



## Surabaya's Coffee Districts: Clustering and Land Use Dynamics in Gubeng Area

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### Abstract

Coffee shops as third spaces have become a vital part of urban life in many cities. Lifestyle trends and shifts in the last decade have contributed towards their expansion. In 2025, Surabaya was noted as having the highest number of coffee shops in Indonesia, with a 17% growth rate in Gubeng District. This study investigates how coffee shops are spatially distributed and whether land use functions affect their spread within the district. Geospatial studies were conducted using publicly available data, with a total of 397 points of interest extracted using Google Places API. The data points were processed through Density-Based Spatial Clustering of Applications with Noise (DBSCAN), Kernel Density Estimation (KDE), and statistical analysis within QGIS. The results reveal that in accordance with retail agglomeration theory, coffee shops in Gubeng mainly form clustered concentrations along main roads, especially in proximity to Universitas Airlangga and Surabaya Gubeng Station, dominated by stand-alone modern coffee shops and warkop typologies. The most modern coffee shops are still concentrated within commercial zones, while warkop tends to expand towards residential areas, which might affect land use dynamics and city planning in the future.

## A. Introduction

Coffee shops have become a vital part of urban life in many cities. As third places, coffee shops provide a balance in the life of urban residents between home and work, much like the balancing point of a tripod (Oldenburg, 1997). In fact, the presence of coffee shops may become a marker for urban vitality (Xu et al., 2024), gentrification, middle-class consumption, and even contribute towards 'liveable urban streetscapes' (Ferreira et al., 2021). However, even as third spaces, coffee shop culture differs across different societies.

As third spaces, the definition of 'coffee shops' has expanded accordingly to include food and beverage establishments whose primary function is social gathering, as well as leisure, regardless of whether coffee constitutes their main menu offering (Purnomo et al., 2021). This concept is consistent with the evolution of coffee shops as documented in recent years, where the social function of such places has become the defining characteristic of space, rather than the beverage they sell (Ferreira et al., 2021).

In Indonesia, the act of coffee-drinking, or *ngopi*, has traditionally been a long-standing part of daily lifestyle (Gumulya & Helmi, 2017). *Ngopi* is considered a uniquely Indonesian cultural form through which people reflect, debate, and co-create meaning in everyday life, rooted in the cultural dispositions of *nyantai* (relaxed ease) and *kebersamaan* (togetherness) (Husniyah, 2026). However, since the late 2010's, a huge shift has occurred towards more modern coffee culture, with the popularity of modern cafes serving western-style brew (Purnomo et al., 2021). The activities in modern coffee shops have expanded to remote working, freelancing (Colliers International Indonesia, 2026; Pratiwi, 2022), and simply becoming a lifestyle and identity expression among the youth (Pratiwi, 2022). This shift has expanded the definition of coffee shops as well as their typologies.

In line with these recent developments and this expanded definition of coffee shops, five typologies of coffee shops are considered in the case of Indonesia:

1. Traditional coffee stalls called *warung kopi* (or *warkop* for short): typically brews instant coffee and *tubruk* coffee. Generally in the form of stalls with a simple bar for brewing coffee and other traditional drinks, packed with simple benches and tables for customers (Purnomo et al., 2021).
2. Modern specialty cafes that promote western-style drip and brew methods. Typically in the form of stand-alone cafes, these cafes may also accommodate people working from cafes (Kester & Rahadiyanti, 2020; Sireki & Wibisono, 2020). Another form of such cafes are typically named *kedai kopi*, a glocalization phenomena that tries to bridge between western style of coffees with local and traditional setting of coffee-drinking (Purnomo et al., 2021).
3. Coffee shops located within other buildings. This marks a broader trend in Surabaya's commercial landscape, where co-working operators and food service tenants have become necessary establishments in office buildings, particularly in Central Surabaya (Colliers International Indonesia, 2026).

4. Mobile vendors/ starling/ kopling, peddlers on bikes or motorized bikes, traditionally selling instant coffee, while modern ones provide concentrated espresso-based coffee with affordable prices (Hizli, 2025; Maulida et al., 2025).
5. Convenience store-café hybrid, typically convenience stores that sell specialty coffee, ready-to-grab drinks, and ready-to-heat foods, such as Indomaret Point or Family Mart coffee chains. These kinds of convenience stores provide a convenient and comfortable dining environment (Hariyanto et al., 2017; Ming-Sung Cheng et al., 2009).

Between these five typologies, the main typologies of cafes and warkop are the most spatially embedded typologies, as they often rely on the presence of other local amenities for accessibility, visibility, and consumer traffic (Siri & Phithakkitnukoon, 2026).

The spatial distribution of coffee shops within urban environments can be explained by two complementary theoretical frameworks: retail agglomeration theory and land use planning theory. Retail agglomeration theory ascertains that competing businesses tend to cluster spatially in order to capture 'visibility spillovers' in the form of shared foot traffic, destination visibility, and economies of proximity from each other (Ballantyne et al., 2022). Thus, various typologies of coffee shops may be found in clusters around certain nodes in the city (Maulana et al., 2021).

This clustering behaviour is often not random, rather, directed by high urban activity nodes, regardless of the formal land use in the area (Litasari et al., 2023). Particularly in Indonesia, misalignments often occur between the Detailed Regional Spatial Plan (RTRW) at provincial level and the Detailed Spatial Plan (RDTR) at city level. This often creates implementation gaps that allow commercial activity to appear in non-commercial zones without clear regulatory restrictions (Lira & Asrianti, 2025). Thus, the clusters of coffee shops could also be analyzed according to the land use zoning where they sit.

This spatial distribution can be statistically analyzed to identify and visualize the spatial pattern produced by points of interest (POI) data. One method of analyzing this data is through DBSCAN (Density-Based Spatial Clustering of Applications with Noise) analysis in QGIS (Quantum Geographical Informational System) software (Tu et al., 2022). Further, Kernel Density Estimation (KDE) analysis can effectively quantify the intensity of each cluster, visualizing them as hotspots, which could function as a proxy for economic vitality and urban renewal (Govorov et al., 2025).

Recently, the city of Surabaya was named as the city with the highest number of coffee shops (Rahayu & Setuningsih, 2026). Coffee shops' existence in the city of Surabaya has been growing rapidly since 2019, with a growth trend increasing 16-18% every year (Pratiwi, 2022). Coffee shop growth in Surabaya itself is not equally widespread across its district. Around 17.1% of coffee shop growth in Surabaya is concentrated in Gubeng district (Middleform, 2026).

Gubeng is widely known as part of the mixed-use district in central Surabaya area. The business and commercial hub sits right nearby the central Surabaya Gubeng

Station, which serves regional trains across Java. The area is also known for its regional district hospital (RSUD Dr. Soetomo), among a number of other hospitals and health facilities, and is also home to one of Indonesia's largest educational institutions, Universitas Airlangga. These spots became attractors for businesses that rely heavily on traffic and congregation of people, such as restaurants and coffee shops (Imelda & Sartini, 2021).

Even though statistically Gubeng dominates with the highest number of coffee shops, there is insufficient information regarding the distribution of coffee shops within the urban fabric. Previous studies in the range of the city of Surabaya have discussed more about the existence of coffee shops as a cultural agent in lifestyle transformation (Kester & Rahadiyanti, 2020; Pratiwi, 2022); the effect of visual and spatial elements in coffee shops as urban lifestyle and cultural identity (Suminto, 2022; Taufani, 2020). Another literature that specifically talks about coffee shops in Gubeng district discusses them from a linguistics, not spatial, perspective (Imelda & Sartini, 2021).

Thus, this study aims to discover how the spatial distribution of coffee shops, specifically in Gubeng district and land use dynamics relate to their clustering behaviour. The findings of this study are expected to contribute to urban spatial planning studies, particularly in understanding the relationship between commercial activity growth and land-use dynamics in urban areas.

To address the gap identified above, this study seeks to answer the following research questions:

- RQ 1: What spatial distribution patterns characterize coffee shops in Gubeng District, Surabaya?
- RQ 2: How closely do the spatial distribution patterns of coffee shops align with land use zoning?

## B. Method

The research method of this article is given as follows. First; determination of study area and creation of basemap which includes district boundaries and land use zoning within the district. Second, coffee shop as points of interest (POI) data were extracted through publicly available data. Third, the collected POI data were preprocessed to eliminate redundant and out-of-range data. Fourth, all extracted data were analyzed within QGIS (Quantum Geographical Information System; Open Source Geospatial Foundation, Delaware, USA) to produce sets of geospatial analysis and statistics.

### 1. Study Area Basemap

The basemap was created using Open Street Map (OSM) Standard imagery through Quick Map Services in QGIS. The Gubeng district boundary area was obtained from the official shapefile of *Peta Batas Administrasi Kecamatan Tahun 2026*,

available publicly in the Satu Data Surabaya (ckan.surabaya.go.id) website, published by the Surabaya City Government.

Land use data of Gubeng District was obtained through manual digitization from Surabaya's Detailed Spatial Plan (Peta Rencana Detail Tata Ruang Surabaya, petaperuntukan.dprkpp.web.id), published by Dinas Perumahan Rakyat, Kawasan Permukiman, dan Pertanahan (DPRKPP) Surabaya (Surabaya Department of Housing, Residential Areas, and Land Affairs). Manual on-screen digitization was used since the platform does not provide direct shapefile download. Images from the RDTR map were georeferenced within QGIS to accurately map out land use zones.

## 2. Data collection and pre-processing

Coffee shop location data were mainly collected through Google Places API (New), accessed through the Google Maps Platform. Since the Nearby Search endpoint is limited to a maximum of 60 results per request, a multi-strategy approach is then applied to ensure comprehensive spatial coverage:

- a. Targeted Text Search: main data source capturing places related to coffee shops, even when not formally named as cafes. A total of 54 queries were performed using local terminology: '*kopi*', '*warung kopi*', '*kedai kopi*', as well as specific street and neighbourhood names within Gubeng, including: Jalan Manyar Kertoarjo, Jalan Dharmahusada, Jalan Sumatera, Jalan Kertajaya, Kalidami, Jojoran, Mojo Kidul, Pucang, and others. All API requests were executed using a custom Node.js script, with a delay of 500 milliseconds between successive calls which comply with API rate limits;
- b. Apify Google Maps Scraper (apify.com): supplementary to the main data source, Apify Google Maps Scraper was used to collect additional cafe listings from Google Maps via a graphical interface. Seven scraping sessions were conducted using the following keyword variations: '*cafe*' '*coffee shop*', '*kopi*' over different spatial extents within the Gubeng and broader Surabaya area.

All results were validated through cross-checking in Google Maps and Google Street View. Cafes or coffee shops that have no photo, are not visible in Google Street View, and or have no reviews or at least the recent reviews are older than 1 year ago, were excluded. Each cafe or coffee shop is then classified into six types based on coffee shops' extended categorization: (1) stand-alone, which coffee shops or cafes that sells specialty coffees, desserts, beverages, and or full courses of meals; (2) inserted into building, which coffee shops or cafes located inside or within a building like shophouses complex or public spaces such as hotel, hospital, or shopping mall; (3) *warkop* (local coffee stalls); (4) mobile coffee hub such as *starling* or *kopling*; (5) convenience stores, which have specialty coffee corner; and (6) other establishments that sell ready-to-go bottled coffee or coffee as ground powder.

Several limitations are acknowledged. First, Google Places API is subject to Google's proprietary indexing and ranking algorithms, therefore results may be biased

towards more prominent establishments. Second, cafes may be listed under slightly different names across sources that may not have been detected as duplicates. Finally, the dataset only represents a temporal snapshot of businesses collected in April 2026.

3. *Spatial clusters*

All spatial processing and visualization were performed in QGIS 3.44 (Solothurn) with the coordinate reference system of EPSG:32749 (WGS 84/ UTM Zone 49S), commonly used for the South-East Asia region. The CSV data containing coffee shop points data were imported into QGIS as a delimited text layer using the location longitude and latitude data as X and Y coordinates respectively.

Spatial clustering analysis was performed using Density-based spatial clustering of applications with noise (DBSCAN) plugin within QGIS. The parameters used were maximum threshold ( $\epsilon$ ) of 100 meters and minimum cluster size (MinPts) of 3, determined after several iterations. MinPts of 3 is consistent with the recommendation that MinPts should generally be twice the dimensions of the dataset (Ester et al., 1996). Since the points dataset is in 2D form, then the maximum number of points should be  $\geq 4$  for two-dimensional data. The 100-meter threshold reflects concentration of businesses at street-block level. It has been taken into consideration that mobility in Surabaya is primarily motorized rather than pedestrian-based (Peters, 2020). Businesses within the 100 meter distance share the immediate commercial node and compete directly for passing vehicle traffic, visibility, and customer attention (Zhao et al., 2023).

4. *Statistical Analysis*

To better understand the acquired data set, the number of coffee shops within each land use parcel division were calculated using Count Points in Polygon, with parameters as described in Table 1. The results obtained are the number of coffee shops in each land use parcel in the form of NUMPOINTS.

Table 1. Set parameters for Count Points in Polygon.

| No. | Parameter | Setting              |
|-----|-----------|----------------------|
| 1.  | Polygons  | Land use shapefile   |
| 2.  | Points    | Coffee shop POI file |

Based on the NUMPOINTS discovered through Count Points in Polygons, descriptive Statistics by Categories analysis was performed to identify the correlation between coffee shop typology, land use zoning, and their spatial distribution. This descriptive iteration dissolved all land use parcels to discover the collective number of coffee shops in each land use zone category as well as identifying their respective typologies. The parameters as listed in Table 2. All datasets were then statistically analyzed to quantitatively confirm all geospatial analyses.

Table 2. Set parameters for zoning compliance via Statistics by Categories.

| No. | Parameter                     | Setting                               |
|-----|-------------------------------|---------------------------------------|
| 1.  | Input layer                   | Count Points results layer            |
| 2.  | Field to calculate statistics | NUMPOINTS                             |
| 3.  | Fields with categories        | Zoning field and Classification field |

### 5. Heatmap distribution of coffee shops

To better understand whether the location of each cluster correlates to their popularity, Kernel Density Estimation (KDE) was performed. As a non-parametric method, KDS produces a continuous density surface from the coffee shop discrete point events. KDE enables the visualization of spatial gradients of cafe density and popularity. The KDE surface was generated using a quartic kernel function with parameters as listed in Table 3.

Table 3. Set parameters for Kernel Density Estimation.

| No. | Parameter        | Setting                               |
|-----|------------------|---------------------------------------|
| 1.  | Point layer      | Coffee shop POI file                  |
| 2.  | Radius           | 200 meters                            |
| 3.  | Pixel size X & Y | 10 meters (high resolution)           |
| 4.  | Kernel shape     | Quartic (for smooth, realistic decay) |
| 5.  | Weight field     | Review count field                    |

## C. Results and Discussion

Two main results are discovered in this analysis. First, the spatial distribution of coffee shops in Gubeng is revealed through a DBScan analysis. The clustering results are processed along with their cumulative review counts to produce a heatmap to discover coffee shop hotspots that correspond to density and popularity in various areas in Gubeng district. Second, the results of this analysis are then joined with the land use data and statistically calculated to discover the quantitative properties of the distribution over different land use zones.

### 1. Results

#### a. Spatial Distribution and Clustering of Coffee Shops in the Gubeng District

Gubeng (7.2729° E, 112.7493° S) is one of the 31 sub-district within the Surabaya municipality, located in central-eastern Surabaya. The area is directly connected to Tegalsari, which houses the main CBD of Surabaya. The district has a total area of 7,93 km<sup>2</sup>, with a population of 132.382 (Badan Pusat Statistik Kota Surabaya, 2024), making it a relatively dense district in Surabaya. The district is

intended for mixed-use zoning, honing commercial, residential, office (governmental) and institutional zones.



Figure 1. Gubeng District location context in Surabaya (Source: Developed by authors).

Based on Surabaya’s RDTR, the primary land use of the area is for residential purposes (53.18%) with a main classification of high-density housing. The commercial (Trades and Services) zone only occupies 23.37% of the land (Table 4.). However, the area is noted as having Central Surabaya's highest office occupancy rate at 73.4% (Colliers International Indonesia, 2026). Thus, the area is notably a high-activity business district. This characteristic is a crucial factor towards attracting a diversity of businesses, including those of food and beverage categories.

Table 4. Land Use Area and Percentage in Gubeng District (RDTR, 2026).

| No.        | Zoning                      | Area (km <sup>2</sup> ) | Percentage |
|------------|-----------------------------|-------------------------|------------|
| 1.         | Residential                 | 4.2165                  | 53.18%     |
| 1.         | Trades & Services           | 1.8533                  | 23.37%     |
| 2.         | Public Service Facilities   | 0.8123                  | 10.24%     |
| 3.         | Other                       | 0.6074                  | 7.66%      |
| 4.         | Open Greens                 | 0.2135                  | 2.69%      |
| 5.         | Office & Businesses         | 0.0935                  | 1.18%      |
| 6.         | Local Protection Zone       | 0.0679                  | 0.86%      |
| 7.         | Water Channels              | 0.0284                  | 0.36%      |
| 8.         | Subordinate Protection Zone | 0.0178                  | 0.22%      |
| 9.         | Rivers and Streams          | 0.0150                  | 0.19%      |
| 10.        | Special Use Zone            | 0.0033                  | 0.04%      |
| Total Area |                             | 7.9291                  | 100%       |

It must be noted that in the RDTR, the Office and Businesses Zone (1.18%) only identifies governmental offices, while most other offices and businesses are categorized within the Trades and Services district. Generally, the commercial zone is located around main roads, bordering the residential zones within. An exception lies in the north-western parcel of the district that borders directly to the Surabaya Gubeng Station, where the area is completely intended for commercial use. This marks the main business district in Gubeng.

The district also has a high percentage of public service facilities (10.24%), which houses hospitals and educational institutions. Other (7.66%) zones unidentified from the digital manualization of RDTR map are mainly roadways, which remain undefined in the digital RDTR map. Meanwhile, the Open Greens (2.69%) mostly house public parks, lawns, cemeteries, and green strips along main roads. The area is also passed by water channels (0.36%) and rivers (0.19%), thus certain areas are reserved for these waterways, with the Subordinate Protection Zone (0.22%) protecting such areas accordingly. Local Protection Zone (0.86%) protects corridors passed by the regional railway line.

General spatial distribution data was produced from the preprocessed POI (coffee shop) data (Figure 2). The total number of coffee shops after cleaning was 397 units, dominated by stand-alone outlets (180 units) and *warung kopi* or *warkop* (133 units). These numbers starkly contrast the rest of the data where the number of units do not reach the hundreds. Generally, the units are spread over various areas of the district, however, clumps where some units overlap indicate the evidence of clustering.

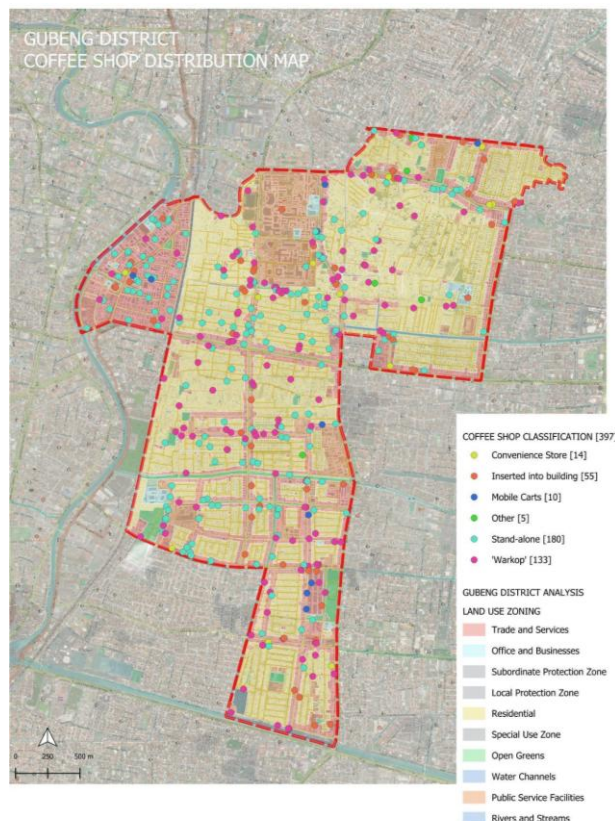


Figure 2. Spatial distribution of coffee shops in Gubeng District (Source: Developed by authors).

Concentrated agglomerations seem to appear in two main locations: around Universitas Airlangga and Gubeng main commercial zone. Based on the multicoloured points, all typology of coffee shops seem to be present within these areas. Units that are found to be in close proximity to each other are mostly *warkop* types. Stand-alone modern coffee shops also tend to clump, but with greater spread than *warkop*. Meanwhile, mobile coffee carts seem to be most dispersed, and are mainly located along main traffic. Coffee shops inserted into buildings and hybrid convenience stores also appear to be dispersed without a certain pattern, but seem to exist in almost every parcel sub-division.

The phenomenon of clustering is further revealed through DBSCAN analysis, with parameters using MinPts of 3 within distances of 100 m. These parameters were chosen to reflect the grouping of units around street nodes and pockets within neighbourhoods. The results show identification of 41 clusters. Meanwhile, coffee shops considered not belonging to any clusters are ruled out and marked in light grey (Figure 3). The clusters are spread out across the district. Most clusters seem to follow main roads and road corridors.

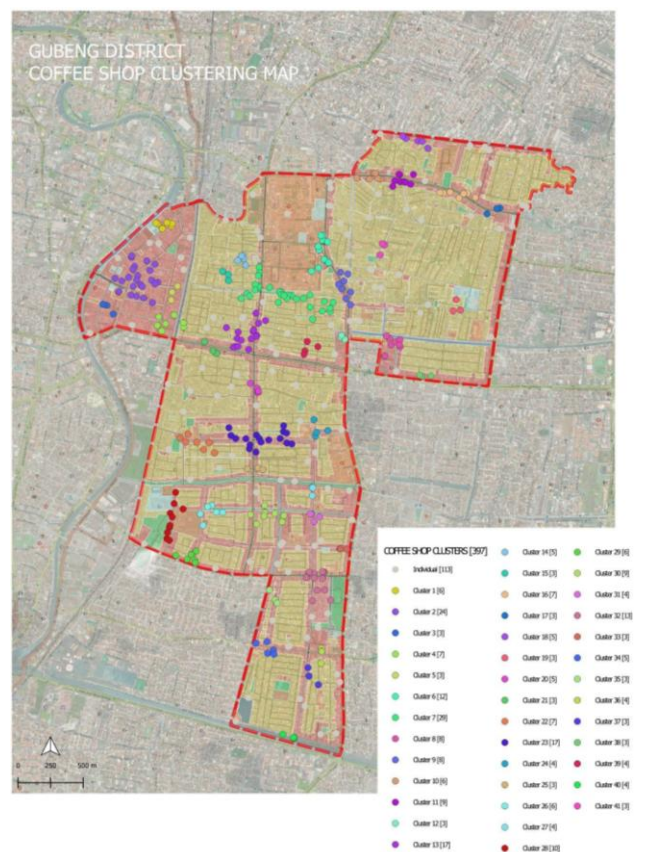


Figure 3. Clustering map of coffee shops in Gubeng District (Source: Developed by authors).

Clusters with a particularly high number of coffee shop units are found in two areas: (1) Cluster 7 with 29 units, around the southern complex of Universitas Airlangga and (2) Cluster 2 with 24 units, around the Gubeng commercial area. These two main clusters seem to correspond well to the land use of their respective areas of educational facility and commercial zones, where concentrations of people, traffic, and activities are most likely to occur.

However, clusters do appear within residential zones. In the case of Cluster 7, they appear to be expansions from the main Universitas Airlangga that disperse off the nearby main roads. The spread into residential neighbourhoods also appear in Cluster 13 (off Jalan Kertajaya), Cluster 23, and Cluster 22 (along Jalan Pucang Anom). Accordingly, in the RDTR, these sub-zones are classified as high-density housing areas, therefore may indicate high market demand for coffee shops in very close proximity towards such neighbourhoods.

Based on these conditions of locality, the forms of each cluster differ. Cluster 2 in the Gubeng main commercial zone reflects centralized agglomeration. In contrast, most other clusters, including Cluster 7, appear in the form of clustered concentrations along nearby main roads. Meanwhile, Cluster 10 appears to be clustered in a line along Jalan Ngagel Timur. Lastly, clusters within residential areas without any high-activity nodes and attractors tend to be dispersed.

A heatmap was produced to seek whether coffee shop locations and density correlate to their popularity, based on their Google Maps review counts (Figure 4). The Kernel Density Estimation (KDE) map calculated a weighted amount between each clusters' density as well as the cafes' popularity. Darker areas indicate concentrations of highly-reviewed establishments.

The heatmap reveals that the darkest red concentration appears in the north-western area (near Surabaya Gubeng Station/ Gubeng main commercial zone), correlating to Cluster 2 which can be perceived as the most dense, as well as the most reviewed/ popular cluster. Surprisingly, although Cluster 7 near Universitas Airlangga housed the highest number of coffee shops, their cumulative review counts did not produce high review points, hinting that their service and spatial quality may be inferior to those located in the Gubeng main commercial zone.

Meanwhile, a secondary concentration runs vertically through the center of the district, suggesting a north-south corridor along Jalan Dharmawangsa - Jalan Pucang Anom Timur with consistently popular cafes. Towards the south, which identifies as around Jalan Ngagel Timur area, a moderate hotspot with dispersed popularity occurs- no single dominant node is present within these hotspots. Meanwhile, an interesting hotspot presents itself on the north-east side; relatively isolated but clearly marked as a popular zone, possibly driven by a single popular spot.

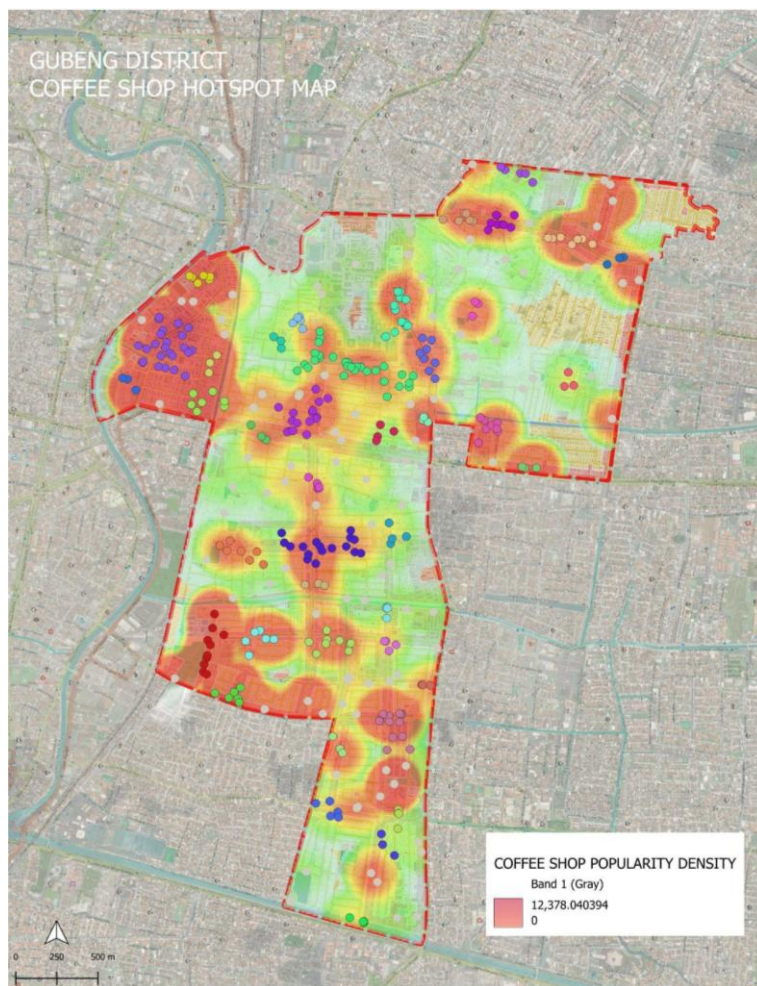


Figure 4. Spatial distribution of cafes per classification.

*b. Relationship Between Land Use Zoning and the Spatial Patterns of Coffee Shops*

Statistical analyses were conducted to observe whether coffee shop locations comply with local land use zonings, in relevance to seeing whether the distribution of coffee shops have shifted into drivers of urban space and contributes to the formation of regional character. Equally necessary is determining whether coffee shops, as an economic activity, continue to develop in line with existing zoning regulations or expand beyond intended limits.

According to the graph in Figure 5, the number of coffee shops in the Trade and Services (commercial) Zone (more than 200 units) still exceeds those residing within Residential Zones. The presence of this data is expected. The unexpected character in this data lies in how many coffee shops have expanded their distribution more widely in residential zones (a little over 100 units), compared to coffee shops in

Public Service Facilities Zones and Office and Business Zones. These findings may hint towards the relevance of coffee shops as important nodes within neighbourhoods.

The presence of coffee shops in other unexpected zones (Open Greens, Local Protection Zone, Water Channels) allude to two possibilities; 1) misalignments in city planning and real development in the field, 2) point misalignment from mapping by individual business owners on Google Places/ Google Maps. To explore and confirm both possibilities, verification may be needed through Google Street View and real-life observation.

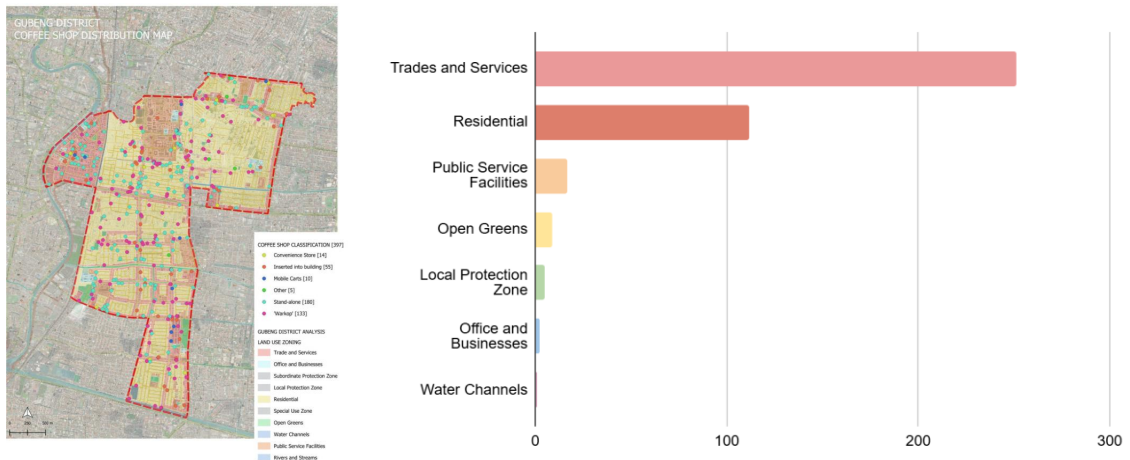


Figure 5. Graph of Coffee Shop and Land Use Compliance in Gubeng District (Source: Developed by authors).

In Figure 6, expands the data further to observe which typology of coffee shop is found within each zone. Both zones with the highest number of coffee shops (Trades and Services Zone and Residential Zone) appear to have a diversity of coffee shop typology within. However, it must be noted that more stand-alone modern coffee shops are present in the Trade and Services Zone, while more locally-flavoured *warkop* joints are present within the Residential Zone.

Coffee shops in the Public Service Facilities Zone also appear to have a number of different typologies, perhaps in relation to the diverse public that they serve. There also appears to be coffee shops inserted within/around governmental complexes, as indicated by their presence in the Office and Businesses Zone. Meanwhile, coffee shops in unexpected areas as previously identified (Local Protection Zone and Water Channels) are unanimously in the type of *warkop*, suggesting that such areas may act as rest/residing areas for surrounding locals.

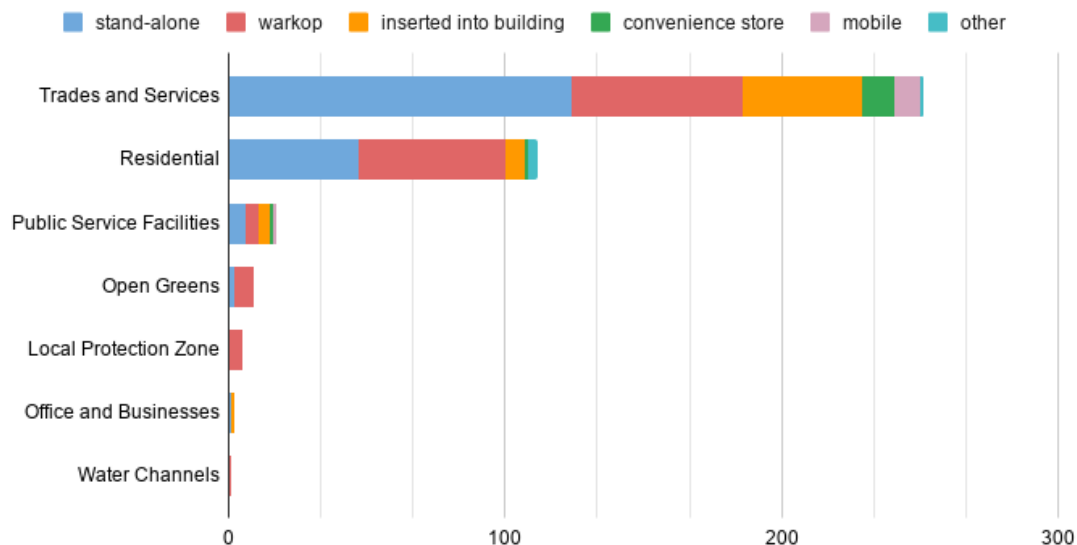


Figure 6. Graph of Coffee Shop Typology and Land Use in Gubeng District (Source: Developed by authors).

## 2. Discussion

Gubeng district, Surabaya, is a high-activity and high-density district. This character consequently becomes an attractor for high retail agglomeration (Ballantyne et al., 2022). Urban agglomeration stimulates increased demand for commercial property and raises the need for land parcels, with high intensity of urban economic activities transforming spatial configurations through the emergence of concentrated commercial areas (Gamal et al., 2024). Retail agglomeration often prioritizes accessibility and market demands over land use definitions, especially in cases within Indonesia (Litasari et al., 2023; Yusuf et al., 2024). The district readily facilitates the expansion of coffee shops in the area, with varying spatial across different parcels of the district.

Four dominant distribution patterns are found in the spread of coffee shops in the case of Gubeng: (1) centralized agglomeration (2) clustered concentrations along major roads, (3) linear development corridors, and (4) dispersed development. They collectively indicate the relationship between coffee shop location decisions and the broader urban structure of Surabaya. These results reinforce previous studies showing that coffee shops tend to emerge in highly accessible and economically active urban areas where mobility, visibility, and social interaction intersect (Maulana, 2021; Nurani, 2021; Zhao et al, 2023; Yusuf et al, 2024).

The first three spatial patterns are present mostly in the Trades and Services (commercial) Zone. Centralized agglomeration is highly related to character in a CBD, where development is driven by the core business area, and disperses towards its periphery (Ballantyne et al., 2022; Maulidi et al., 2024). The main emerging spatial

form, clustered concentrations along main roads, reflect how activity nodes are spread out in the district, but still bound by road visibility and accessibility (Litasari et al., 2023; Maulana et al., 2021; Zhao et al., 2023). This seems consistent in areas with high motorized accessibility. Meanwhile, the linear distribution that occurs over a single road in the south-western corner of the district reflects how a main spine drives collective development in the area (Abdillah et al., 2025; Haryanto et al., 2016; Zhao et al., 2023). The dispersed distribution in residential areas reflect the discontinuous nature of residential zones in Gubeng, lacking proximity towards any high-activity node (Litasari et al., 2023; Nurani et al., 2021; Yusuf et al., 2024).

The different nature of the clusters are also marked by different dominant typologies of coffee shops. In high-activity nodes and zones dedicated towards public activity, such as in Gubeng main commercial zone and Universitas Airlangga complex, a diversity of coffee shops appear. This is explained by the tendency for coffee shops to cluster in areas with high accessibility, traffic exposure, and the presence of local landmarks (Maulana et al., 2021; Nurani et al., 2021; Zhao et al., 2023).

As a transit-based activity node, Surabaya Gubeng Station generates sustained pedestrian, vehicular movement, and social interaction favoured by retail agglomeration. This transit-based activity acts the same way for hospitals such as RSUD Dr. Soetomo, still in proximity to the main commercial zone. Categorized as waiting facilities, inherent waiting properties and the captive audience generated within create heightened demand for coffee shops. Visitors, patients' families, medical staff in the hospital become a sustained and geographically concentrated consumer base with demand for accessible food and beverage options (Zhao et al., 2023).

Meanwhile, the presence of a large student population in Universitas Airlangga also provides a consistent and large captive consumer base for coffee shops. Student populations also often overlap with commercial activity, creating environments that support a diverse mix of coffee shop formats (Nurani et al., 2021). Each serving distinct segments of the student market, with differences in price point and preference of dwelling time. The popularity of stand-alone coffee shops around the university could confirm findings that young people in Surabaya often use coffee shops for studying, group work, and social interaction (Pratiwi, 2022). Meanwhile, the presence of mobile vendors around university campuses often provide affordable and accessible coffee options for students with busy academic schedules (Maulida et al., 2025).

Concentrated clusters of coffee shops possibly create a stronger agglomeration effect (Ballantyne et al., 2022; Piovani et al., 2017), where the presence of multiple coffee shops within close proximity may collectively increase the attractiveness of an area as a social and lifestyle destination (Ferreira et al., 2021). However, in the case of Gubeng, only stand-alone modern coffee shops and *warkop* tend to cluster. Other typologies including coffee shops in buildings, hybrid cafe-convenience stores, and mobile coffee carts cluster far less. This might indicate that they benefit less from

agglomeration and may prioritize strategic placement within targeted traffic (Maulida et al., 2025; Zhao et al., 2023).

Linear clusters along main roads may suggest such roads are prominent transit areas between home and work environments. This is similar in the case of Surakarta, where coffee shops also emerge along corridors connecting major institutional facilities to residential areas (Maulana et al., 2021). This institutional attractor effect helps to explain the observed clustering in Gubeng's central zone in areas not formally zoned for commercial use, since market demands often override zoning codes in favour of proximity to high-footfall institutional facilities.

The spread of coffee shops towards residential areas may be explained by several conditions. Firstly, the lack of high-activity nodes within residential areas coffee shops likely become such nodes- facilitating activities of gathering, relaxing, and alternative working (Ferreira et al., 2021; Oldenburg, 1989). Increasing expansion of coffee shops in residential areas marks emerging social needs and their recognition as strategic business opportunities amid shifting urban lifestyles (Nindhita & Arifin, 2024; Pratiwi, 2022). Coffee shops have turned into social spaces, workplaces, and venues for family and community gathering. This demand encourages customers to choose coffee shops with higher accessibility and in closer proximity towards their places of living, thereby eliminating the need to travel to city centers, endure traffic congestion, or spend excessive time commuting solely for coffee and social interaction (Maspul & Almalki, 2024). Furthermore, lifestyle transformations such as working from home, freelancing, and more flexible work arrangements, have heightened demand for coffee shops to be closer to residential areas as alternative spaces for work and daily activities. These behavioural shifts are captured by business operators by providing cafes in residential neighbourhoods (Nindhita & Arifin, 2024; Pratiwi, 2022).

Second, consumer preference towards coffee shops in residential areas may be driven by calmer ambience, lower noise levels, reduced vehicular movement, greater privacy, and a sense of personal familiarity (Maspul, 2023). These qualities contribute towards consumers' sense of belonging and psychological comfort, turning the coffee shop from a mere consumption space into a restorative environment embedded within the neighbourhood's daily rhythms (Ferreira et al., 2021; Oldenburg, 1989). This aligns with the *nyantai* and *kebersamaan* feature of Indonesia's coffee culture that emphasizes relaxed ease and togetherness (Husniyah, 2026), cultivated by the unhurried atmosphere in a residential setting rather than in a dense commercial corridor.

Third, increasing density and rising rental costs of commercial zones (Gamal et al., 2024) also compel coffee shop operators to seek alternative locations, often within residential areas. Residential areas often feature lower land and rental costs that subsequently reduce operational costs and also offer competitive pricing. Such cost-driven spatial shift broadens the consumer base of residential coffee shops, attracting more price-sensitive segments such as students, freelancers, and neighbourhood residents (Maulida et al., 2025; Pratiwi, 2022). This finding is also consistent with

broader observations of informal commercial intrusion into residential areas documented across Indonesian cities (Lira & Asrianti, 2025; Litasari et al., 2023).

Meanwhile, the tendency for *warkop* to dominate within residential neighbourhoods in contrast to stand-alone modern coffee shops may be closely related to their respective customer bases and where they tend to reside. Providing a more simple and affordable coffee-drinking experience, *warkop* focuses mainly on providing for the local community within their vicinity, especially those of older generations. In contrast, modern coffee shops with attractive styles, menus, and competitive pricing, appeal towards a wider audience through social media promotion (Nindhita & Arifin, 2024; Pratiwi, 2022; Purnomo et al., 2021). Therefore, the success of *warkop* depends on their strength of being a local node within a neighbourhood (Gao et al., 2025; Oldenburg, 1989), while the success of modern coffee shops relies heavily on accessibility and visibility- two things better provided through agglomeration within a commercial zone (Ballantyne et al., 2022; Zhao et al., 2023).

#### D. Conclusion

Overall, the spatial patterns identified in Gubeng illustrate how market-driven retail agglomeration dominates the spread of coffee shops in the district. Their distribution reflects not only economic considerations and accessibility factors, but also broader cultural tendencies, especially recent lifestyle shifts in the last decade. The clustering observed in this study confirms that coffee shop distribution is strongly shaped by high-activity nodes of business, education, and transportation accessibility. These factors tend to dominate more than land use intentions, which often meet misalignments between regional and city planning, as well as real-life development. This has enabled the expansion of coffee shops towards non-commercial, particularly residential zones. Intertwined factors further drive the emergence of coffee shops in residential zones: the evolution of coffee shop functions, lifestyle shifts, and lower costs of rent and land.

The spread of coffee shops from commercial zones towards other land use zones mark how coffee shops have become crucial actors within the urban context. The concentration of coffee shops along Gubeng district's development corridors suggests that future commercial growth in Surabaya may continue to follow mixed-use development trajectories. Consequently, local governments and urban planners and designers may need to consider how coffee shop expansions affect parking demand, pedestrian activity, public space use, and neighborhood transformation that may be unaddressed by current land regulations. Coffee shops can contribute positively to urban vibrancy and local economies, yet uncontrolled concentration may also intensify traffic congestion and accelerate commercialization within residential areas.

The writers acknowledge that the findings of this study are highly limited to qualitative geospatial interpretations, relying on data based on public contribution

that may contain errors and inconsistencies which are not directly identifiable within the scope of this study. Validation through field observations and more qualitative data intensification may be further needed to confirm the findings of this study

### **Declaration of Competing Interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### **Declaration of Generative AI**

During the preparation of this work the authors used Claude AI for technical verification of operational methods within QGIS. After using this tool/service, the authors performed all analysis independently, reviewed and verified the methods as needed and take(s) full responsibility for the content of the published article.

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