FROM VILLAGES TO GATED COMMUNITIES: MAPPING ACCESSIBILITY DISPARITIES IN SUBURBAN CHINA

A Case Study of Panyu District, Guangzhou, China

A Research Paper

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ABSTRACT

This study examines the geographical inequalities in walking accessibility of essential services such as transit, shopping, healthcare, education, and recreation across four different community types in Panyu District, Guangzhou: urban villages, redeveloped communities, commodity housing communities, and rural villages. The accessibility is examined by coverage of Points of Interest (POIs) within 15-minute isochrones of community boundaries, a spatial boundary representing the area reachable within a set time frame. Transit, shopping, healthcare, education, and recreational amenities are selected as key amenities for examination. Redeveloped communities and commodity communities demonstrate higher overall accessibility in the 15-minute isochrones, while rural villages and urban villages exhibit lower accessibility to services out of the community boundary, and with more services inside the community The data indicate historical biases in urban planning, emphasizing unit-based and commodity housing growth while systematically neglecting informal and rural populations.

The core aim of this research is to uncover how historical planning policies and land ownership structures have shaped spatial gaps in service by community types in a quantitative approach. As cities in China pursue “15-minute living circles,” aiming to make access to urban services for communities by active transportation, the study offers recommendations for improving equitable infrastructure and explore mixed-use developments, especially in under-resourced areas.

BIOGRAPHICAL SKETCH

Yizhou Wang is a candidate for the Master of Regional Planning degree in the Department of City and Regional Planning at Cornell University. Prior to joining Cornell, Yizhou completed a Bachelor of Engineering in Urban Planning and Design at Xi'an Jiaotong-Liverpool University, graduating with First-Class Honors. His academic interests focus on transportation planning, accessibility equity, and data-driven urban policy evaluation.

Yizhou's expertise spans transportation planning, climate resilience, and data analytics. She has gained extensive experience through her internship at the Chicago Metropolitan Agency for Planning (CMAP), where she explored urban densification, transit policies and transportation modeling. Additionally, as a Research Assistant in Cornell's Systems Engineering department, she developed algorithms for merging transportation data from various sources, enhancing the accuracy and integrity of complex datasets.

Yizhou believes that transportation planning reflects societal values within our physical environments. Her commitment extends beyond analyzing urban data to understanding the socio-economic dynamics that shape our communities. Her work was presented at the American Association of Geographers Annual Meeting in 2024, where she explored the disparity between gated and non-gated communities in Guangzhou. At Cornell, she serves as Vice President of the International Planning Student Organization (IPSO), organizing events that promote diversity and cultural exchange. Dedicated to advancing equity in transit and climate resilience, she seeks to ensure that future transportation systems and urban planning efforts are both inclusive and sustainable.

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my primary advisor, **Professor George Frantz**, whose insights into global urban typologies and land use patterns have been invaluable to the development of this project. I am also grateful to **Mitchell Glass**, whose thoughtful guidance on community planning practices and thematic direction helped refine both the content and structure of my writing. Special thanks go to **Professor Wenfei Xu**, whose course *Mapping and Countermapping* profoundly inspired me to explore how technology can be used to map spatial inequalities and reveal the narratives behind those maps, and decided to start this project mapping my hometown.

Lastly, I am deeply thankful for the unwavering support of my **parents and friends**, whose encouragement has sustained me throughout my academic journey.

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1 Introduction

The concept of accessibility is commonly employed in the domains of regional economics and urban transportation, and its connection to community planning and layout has been extensively explored. Black & Conroy's (1977) cumulative opportunity-based method of calculating accessibility is one of the most influential approaches. It has been used in later studies to evaluate how easy it is for community members to access employment opportunities, facilities, transportation, and essential services. The differences in access to these services among communities have also been the subject of numerous studies, which have looked at the effects of accessibility on environmental sustainability, urban mobility, and social fairness.

Rapid urbanization between 1990 and 2010 encouraged the imbalanced expansion and diversity of urban area within the framework of China's land economy. Different communities, ranging in size from single structures to superblocks spanning more than 5,00 acres, were constructed or altered during this time. Significant differences in community layout, density, and design logic have also resulted from the contrast between recently constructed commodity communities and the prior uniform distribution of "Danwei" housing. At the same time, informal housing areas with limited property rights have emerged. The emergence of a new middle class, resulting from the opening up of the commodity housing market, further deepened this divide by pursuing enclave urbanism. Large, gated communities have been developed and have been criticized as restricting access to internal services within them for outsiders(Miao, 2003). Disparities in accessibility may result from these layout and density variations, which can have an impact on how services and public transit are distributed. Residents' quality of life and social chances may be impacted by an uneven distribution of social resources brought about by such disparities. Thus, it is essential to look into these differences and offer suggestions for future resource allocation and urban design in order to advance social equity.

This study examines the accessibility trends in various neighborhoods in 20 selected communities out of 574 community located in Panyu District of Guangzhou. The communities are selected as the representative of 4 typical community types. **Panyu District**, located in the southern part of Guangzhou, was a rapidly urbanizing area that serves as a microcosm of the planned and unplanned suburban transition in China’s commodity housing market. Driven by the expansion of the Pearl River Delta economic zone, high levels of migration, land-use conversion, and real estate development have largely reshaped the community and urban forms. . A range of community types are included, including informal urban village communities, redeveloped communities (from the previous "Danwei" housing), commodity housing, and rural communities, discussed in Chapter 3 – Site Analysis. These varying urban forms have created significant differences

in how residents access services and amenities. In regard to this, it's crucial to comprehend how these community kinds affect locals' access to services. This makes it an ideal site for examining the spatial consequences, accessibility and equity of urban growth.

Therefore, the study focuses on the disparities in terms of the 15-minute distance metric to key amenities between different community types in Panyu District. For community stakeholders, legislators, and urban planners, the study's findings can offer insightful advice on how to create and alter urban environments to make them more practical, sustainable, and equitable. This is especially relevant in the context of China’s unique urban development patterns, contributing to more effective urban planning and policy adjustments.

2 Literature Review

This chapter provides an overview of different types of communities in China, exploring their links with urban form, planning history and land economics. It also analyzes the evolution from uniformed "Danwei "housing to enclave urbanism in the context of policy change. Subsequently, the differences in accessibility between different types of communities emerged in the history is discussed.

2.1 Community Types in China: The Rise of Enclave Urbanism and Dilemma of Rural Property Rights

2.1.1 Danwei Communities

In the planned economy of the pre-reform and opening-up era, the “Danwei” was the basic unit of social and spatial organization in cities, with large state-owned enterprises or institutions providing integrated housing and other services for their workers (Bray, 2005). Between the late 1940s and the early 1990s, each Danwei was not only a place of employment, but often a place that provided workers with welfare, health, education, culture, safety, and economic support (Dai & Frantz, 2020). With the reform of the urban housing system initiated in the late 1980s, Danwei housing began to gradually move towards marketization, with apartment flats being sold to individuals through housing reform or merged into the commodity housing market circulation at a later stage. These communities are then referred to as redeveloped communities. At the same time, the comprehensive services of employees' life by the Danweis were reduced, and residents relied more on the market or social services (Bray, 2005). The spatial form of this type of housing has also transitioned from the original “walled” or “courtyard” communities by state-owned companies to more open or privatized residential communities, making them gradually integrated into the wider urban landscape. (Zhang, 2012).

2.1.2 Commodity Housing after Marketization

A more varied and market-oriented housing supply has gradually supplanted the social role of the Danwei because of market-oriented reforms and the growth of the real estate sector (Zhang, 2012). Consequently, China has witnessed the rise of numerous commercialized, developer-driven, expansive neighborhoods. According to Whiting (2004), many super-blocks developed in China as a result of the parallel and peripheral block layouts of Dutch,

Austrian, and Russian architects in the early 20th century. Furthermore, the land auction preference of the developers for large-scale real estate projects has aided in the expanded use of super-block, which are now typical in many cities. These blocks typically have large areas, measuring between 300 and 500 meters in length and width, and are surrounded by wide arterial roads. They are occasionally walled or traffic-controlled to keep them isolated from the outside world. Clusters of single-family or multi-family homes made of high-rise housing are located on each 12–20-hectare lot. Each of these clusters can house ranging from 150 to 3,600 dwelling units, or 10,800 people, namely 200–900 people per hectare or more (Miao, 2003; Rowe, Forsyth, and Kan, 2016). Small retail establishments and community facilities will also support some of these neighborhoods; some of these facilities will be located within the wall of the gated communities, while others will be connected to its outer borders.

The emergence of a new middle class in the post-Reform and Opening Up period, which has made urban space more stratified by income and social status. Along with the promotion of large commodity communities by real estate developers and urban planners, there was a phenomenon of gated communities, a common form of enclave urbanization (Miao, 2003). The developers portrayed a image to high-end amenities, security systems, and private green spaces are common features of gated communities to the new middle class (Zhang, 2012). However, these communities make public space less accessible and results in an unequal distribution of urban resources (Miao, 2003). In addition to disparities in living standards, this inequality is also evident in the accessibility of public resources like healthcare, education, and business (Wu, 2007). In academia and public policy, the ensuing issue of urban social segregation has gained significant attention. The ensuing problem of urban social segregation has gained a lot of attention in both academia and public policy. According to Walks (2014), gated communities may result in "civic separation," in which wealthy and/or white neighborhoods try to keep out people who are different from them. However, according to other scholars, this type of community is more likely to result from a desire for specialized facilities and shared amenities or from an emphasis on property value preservation than from social segregation (Blakely and Snyder, 1997; Pompe, 2008).

Wu (2012) claims that because traditional zoning necessitates wide roads and large lot development, it leads to inadequate street density, large urban lot sizes, and unfavorable pedestrian environments. China's State Council has suggested constructing smaller public streets and opening existing oversized neighborhoods and larger unit compounds to improve accessibility to these communities. While planners in the United States have recently criticized mega-block neighborhoods, Dai & Frantz (2020) contend that in China, the periphery of mega-block neighborhoods that face arterials typically offers pedestrian-

oriented commercial areas. More than 20% of the total street frontage in several Shanghai communities was made up of street-facing commercial space, which provides a desirable walkability for the communities around. Additionally, the small block grid in the city center causes heavy traffic to flow through residential areas, making redeveloped communities and urban villages uninhabitable.

2.1.3 Urban villages and Rural Villages

According to Long et al. (2012), China's rural land is subject to the "collective ownership system," which implies that the village or township collective economic organization owns the land, and farmers only have the authority to contract and manage it. This approach was mostly employed in the planned economy to coordinate farmers' output through "production teams" or "people's communes." Farmers' rights to utilize the land were reinforced by the household contract responsibility system following the reform and opening up, although common ownership of the land remained. The flexibility and constraints of the communal land ownership system in rural regions have become more noticeable as a result of the growing demand for land purchase and transfer brought on by urbanization (Lin, 2009).

Villages that were once on the outskirts of cities or on rural collective land have been surrounded or engulfed by urban land as a result of the rapid urban sprawl caused by the commercialization of real estate. This has led to the creation of a unique social and spatial pattern known as the urban villages, while the land is still belonging to the rural collectives" (Wu, Zhang, & Webster, 2013). China's land system permits the state to lawfully expropriate or turn collective land in rural areas into state-owned land for the purpose of building cities. To save money on expropriation or to avoid difficulties with demolition and compensation for relocation of residents, local governments, however, are frequently unable or unwilling to fully expropriate village collective land in a short amount of time. At the same time, some village collectives may enter into agreements with local governments or developers in the form of "self-retained development" or "reserved land," setting aside a portion of the land for self-renovation. This way, the areas may still retain the original form of collective property rights and are neither entirely urban nor traditional rural land. Because of this, these regions may still have their original type of community property rights and are neither entirely urban nor traditionally rural (Xu, Yeh & Wu, 2009). Some village collectives or villagers construct homes on their own or collective land during the marketization process, then rent them out for profit.

As the urban economy's absorptive power has grown, many young and middle-aged people

from rural areas have left their homes to work in cities and towns, which has led to a decline in the number of native people living in villages and the seriousness of aging or underutilized housing (Long et al., 2010). Many urban migrant workers choose to live in urban villages because they are closer to urban employment centers and have lower rents because they find it difficult to enter the formal commodity housing or guaranteed housing system due to the limitations of the urban household registration system. Urban villages have consequently taken on a significant role as "transitional spaces" in the urban housing system (Chen & de'Medici, 2010). These transitional neighborhoods are where informal rentals market are located. The majority of these rental properties are targeted at low-income or migrant workers, progressively creating high-density rental communities (Wu, Zhang & Webster, 2013).

Urban villages are typically denser, more congested in terms of building form, and comparatively underfunded in terms of public services and infrastructure as compared to formal urban residential neighborhoods. China's distinct rural land tenure system and the institutional and market shocks it has experienced during its urbanization process must both be taken into account in order to comprehend this phenomenon. Rising urban land values and the transitional legal status for collectively owned rural land incentivized informal development, speculative construction, and unauthorized land leasing, creating a fragmented and often chaotic peri-urban landscape. Furthermore, the existing state and future development routes of traditional rural and urban villages have also drawn a lot of attention due to the implementation of new rural building and rehabilitation initiatives (Long et al., 2010).

2.2 Types of Communities in Suburban China

There are types of communities in a Chinese city, especially in an urban-rural or suburban area. They are as follows:

2.2.1 Urban Villages

Urban villages are a form that often evolved from rural collective land during rapid urban expansion and can be characterized by high population densities and inadequate infrastructure and public spaces. Migrant workers and disadvantaged urban groups often dominate the population (Zhang, 2012; Wu, 2007).

Figure 1. Typical Urban Village: Beilian Village and Jushu Village in Panyu District, Guangzhou Guangdong Province

2.2.2 Redeveloped Villages (Danwei Communities)

These communities are mostly residential areas developed at an earlier stage, in the decades following establishment of the Peoples Republic, sometimes without obvious walls or gated systems. They are usually located in the older city areas, emphasizing street connectivity and sharing of public space. However, as the scale of this type of community is usually smaller, the scale of public facilities and green spaces inside are often relatively limited.

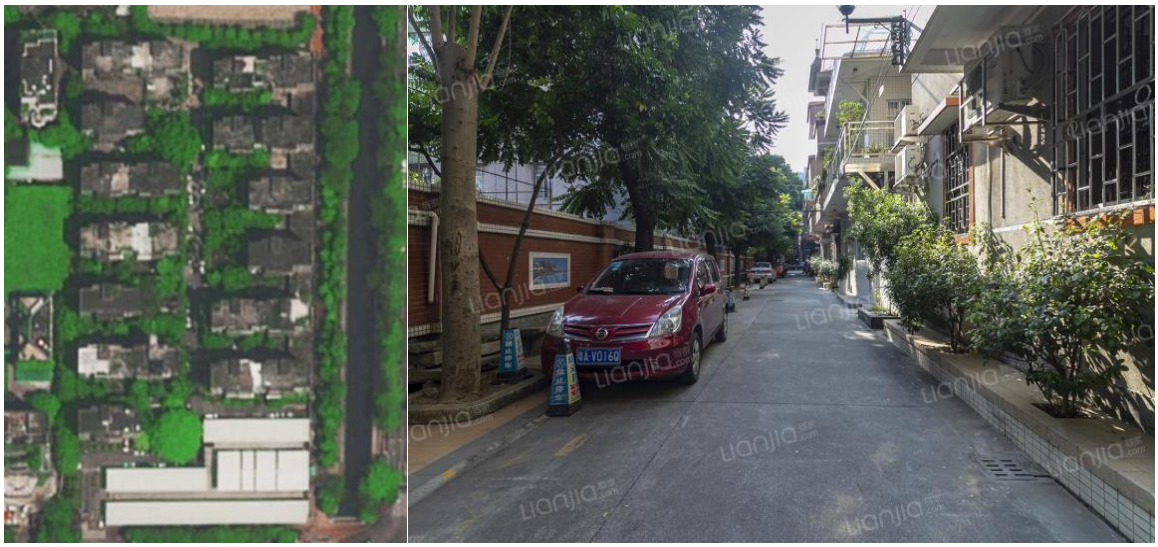

Figure 2. Typical Danwei Community: Dianli New Village and De'an New Village in Panyu District, Guangzhou Guangdong Province (Beike, 2024)

2.2.3 Commodity Communities

Since China's market economy reforms accelerated at the end of the 20th century, large-scale commodity communities have developed rapidly in large cities. These communities are often led by the same developer, have property management, and cover a large area with security gates, separate greenery, and high-quality public amenities to meet the needs of middle- and high-income groups for security, privacy, and environmental quality (Zhang, 2012). However, some scholars have pointed out that the closure and isolation of public space in gated communities has increased social stratification and reduced neighborhood connectivity (Miao, 2003).

Figure 3. Typical Commodity Community: Yajule Garden in Panyu District, Guangzhou Guangdong Province (Beike, 2024)

2.2.4 Rural Villages

Rural villages, which still rely on agricultural production as their main economic activity, have retained their traditional village patterns and cultural practices, but also face challenges such as population exodus and inadequate infrastructure (Long et al., 2010). However, some rural villages are also at the edge of the city and are gradually becoming like urban villages in terms of hosting foreign populations. In the process of urbanization, the preservation and renewal of rural villages is important for the continuation of local culture and the preservation of agricultural functions.

Figure 4. Typical Rural Village: Jiang'ou Village and Fusu Village in Panyu District, Guangzhou Guangdong Province (Beike, 2024)

2.3 Differences in Communities' Accessibility

2.3.1 Accessibility Assessment Method Based on Service Coverage

Accessibility, which primarily includes trip time, travel cost, and service coverage, is frequently considered a key indicator in urban research that measures how open urban resources and services are to various categories of people (Geurs & Van Wee, 2004). Various researchers have suggested accessibility measures in particular studies from a variety of perspectives, such as indicators based on cumulative opportunities (Morris, Dumble & Wigan, 1979), indicators based on spatial barriers (Ingram, 1971), and multidimensional analysis that stresses the alignment of socioeconomic characteristics with the distribution of public services (Wang & Zhou, 2022). In order to quantitatively evaluate the ease of access to resources across various communities, researchers frequently utilize geographic information systems (GIS) to overlay the distribution of important facilities, such as schools, hospitals, and commercial centers, with the community's location in accessibility studies of opportunity accumulation (Talen & Anselin, 1998; Higgs, 2004).

2024 According to a survey on Chinese residents' preferred modes of transportation, 32.18% of respondents said they preferred to take the subway for their daily commutes, followed by private vehicles, public transportation, and owned electric bicycles or motorbikes (25.61%, 11.07%, and 14.53%, respectively) (Miao, 2024). Mega cities, semi-mega cities,

and large cities [1] have average walking distances of 1,158, 1,106, and 1,057 meters respectively (Amap, 2024). The capacity to access public facilities and community services within a 15-minute walking radius has thus become a more significant accessibility assessment criterion in Chinese communities, where walking and then transferring to public transportation is a more vital form of mobility.

The amount of "opportunities" that are accessible within a specific time or distance—such as the number of employment, shops, hospitals, etc.—is the main focus of the cumulative opportunity-based approach (Morris, Dumble & Wigan, 1979). This method highlights that the quantity of resources and services available rises in tandem with the allowable range of travel (Allen et al., 1993). For instance, by gathering data on the location and transit system of key city facilities, including public transportation, hospitals, pharmacies, and food stores, the TransitCenter Equity Dashboard created a multifaceted system of accessibility metrics (Klumpenhouwer et al., 2021). A 15-minute walk is frequently utilized as the assessment criteria when researching neighborhood commercial accessibility (Wang & Zhou, 2022). The "15-minute living circle" has been adopted as a public service system idea at the urban planning level in numerous Chinese cities. This idea highlights that people' essential requirements, such as access to healthcare, education, sports, cultural events, and commerce, should all be satisfied within a 15-minute walk (about 800-1000 meters) (Yang et al., 2023).

2.3.2 Accessibility Gaps of Different Communities

Scholars have made a variety of claims about the differences in accessibility in different Chinese communities. Several studies have specifically investigated the relationship between pedestrian access and the built environment around transit stations (Cervero and Murakami, 2009; Woldeamanuel and Kent, 2016; Sun, Wallace & Webster, 2020). They found that higher density-built environments and more diverse land uses make walking to stations more feasible and beneficial.

[1] According to China's State Council (2014)'s urban classification, **Mega cities (超大城市)** have an urban resident population of over 10 million (e.g., Beijing, Shanghai, Guangzhou, Shenzhen); **Semi-mega cities (特大城市)** have between 5 million and 10 million urban residents (e.g., Qingdao, Shenyang, Nanjing); **Large cities (大城市)** have between 1 million and 5 million urban residents (e.g., Lanzhou, Xiamen, Kunming).

However, while the density of gated communities may not necessarily be higher than that of Danwei neighborhoods or urban villages due to their larger footprints, studies have pointed out that gated communities, which tend to attract more investment and have higher land values, are able to be better equipped with public or commercial services to meet the diverse needs of their residents (Zhang, 2012). In contrast, other communities have weaker infrastructure and public services, and residents often need to travel longer distances to meet basic needs such as education, healthcare and shopping (Wu, 2007). In order to improve the unequal distribution of resources, the government and planning authorities intend to investigate methods of reopening roads in neighborhoods that have been closed and bolstering public assistance in older communities. The Central Committee of the Communist Party of China (2016) also has stated that priority should be given to the development of public transportation. By 2020, the country's strategic vision for enhancing public transportation accessibility called for raising the percentage of public transportation to between 20 and 40 percent. Nevertheless, there are several policy, economic, and social approval strategies that must be utilized in the actual implementation.

However, the majority of gated community inhabitants are hesitant to open their internal roads because they feel that it is unfair to them, who pay higher property prices, to share facilities with the general public, according to Wang & Pojani (2019). In recent years, the government has likewise been less eager to put this strategy into effect and has not kept up its active promotion of it. Therefore, the question of whether gated communities will become more accessible as a result of their opening or if their greater accessibility to facilities would lead to an unequal distribution of social resources has to be addressed.

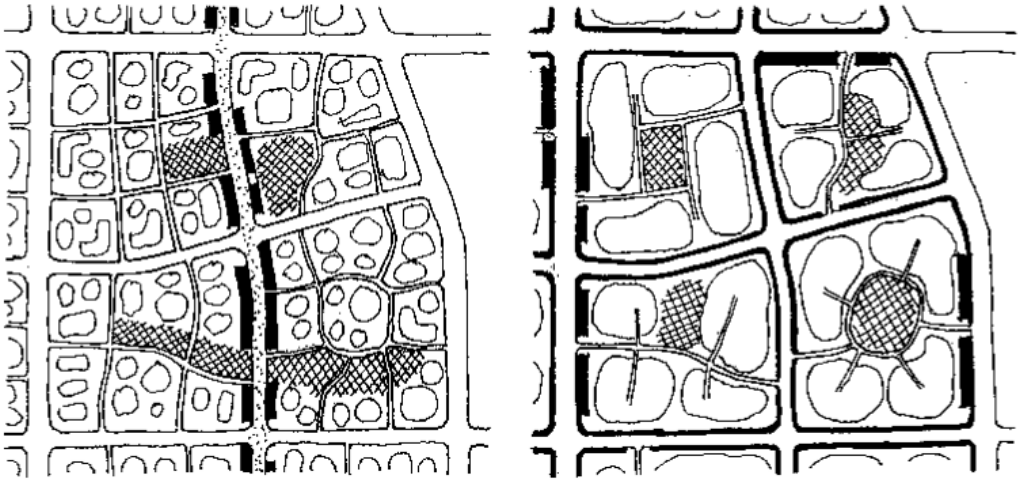

Figure 5. Comparison of Gated and Non-Gated Community (Miao, 2003)

3 Site Analysis

3.1 Historical background and urban development process

Panyu District occupies around 530 square kilometers and is situated in the south-central region of Guangzhou City (Guangzhou Municipal Statistics Bureau, 2023). As the core area of Guangzhou has seen fast urban expansion and reconstruction since the 1990s, Panyu was merged into Guangzhou in 2000 as a place to house the excess population and land opening from Guangzhou. Rural industrialization, typically involving labor-intensive industry centered in small towns and villages and created from the ground up by local governments or villagers, was a defining feature of China's urbanization process from the 1980s to the 2010s (Qu, Tai & Nadin, 2012). Thus, Panyu District, a significant administrative district of Guangzhou, is part of a major metropolitan area in South China and, like the majority of China's urban-rural areas, has seen rapid urban-rural transformation and functional expansion since the 1990s due to economic development and urbanization. The traditional townships originally centered on agriculture and fishing, have been progressively converted into comprehensive towns and developing urban areas as a result of the urbanization wave. This has drawn many migrant workers and commuters from other districts in addition to local residents (Dai et al., 2024). Panyu District had 1.82 million residents, with over 50% of them not being local by the end of 2023 (Guangzhou Municipal Statistics Bureau, 2023). This demographic diversity provides an important context for the evolution of community forms and the transformation of residents' lifestyles.

According to the author's interviews with community residents, many middle-income and above residents choose properties with more supporting facilities and nearby subway stations, bus stops, or subway stations under construction. While gaining convenience in commuting to the city, they hope that the accessibility brought by more supporting facilities in the future will increase the value of their properties. Migrant workers in urban and rural areas focus on finding affordable and short-term rental housing near villages where factories gather. Electric vehicle charging points and convenient catering services are very important to them. Some residents of gated commodity communities hope that the housing prices could allow them to have exclusive resources and thus ensuring the superiority of their accessibility.

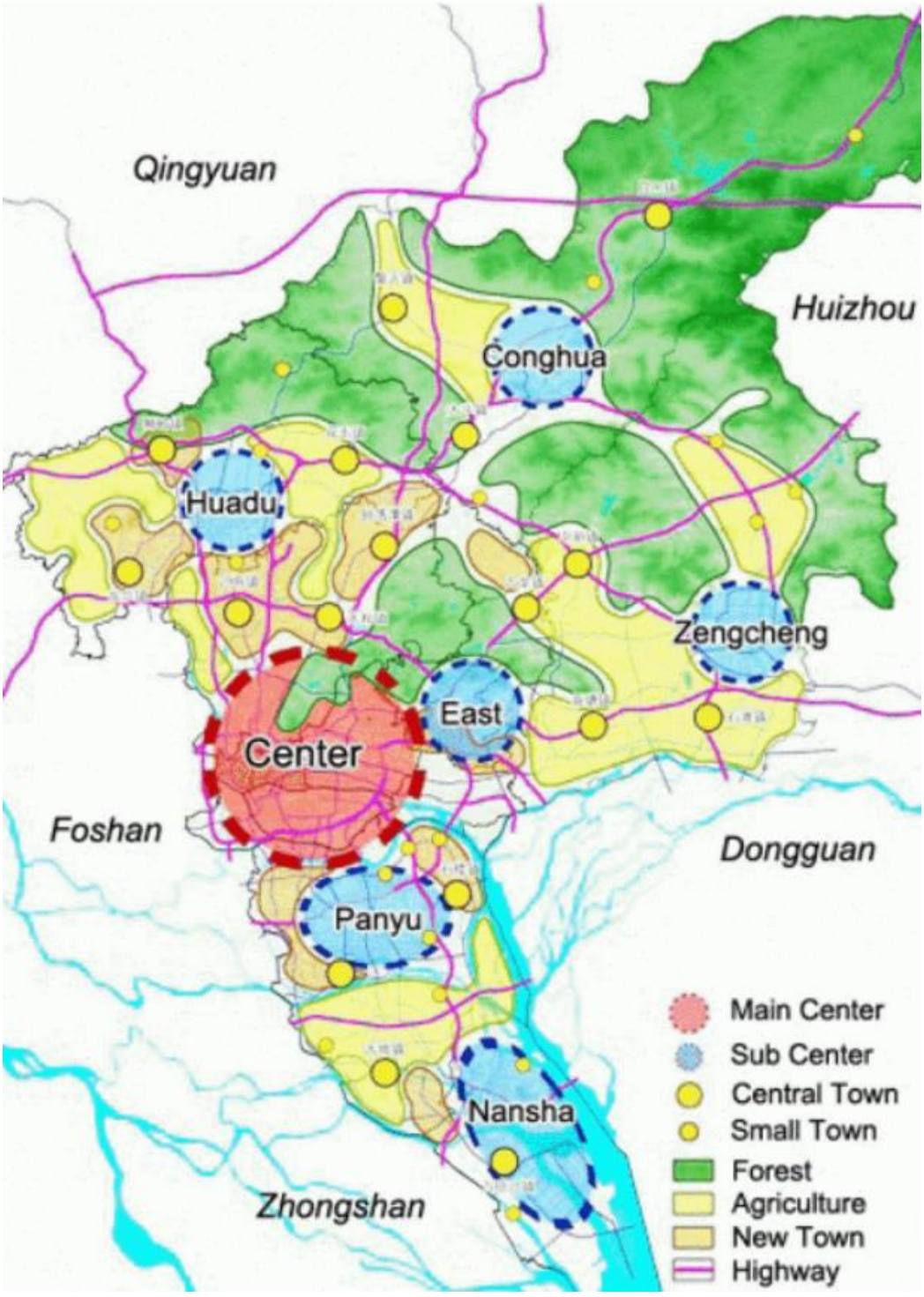

Figure 6. Location of Panyu in Guangzhou Spatial Structure Plan of Guangzhou 2020 (Source: redrawn by Qu, Yuting Tai & Nadin (2012) based on Overall Development Strategy of Guangzhou 2020, Guangzhou Planning Bureau, 2007)

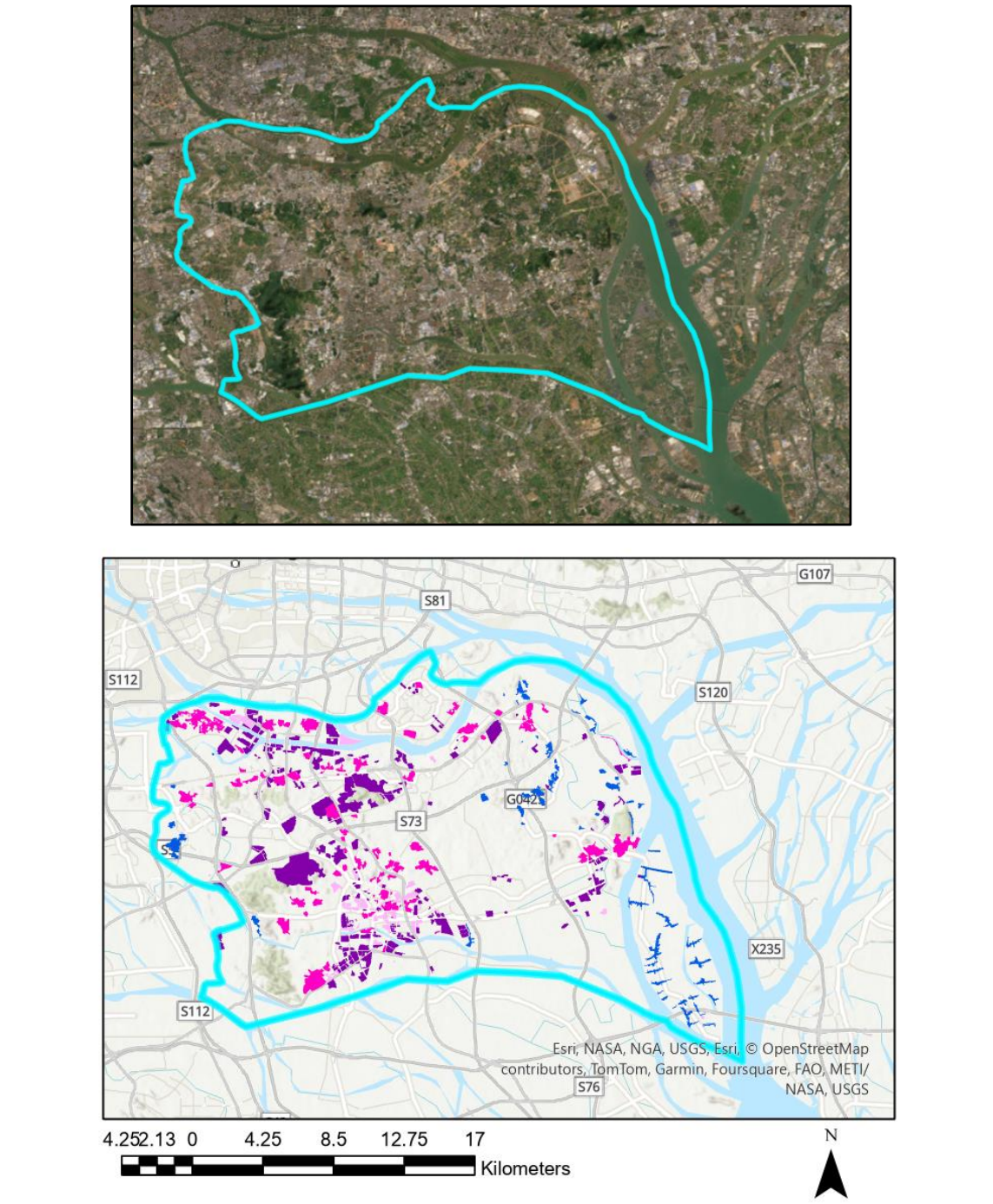

Figure 7. Distribution of Panyu's Communities (Wang, 2024)

3.2 Introduction to the Selected Communities

To further explore the actual development status of different types of communities in Panyu District, this study selected 3 typical communities (a total of 12) from each of the 4 types for field research, data collection, and data analysis. The nature of the communities is determined by field visits or street views from Anjuke or Baidu Street Map. The scale of communities varies from small, compact redeveloped villages, such as De'an New Village (0.013 km², 495.78 meters for perimeter) to large rural villages and urban villages such as Weipu Village (0.68 km², 6538.98 meters for perimeter). These differences in area and perimeter reflect distinct urban forms and development patterns, which directly impact accessibility.

Type	*Type Code*	*Community Name (Chinese)*	*Community Name (English)*	*Boundary Perimeter (m)*	*Average Side Length (m)*	*Area (km²)*
Urban Village	1	南村镇朝阳新区	Nancun Town Chaoyang New District	2834.93	404.99	0.4874
		洛溪村	Luoxi Village	2547.83	97.99	0.2244
		贝岗村	Beigang Village	1429.83	89.36	0.1255
Redeveloped Villages (Danwei Community)	2	东沙小区	Dongsha Community	662.87	82.86	0.0216
		德安新村	De'an New Village	495.78	55.09	0.0134
		电力新村	Dianli New Village	495.16	61.90	0.0141
Commodity Community	3	富丽家园乳芳园	Fuli Jiayuan Rufang Garden	794.15	132.36	0.0325
		广州奥林匹克花园	Guangzhou Olympic Garden	1449.61	96.64	0.1006
		祈福新村康怡居蝶舞轩	Clifford Estates Kangyiju Diewuxuan	2139.19	237.69	0.2444
	4	山门村	Shanmen Village	2722.45	64.82	0.1758

Rural Village	雁洲村	Yanzhou Village	4247.32	55.16	0.1690
	韦浦村	Weipu Village	6538.98	79.74	0.6874

Table 1. Selected Communities' area and Side Length

The selected communities are spread across Panyu District, with some communities located closer to urban center of Guangzhou, which may have a better access to jobs and recreations. The redeveloped communities are in the former Panyu City's center, showing they are in the old urban area and may have accessibility to the life services. Rural communities are usually situated in suburban or peripheral areas, often having fewer nearby POIs (Point of Interests), resulting in potentially lower accessibility and greater reliance on external resources.

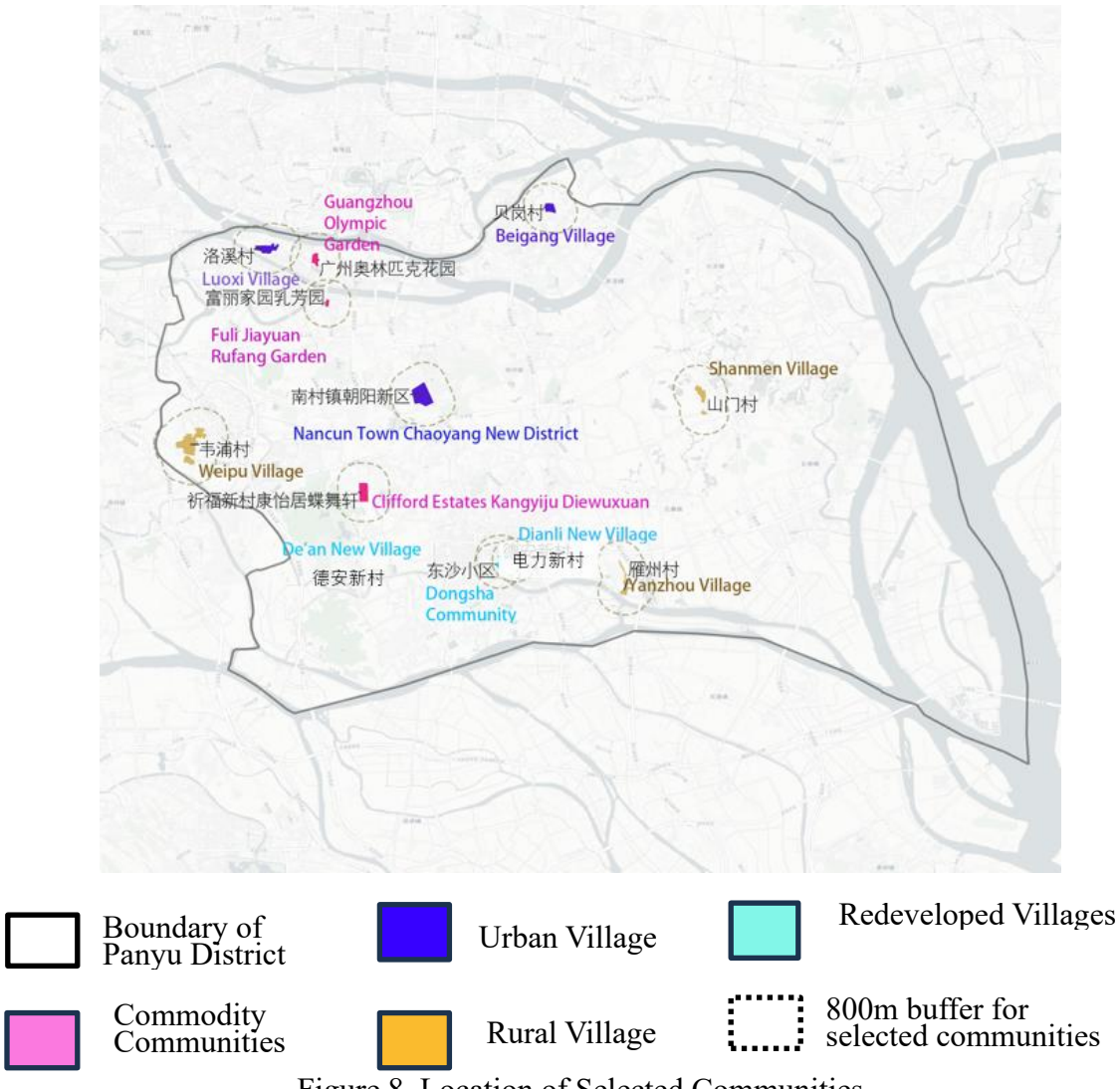

Figure 8. Location of Selected Communities

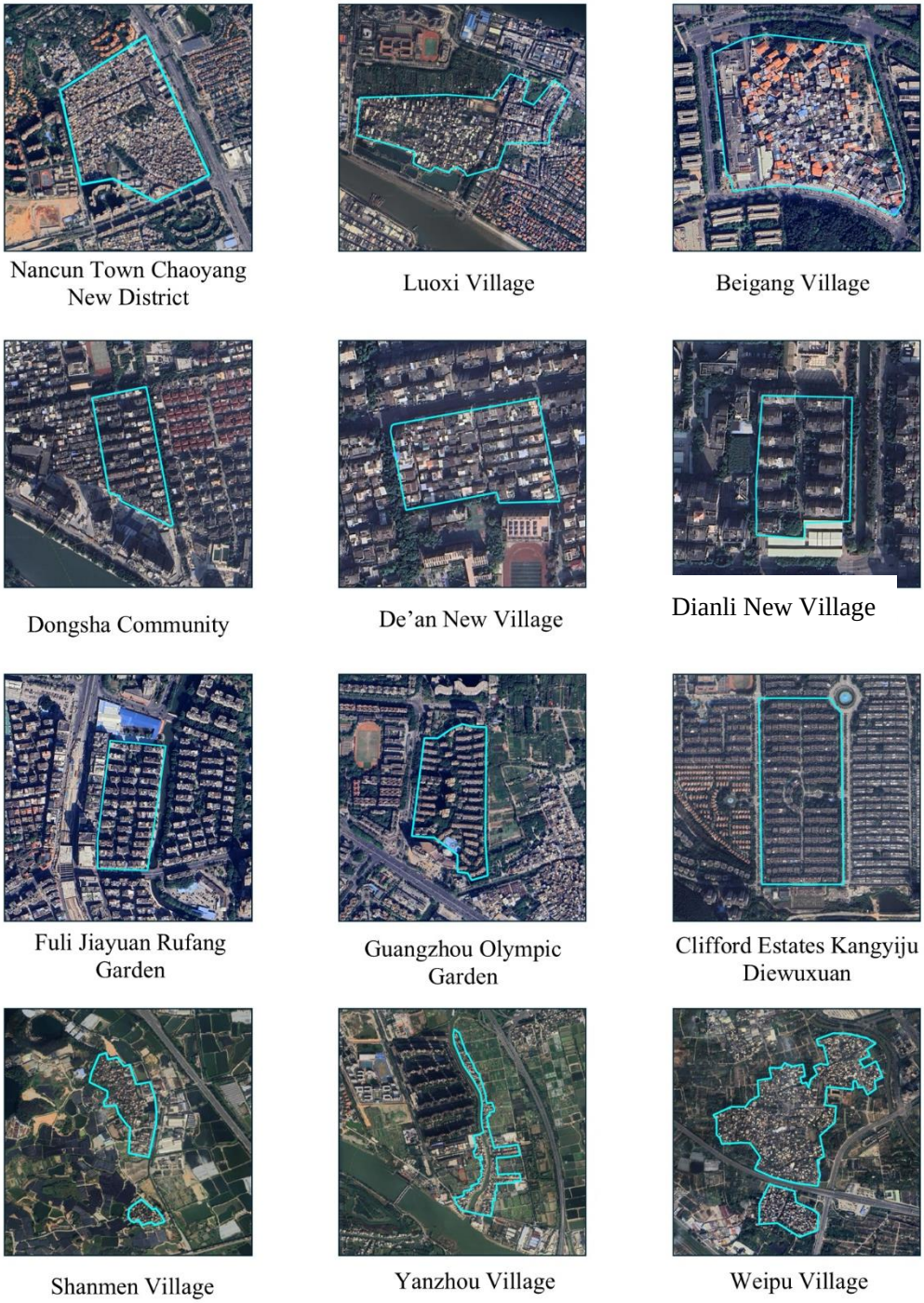

Figure 9. Satellite Images of the Communities (not on the same scale)

In communities, due to the varying sizes of different communities, the accessibility of internal points to external facilities may also differ. In each community, 3 to 39 sampling points were selected based on their area size, classified as either exits at the edge of the community, or internal community points. The accessibility by the coverage of POIs of different communities are conducted by the average performance of points of the same type.

Type	*Type Code*	*Community Name (Chinese)*	*Community Name (English)*	*Internal Points*	*Exit Points*
Urban Village	1	南村镇朝阳新区	Nancun Town Chaoyang New District	34	5
		洛溪村	Luoxi Village	6	3
		贝岗村	Beigang Village	17	5
Redeveloped Villages (Danwei Community)	2	东沙小区	Dongsha Community	11	4
		德安新村	De'an New Village	8	2
		电力新村	Dianli New Village	8	4
Commodity Community	3	富丽家园乳芳园	Fuli Jiayuan Rufang Garden	1	2
		广州奥林匹克花园	Guangzhou Olympic Garden	4	6
		祈福新村康怡居蝶舞轩	Clifford Estates Kangyiju Diewuxuan	5	4
Rural Village	4	山门村	Shanmen Village	9	3
		雁洲村	Yanzhou Village	9	5
		韦浦村	Weipu Village	25	11
		Total	191	137	54

Table 2. Selected Communities and Number of Internal Points.

4 Methodology

4.1 Data Source

To define the boundaries of communities in Panyu District, AMap API was utilized. By requesting the name of each community, the geographic boundaries for the year 2023, were retrieved, and manual editing by the author was conducted to ensure the accuracy. The type of community was determined using Baidu Street View, property transaction data from Beike, and field visit.

4.2 Quantitative Characteristics and Spatial Distribution of Community Facilities

This study selected several types of POIs (Points of Interest), including transportation facilities, shopping services, healthcare services, cultural and educational institutions, and recreational as key amenities. These POIs were retrieved using the AMap API, with their corresponding classifications summarized in the table below. The accessibility analyses were conducted by Mapbox API based on isochrones for 5-, 10-, and 15-minute walking distances from 191 sampling points across 12 communities. The number of the POIs within these isochrones are accumulated to calculate the average performance of accessibility of key amenities within different walking times of each community types.

Type	*Semi-Type*	*Amap POI Category (Chinese)*	*Amap POI Category (English)*
Transit Amenities	Bus Stop	交通设施服务-公交车站	Transportation Facilities Services - Bus Stations
	Metro Stop	交通设施服务-地铁站	Transportation Facilities Services - Subway Station
	Grocery Stores	购物服务-便民商店/便利店	Shopping Services - Convenience Store/Convenience Store
Shopping Amenities	Market	购物服务-商场 + 购物服务-超级市场	Shopping Services - Shopping Mall | Shopping Services - Supermarket
	Pharmacy	医疗保健服务-医药保健销售店	Healthcare Services - Healthcare Sales Store
Healthcare Amenities	Hospital	医疗保健服务-专科医院 + 医疗保健服务-综合医院	Healthcare Services - Specialist Hospital | Healthcare Services - General Hospital
Education amenities	Kindergarten	科技文化服务-学校-幼儿园	Technology and Culture Services - Schools - Kindergartens
	Primary School	科技文化服务-学校-小学	Technology and Culture Services - Schools - Primary Schools
	High School	科技文化服务-学校-中学	Technology and Culture Services - Schools - Middle Schools
	Vocational School	科技文化服务-学校-职业技术学院	Technology and Culture Services - School - Vocational and Technical College
Recreation Amenities	Parks	风景名胜-风景名胜 + 公园广场-公园 + 公园广场-城市广场	Scenic Spots - Scenic Spots+Park Squares - Parks | Park Squares - City Squares

Table 3. Key Amenities Selected

5 Result

5.1 Size of Isochrones

The isochrones generated in this study (5 minutes, 10 minutes, and 15 minutes) clearly depict the walking accessibility of different community points. It can be clearly seen that the coverage of the 15-minute isochrone is the largest, while the 5-minute and 10 minute isochrones gradually decrease. These 573 isochrones are generated based on the superposition of 191 sampling points, showcasing the walking range that can be covered by different points in the community. The darker the color within the waiting circle, the higher the walking ratio in that area, indicating that more areas in the community can easily reach these points. By comparing the isochrone with an 800-meter buffer zone, it can be found that most POIs are located within the isochrone range. However, due to the obstruction of rivers and roads, the actual isochrone range in some areas is smaller than the 800-meter buffer zone.

The size of the isochrone significantly depends on the density of the road network, including vehicle lanes, pavements and bike lanes. The distribution of POIs is also mostly around the road network, which indirectly reflects the location of living facilities and shops on the street. It is accords with the field trip of the author that the outskirts of communities in Panyu are mostly street facing shops, and there are relatively more mixed used lots. The isochrone of redeveloped communities and urban villages is relatively large, which is likely related to the denser road network nearby.

For two of the three rural communities, Shanmen Village and Yanzhou Village, their isochrones are significantly smaller than the size of the 800m buffer zone, indicating limited connectivity between rural communities and the outside world, and underdeveloped pedestrian transportation. However, the isochrone of Weipu Village is significantly larger than the other two rural areas, which may represent the trend of the village's development from rural to urban. Although there is still a large amount of farmland near the village utilized for agricultural activities, there is also Guangzhou South Railway Station nearby, and a highway passes through, making transportation convenient. It is also close to some industrial areas in Foshan, which may attract more migrant workers to live in and represent a community in a state of transformation.

For commodity communities, smaller communities have a similar isochrone size to redeveloped communities due to convenient transportation nearby. Although the isochrones of Clifford Estate Kangyiju Diewuxuan, is relatively small, on the one hand, it is blocked by geographical mountains in the south, and on the other hand, the community

is one of more than 20 semi communities developed by the same developer in the large-scale commodity housing community Clifford Estate. The large community cluster has internal clubs providing living services, as well as resident specific buses shuttling between different communities, not relying solely on walking to public bus stops and living service facilities. Therefore, the accessibility of it may have been underestimated.

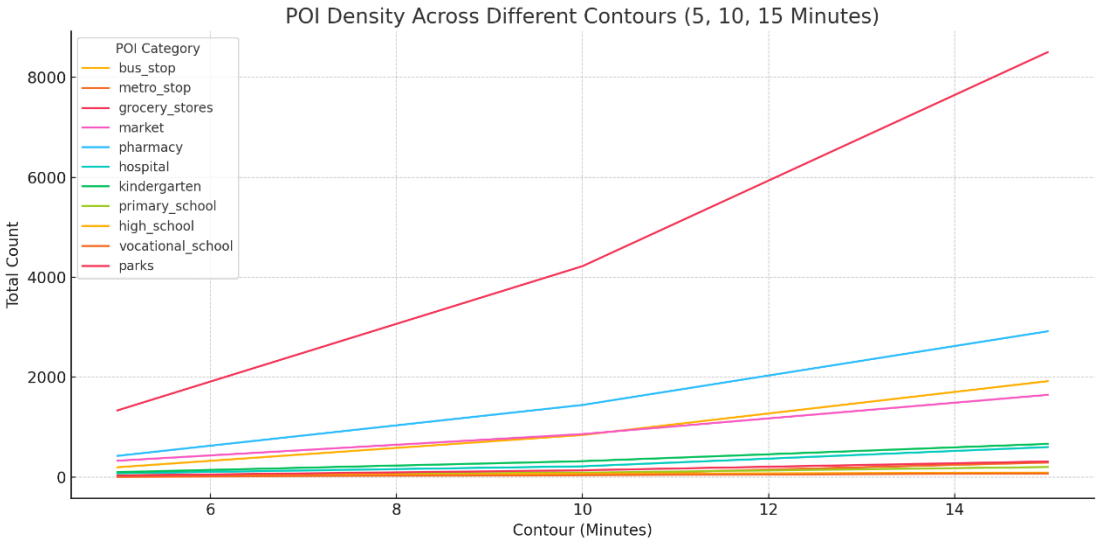

Figure 10. POI Counts accords with Isochrones

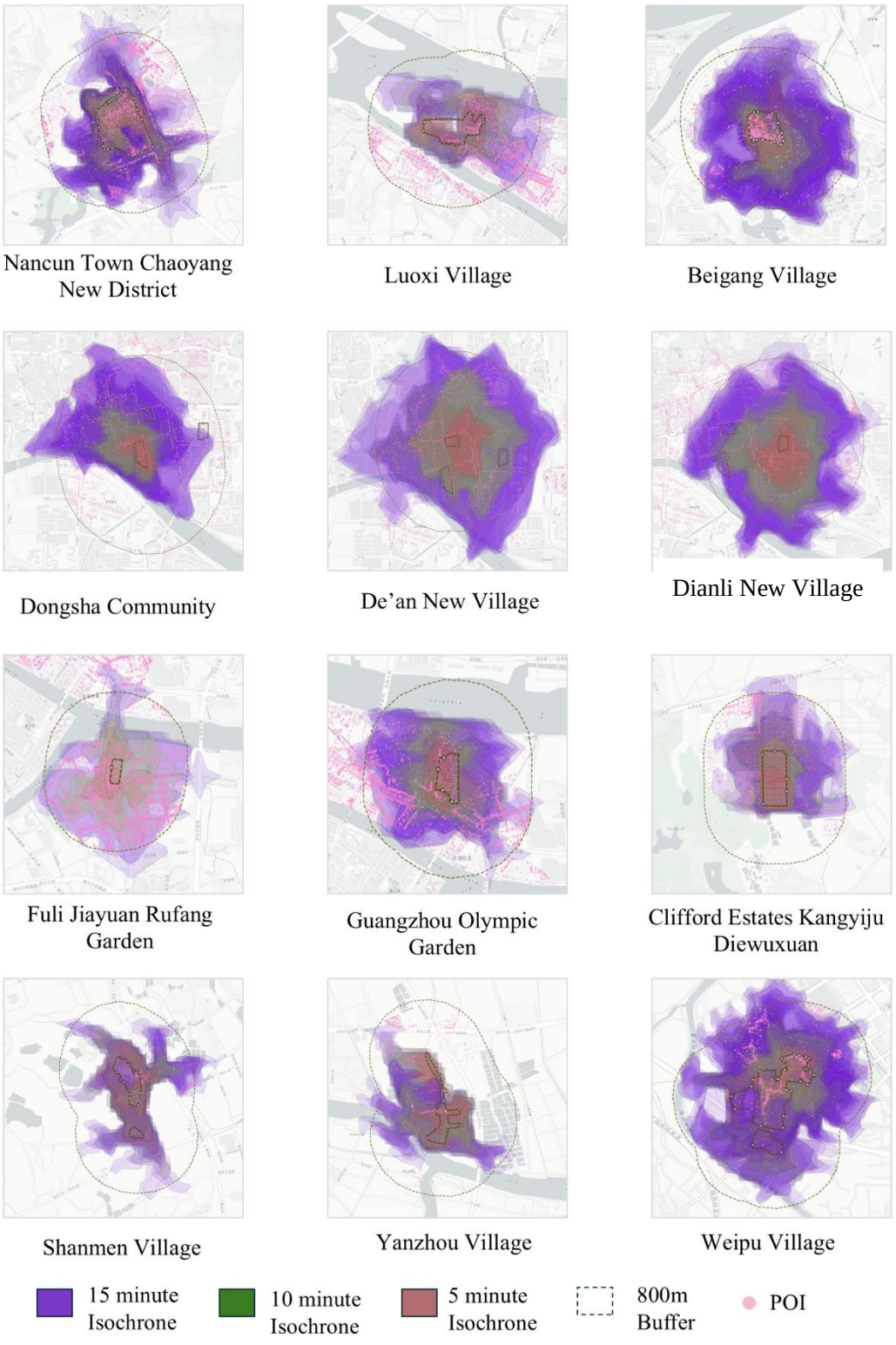

Figure 11. Isochrones of the 12 Communities

5.2 POI Distribution within Isochrones and Communities

The average number of POIs accessible within 15-minute isochrones reveals clear trends across different community types.

The redeveloped communities (84.77) and the commodity communities (56.07) have much more of total POIs in the 15-minute isochrones, while urban villages (35.31) and rural villages (32.61) have similar results. For transit amenities, redeveloped communities have the highest number of bus stops (10.77) and metro stops (1.90), reflecting their central location in older urban areas with well-established public transit infrastructure. Commodity communities and urban villages show moderate access to transit amenities, while rural villages have the lowest number of bus stops (3.03) and metro stops (0.29). The shopping amenities are with the same pattern, as a high number of grocery stores in commodity communities (31.18) and redeveloped communities (39.34) reflects balanced planning to meet residential needs. However, there are more markets in urban villages (7.91), which may reflect a more traditional shopping behavior and cooking at home due to restraint of income. Redeveloped communities also have a significantly higher accessibility to healthcare amenities, kindergartens (2.72) and primary schools (1.23), showcasing their historical advantage of being close to established educational resources.

Type	***Semi-Type***	***Urban Village***	***Redeveloped Community***	***Commodity Community***	***Rural Village***
Transit Amenities	Bus Stop	3.60	10.77	5.56	3.03
	Metro Stop	0.30	1.90	0.02	0.29
Shopping Amenities	Grocery Stores	17.45	39.34	31.18	15.63
	Market	7.91	5.74	4.21	3.42
Healthcare Amenities	Pharmacy	3.23	16.09	10.70	6.35
	Hospital	0.13	5.34	0.53	0.82
Education amenities	Kindergarten	0.66	2.72	2.64	1.37
	Primary School	0.32	1.23	0.73	0.34
	High School	0	0.72	0.18	0.44
	Vocational School	0	0.36	0.09	0
Recreation Amenities	Parks	1.71	0.57	1.14	0.90
Total		*35.31*	*84.77*	*56.97*	*32.61*

Table 4. Average Number of POIs within 15 Minute's Isochrone for Community Types

Compared to the result of the 15-minute isochrones, the internal POIs within the community boundaries showed a conversed pattern. Urban villages (43.33) have the highest total internal POIs, significantly surpassing rural villages (13.00), while

commodity communities (0.66) and redeveloped communities (0) have far fewer. For shopping amenities, urban villages stand out with the highest number of internal grocery stores (27.33), reflecting their self-sustaining nature and dense, informal commercial activity. Rural villages follow with 16.00 grocery stores, highlighting their reliance on localized markets to meet residents' basic needs. Urban villages (2.0) and rural villages show a higher number of kindergartens also lead in kindergartens (2.00), emphasizing their focus on self-sustained basic education. However, redeveloped and commodity communities have virtually no internal amenities, showcasing their reliance on external, well-planned infrastructure to support residents.

Type	***Semi-Type***	***Urban Village***	***Redeveloped Community***	***Commodity Community***	***Rural Village***
Transit Amenities	Bus Stop	0	0	0	0
	Metro Stop	0	0	0	0
Shopping Amenities	Grocery Stores	27.33	0	0.66	16
	Market	7.66	0	0	2.66
Healthcare Amenities	Pharmacy	5.33	0	0	4.33
	Hospital	0	0	0	0.33
Education amenities	Kindergarten	2	0	0	5.33
	Primary School	0.66	0	0	0.33
	High School	0	0	0	0
	Vocational School	0.33	0	0	0
Recreation Amenities	Parks	0	0	0	1
Total		*43.33*	*0*	*0.66*	*13*

Table 5. Average Number of POIs within each Type of Community

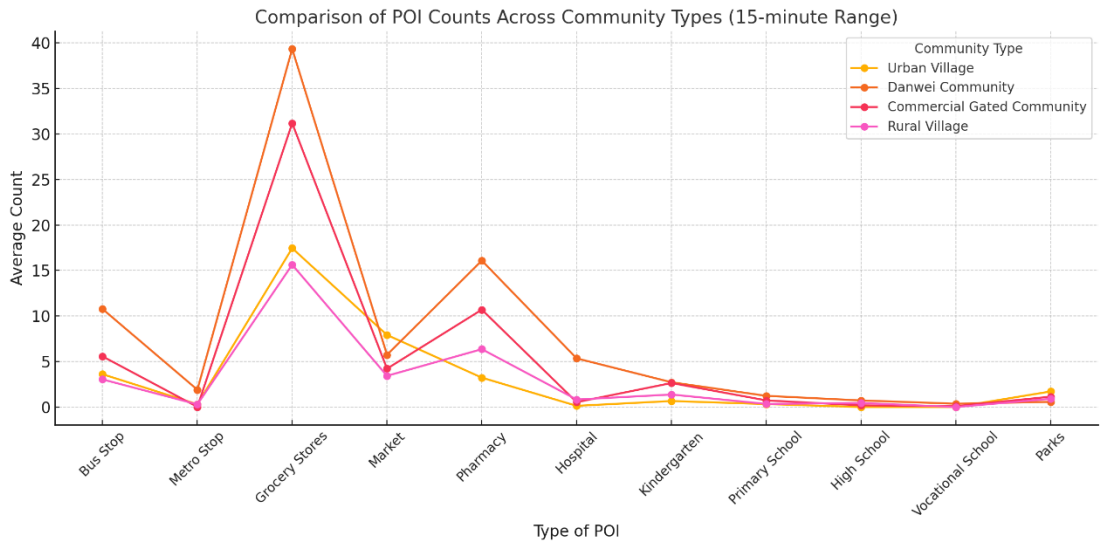

Figure 12. POI Counts across Community Types

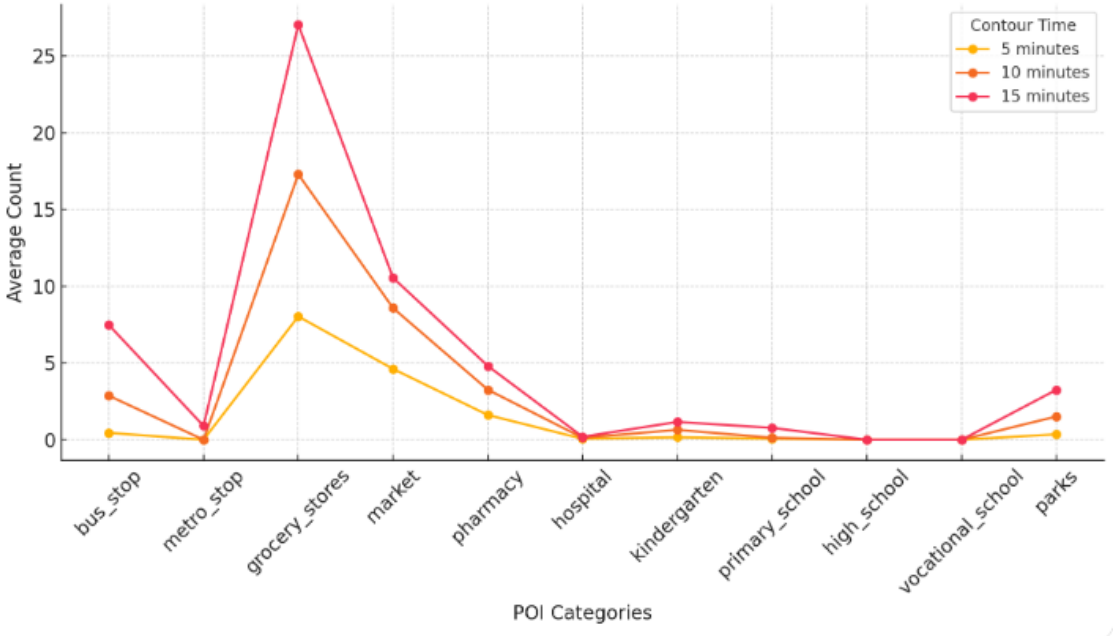

Figure 13. Average POI Distribution for Urban Village

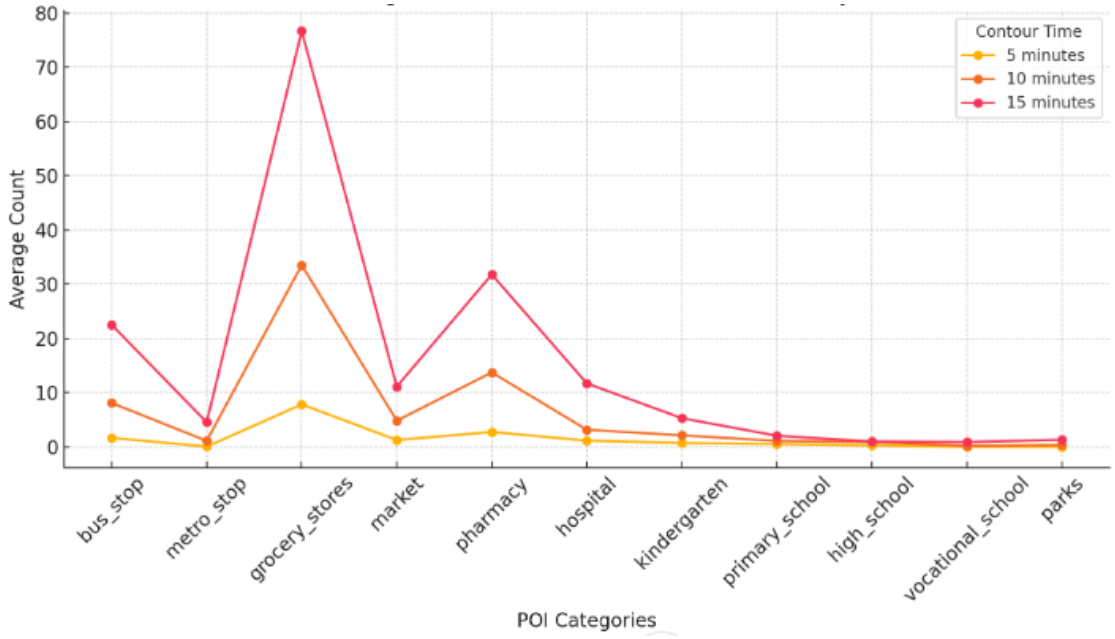

Figure 14. Average POI Distribution for Redeveloped Villages

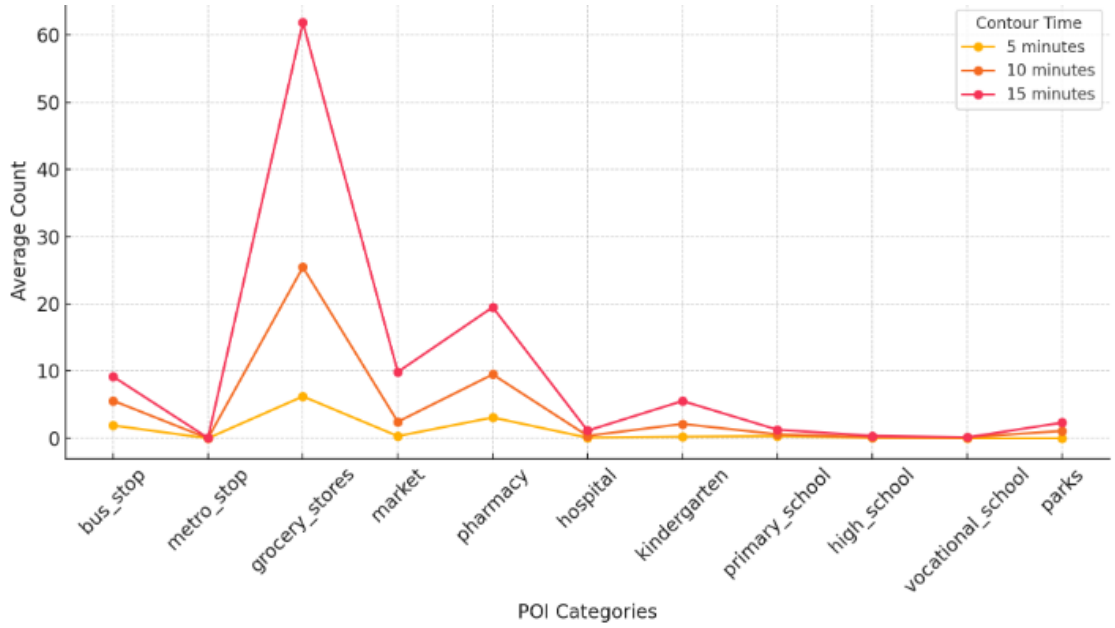

Figure 15. Average POI Distribution for Commodity Communities

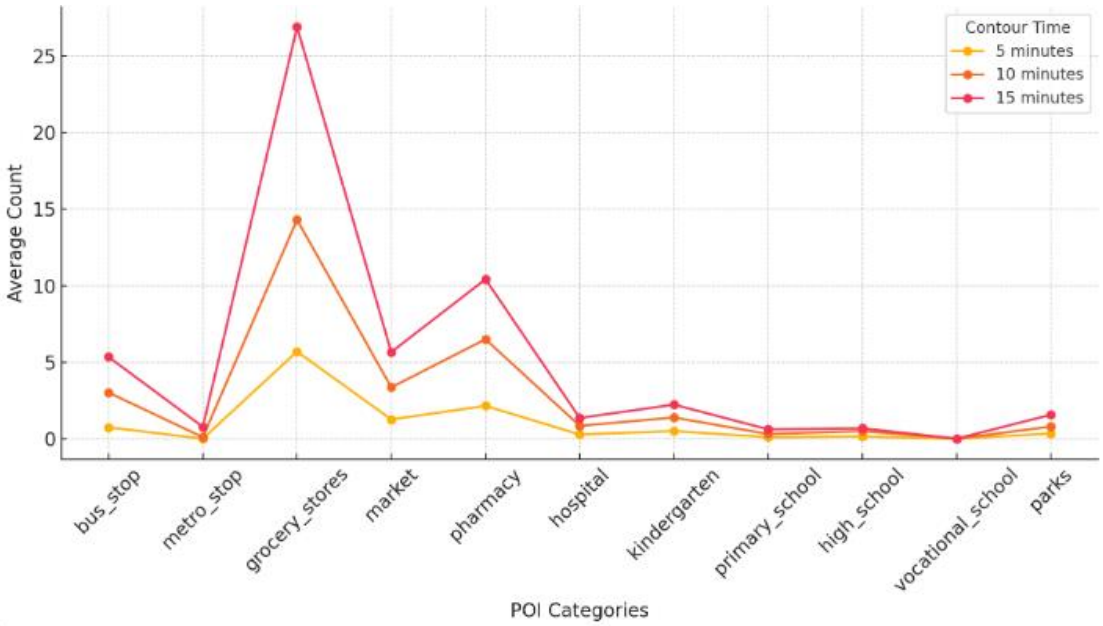

Figure 16. Average POI Distribution for Rural Villages

6 Discussion and Conclusion

According to the study, there are notable differences in accessibility between the various community types in Panyu District. These variations show the range of land development patterns, urban planning histories, and socioeconomic circumstances in addition to the distribution of internal and exterior service amenities.

Commodity housing communities and redeveloped communities are more likely to benefit from more favorable urban planning considerations at different historical stages, leading to better accessibility. Redeveloped communities, typically located in the cores of old urban areas, have more mature surrounding facilities due to early planning efforts that emphasized connectivity. The surroundings of these communities are characterized by dense road networks and higher walkability, enabling residents to easily access transportation and living services. This indicates that, before the emergence of commodity housing, historical urban planning focused on supporting comprehensive living functions for each work unit. After the commercialization of housing, as more people moved into city centers, residents of old communities who were no longer part of Danwei work units sold or rented their properties to newcomers. Because of their higher urban density, these neighborhoods continue to enjoy better facilities.

A market-driven approach to urban planning is reflected in commodity housing communities. These communities are frequently gated, upscale, and dependent on superior outside resources despite having few amenities inside. Commodity housing communities must take into account thorough facility layouts during the development phase in order to comply with applicable regulations. Additionally, developers usually choose locations with a variety of amenities around, including commercial services, healthcare, and education, to cater to the varying requirements of the home buyers and make their projects more appealing. Developers create safe and cozy living spaces for middle- and upper-class populations by making extensive use of land and using thoughtful design. This gated feature, though, has the potential to divert valuable resources from urban development priorities.

The studied communities however may not exhibit the well-known problem of gated commodity housing communities preventing non-residents from internal services. Based on field visits, in small, gated communities, services are situated in street-facing stores built by the same developer on the community's boundaries, while the interior of the community is often made up of residential and green areas. Due to commercial interests, these stores typically do not turn away outside customers. Even while some amenities (such internal shuttle buses) are limited to huge, gated commodity housing complexes like superblocks, it is not feasible or cost-effective to keep thousands of acres completely gated. As a result,

big, gated communities like Clifford Estates frequently split up into smaller, internally unconnected gated clusters. Usually located within the larger community, shared community facilities of the whole Clifford Estates served all the 27 communities by the same developer. Some large communities even allow non-residents to purchase admission to its facilities, however the cost is higher than for home buyers. However, due to restrictions on external vehicles entering or parking in these communities, their large scale tends to discourage external residents from frequenting them for shopping or service purposes.

Urban villages and rural villages largely shared some similar accessibility patterns. As low-cost and informal living places, urban villages are distinguished by their self-sustaining internal commercial facilities and dense layouts. Urban villages are vital housing options for low-income groups in the city due to their high population density and formal or informal economic activity, despite the lack of external infrastructure assistance. Rural communities, primarily located on urban fringes, rely on agriculture as the dominant land use. While some of these communities retain certain traditional rural characteristics, their remote locations and insufficient infrastructure investment result in limited external resources. However, the Weipu village also has shown a characteristic of the transitioning communities, as it is close to a major railway hub and with more factories nearby, sharing the characteristic of urban villages. The development and management of land in both urban and rural settlements are further limited by the separation of land use rights from ownership. Because of this system, state-owned property development is given priority by local governments, underfunding collective land and impeding infrastructure development. It is frequently difficult for governments to get involved directly in the building of infrastructure in these places, and developers have difficulties when trying to get involved on a broad basis. These settlements tend to be self-sufficient because of their limited external accessibility as a result of long-term neglect in urban development.

Additionally, there are instances when there is a de facto symbiotic link between commodity housing communities and urban villages. Due to their variety of reasonably priced housing options, urban villages draw people from neighboring commodity housing areas. However, some inhabitants of commodity housing may also avoid entering urban villages due to worries about identity segregation and safety, and they may also be against the entry of urban village residents for activities like street hawking (Feng, Breitung & Zhu, 2011).

However, the conclusion drawn by the research still have several limitations due to the data acquisition and accuracy. As the road network and the POI data for informal business remain insufficient, the activities and the accessibility of the communities, especially the

urban village, may be underestimated. As the isochrones are generated based on walking distance following the roads, the informal alleys or routes inside the villages may be not specified in the online map and may cause inaccuracy for the estimation. As the isochrone generated in a shorter time period, the inaccuracy is limited, but still an improvable element of futural research. The different travel mode could be also considered in future research, as residents from different communities may have different preferences for the travelling mode, including e-bikes, cars and public transit.

Urban planners can take specific action to reduce accessibility gaps in both rural and urban village communities based on the current accessibility situation. In order to balance the geographical distribution of amenities and enhance the quality of life for locals:
More funding must be allocated to **public infrastructure**, especially in the fields of healthcare, education, and transportation, which are the three service areas with the greatest disparities across community type.

Additionally, as **walkability** is directly impacted by road network density, it is imperative to optimize pedestrian environments and road networks. Enhancing pedestrian and public transportation systems can help people in rural villages and outlying areas increase their variety of activities while lessening the effects of geographical constraints. At the community level, the local authorities should encourage traditional market facilities to upgrade and transform while retaining the characteristics of low cost and community connection by bottom-up approach. Market regulatory authorities can provide subsidies for upgrading small and micro vendors in urban villages (such as sunshades, rain shelters, and cold chain boxes) to improve service quality, hygiene and fire safety standards. After communicating with the neighborhood committee of commodity communities, the local government could encourage the regular opening of shared spaces outside the community, allowing external vendors to operate, in order to increase the accessibility of commodity housing communities and redeveloped communities to convenience stores and markets. In terms of education, encourage community education space sharing, such as opening activity rooms or playgrounds to surrounding families during non teaching hours in commercial housing community kindergartens.

In order to integrate **buses of super-blocks in large communities into public transportation networks** and link to outside amenities, additional bus routes and stations should be built in urban villages, with a focus on short-distance transit connections. Bus companies and local governments should pay more attention to densely populated urban villages and rural nodes where lack of access to subway systems, and prioritize the installation of short distance buses and shared bicycles. These act could connect villages

with subway stations or centers where factories gather, in order to prevent overcrowding in urban villages near specific factories. At the same time, local governments should encourage landlords to renovate the internal streets of urban villages, punish the behavior of arbitrarily increasing and encrypting informal housing to obtain rent, and provide subsidies for the demolition of additional housing units that obstruct the streets. This can prevent the streets from being too narrow or too dense, hindering the passage of bicycles, electric vehicles, and buses. Urban and rural villages should also build infrastructure such as non motorized vehicle parking areas and pedestrian signage to increase accessibility.Cities can utilize strategies like **"reserved land development,"** which converts a piece of common property into commercial use while keeping other sections for public amenities to enhance living standards generally, to solve the issues of collective land development and inadequate facilities. **Local townships and village committees**, supported by the **Panyu Natural Resources Bureau**, can lead negotiations and implementation, with technical support from district planners. Forurban villages, implementing **flexible land-use planning** can lessen their citizens' need on outside resources by, such as allowing small-scale commercial establishments inside residential zones. For commodity communities, including street-facing stores along the edge of gated communities is one way to create semi-open borders that encourage interaction without sacrificing security. To increase resource efficiency, external inhabitants might be encouraged to use services from gated communities through subsidies or incentives to the community committees.

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