Analysis of the Impact of Restaurant Genre Diversity on Staying Population — Using Data from Private Gourmet Information Websites —

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Abstract

In the context of smart city development, restaurants are key elements contributing to urban vibrancy. While previous studies have emphasized the number of restaurants as a driver of urban activity, this study investigates not only the number but also the genre diversity of restaurants around train stations and their effects on the staying population, an indicator of vibrancy. Using restaurant data scraped from the gourmet website "Tabelog" and smartphone-based population flow data provided by CSIS at the University of Tokyo, this study analyzes 10,164 250-meter mesh units within Tokyo's 23 wards. Simpson's Diversity Index was employed to quantify genre diversity, and Ordinary Least Squares (OLS) regression was used to evaluate the relationship between the staying population and several factors, including restaurant count, diversity index, proximity to train stations, and the number of establishments.
The results show that restaurant genre diversity has a statistically significant and positive effect on the staying population, independent of restaurant count. Additionally, areas near train stations tend to have both higher restaurant concentrations and greater diversity, confirming stations as hubs of urban diversity. These findings suggest that enhancing vibrancy in urban areas requires not only increasing the number of restaurants but also promoting genre diversity. This research highlights the value of private gourmet information websites as rich sources for detailed urban analysis in the era of smart cities.

1. Introduction

In urban spaces, restaurants are attractive elements that draw people in. As a result, areas with restaurants tend to become lively, and places with a higher number of restaurants generate greater vibrancy. It has also been pointed out that vibrancy is related to train stations. For example, research has been conducted that uses drive recorders to measure pedestrian density and analysed its relationship with store density (Oda and Yoshimura, 2024). Train stations are transportation hubs where people and goods converge and intersect.

In this study, the focus will continue to be on the number of restaurants. In addition to this, attention will be given to diversity. As Jacobs (1961) suggests, cities thrive when they embrace diversity, and it has been observed that greater store diversity can lead to increased sales (Yoshimura et al., 2022). Urban diversity has been pointed out to have a positive impact on cities. However, the diversity of restaurant genres may not necessarily influence urban areas. For instance, this could be the case in areas renowned for the concentration of specific types of restaurants. This study investigates whether this concept also applies to restaurant genres and how the diversity in genres affects the population density in areas around train stations.

However, genre information is not easily obtainable. Public statistics such as the Economic Census only provide data on the number of restaurants and at a 500-meter mesh unit. Therefore, in this study, data from private gourmet information websites will be used to obtain information about individual restaurants. The use of data from private gourmet information websites allows for detailed information about individual restaurants and has been pointed out to have high consistency with public statistical data (Tsuchiya and Horita, 2025). Research using SNS data also exists. For instance, studies have analysed the relationship between the locations of highly rated restaurants and urban facilities using consumer review sites (Zhai et al., 2015). Additionally, GPS data is used to analyse areas of human congregation and vibrancy.
The goal of this study is to analyse the impact of the number and genre diversity of restaurants located around train stations on the population density in these areas. This is important as it provides necessary insights for urban planning, such as the creation of vibrancy around train stations and the placement of restaurants.

2. Data and Methodology

2.1 Restaurant Data

The restaurant data used in this study was scraped from "Tabelog," a private gourmet information website. Tabelog is Japan's largest gourmet website, with restaurant information provided either through registration by store owners or reviews by users. As Tabelog does not explicitly prohibit scraping for research purposes, the data was collected using Python while carefully considering the server load. The scraping process was conducted in June 2024, focusing on the 23 wards of Tokyo. This area contains a total of 111,104 restaurants, with a notable concentration in central wards and around major terminal stations. The restaurant distribution was aggregated every 250 meters, and the results are presented in Figure 1.

Additionally, the restaurant genres are based on the 16 genres registered in Tabelog. Figure 2 shows the composition of genres across the 23 wards of Tokyo. The results reveal that Japanese cuisine and izakaya (Japanese-style pubs) account for more than 10% each, making them the most common genres. Furthermore, the diversity of genres indicates a wide variety of restaurant types across Tokyo. In addition, the restaurant landscape includes a variety of genres such as Cafes, Others, Western, Bars, Other Restaurants, and Sweets, contributing to its diverse composition.

The "Others" category includes various facilities such as karaoke bars, darts bars, hotels, inns, wedding venues, roadside stations, convenience stores, supermarkets, and kiosks. The "Other Restaurants" category covers a wide range of dining options, including family restaurants, cafeterias, creative and organic cuisine, bento shops, meat and seafood dishes, buffets, and even dining experiences on houseboats or cruise ships.

2.2 Diversity Index of Restaurants

This study evaluates the diversity of restaurants using Simpson's Diversity Index λ (Simpson, 1949). This index quantitatively represents the diversity of restaurant genres within an area and is expressed by the following formula (1):

$$\lambda = 1 - \sum_{i=1}^{S} P_i^2 \quad (1)$$

where S represents the number of species,
P_i is the relative abundance of species i,
n_i is the number of individuals of species i, and
N is the total number of individuals.

$$P_i = \frac{n_i}{N}$$

Here, Pi represents the probability that two randomly selected restaurants belong to the same genre. The value of the index λ ranges from 0 to 1, where 0 indicates the presence of only one genre, and values closer to 1 indicate higher diversity in genres.

Based on the previously mentioned restaurant data, the diversity index was calculated for each 250-meter mesh. The results are shown in Figure 3. Meshes without restaurants are not displayed. Unlike the concentration of restaurant numbers, the diversity index does not exhibit as much clustering. Comparing Figures 1 and 3 reveals that even areas with relatively few restaurants can have a high diversity index.

The relationship between the number of restaurants and the diversity index was clarified through correlation analysis. The scatter plot is shown in Figure 4. The correlation coefficient was 0.34, indicating no strong correlation between restaurant diversity and the number of establishments. This suggests that even in areas with many restaurants, there may be meshes dominated by a single genre.

For example, the top three meshes in terms of the number of restaurants are 5339460024 (Ginza), 5339369043 (Shimbashi), and 5339453613 (Shinjuku). The numerical values represent mesh IDs. However, their diversity indices are in the 0.7 range, indicating that the diversity of restaurant genres is relatively low. Figure 5 shows the genre composition of these meshes. The values shown in the bar graphs represent the top three genres in each mesh. In 5339460024 (Ginza), Japanese cuisine and bars each account for over 30%. In 5339369043 (Shimbashi), izakaya

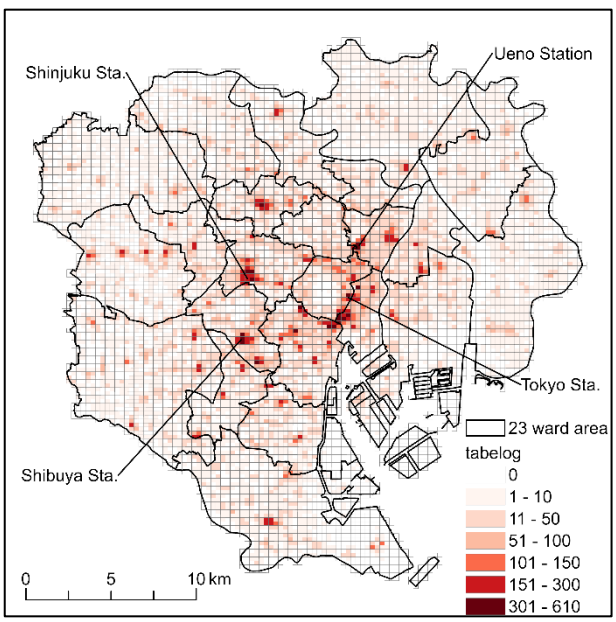

Figure 1. Number of Restaurants

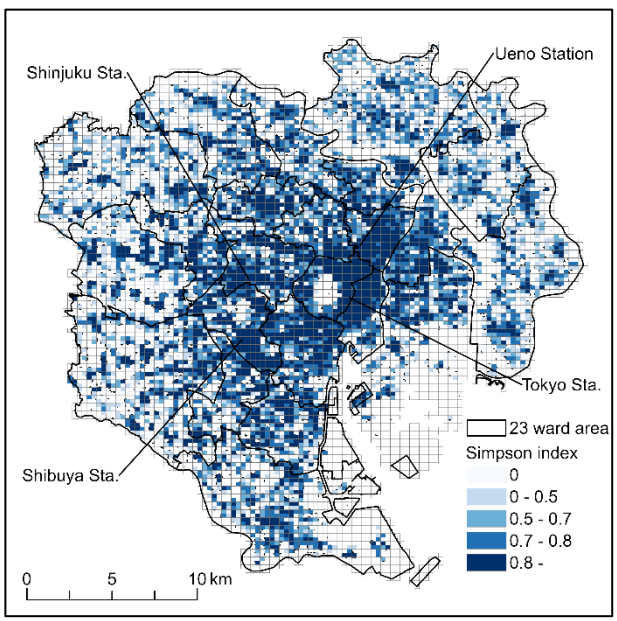

Figure 3. Simpson's Diversity Index

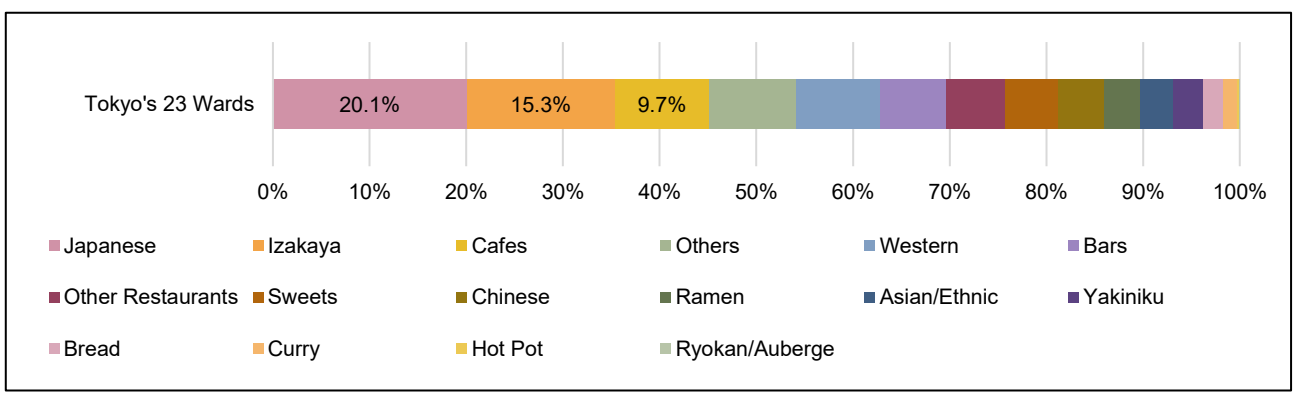

Figure 2. Genre Composition of All Restaurants in Tokyo's 23 Wards

(Japanese-style pubs) make up 44.7%, dominating the area. Mesh 5339453613 (Shinjuku) is similar to 5339369043 (Shimbashi), with izakaya comprising 39.0% and a notable proportion of "others" at 9.0%. The concentration of izakaya and bars may contribute to enhancing the value of the area.

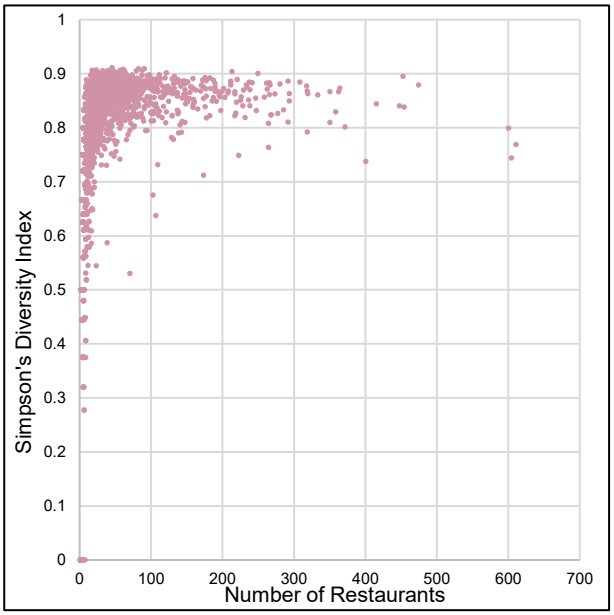

Figure 4. Scatter Plot of Number of Restaurants and Simpson's Diversity Index

Conversely, all of the top 10 meshes ranked by diversity index have fewer than 100 restaurants, suggesting that a high diversity index does not imply a large total number of restaurants. The mesh with the highest diversity index is 5339451431, located around Hatagaya in Shibuya Ward. Figure 6 shows the genre composition. The numbers in the bar graph indicate the number of restaurants. Although the total number of restaurants is relatively small, it can be observed that a variety of genres are evenly represented.

2.3 Data on Staying Population

The staying population data was provided by the Center for Spatial Information Science (CSIS) at the University of Tokyo. This dataset is based on smartphone location information and includes a sample of 869,840 users. On average, the dataset captures approximately 3 million trips per day and records about 65 million data points daily. To calculate the population staying in the area, the number of trips passing through each mesh was computed. It should be noted that if the same person passes through the same mesh on the same day, duplicates are not counted. The analysis was conducted using ArcGIS Pro and the Python library GeoPandas.

In this study, the data were aggregated at the grid level, and the average values over the 31 days of May 2023 were calculated to represent the staying population for each grid. Figure 7 displays a choropleth map illustrating the distribution of the staying population across the grids.

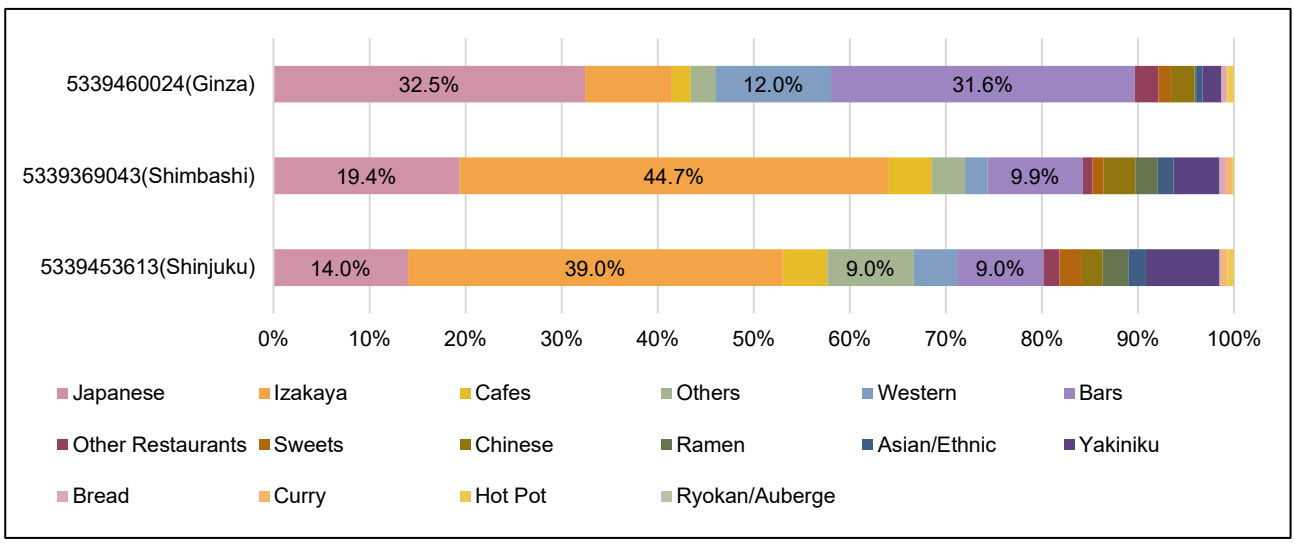

Figure 5. Genre Composition of the Top Three Meshes by Number of Restaurants

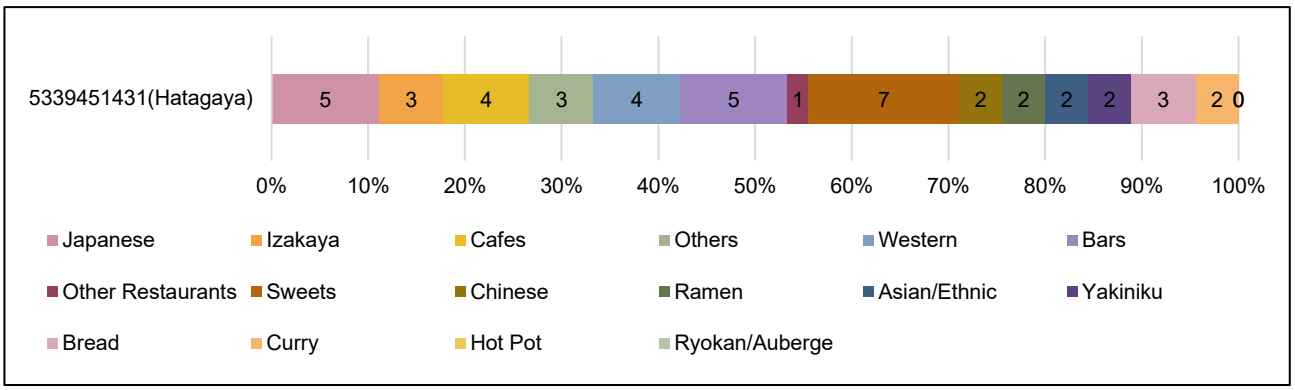

Figure 6. Restaurant genre composition in Mesh 5339451431 (Hatagaya, Shibuya)

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2.4 Other Data and Models

In this study, data on railway stations were obtained from the Digital National Land Information provided by the Ministry of Land, Infrastructure, Transport and Tourism. Using GIS, the distance from the center of each grid cell to the nearest railway station was measured, and this was defined as the distance to the station. A 250-meter grid was adopted as the unit of analysis, and an ordinary least squares (OLS) regression model was employed.

The dependent variable was set as the population staying in the area, serving as an indicator of vibrancy. The independent variables included: (1) the number of restaurants, (2) the index representing the diversity of restaurant genres, (3) the distance to the nearest station, and (4) the number of establishments (based on the Economic Census). The objective of this study is to quantitatively examine the impact of these factors on the population staying in the area.

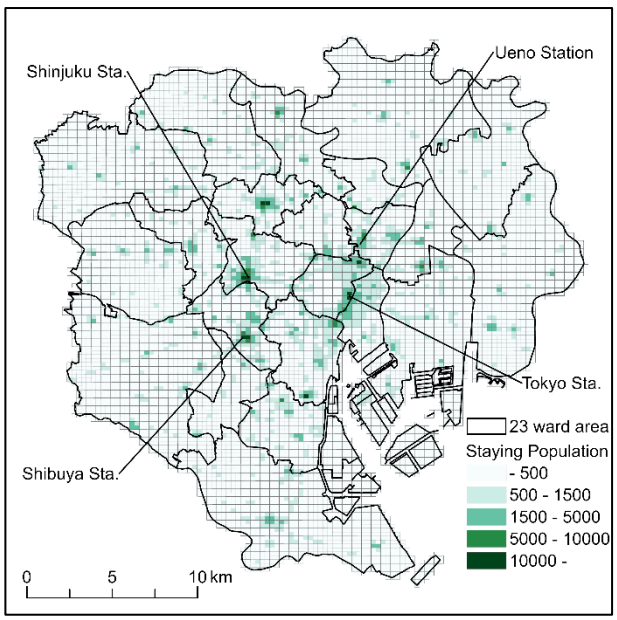

Figure 7. Staying Population

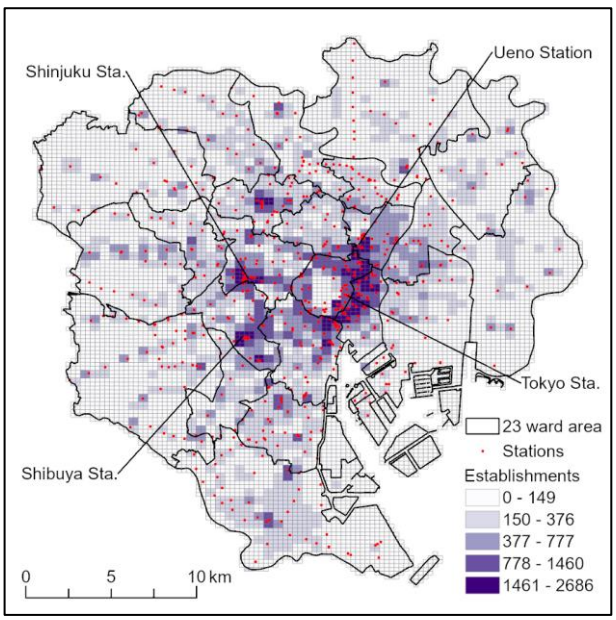

Figure 8. Establishments and Stations

To illustrate the spatial distribution of the data used in the analysis, Figure 8 shows the locations of railway stations (red dots) and the number of establishments represented on a 250-meter grid. The data on the number of establishments were derived from the 500-meter mesh of the Economic Census.

3. Results and Discussion

3.1 Descriptive Statistics of Variables

First, regarding the unit of analysis, the mesh data is based on a 250m mesh, and the analysis was conducted using 10,164 meshes within the 23 wards of Tokyo.

Next, the variables used in the analysis are described. The results of the descriptive statistics are shown in Table 1. It should be noted that the population staying in the area and the number of establishments were log-transformed to account for their distributions. The correlation coefficient between the number of restaurants and the distance to the nearest station was -0.29. The correlation coefficient between the diversity index and the distance to the nearest station was -0.41, indicating a weak negative correlation. This suggests that the closer a location is to a station, the higher the number of restaurants and the greater the diversity of restaurant genres.

variables	mean	std	min	max
staying population(log)	5.0	1.4	0	10
num of restaurants	10.9	32.4	0	610
diversity index	0.4	0.4	0	1
distance to the nearest station	701.1	567.3	3	4,838
num of establishments(log)	4.5	1.5	0	8

Table 1. Descriptive Statistics of Variables

There were no variables among the independent variables that had a strong correlation with a correlation coefficient of 0.7 or higher. In this study, to ensure that multicollinearity among the explanatory variables used in the estimation was not an issue, we calculated the Variance Inflation Factor (VIF). The VIF values for all explanatory variables were below 5, confirming that there were no multicollinearity problems. A low VIF indicates that each explanatory variable is independent of the others, which strengthens the reliability of the model. Therefore, the interpretation of the estimation results is considered valid, with the effects of each variable accurately reflected.

3.2 Model Estimation Results

An OLS regression analysis was conducted using the previously mentioned variables. The coefficient of determination (R-squared) was 0.733, indicating that a highly fitted model was created. The model's overall significance is confirmed by the F-statistic of 6973 ($p < 0.001$), which suggests that the independent variables collectively have a statistically significant effect on the staying population. The estimation results are shown in Table 2.

The discussion is based on the multiple regression analysis results of this study. All coefficients were significant at the 0.1% level. First, regarding the number of restaurants, the regression coefficient was 0.005, indicating a positive relationship with the staying population. Areas with more restaurants tend to attract people more strongly, and the increased appeal of these areas due to dining and other activities likely leads to a rise in the staying population.

independent variables	coef	t	VIF
num of restaurants	0.005	21.07***	1.25
diversity index	0.674	28.14***	1.64
distance to station	-0.001	-35.42***	1.49
num of establishments(log)	0.474	72.90***	1.97
dependent variable	staying population(log)		
sample size			10,164
Adj. R-squared			0.733
F-statistic	6973	Prob. (F-statistic)	0.00

*** < 0.001, ** <0.001, *<0.05

Table 2. Model Results

Next, regarding the diversity index (the diversity of restaurant genres), the regression coefficient was 0.674, showing a strong positive relationship with the staying population. A 0.1 increase in the diversity index leads to an approximately 6.74% increase in the staying population. This indicates that areas with higher diversity in restaurant genres tend to have a higher staying population. The importance of diversity in urban spaces, as demonstrated in previous studies, aligns with these findings, confirming that the diversity of restaurant genres contributes to creating vibrancy and enhancing the vitality of urban areas.

Furthermore, the distance to the nearest station had a regression coefficient of -0.001, indicating a weak negative relationship. This suggests that areas closer to stations tend to have a higher staying population, highlighting the role of stations as important transportation hubs and starting points for creating vibrant areas. The convenience and accessibility of stations are likely factors that promote people's stay in these areas.

Finally, the coefficient for the number of establishments (log-transformed) was 0.474, indicating a positive relationship between the number of establishments and the staying population. This suggests that areas with a higher concentration of businesses are more attractive as employment and commercial hubs, which in turn increases the staying population.

The number of restaurants, diversity of genres, and business density were found to have a significant positive relationship with the staying population. This suggests that urban areas with a high concentration of diverse restaurants are more likely to attract and retain people, reinforcing the importance of considering both quantity and diversity in urban planning to foster vibrant, lively communities.

4. Conclusion

4.1 Main Findings

This study proposed a restaurant genre diversity index and quantitatively examined its relationship with urban vibrancy, measured by the population staying in an area. Using data obtained through web scraping of private gourmet information websites, we conducted an ordinary least squares regression analysis, controlling for the number of restaurants, number of establishments, and distance to the nearest railway station.

The results revealed that restaurant genre diversity is positively associated with the staying population. In addition, correlation analysis showed that areas closer to train stations tend to have more restaurants and higher diversity index scores. These findings suggest that transportation hubs such as train stations function not only as mobility nodes but also as urban attractors that promote diversity and vibrancy.

By integrating the concept of diversity into urban analysis, this study demonstrates the value of going beyond simple quantitative indicators such as restaurant count. It provides a new perspective for evaluating the quality and character of urban spaces through the lens of functional diversity.

4.2 Policy Implications and Considerations

The findings indicate that in urban planning and revitalization efforts, focusing solely on increasing the number of restaurants may be insufficient. Instead, considering the diversity of restaurant genres can be a more effective strategy for enhancing urban vibrancy. By introducing underrepresented genres into areas where they are lacking, planners and policymakers can attract a broader range of users and promote longer stays.

For example, Tsuchiya et al. (2021) point out that in Japanese regional cities, the characteristics of central urban dining differ between areas around train stations and traditional downtown districts. Such variation in the character of city centres may contribute to increased urban vibrancy.

Such an approach not only contributes to commercial activation but also enhances inclusivity and the attractiveness of public spaces. Especially around train stations, where a natural convergence of people occurs, supporting genre-diverse restaurant clusters can serve as a catalyst for vibrant urban experiences.

4.3 Future Challenges and Research Directions

A key challenge for future research is to clarify the individual impact of specific restaurant genres on the staying population. For example, some genres may be more effective at drawing daytime workers, while others attract evening visitors or families on weekends. It is also possible that certain genre combinations, such as sushi and French, or ramen and cafés, create synergistic effects in increasing urban vibrancy.

While this study focused on four explanatory variables, future work should incorporate additional urban indicators such as land use composition, demographic profiles, and accessibility metrics to further strengthen analytical validity.

Furthermore, attention should be paid not only to overall vibrancy but also to the nature of vibrancy itself—who is staying in the area, for what purpose, and at what time of day. By disaggregating vibrancy by attributes such as age, gender, or activity type, and by analyzing temporal patterns (e.g., daytime vs nighttime, weekday vs weekend), we can gain a more nuanced understanding of how diversity affects different dimensions of urban life.

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The idea of the diversity index used in this study was presented as an oral presentation at the 2024 Geographic Information Systems Society conference and was not peer-reviewed. In this study, the index was recalculated on a 250-meter mesh basis, extended with data from other urban facilities, and analyzed for its impact on the staying population.

References

Jacobs, J. 1961: *The Death and Life of Great American Cities*. Random House, New York.

Oda, T., Yoshimura, Y., 2024: Quantifying the vibrancy of streets: Large-scale pedestrian density estimation with dashcam data, *Transportation Research Part C: Emerging Technologies*, 167, 104840. doi.org/10.1016/j.trc.2024.104840

Simpson, E., 1949: Measurement of diversity. *Nature*, 163, 688. doi.org/10.1038/163688a0

Tsuchiya, Y., Horita, Y., 2025: Spatial Comparison of Restaurant Information From Private Gourmet Information Websites and Economic Census—As a Verification for Use in Urban Analysis. *JAPAN ARCHITECTURAL REVIEW*, 8(1), e70018. doi.org/10.1002/2475-8876.70018

Tsuchiya, Y., Nakai, N., Numata, M., Sakamura, K., 2021: Study of the division of functions among urban centers and their changes in cities with two urban centers. Journal of the City Planning Institute of Japan, 56(3), 1389–1396. (in Japanese) doi.org/10.11361/journalcpij.56.1389

Yoshimura, Y., Kumakoshi, Y., Milardo, S., Santi, P., Arias, J. M., Koizumi, H., Ratti, C. 2022: Revisiting Jane Jacobs: Quantifying urban diversity. Environ. *Plan. B Urban Anal. City Sci.*, 49(4), 1228–1244. doi.org/10.1177/23998083211050935

Zhai, S., Xu, X., Yang, L., Zhou, M., Zhang, L., Qiu, B., 2015: Mapping the popularity of urban restaurants using social media data. *Appl. Geogr.,* 63, 113–120. doi.org/10.1016/j.apgeog.2015.06.006