

Mapping Coffee Shops as Informal Cooling Spaces: Evidence from Land Surface Temperature and Urban Activity Patterns

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ABSTRACT

This study explores the role of coffee shops as informal cooling spaces within the context of the Urban Heat Island (UHI) phenomenon in Jember, Indonesia. As a rapidly growing secondary city, Jember faces increasing thermal stress due to urbanization, limited green infrastructure, and uneven spatial development. While formal cooling strategies such as urban green spaces remain limited, coffee shops have emerged as accessible semi-public spaces that may contribute to thermal comfort in everyday urban life. This research adopts a quantitative spatial approach by integrating remote sensing and Geographic Information Systems (GIS). Land Surface Temperature (LST) was derived from Landsat 8 imagery to identify urban heat patterns, while coffee shop location data were collected from Google Maps and analyzed using Kernel Density Estimation to detect clustering patterns. An overlay analysis was conducted to examine the spatial relationship between coffee shop distribution and high-temperature zones. The results show that high LST areas exceeding 37°C are concentrated in densely built-up districts, particularly Sumbersari and Kaliwates, which are dominated by residential, commercial, and service activities. In contrast, lower temperature zones are associated with vegetated land uses such as rice fields, plantations, and community forests. Coffee shops exhibit a strong agglomeration pattern in urban cores, with significant hotspots identified in Sumbersari and secondary clusters in Kaliwates. The overlay analysis reveals that a substantial number of coffee shops are located within high-temperature zones, indicating a spatial alignment between areas of high cooling demand and the presence of these establishments. These findings suggest that coffee shops have the potential to function as informal cooling infrastructures, providing thermal refuge in dense urban environments. However, their uneven distribution also reflects spatial inequality, as peripheral areas have limited access to such amenities. This study highlights the importance of recognizing informal and privately operated spaces in urban heat mitigation strategies, particularly in secondary cities where formal cooling infrastructure is insufficient.

Key Words: Urban Activity Patterns, Coffee Shops Hotspot, Urban Cooling Refuges

INTRODUCTION

Land Surface Temperature (LST) plays a crucial role in identifying potential cooling spaces within urban environments, particularly in the context of increasing urban heat stress. Urban Green Spaces (UGS) have been widely recognized as key contributors to LST reduction, where higher vegetation density significantly lowers surface temperatures through shading and evapotranspiration mechanisms (Shetty & g s, 2020; Zhang et al., 2026). However, in many rapidly growing urban areas, especially in secondary cities, the availability and accessibility of formal green spaces remain limited.

In this context, coffee shops are increasingly recognized as “third places” that support social interaction, community engagement, and everyday urban life (Ferreira et al., 2021). Beyond their social function, coffee shops may also serve as informal cooling infrastructures, particularly when they incorporate design elements such as vegetation, shaded outdoor seating, and adequate

ventilation systems. This role becomes especially relevant in dense urban areas where formal cooling spaces are scarce (Noaime et al., 2025a).

Jember, as a secondary city in Indonesia, presents a compelling case for examining this phenomenon. Unlike major metropolitan areas, Jember experiences urban growth characterized by incremental densification, mixed land use, and uneven distribution of green infrastructure. At the same time, the proliferation of coffee shops in Jember, driven by youth culture, student populations, and local economic dynamics, has transformed these spaces into accessible and widely distributed urban nodes (Niki Suma & Shofwan, 2023). Despite this rapid growth, their spatial relationship with urban heat patterns has not been systematically studied.

Urban activity patterns further influence the effectiveness of coffee shops as informal cooling spaces. During periods of high temperature, individuals tend to seek thermally comfortable environments, including semi-public indoor spaces such as coffee shops (Hafizh et al., 2026; Noaime et al., 2025b). High temperatures often lead to increased use of air conditioning and other cooling systems, as seen in studies linking search frequencies for air conditioning devices to thermal discomfort (Mastrucci et al., 2022; Singh et al., 2018). The effectiveness of these spaces is shaped by factors such as building design, ventilation, and accessibility (Ilmi & Sunarya, 2024; Waskitaningrum & Avenzoar, 2024). In Jember, where public cooling facilities are limited, urban green space is only 0,02% below the regulation standard (Putri Kinanti & Syafe'i, 2025). Coffee shops located near commercial corridors, campuses, and transit routes may play a critical role in providing thermal refuge, particularly for vulnerable populations.

While previous studies have explored the spatial distribution of coffee shops and their socio-cultural functions, limited research has examined their relationship with Land Surface Temperature (LST), particularly in secondary cities. Therefore, this study aims to map and analyze coffee shops as informal cooling spaces in Jember, focusing on their spatial distribution in relation to LST patterns.

Methodologically, this research integrates remote sensing and spatial analysis to assess the potential of coffee shops as cooling infrastructures. Satellite imagery will be utilized to derive LST data, while secondary datasets and field verification will identify the distribution and characteristics of coffee shops. Geographic Information Systems (GIS) will be employed to overlay LST patterns with coffee shop locations, enabling the identification of areas where these establishments coincide with high-temperature zones (Oraiopoulos et al., 2026). This approach allows for a more nuanced understanding of how informal urban spaces can contribute to thermal comfort and urban resilience in secondary cities like Jember.

LITERATURE REVIEW

a. Urban Heat Island

The Urban Heat Island (UHI) effect refers to the phenomenon where urban areas exhibit higher temperatures than their rural surroundings due to factors such as urbanization, land use changes, and anthropogenic heat emissions. This localized warming has significant environmental, social, and economic implications, particularly in the context of climate change (Hossain et al., 2025).

Primary Causes of the Urban Heat island Effect :

- **Urbanization** : The replacement of natural vegetation with impervious surfaces (like asphalt and concrete) leads to increased heat absorption and reduced cooling through evaporation (Mekonnen et al., 2024)
- **Land Use Changes** : As cities expand, the conversion of green spaces into built environments exacerbates the UHI effect. Areas with dense buildings and limited vegetation tend to retain heat more than those with ample greenery (Anitha & Prabha, 2026)

- Human Activities : Increased energy consumption for cooling, transportation, and industrial processes contributes to higher local temperatures (Anitha & Prabha, 2026)

Environmental and health Impacts :

- Increased energy Demand : Higher temperature lead to greater energy consumption for cooling, which can strain energy resources and increase greenhouse gas emissions (Santamouris, 2023)
- Public Health Risks : Elevated temperatures are linked to heat-related illnesses, exacerbating conditions such as cardiovascular and respiratory diseases, particularly among vulnerable populations. The UHI effect can increase heat related mortality rates, especially during heat waves (Heaviside et al., 2017)
- Degradation of Air Quality : Higher temperatures can lead to increased ground-level ozone concentrations, worsening air quality and impacting respiratory health (Santamouris, 2023)

b. Land Surface Temperature (LST)

Land Surface Temperature (LST) is a critical parameter that reflects the thermal state of the Earth's surface, influencing both local and global climate patterns. It is defined as the temperature of the Earth's surface, including soil, vegetation, and built structures, and is typically measured in degrees Celsius (Sheela et al., 2025). Understanding LST is essential for various applications, including climate monitoring, agriculture, and urban planning.

Primary Methods of Measuring LST

- Satellite Measurements : Satellites equipped with thermal infrared sensors provide a broad view of LST across large areas. For instance, the MODIS (Moderate Resolution Imaging Spectroradiometer) and Landsat satellites are commonly used for this purpose . These satellites capture thermal radiation emitted from Earth's surface, allowing for the estimation of LST (Hussain et al., 2026)
- Algorithmic Approache: Various algorithms, such as the Temperature Emissivity Separation algorithm, are used to process satellite data and improve accuracy. The choice of algorithm can significantly affect the results, especially in heterogeneous landscapes (Benmecheta et al., 2013)

Influence of LST on Climate Patterns

LST plays a vital role in energy and moisture exchange between the Earth's surface and the atmosphere, impacting weather and climate patterns/

- Climate Change Implications: Rising LST is closely to global warming, with significant increases observed in urban areas due to factors like urbanization and land cover changes. For example, studies have shown that urban areas can experience LST increases of over 10C compared to rural areas (Jasim, 2025)
- Local Climate Effects : Variations in LST can influence local weather patterns, such as precipitation and humidity levels. For instance, changes in land use can lead to increased LST, which may exacerbate heat waves and alter local ecosystems (Patle & Ghuge, 2025)

c. Urban Activity Patterns

Social and economic activities, such as commercial and industrial operations, contribute significantly to UHI by increasing land surface temperatures, and commercial activity intensity was found to be a substantial driver. Different urban growth patterns (e.g., edge expansion, high-density developments) influence UHI intensity. High-rise, high-density, and low-rise, high-density developments are particularly associated with higher land surface temperatures (LST) due to increased impervious surfaces and reduced vegetation. However, in terms of socioeconomic

factors, population density and impervious surface are key socioeconomic and physical variables influencing UHI (Sukma et al., 2025; Tang et al., 2017).

d. Coffee Shops as Semi-Public Spaces and Informal Cooling Spaces

Coffee shops function as semi-public spaces that bridge the gap between private and public realms. They play a vital role in fostering social connections, supporting urban sustainability, and contributing to local economies. However, their effectiveness as inclusive and communal spaces depends on thoughtful design, accessibility, and a balance between commercial and social objectives (Lukito & Xenia, 2017).

Around the world, it exhibits varying characteristics based on cultural contexts. For instance, in some regions, they may serve as traditional gathering spots, while in others, they might be more commercialized and focused on individual consumption. This cultural diversity shapes how coffee shops function as semi-public spaces, influencing social interactions and community dynamics (Deng, 2021; Sobierajski, 2025).

RESEARCH METHODOLOGY

Research Approach

This study adopts a quantitative spatial analysis approach integrating remote sensing and Geographic Information Systems (GIS) to describe the relationship between Land Surface Temperature (LST) and the spatial distribution of coffee shops as informal cooling spaces in Jember. The study is designed as a cross-sectional spatial analysis, focusing on identifying spatial patterns, associations, and potential cooling functions of coffee shops within urban thermal environments.

Study Area

The study is conducted in Jember Regency, East Java, with a focus on urbanized districts :

- Kecamatan Sumbersari
- Kecamatan Kaliwates
- Kecamatan Patrang

These areas represent the urban core, characterized by high population density, concentration of commercial activities, significant growth of coffee shops, and limited and uneven distribution of green spaces (Putri Kinanti & Syafe'i, 2025).

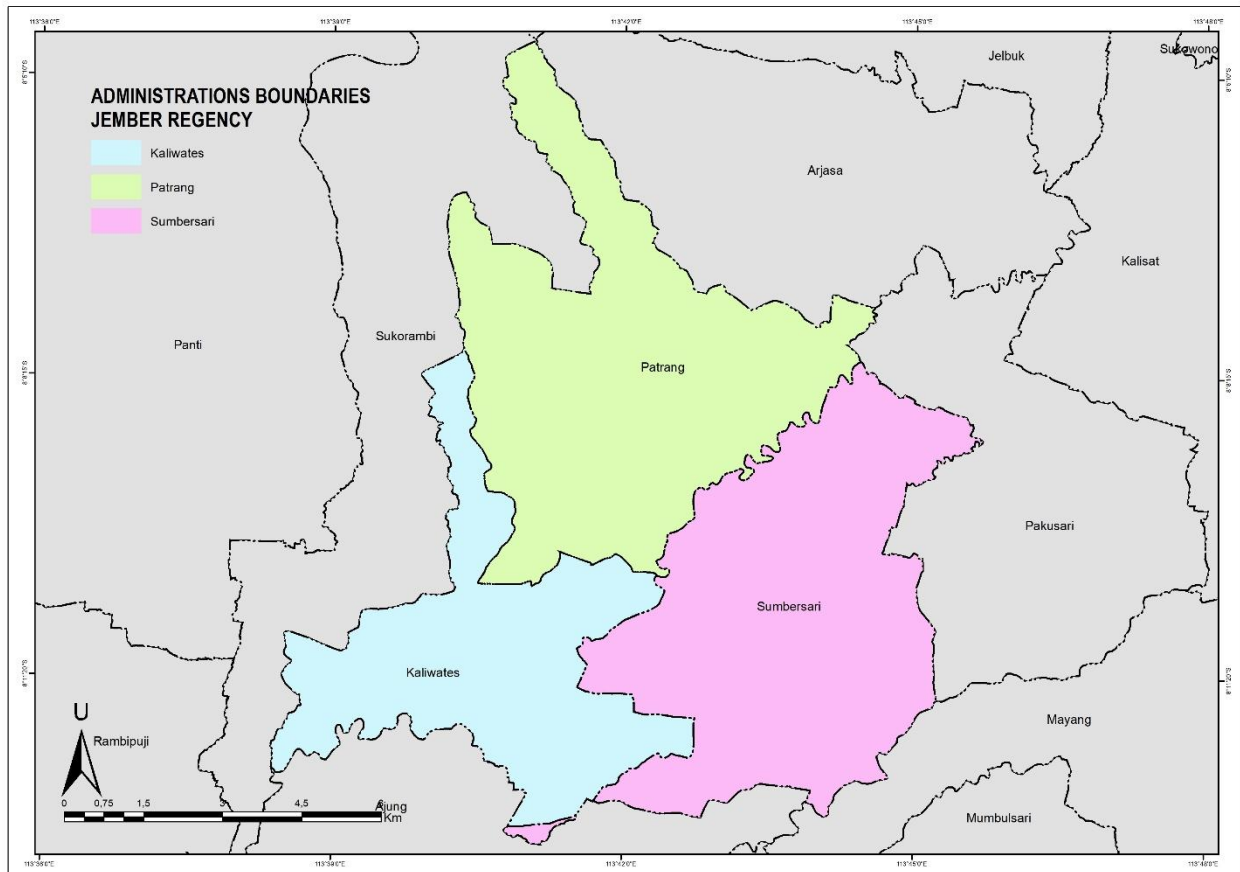


Figure 1. Study Area

Source: Data Analysis, 2026

Data Types and Sources

Data types are mostly secondary and available online for free. The research is conducted systematically, starting with the problem statement, the research gap, data collection and analysis, and the strategy to understand the dynamics of coffee shop distribution related to Land Surface Temperature.

a. Land Surface Temperature (LST) Data

- Source: Landsat 8, Band 5 dan Band 4
- Acquisition: USGS Earth Explorer
- Temporal Section: Dry season
- Output: Raster

b. Coffee Shop Location Data

- Source: Google Maps
- Attributes: Coordinate, name of the coffee shop
- Method: Data Scraping

c. Supporting Spatial Data

- Land use/land cover: Ina-Geoportal
- Administration Boundary: Ina-Geoportal

ANALYSIS AND DISCUSSION

LST Extraction

To obtain Land Surface Temperature data, the research started by creating the LST map. LST is derived from Landsat thermal bands through several steps :

1. Calculating NDVI

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

2. Calculating the Proportion of Vegetation (P_v)

$$P_v = \left(\frac{NDVI - NDVI_{min}}{NDVI_{max} - NDVI_{min}} \right)^2$$

3. Calculating Emissivity (ϵ)

$$\epsilon = 0.004 \cdot P_v + 0.986$$

4. Creating LST Final

Last, emissivity score is used for the last formulation to correct the Brightness Temperature (BT)

$$LST = \frac{BT}{1 + \left(\lambda \cdot \frac{BT}{p} \right) \cdot \ln(\epsilon)}$$

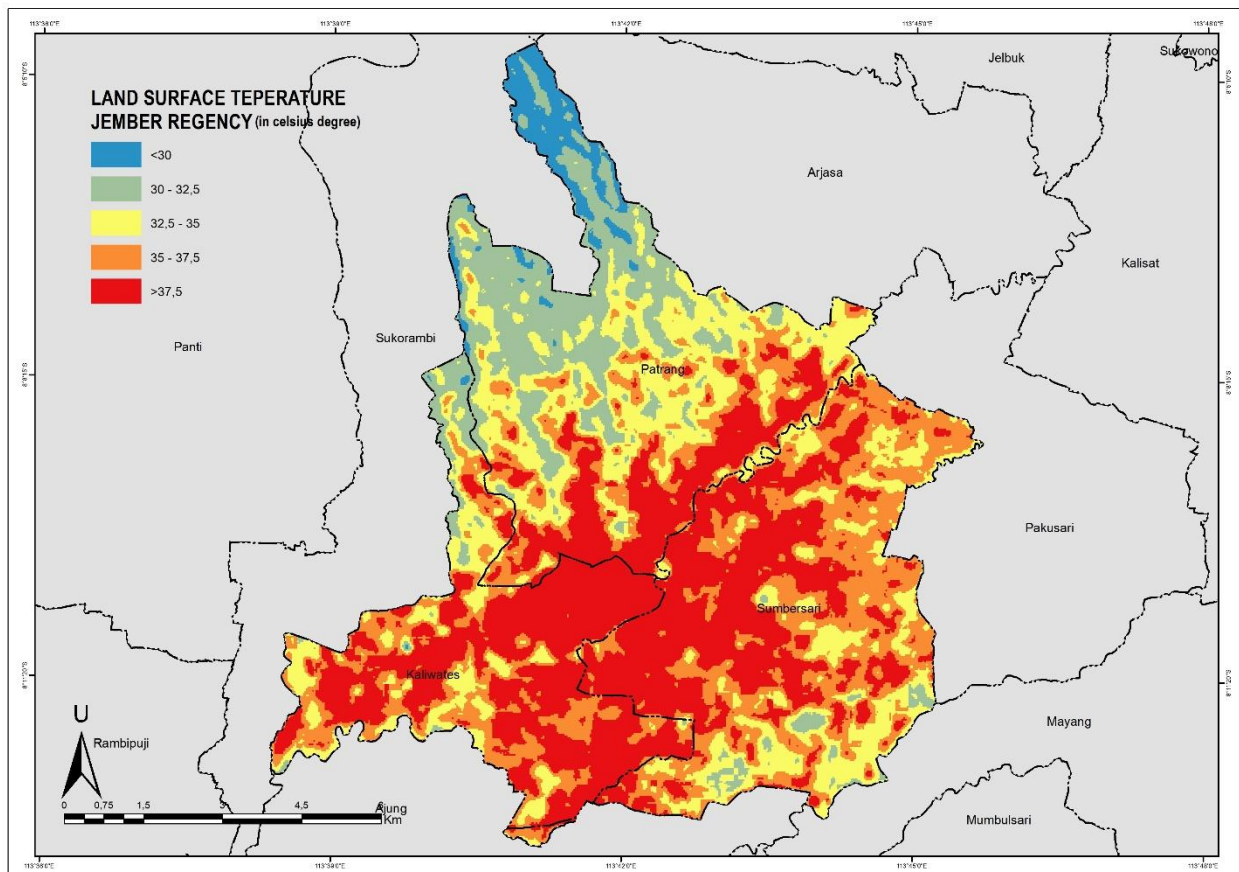


Figure 2. LST Map

Source: Data analysis, 2026

From the figure above, this study reveals that the highest Land Surface Temperature (LST) in the Jember Urban Area exceeds 37°C, covering approximately 3,422 hectares, while the lowest temperature zones fall below 30°C, with a much smaller extent of around 288 hectares. The spatial distribution indicates that high-temperature areas are predominantly associated with built-up land uses, particularly those characterized by dense concentrations of residential settlements, office

complexes, and commercial and service activities. These areas tend to exhibit higher thermal intensity due to extensive impervious surfaces, limited vegetation cover, and intense anthropogenic activities.

In contrast, the lowest temperature zones are largely found in areas dominated by plantations, rice fields, and community forests, which provide significant cooling effects through vegetation density, shading, and evapotranspiration processes. The stark contrast between these land cover types highlights the critical role of vegetated landscapes in mitigating urban heat and emphasizes the uneven spatial distribution of thermal comfort across the Jember Urban Area.

Coffee Shop and Population Density Mapping

Coffee shop map derived from several stages of analysis :

1. Collecting all coffee shop locations into point data from Google Maps
2. Check and clean duplicates and irrelevant entries
3. After that, use the scraping extension to download all the coffee shops data
4. Overlay with the population density map, which was derived from Google Earth Engine database

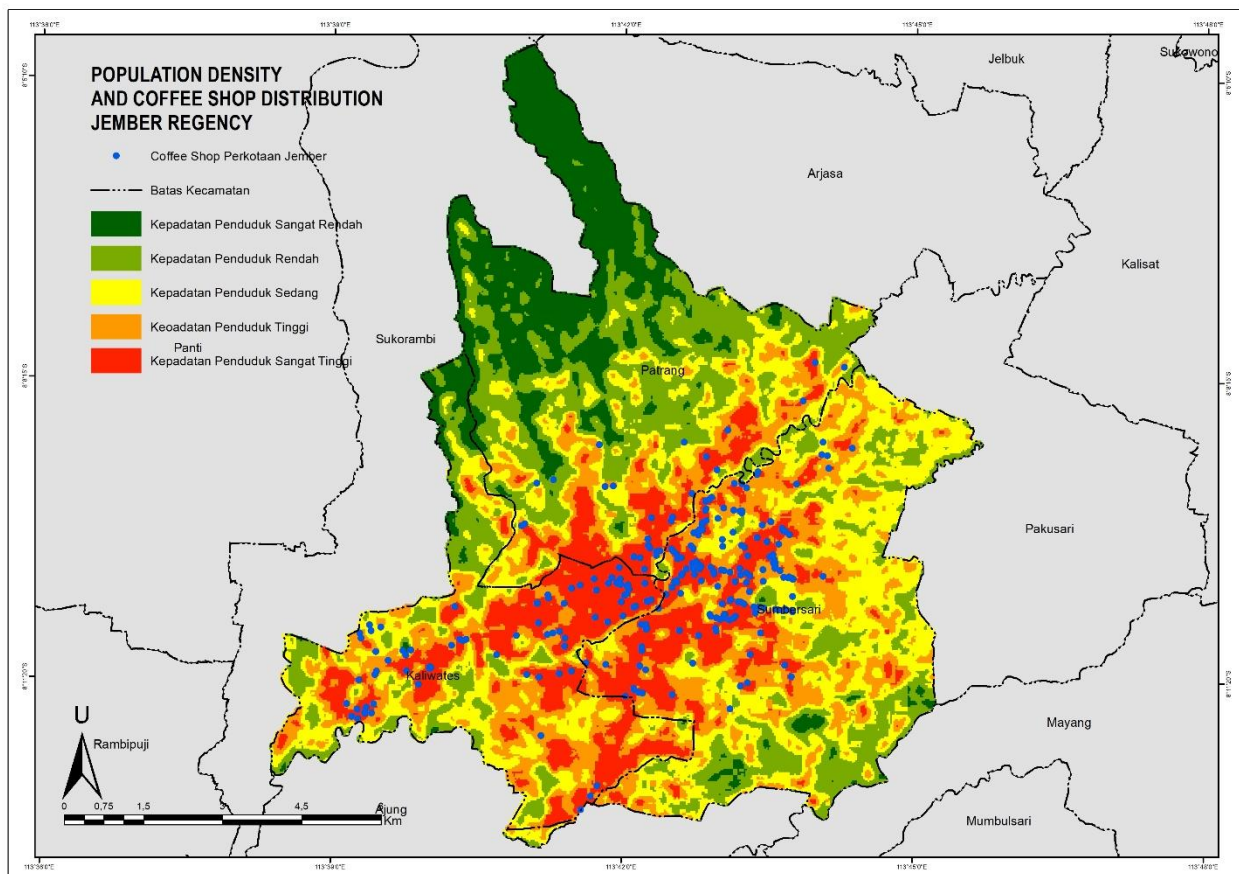


Figure 3. Population Density and Coffee Shops Distribution

Source : Data Analysis, 2026

As shown in Figure 3, coffee shops (represented by blue dots) are predominantly clustered in areas classified as having high to very high population density, particularly in the districts of Summersari, Kaliwates, and Patrang, which together form the urban core of Jember Regency. The pattern is consistent with central place theory, which states that commercial establishments, including food and beverage services, tend to locate in areas with the largest accessible consumer base.

Sumbersari is home to the University of Jember campus, which serves as a significant demand generator, as the student population constitutes a major segment of coffee shop patronage in Indonesian urban settings. In Kaliwates, the convergence of high population density and commercial activity creates a favorable environment for coffee shop proliferation. The district functions as a commercial and administrative hub, attracting both resident and non resident populations throughout the day, thereby sustaining higher foot traffic and consumer demand. Areas with moderate population density, shown in yellow across the mid sections of study area, display a scattered but present coffee shop distribution. These transitional zones, located between the dense urban core and the sparse rural periphery, suggest that coffee shop establishment is sensitive to threshold population levels a minimum density may be required before commercial coffee shop activity becomes economically sustainable.

Overlay map of coffee shops vs heat zones

Overlay coffee shop points with LST raster, then identify whether coffee shops are located in High LST zones (potential cooling demand areas) or low LST zones (already comfortable areas).

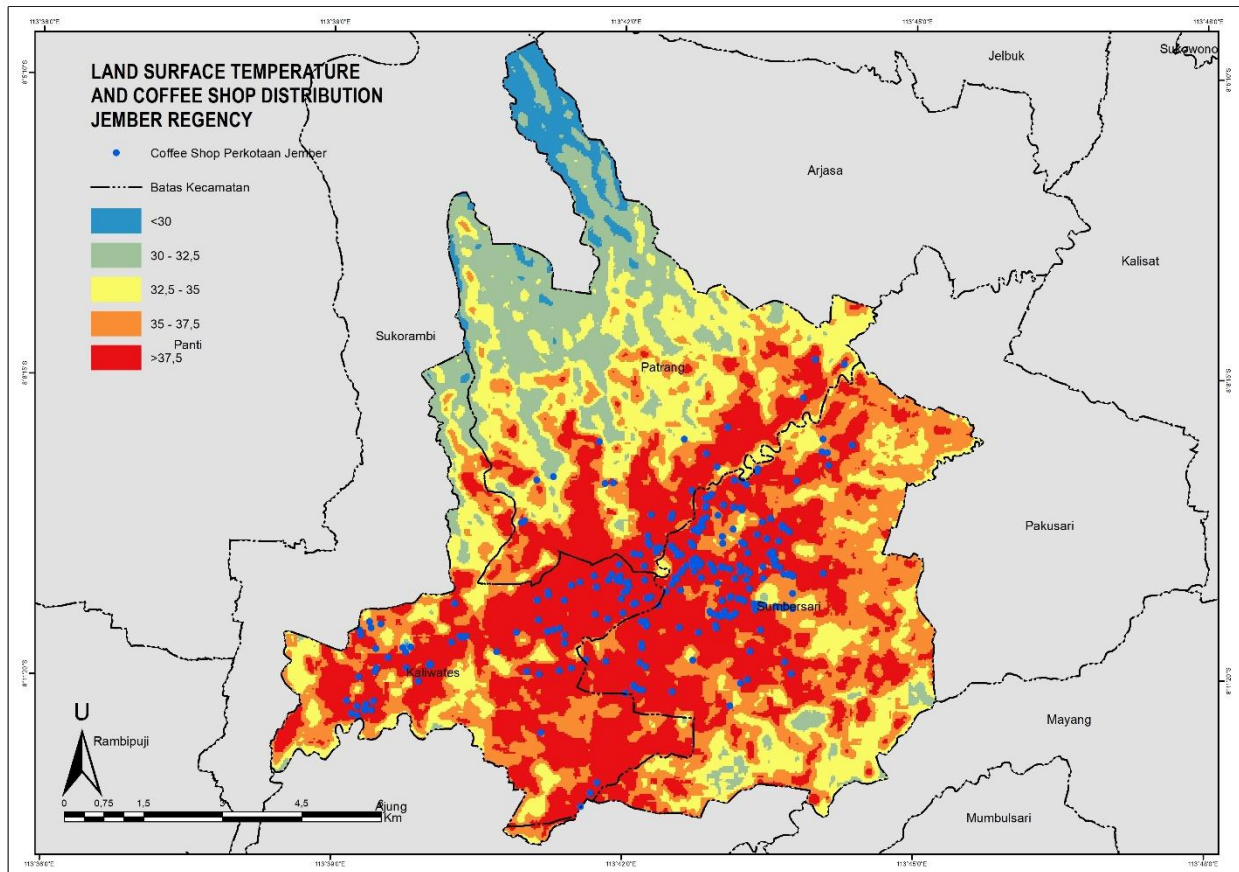


Figure 4. Overlay map of coffee shops and heat zones

Source: Data analysis, 2026

The spatial analysis presented in this study examines coffee shop distribution in Jember Regency through three overlapping geographic lenses: Population density, land use classification, and Land Surface Temperature as a proxy for Urban Heat Island (UHI) intensity. Taken together Figure 4 and figure 5, reveal that coffee shops in Jember are not randomly distributed across the urban landscape, but are instead systematically concentrated in zones where population density is highest, residential settlement is most continuous, and surface temperatures are most elevated the very conditions that define the urban heat island effect. This convergence positions coffee shops

not merely as commercial establishments, but can be seen as informal cooling spaces embedded within the hottest and most densely inhabited parts of the city.

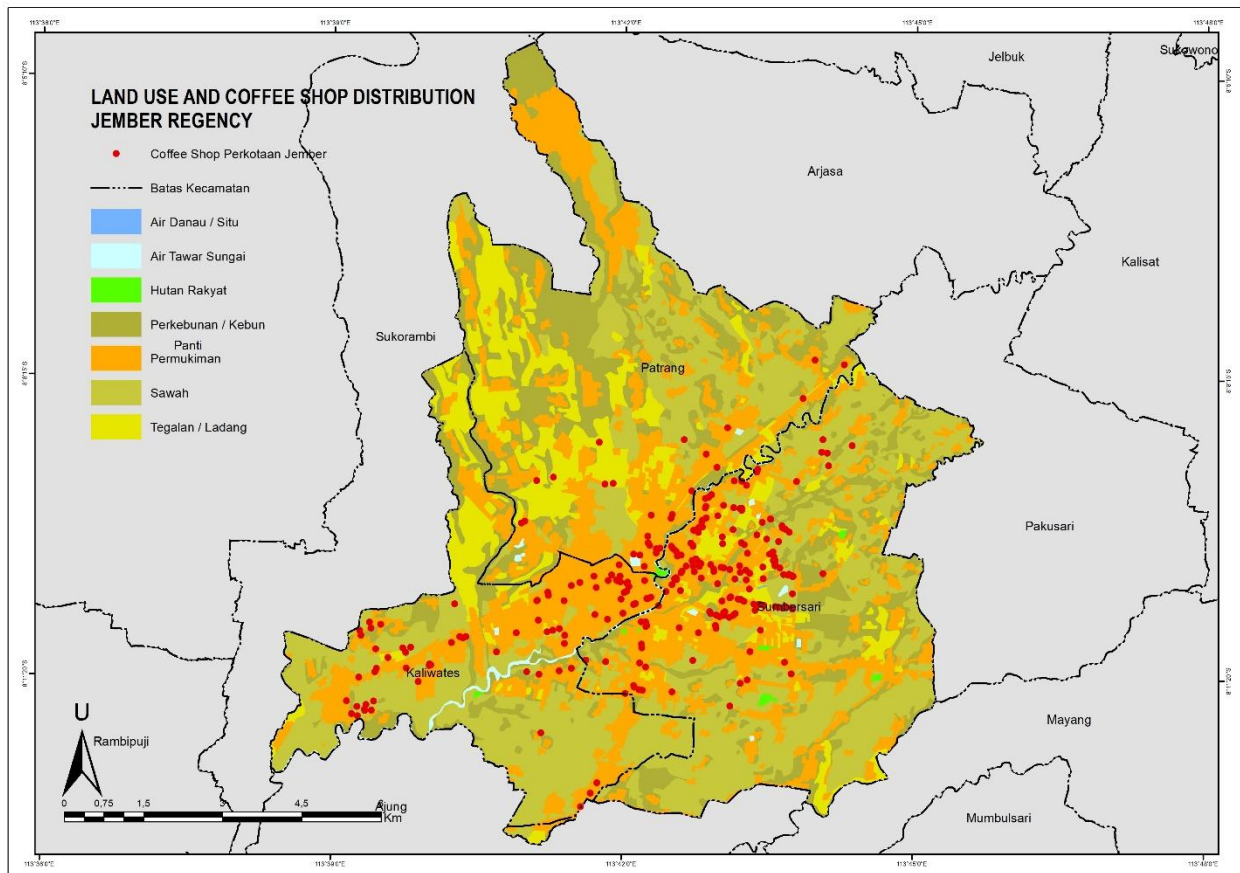


Figure 5. Land Use and Coffee Shops Distribution

The most analytically significant finding of this study emerges from the overlay of coffee shop locations with the LST map. The overwhelming majority of coffee shops in Jember Regency are located within zones recording surface temperatures above 35°C , with the densest clustering occurring squarely within the $>37.5^{\circ}\text{C}$ thermal core of Summersari and Kaliwates. This spatial coincidence is not incidental it reflects the structural reality that the urban populations most exposed to UHI-related thermal stress are also the primary consumers of coffee shop services, and that coffee shops, by their nature as enclosed, typically air-conditioned or shaded commercial spaces, offer a form of thermal refuge that is otherwise scarce in the high-density built environment.

In this sense, coffee shops in Jember function as informal cooling spaces privately operated, commercially motivated venues that nonetheless provide a public-good-adjacent thermal service to urban residents navigating one of the hottest zones in the regency. This interpretation is consistent with a growing body of urban climate literature that recognizes informal and commercial spaces including cafés, shopping centers, and markets as critical components of the urban population's adaptive thermal repertoire, particularly in tropical cities where outdoor temperatures routinely exceed physiological comfort thresholds.

The three-variable overlay produces a coherent and mutually reinforcing spatial narrative. In Summersari and Kaliwates, all three enabling conditions peak simultaneously: population density is at its highest, land use is dominated by continuous housing, and LST exceeds 37.5°C across large contiguous areas. It is precisely in these zones that coffee shop density is most intense. This triangulation strongly supports the interpretation that coffee shop agglomeration in Jember is

driven not by a single factor but by the compounding effect of urban density, built environment configuration, and thermal exposure all of which are spatially co-produced by the urbanization process.

In the transitional district of Patrang, where population density is moderate, land use is fragmented between housing and agricultural zones, and LST ranges between 32.5–37.5°C, coffee shop distribution is correspondingly more dispersed. The partial satisfaction of all three enabling conditions produces partial clustering coffee shops appear along road corridors and within settlement patches, but without the intensity observed in the southern urban core. This graduated response further validates the multi-variable spatial model proposed in this study.

In peripheral districts Panti, Sukorambi, and Arjasa all three variables fall below the apparent viability threshold simultaneously: population density is very low, land use is predominantly agricultural, and surface temperatures are the coolest in the study area. The near-total absence of coffee shops in these zones is therefore overdetermined, with each variable independently sufficient to explain their exclusion and all three reinforcing one another.

The spatial evidence presented here carries significant implications for urban climate adaptation policy in Jember and analogous secondary cities in tropical Indonesia. The populations most exposed to UHI thermal stress those living in the high-density, high-temperature core of Summersari and Kaliwates are also the populations with the greatest reliance on informal commercial cooling spaces such as coffee shops. This creates a de facto private-sector cooling infrastructure that operates without public planning recognition or support, yet performs a demonstrably important thermal comfort function for a large urban population.

Recognizing coffee shops and similar commercial venues as informal cooling spaces opens new possibilities for climate-responsive urban planning. Local governments could, for example, incorporate the spatial distribution of commercial air-conditioned venues into urban heat vulnerability assessments, identify UHI hotspots underserved by both formal green infrastructure and informal commercial cooling, and develop incentive frameworks that encourage cooling-compatible commercial development in thermally stressed neighborhoods.

At the same time, the concentration of coffee shops in the UHI core raises questions about the feedback relationship between commercial activity and thermal intensification. The energy consumption of air-conditioned commercial establishments contributes to anthropogenic heat emissions, potentially exacerbating the very UHI conditions that drive demand for indoor cooling. Future research should investigate this feedback dynamic and explore whether cool urban design interventions such as street tree canopy expansion, reflective surfaces, and green corridors could reduce UHI intensity in ways that simultaneously moderate the thermal demand placed on informal cooling spaces like coffee shops.

CONCLUSION

1. This study demonstrates that Urban Heat Island (UHI) intensity in Jember Urban Area is strongly associated with built-up land use, where high Land Surface Temperature (LST) zones (>37°C) are predominantly located in dense urban areas such as Summersari and Kaliwates, while lower temperature zones are found in vegetated areas including rice fields, plantations, and community forests.
2. The overlay analysis between coffee shop locations and LST shows that a large proportion of coffee shops are located within high-temperature zones, suggesting that these establishments are situated in areas with higher cooling demand. This indicates their potential role as informal cooling spaces within dense urban environments.

3. Despite this potential, the findings also highlight spatial inequality, as peripheral and cooler areas have limited access to coffee shops, suggesting that the benefits of such informal cooling infrastructures are unevenly distributed across the study area.
4. From an urban planning perspective, this study underscores the importance of integrating informal cooling spaces, such as coffee shops, into urban heat mitigation strategies, especially in secondary cities where formal green infrastructure is limited.
5. Coffee shop distribution in Jember Regency is spatially determined by the convergence of high population density, housing land use, and elevated Land Surface Temperature. These three variables are not independent but are structurally linked through the urbanization process, and their spatial co-occurrence defines the geographic boundaries within which coffee shop agglomeration is both commercially viable and socially significant. The evidence presented in this study positions coffee shops as informal cooling spaces embedded within the UHI core of Jember's urban landscape, contributing to the thermal resilience of urban residents in ways that merit explicit recognition in urban climate adaptation frameworks.

STUDY LIMITATIONS

1. This study relies heavily on secondary data sources, including Landsat imagery and Google Maps data, which may contain limitations in accuracy, completeness, and temporal consistency, particularly in representing the most up-to-date coffee shop locations.
2. The research adopts a cross-sectional approach, meaning that it does not account for temporal variations in temperature or coffee shop activity patterns (e.g., daytime vs nighttime conditions or seasonal changes).
3. The study focuses primarily on spatial relationships and does not include user perception data.
4. The analysis does not differentiate between types of coffee shops (e.g., indoor vs outdoor, air-conditioned vs naturally ventilated), which may significantly influence their effectiveness as cooling infrastructures.

References

- Anitha, V., & Prabha, D. (2026). *Land Use Land Cover Analysis: Understanding the Relationship Between Urban Development and Urban Heat Islands* (pp. 45–55). https://doi.org/10.1007/978-3-032-11580-5_5
- Benmecheta, A., Abdellaoui, A., & Hamou, A. (2013). A comparative study of land surface temperature retrieval methods from remote sensing data. *Canadian Journal of Remote Sensing*, 39(1), 59–73. <https://doi.org/10.5589/m13-008>
- Deng, S. (2021). An Ethnographic Study on the Linguistic Landscapes of the Coffee Shops in Songjiang University Town in Shanghai From the Perspective of “The Third Place.” *Theory and Practice in Language Studies*, 11(6), 652–660. <https://doi.org/10.17507/tpls.1106.08>
- Ferreira, J., Ferreira, C., & Bos, E. (2021). Spaces of consumption, connection, and community: Exploring the role of the coffee shop in urban lives. *Geoforum*, 119, 21–29. <https://doi.org/10.1016/j.geoforum.2020.12.024>
- Hafizh, M. F., Koerniawan, M. D., & Firmansyah, F. (2026). The relationship between the cooling effect of parks and the urban heat island effect in Jakarta and Bandung. *E3S Web of Conferences*, 685, 03001. <https://doi.org/10.1051/e3sconf/202668503001>
- Heaviside, C., Macintyre, H., & Vardoulakis, S. (2017). The Urban Heat Island: Implications for Health in a Changing Environment. *Current Environmental Health Reports*, 4(3), 296–305. <https://doi.org/10.1007/s40572-017-0150-3>
- Hossain, A. K. M. A., Campbell, S., Jones, S., & Shirmeen, T. (2025). Urban Heat Island Effect of Small Cities in the United States. In *Handbook of Climate Change Mitigation and*

- Adaptation* (pp. 2731–2764). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-84483-6_187
- Hussain, R. N., Mozahim, R., Alhadithi, M., Massarwa, F. A., & Elrayah, A. (2026). *Land surface temperature assessment using landsat satellite images: A review*. 050064. <https://doi.org/10.1063/5.0306432>
- Ilmi, A. M., & Sunarya, W. (2024). Analysis of the Principles of Green Architecture in Bogor Creative Hub. *DEARSIP: Journal of Architecture and Civil*, 4(02), 12–25. <https://doi.org/10.52166/dearsip.v4i02.6742>
- Jasim, B. S. (2025). Spatiotemporal Impact Analysis of Land Surface Temperature Variations: A Case Study of the Northeastern Part of Baghdad Province, Iraq (2000-2024). *Al-Bahir*, 6(1). <https://doi.org/10.55810/2313-0083.1081>
- Lukito, Y. N., & Xenia, A. P. (2017). Café as third place and the creation of a unique space of interaction in UI Campus. *IOP Conference Series: Earth and Environmental Science*, 99, 012028. <https://doi.org/10.1088/1755-1315/99/1/012028>
- Mastrucci, A., Byers, E., Pachauri, S., Rao, N., & van Ruijven, B. (2022). Cooling access and energy requirements for adaptation to heat stress in megacities. *Mitigation and Adaptation Strategies for Global Change*, 27(8), 59. <https://doi.org/10.1007/s11027-022-10032-7>
- Mekonnen, G. T., Berlie, A. B., Wubie, M. A., & Legesse, S. A. (2024). Drivers of surface urban heat island of Gondar City, Ethiopia: a comparative study. *Cogent Social Sciences*, 10(1). <https://doi.org/10.1080/23311886.2024.2354974>
- Niki Suma, N., & Shofwan, M. (2023). Aplikasi google earth untuk menganalisis fenomena gentrifikasi akibat komersialisasi ruang di area sekitar kampus. *WAKTU: Jurnal Teknik UNIPA*, 21(02). <https://doi.org/10.36456/waktu.v21i02.7546>
- Noaime, E., Alalouch, C., Mesloub, A., Hamdoun, H., Gnaba, H., & Alnaim, M. M. (2025a). Sustainable cities and urban dynamics: The role of the café culture in transforming the public realm. *Ain Shams Engineering Journal*, 16(3), 103320. <https://doi.org/10.1016/j.asej.2025.103320>
- Noaime, E., Alalouch, C., Mesloub, A., Hamdoun, H., Gnaba, H., & Alnaim, M. M. (2025b). Sustainable cities and urban dynamics: The role of the café culture in transforming the public realm. *Ain Shams Engineering Journal*, 16(3), 103320. <https://doi.org/10.1016/j.asej.2025.103320>
- Oraiopoulos, A., Wieser, M., Verdier, M., Lambert, R., Fennell, P., & Ruyssevelt, P. (2026). Improving habitability in informal settlements in the Global South: Exploring the impact of community urban green infrastructure on outdoor heat stress. *Building and Environment*, 287, 113787. <https://doi.org/10.1016/j.buildenv.2025.113787>
- Patle, S., & Ghuge, V. V. (2025). Investigating daytime and nighttime cooling impacts of different land covers using landscape metrics: A case of Jaipur city. *2025 IEEE International Conference on Next-Gen Technologies of Artificial Intelligence and Geoscience Remote Sensing (EarthSense)*, 1–5. <https://doi.org/10.1109/EarthSense66084.2025.11297217>
- Putri Kinanti, S. A., & Syafe'i, A. D. (2025). ESTIMASI SERAPAN KARBON MENGGUNAKAN INVENTARISASI PADA RUANG TERBUKA HIJAU DI WILAYAH PERKOTAAN KABUPATEN JEMBER. *JISO: Journal of Industrial and Systems Optimization*, 8(1), 118–127. <https://doi.org/10.51804/jiso.v8i1.118-127>
- Santamouris, M. (2023). Urban overheating—energy, environmental, and heat-health implications. In *Urban Climate Change and Heat Islands* (pp. 165–225). Elsevier. <https://doi.org/10.1016/B978-0-12-818977-1.00007-7>
- Sheela, Jha, M., & Ohri, A. (2025). *Temporal and Spatial Analysis of Land Surface Temperature (LST) and Its Correlation with Air Temperature for Environmental Monitoring* (pp. 347–355). https://doi.org/10.1007/978-981-96-9841-7_32

- Shetty, P., & g s, D. (2020). *Examining the Effects of Heat Mitigation on the Physical Properties of Urban Green Space and Urban Blue Space: A Case Study*. <https://doi.org/10.5194/egusphere-egu2020-760>
- Singh, T., Siderius, C., & Van der Velde, Y. (2018). When do Indians feel hot? Internet searches indicate seasonality suppresses adaptation to heat. *Environmental Research Letters*, 13(5), 054009. <https://doi.org/10.1088/1748-9326/aaba82>
- Sobierajski, T. (2025). Social Aspects of Coffee: Globalization and Lifestyle. In *The Link Between Coffee and Health* (pp. 629–634). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-93459-9_38
- Sukma, M. F. A., Setiyo Cahyono, H., & Carina, A. (2025). ENVIRONMENTAL SUSTAINABILITY ANALYSIS IN KAMAJAYA HOUSING IN SUPPORTING THE FEASIBILITY OF LIVING. *DEARSIP: Journal of Architecture and Civil*, 5(02), 257–274. <https://doi.org/10.52166/dearsip.v5i02.11074>
- Tang, J., Di, L., Xiao, J., Lu, D., & Zhou, Y. (2017). Impacts of land use and socioeconomic patterns on urban heat Island. *International Journal of Remote Sensing*, 38(11), 3445–3465. <https://doi.org/10.1080/01431161.2017.1295485>
- Waskitaningrum, N., & Avenzoar, A. (2024). PENERAPAN GREEN ARCHITECTURE TERHADAP PERPUSTAKAAN UNIVERSITAS INDONESIA. *DEARSIP: Journal of Architecture and Civil*, 4(01), 95–103. <https://doi.org/10.52166/dearsip.v4i01.6275>
- Zhang, X., Hu, J., Xia, T., Mao, Y., Li, X., Hu, C., & Zhang, J. (2026). Cooling varies with green space characteristics: Unraveling nonlinear spatial heterogeneity in cooling effects of urban green spaces with geographic explainable AI. *Environmental Impact Assessment Review*, 119, 108401. <https://doi.org/10.1016/j.eiar.2026.108401>