reject the null hypothesis. For this reason, z takes very large values (positive or negative) when the p-value is small.

Spatial pattern analysis with ArcGIS: Spatial relationship (Morans I index)

This type of spatial pattern analysis in ArcGIS analyzes the distribution pattern of feature values. We have a collection of weather stations with average annual precipitation values, so this analysis will allow us to see how precipitation values are distributed in our study area.

This tool calculates the mean and variance of the attribute we are evaluating (precipitation) and infers whether the distribution pattern presented by the data is clustered, dispersed, or random by measuring spatial autocorrelation based on the location and value of the feature.

Morans index yields a positive result when values are clustered, i.e., high values are mixed with other high values and low values with other low values. Conversely, if the values were distributed unevenly (high values very close to low values), the index would yield a negative result.

This means that whenever the z and p values obtained indicate that we can reject the null hypothesis, a Moran's index greater than 0 will indicate that the values tend to cluster; conversely, an index less than 0 will indicate that the values tend to be scattered.

Spatial pattern analysis with ArcGIS: High/Low Clustering (Getis Ord's G)

Using Moran's I index, the distribution pattern of the analyzed values can be classified as random, scattered, or clustered. To measure the concentration of high or low values within the same study area, ArcGIS spatial pattern analysis will be used. The analysis tool calculates an observed rate labeled "General G" and compares it with the expected index.[17]

In this case, a z-value greater than zero indicates the presence of a concentration of high values, whereas if the z-value is negative, there is a concentration of lower values. Logically, if the z-value is very close to zero, there is no obvious clustering of entity values.

Hot spot analysis (Getis-Ord Gi*) (Spatial statistics)

This tool works by observing each feature within the argument of neighboring features. A feature with a high value is interesting, but it may not be a statistically significant critical point. To be a statistically significant hot spot, a feature will have a high value and be surrounded by other features with high values as well.

IDW Interpolation (Heat Map)

The IDW (Inverse Distance Weighting) tool uses interpolation to estimate cell values by calculating averages of the values of sample data points in the vicinity of each processing cell. The closer a point is to the center of the cell being considered, the more influence or weight it will have in the average calculation process.

RESULTS AND DISCUSSION

The diversification of commercial activity in the city of Portoviejo can be very broad, as shown by a clear tendency to concentrate in certain areas, as can be seen in the commercial activity map (figure 1). According to the spatial analysis performed in the ArcGIS 10.3 program, the spatial distribution of commercial activities shows a clear degree of concentration in the city of Portoviejo (figure 2).

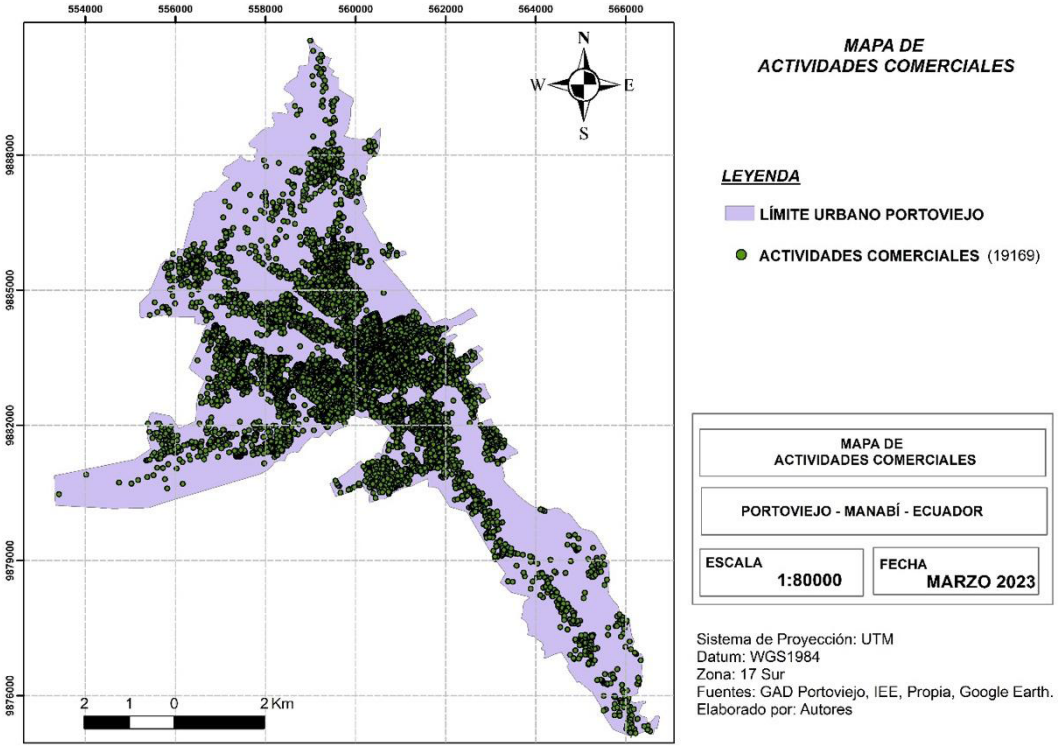

Figure 1. Map of commercial activity in the city of Portoviejo

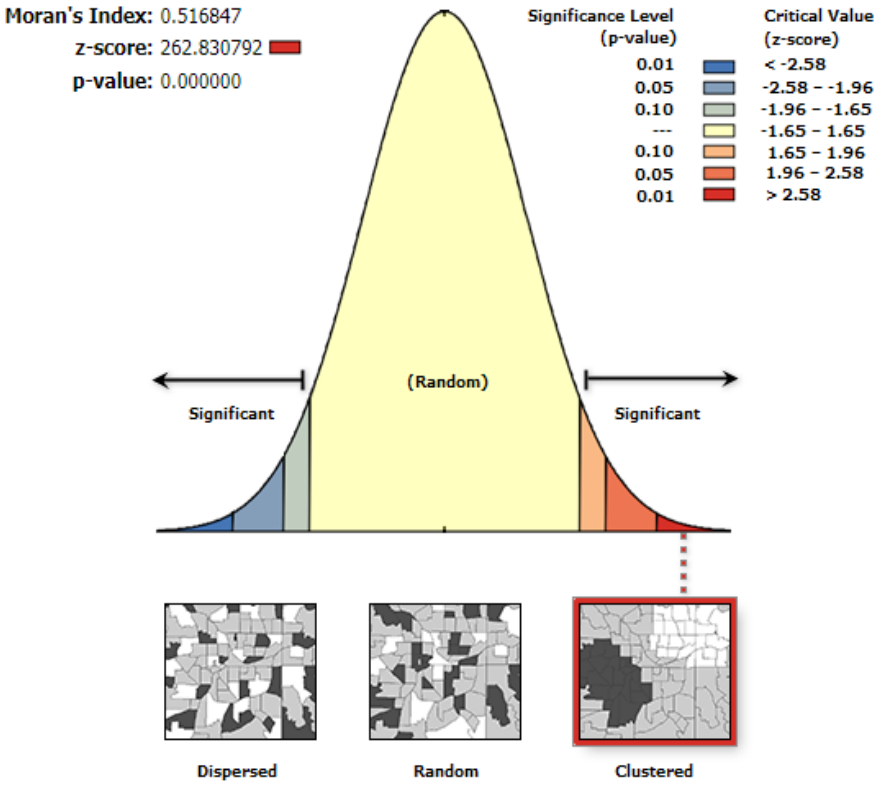

Figure 2. Analysis of spatial patterns (Morans I Index)

The probability that the null hypothesis is true is indicated by a p-value, as shown in figure 2. A p-value of 0 suggests that the possibility of randomly distributed precipitation values is negligible, which invalidates it. Consequently, z must take high values, as demonstrated by the value of 262,83. Morans index has a positive value of 0,516, indicating a pattern of concentration in the distribution of precipitation. Therefore, statistical evidence confirms that precipitation follows a concentrated distribution pattern.

The concentration analysis (figure 3) is high, as it shows a positive z value (z = 27,55); this implies that there is sufficient statistical evidence to certify that there is a concentration of high precipitation values.

The hot spot map (figure 4) shows that commercial activities tend to be concentrated mainly in the central area of the city of Portoviejo, followed by cold spots and some significant spots on the outskirts.

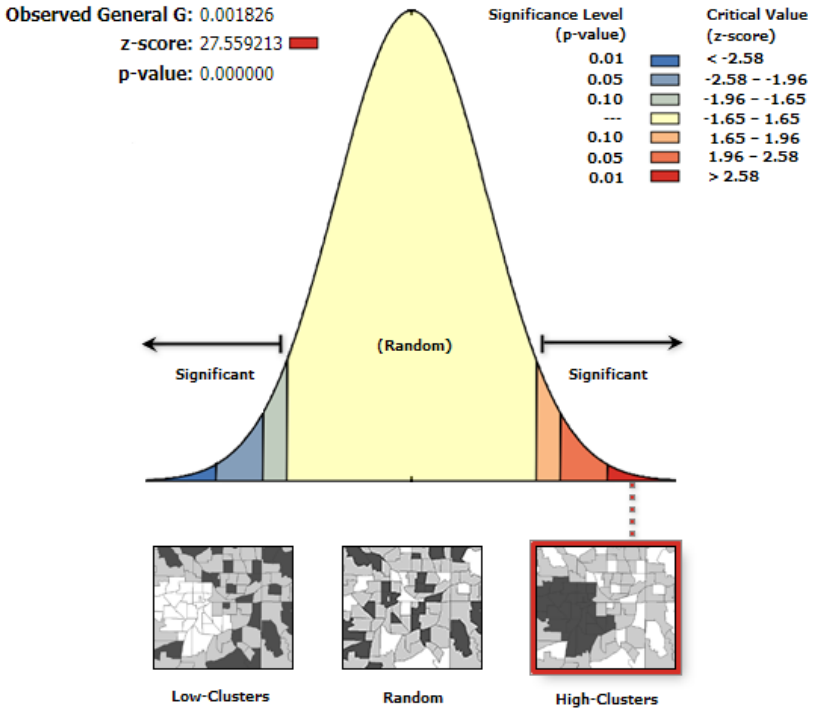

Figure 3. Analysis of spatial patterns High/Low concentration

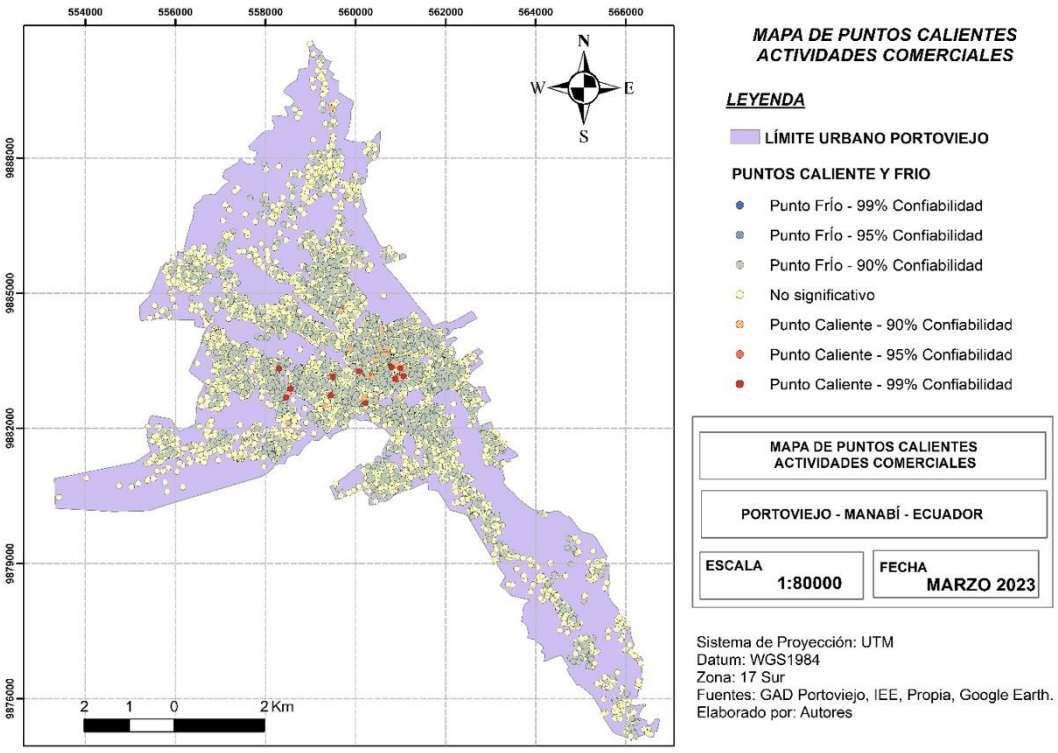

Figure 4. Map of hot spots

The heat map (figure 5) shows the results of the hot spot map analysis (figure 4). It can be seen that the high value of commercial activities is found in the central area of the city, the average value accumulates the highest amount of commerce around the high value, and, as expected, the low values are found in the outskirts of the city.

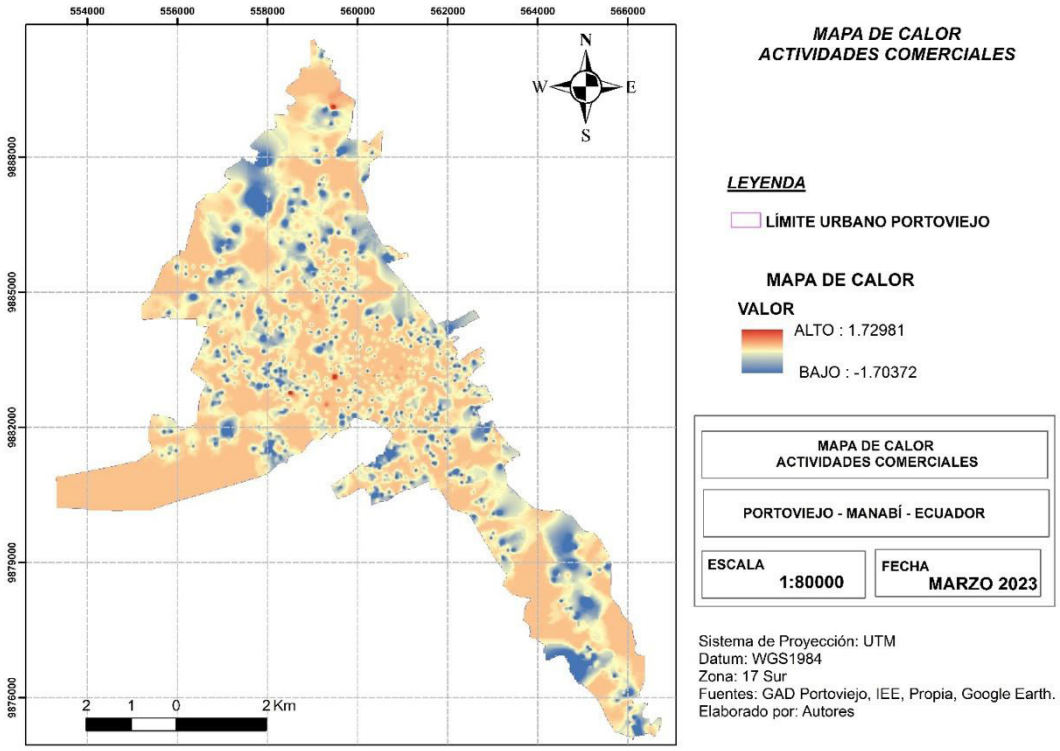

Figure 5. Heat map

The land use map (figure 6) includes all land use categories dedicated to sectors such as education, associative activities, recreation, culture, and sports. We can see that commercial activities are changing land use.

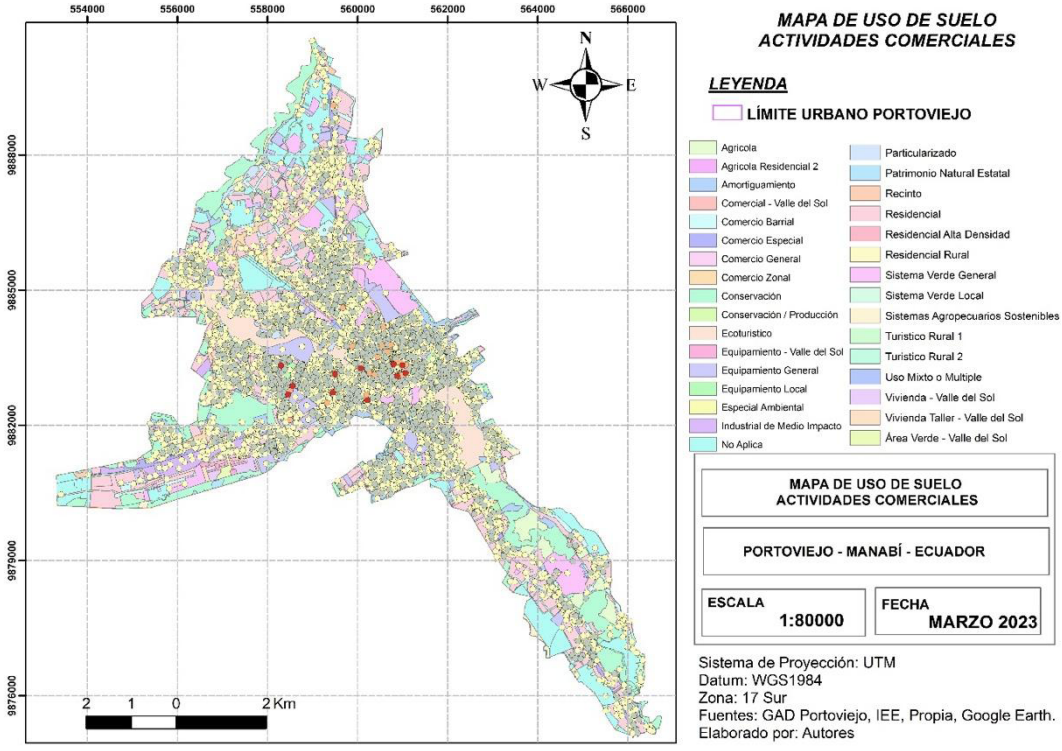

Figure 6. Land Use Map

We will now analyze the spatial patterns on a micro level, focusing on the center of the city of Portoviejo, where commercial activity is most concentrated, as we have seen in the previous maps. To do this, we have limited our study area and classified it into a north zone, south zone, center zone, east zone, and west zone (figure 7). According to the spatial analysis carried out in the ArcGIS 10.3 program, the spatial distribution of commercial activities in this polygon shows a clear degree of concentration in the city of Portoviejo.

We see in figure 8 that the value of p is equal to 0, which indicates that the probability of the null hypothesis is very low, so we can rule out that the probability values of precipitation are rarely distributed randomly. Furthermore, when the value of p is small, z must take a very high value of 0 (z = 18,32). Given that Moran's index is positive (0,090), we can be sure that there is a concentrated pattern of rainfall distribution. Therefore, there is sufficient statistical evidence to affirm that precipitation follows a concentrated distribution pattern.

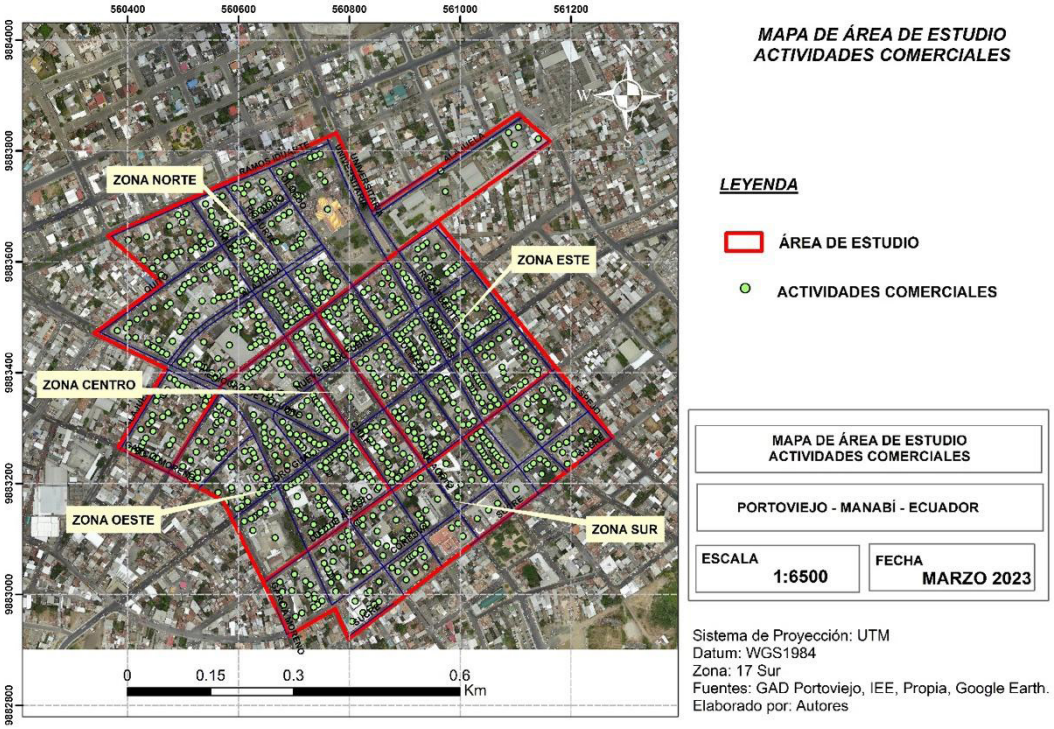

Figure 7. Map of the study area with commercial activities

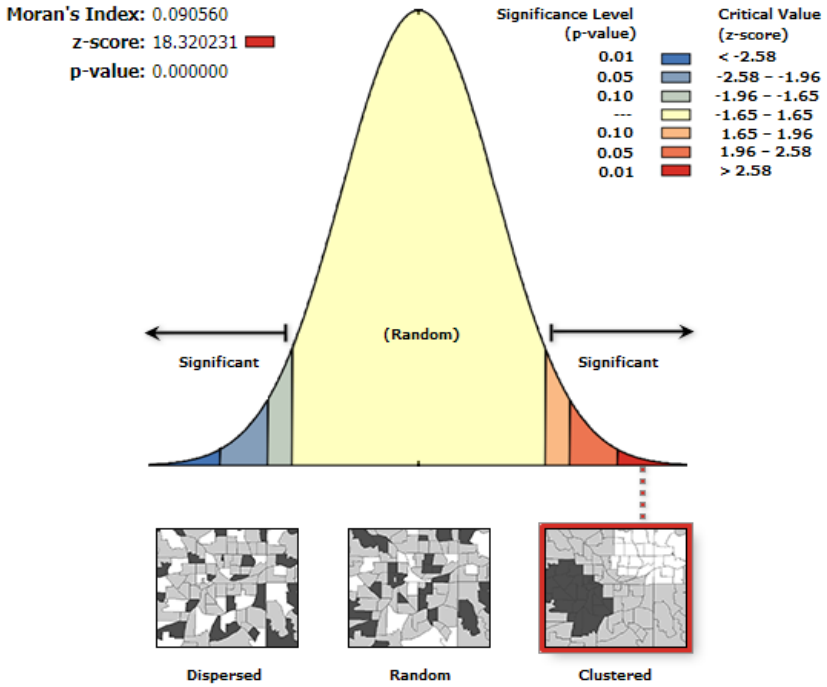

Figure 8. Analysis of spatial patterns (Morans Index I)

The concentration analysis (figure 9) is high, as it shows a positive z value (z = 7,26); this implies that there is sufficient statistical evidence to certify that there is a concentration of high precipitation values.

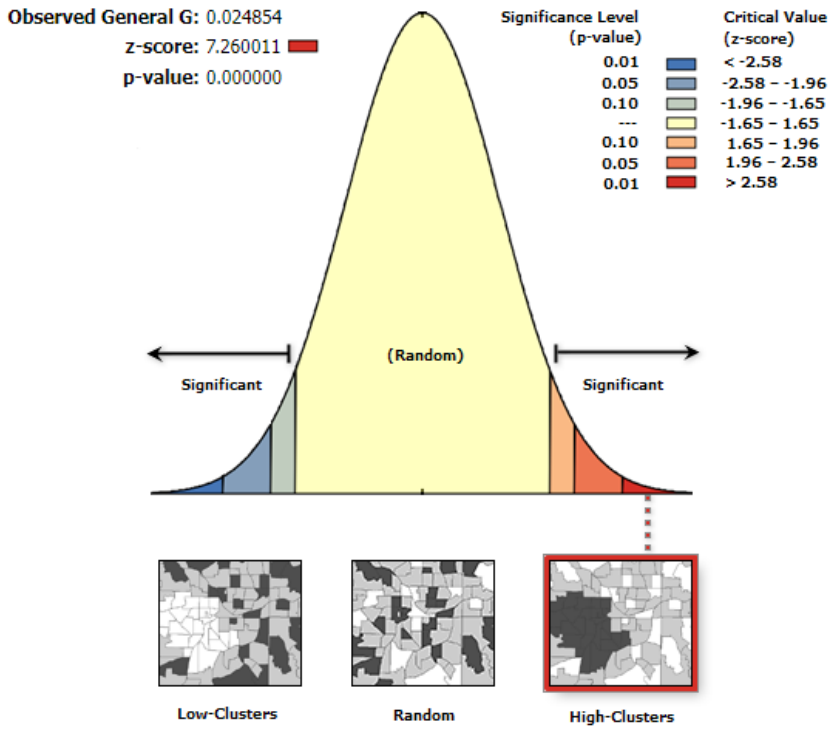

Figure 9. Analysis of spatial patterns High/Low concentration

The hot spot map (figure 4) shows that commercial activities tend to be concentrated mainly in the center of the city of Portoviejo, followed by cold spots and some significant spots on the outskirts.

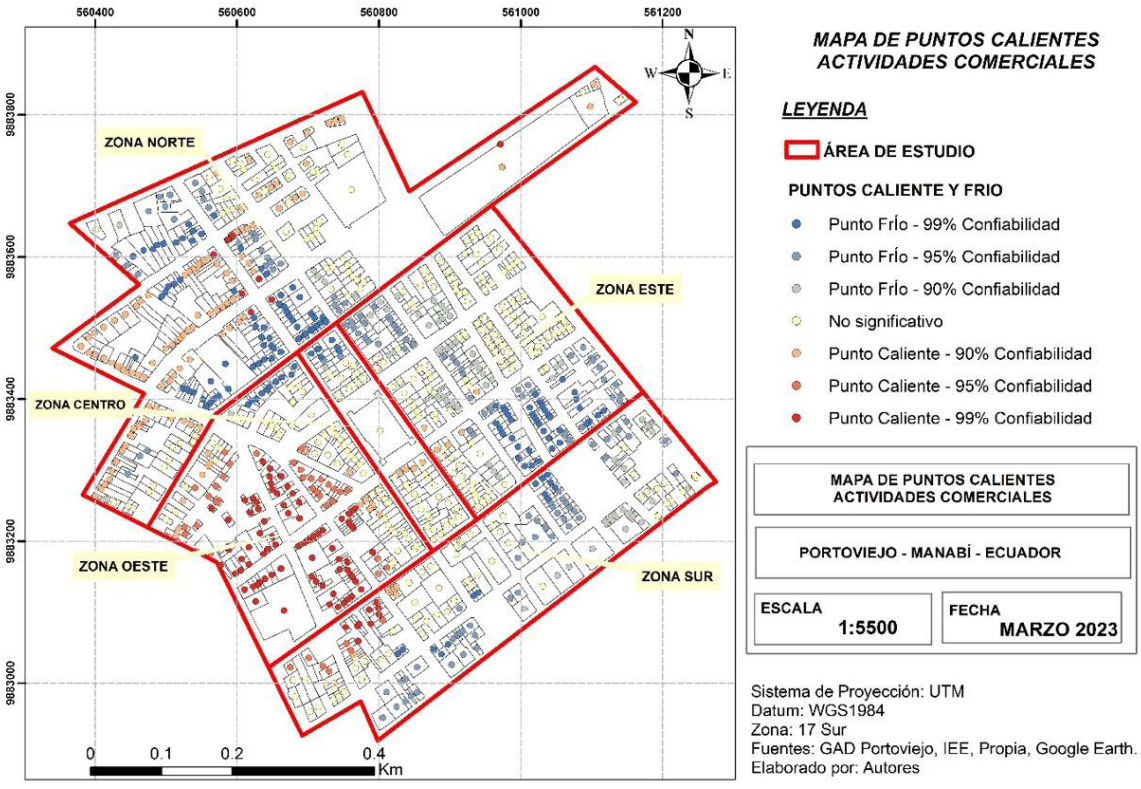

Figure 10. Hot spot map

The hot spot map (figure 10) shows that commercial activities tend to be concentrated mainly in the western part of the city of Portoviejo, extending towards the north, followed by cold spots and some significant spots in the eastern and southern areas. It should be noted that the downtown area has cold, hot, and significant spots because before the April 16 earthquake, they were more concentrated on this side, but they have been disappearing and concentrating more in the downtown and western areas.

The heat map of commercial activities (figure 11) shows the results of the analysis of the hot spot map of commercial activities (figure 10). It can be seen that the high value of commercial activities is in the western and northern parts of the city. In the northern part, it should be noted that on the eastern side of the map there is an area of high and medium values, which is because the "Alajuela" trade is concentrated there. In the central area, the values are medium, high, and cold, and the low values are more pronounced in the eastern part of the study area.

The land use map of the central area (figure 12) shows that most of the commercial activities in our study area, which is the central part of the city, are located in a commercial zoning area.

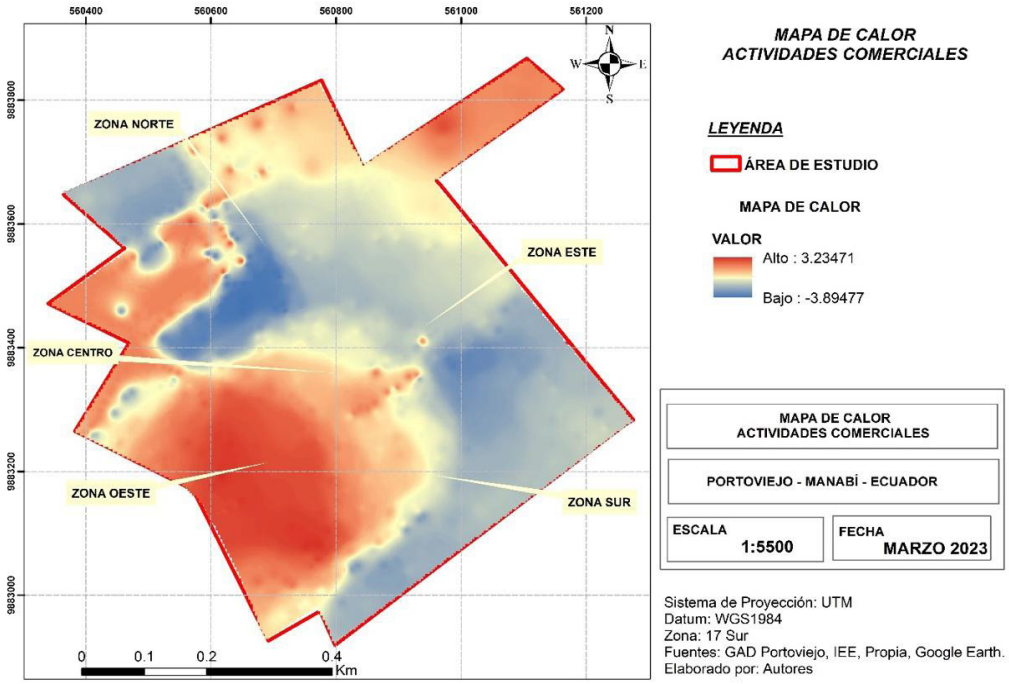

Figure 11. Heat map of commercial activities

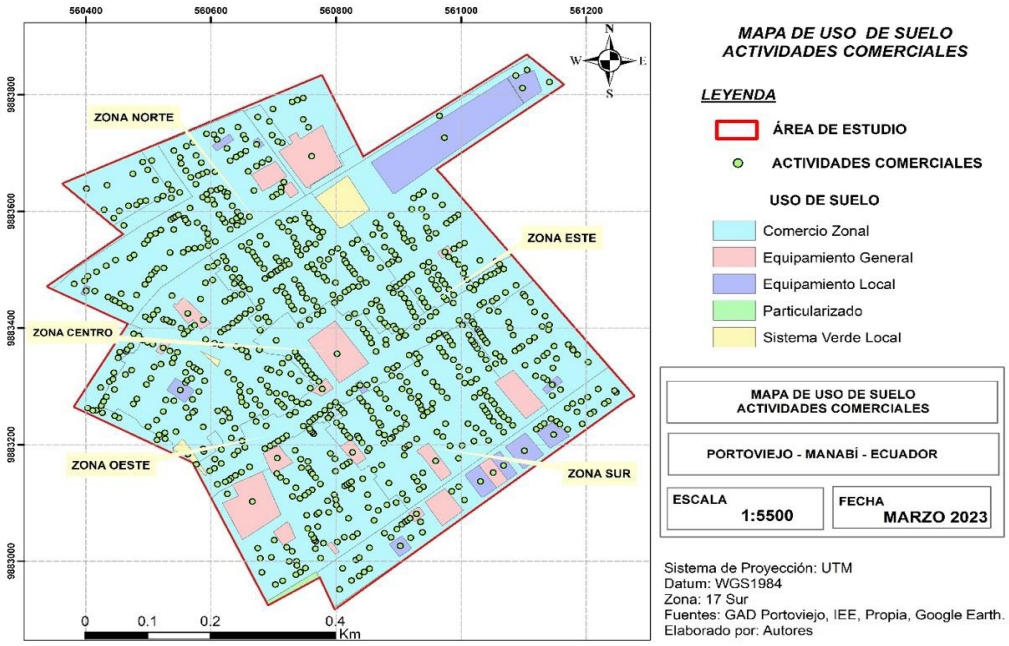

Figure 12. Land use map of commercial activities

The hot spot map (figure 10) shows that commercial activities tend to be concentrated mainly in the western part of the city of Portoviejo, extending towards the north, followed by cold spots and some significant spots in the eastern and southern areas. It should be noted that the downtown area has cold, hot, and significant spots because before the April 16 earthquake, they were more concentrated on this side, but they have been disappearing and concentrating more in the downtown and western areas.

DISCUSSION

This article presents an exploratory spatial analysis of commercial activities in the city of Portoviejo. Using georeferenced data and applying spatial cluster identification techniques, it has been possible to determine the ways in which these types of activities are agglomerated in a continuous space, as well as their degree of concentration. The results indicate that economic activities do not follow a random distribution pattern, but tend to concentrate in the urban center.

There is ample empirical evidence that economic activities are spatially distributed unevenly, meaning that they aggregate more or less in certain regions and form clusters.[18] Krugman's[14] contributions to the new economic geography emphasized the benefits of agglomeration described above. A clear example of spatial agglomeration can be found in high-tech companies in Silicon Valley, USA, as illustrated by Bresnahan et al.[19]. In Mexico, for example, the textile industry in Tijuana and Ciudad Juárez or the chemical industry in Tampico and Campeche.[20] That said, commercial activities tend to concentrate in spaces that provide them with an environment conducive to growth and deve GEASIG lopment. To consolidate themselves and achieve this, they seek to maintain close links with other relatively similar firms in order to take advantage of a range of benefits such as information flow and knowledge spillovers, to name a few.

By organizing and strengthening autonomous trade, it will be possible to resolve urban conflicts and revitalize the economy of Portoviejo. In addition, trade will be boosted by creating savings banks and customs warehouses for merchants and training them in good business practices.[21]

CONCLUSIONS

The spatial patterns of commercial activity in the city of Portoviejo have been analyzed, and the maps and statistical analyses produced by the ArcGis 10.3 program confirm that commercial activities are highly concentrated. The results of the statistical analyses also show graphs of concentration patterns, as commercial activities have been grouped together and, according to the commercial history of the city of Portoviejo, it has always been a city of commercial concentration.

Specifically, this research involved creating maps and analyses using an identified study area, which led us to conclude the following points:

1. The highest concentration of commercial activity in the city occurs in the northern and western areas, with a medium concentration in the central area and a lower or insignificant concentration in the eastern and southern areas.
2. This concentration of commercial activity in the northern and western areas of the city has been analyzed as having a turning point in the central area after the 16A earthquake, as commercial activities located in this area have been concentrated in other northern and western areas.
3. It was determined that most commercial activities are compatible with commercial land use, as identified by the GAD PORTOVIEJO.

In this sense, this research work can be an important source of information for decision-making in terms of public policy, as it provides a series of maps and statistical analyses that identify the areas of the city where commercial activity is moving, while also analyzing which areas are lacking or concentrating.

Finally, in urban development, commercial activities can help to regenerate urban structures that are in poor condition or disuse, which is why urban policy strategies are suggested to encourage the creation of this type of analysis in abandoned areas of the city. This research can also contribute to future research linking commercial activities with economic indicators that reveal the factors involved in the economic growth of urban areas.

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CONFLICT OF INTEREST

None.

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Writing - proofreading and editing: Jesús Adrián Pisco-Palacios, Adrián Eliceo Reyna-García.