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Identifying Resettlement Communities' Urban Regeneration Opportunity Through GIS-based Spatial Analysis in Suzhou Metropolitan Area

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Abstract: Urban regeneration is mentioned for the first time in the Chinese 14th five-year plan, and its main content is the old communities built before the year 2000. Due to the different construction standards for different communities, the old communities in need of transformation in the current city are referred to as resettlement communities. The existing urban regeneration guidelines and design intervention methods in China are at three approaches: demolition, reconstruction, and retention. There are still disputes on how to guide the regeneration of resettlement areas in different urban conditions effectively. We try to introduce the method of spatial analysis using GIS to evaluate the existing 176 resettlement communities we found in Suzhou Metropolitan Area. We classified the resettlement communities into four categories upon multiple factors, which could be assessed using the densification concept's index weight. According to the matching degree of overall property value and construction intensity, and put forward relevant regeneration strategies. At the same time, the feasibility assessment is verified in combination with the comprehensive regeneration plan from the government in recent years. The results show the current government's reconstruction focuses on low-density and below the medium housing prize communities, which is also the lowest grade in the previous assessment. We encourage these communities could be regenerated by reconstruction, demolition, and reconstruction simultaneously, gradually increasing the density and accessibility and enhancing public services. The study also attempts to discuss the corresponding regeneration strategies for the other three types of resettlement areas. This research of resettlement communities in the Suzhou Metropolitan area can further promote urban regeneration policies and guidelines for sustainable design intervention.

Keywords: GIS-based Spatial Analysis, Densification, Sustainable Regeneration, Resettlement Community

1. Introduction

Resettlement community is built by resettling the relocated residents to solve the land use replacement in urbanization in China. Compared with commercial communities, resettlement communities' internal living conditions are pretty different. The common phenomenon is that most of them are in less developed regions. And due to the unique homogeneous property of resettlement housing, the layout of most communities is relatively single, and the landscape has no hierarchy. There is no diversity of space and gathering public space [1–4]. The construction quality is also relatively worrying. As time goes by, the problem of resettlement communities becomes increasingly prominent. The high-quality development of urbanization, the sustainable regeneration of resettlement communities, and the improvement of regional services are put on the agenda [5, 6].

Demolition and redevelopment used to be the most common intervention of regeneration before the Chinese 14th five-year plan [7–9]. 14th five-year plan proposes to "accelerate urban regeneration, transform and improve the functions of existing areas such as old communities, old

factories, old blocks and villages in the city" [10, 11]. In terms of the overall concept, we have transitioned from demolition and reconstruction (dilapidated houses and shantytowns renewal) to demolition and reconstruction, progressive spatial regeneration, and people-oriented refined urban space promotion. The regeneration objects focus much on those old communities built before 2000 [12] since many the building quality had reached the end of their original construction life.

As a national pilot city to transform old urban communities, Suzhou is fully implementing the urban regeneration action. The local government is promoting relevant transformation and regeneration measures. Multiple factors influence the resettlement community regeneration decision-making, and it is difficult to draw general guidelines from the measurement of limited elements. It needs to study the built environmental quality and spatial characteristics of resettlement communities and their surrounding areas further to promote the sustainable regeneration and development of resettlement communities.

The urban spatial network reflects the structural relationship of urban space. However, due to the complexity of the city, it is difficult to characterize the urban spatial network effectively [13]. Urban spatial analysis based on geographical information system (GIS) platform can systematically analyze the unobservable urban space and grasp the spatial characteristics and surrounding relations to help have a deeper understanding of the spatial elements of the research object. Spatial network analysis integrates spatial elements comprehensively evaluated by accessibility, facility and environmental comfort, regional economic level, social status, and other elements.

This paper attempts to establish an evaluation system of the comprehensive quality of the built environment around the community through multi-source data. At the same time, combined with the transformation measures of urban regeneration based on densification, classify the layout characteristics and spatial differentiation of existing resettlement houses, and tap the possible regeneration opportunities to support the decision-making of subsequent regeneration strategies in resettlement communities. This paper attempts to answer the following questions:

1) How to comprehensively quantify the quality of resettlement community and surrounding built environment in GIS?
2) How to form a precise classification of resettlement communities through GIS-based spatial analysis?
3) How to establish resettlement community regeneration guidelines corresponding to different renewal classifications?

The paper is structured as follows. First, generate an analysis framework according to the literature review of urban network analysis and the notion of densification to promote sustainable urban regeneration. Second, this paper will explain the data sources of resettlement communities in Suzhou. Third, the research will make an analysis and categorize the 176 resettlement communities. Finally, generate the correlated analysis results and discuss relevant regeneration strategies and design guidelines.

2. Literature Review

2.1. Urban Network Analysis

With the increasingly prominent status of spatial analysis technology, some scholars carry out quantitative research on urban public space through GIS spatial analysis methods [14-16]. GIS spatial analysis can measure the efficiency of public space layout at macro and micro scales. In recent years, geography and urban-rural planning have gradually realized that the structure of spatial networks plays a vital role in measuring urban spatial characteristics and functions [17]. At present, the research of spatial networks mainly focuses on the macro and micro levels, such as urban agglomeration spatial structure [18], spatial tourism network [19], and street spatial network [20], urban green space [21], etc.

In this paper, GIS-based spatial analysis integrates with these spatial elements mainly evaluated by accessibility, facility and environmental comfort, regional economic level, social status, and other factors.

Spatial accessibility is one of the essential indicators to measure whether the allocation of public service facilities is reasonable. It refers to the relative difficulty from one given location to another [22], which can intuitively describe the balance of spatial distribution of facilities. The current research mainly focuses on the spatial accessibility of public service facilities. For example, Harzele selects distance as the evaluation factor to analyze and compare the accessibility of public service facilities in different cities [23]. At the same time, there are also studies on the establishment and application of accessibility models and the optimization of urban spatial layout.

Facility environmental comfort mainly includes two aspects: facility and ecological quality. The diversity of facilities can be generalized as land-use diversity, land-use evenness, and function density, which are considered measurement variables for urban vitality [24–26].

The regional economic level is mainly reflected in the price of secondhand houses. Housing prices can reflect the overall land value. The research on whether the current community development intensity fully matches the current land value can tap the potential of land regeneration and transformation [27].

Social status mainly refers to the state of people living and physical space in the region. Previous research reveals that high-density communities can accommodate more city dwellers, job opportunities, and available destinations within the same commuting radius [28]. Hence, the quantifiable variables chosen in this study to measure density would be population density, architectural density, and floor area ratio (FAR).

According to the former analysis, the overall assessment framework formed:

Table 1. *GIS-based spatial analysis assessment metrics.*

Regional traffic accessibility	Traffic Accessibility	Public transport convenience
		Urban locations
Facility environmental suitability	Facility convenience	Relative quantity of facilities
		Facility accessibility
		Facility diversity
	Environmental quality	Accessibility of green space
		Adverse environmental exposure
Regional economic	Regional economic level	Secondhand housing prices
Social status	Regional development intensity	FAR (floor area ratio)
		Building density
	Population aggregation degree	Population density

2.2. Densification for Sustainable Urban Regeneration

2.2.1. Densification Promote Sustainable Development

Densification can promote sustainable development. Many scholars have put forward evidence that the high density of urban areas is related to various ideal factors. Including greater environmental sustainability, more excellent financial stability of local governments, a more pedestrian and healthier living environment, economic development, housing diversity and affordability, and strengthening community characteristics and cultural vitality [29–33].

Densification means achieving more residential units and more facilities and services in a given area than existing conditions.

Generally speaking, adding new houses on the edge of cities is cheaper and easier than inbuilt areas because it requires less design thinking and fewer construction stages. However, in the past 20 years, several major cities have explored the concept of urban intensification and those already medium or high-density cities [31]. The main reasons for promoting these densification projects are as follows:

1. The original living and housing quality is meager, and the space needs to be rebuilt to meet the new living needs.
2. If the existing land is demolished and rebuilt at a higher density, the potential profits of developers will be very considerable.
3. Construction land is scarce due to geographical conditions and agricultural land protection. Improve the intensity of land opening to deal with urban sprawl.

Both reasons justify the densification actions promoted in Paris [34], Seoul [35-37], Rotterdam [38, 39] or London [40]; Policies and projects vary from city to city because they are adapted to local conditions, including local living and cultural patterns.

2.2.2. Densification in Urban Regeneration

The resettlement community is affected by interesting examples of intensification: at the edge of the community, high-rise buildings are filled with open space, such as the "vertical courtyard apartment" of Wang Shu [41] in Hangzhou and the "third space" of Li Xingang [42] in Tangshan, Hebei - or all demolished and rebuilt, such as Tuanjie Village, Kunshan, Jiangsu Province. Over time, it can also be noted that the long-distance increase trend of new resettlement villages: the density of communities built since the first half of the 1990s is slightly higher than that of previous communities [43].

At the same time, combined with the current policy, the transformation of old communities is still based on micro renewal. Therefore, densification is more reflected in improving public service facilities, enhancing high-quality vitality space, and more creative design placement.

The corresponding spatial analysis results of the resettlement community need to combine with the different assignments of the index weight of each factor in the context. According to the previous illustration, factors such as secondhand housing price, development intensity, accessibility, facility convenience, and the construction age need to be strengthened.

3. Data and Method

3.1. Data Collection

The study collected 176 resettlement communities in six districts of the Suzhou metropolitan area (Gusu, Xiangcheng, Suzhou Industrial Park, Wuzhong, Wujiang, and Suzhou New Area). These resettlement communities have been built since the 1980s, covering a broad area of more than 2200 hectares and nearly 360000 units. Considering the factors of population mobility, it can accommodate about 1 million people because these communities include a large proportion of immigrants (official data on floating population are not available; the data considered are from Lianjia, a secondhand housing sales website.).

At present, we have detected the number distribution of some resettlement communities as shown in the figure below:

Table 2. *Number of resettlement communities selected from each district in Suzhou.*

Administrative Region	Gusu District	New District (SND)	Industrial Park (SIP)	Xiangcheng District	Wuzhong District	Wujiang District	Total
Resettlement Communities' Number	20	38	40	37	32	9	176

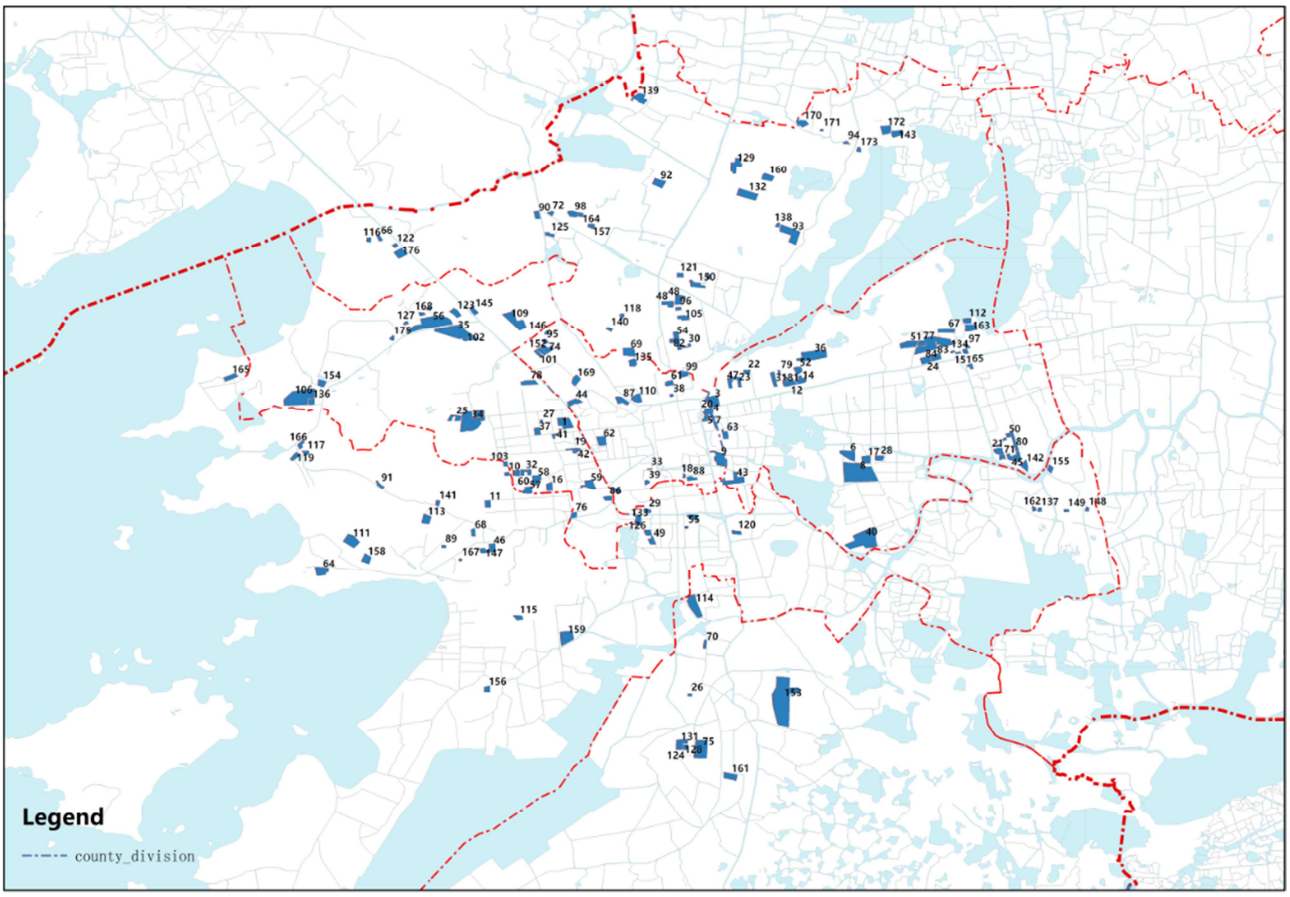


Figure 1. *The distribution of resettlement communities in Suzhou metropolitan area, drawn by the author.*

The public transport subway station required for public transport convenience is obtained from the high-tech map POI. The POI point considered for facility convenience is derived from Suzhou POI data of 2020 by "urban data dispatch." The green space contact degree downloads the green space vector data from Beidou satellite (北斗卫星), and then it is made up by satellite map mapping. The high-tech bottom map POI crawls the POI of the factory, and the secondhand house price data is The historical transaction data of " Lianjia"(链家网) is crawled, and the time is in the second half of 2020. The FAR, building density, and residential units are obtained by the website as well.

3.2. Research Methods

Through a series of indicators to measure the selection of these resettlement houses, we use this metric to evaluate the quality level of these resettlement houses, as in table 1.

The analysis of public transport convenience is that the subway station and bus station within 1km of the resettlement area are weighted by 2:1 to get the number of stations.

The distance from the selected point expresses city location analysis to the nearest city center (Shishan Longhu Tianjie district; Guanqian Street District; Suzhou central district; prosperous central district; Nanmen district; Wujiang Cultural Square District).

The relative number of facilities is the number of POI points within 1km of the resettlement area; the accessibility of facilities is within 1km of the resettlement area, and the weight of catering, shopping, medical treatment, education, and transportation is 0.5, the weight of life service, sports and leisure, science and education and culture is 0.3, and other weights are 0.2.

Shannon Wiener index was used to represent the diversity of facilities around the selected sites: $H = -\sum_{i=1}^{k} \frac{n_i}{N} ln \frac{n_i}{N} i$, (Among them, H is the diversity of facilities, K is the number of functional types of POI points, Ni is the number of class I functions, and N is the total number of all poi facilities in the selected area).

The contact degree of green space is obtained by taking the green space area within 1000m, 2000m, and 12500m, respectively, considering walking, riding, and driving, and weighted superposition with the ratio of 0.5:0.3:0.2. The linear distance from the selected point to the nearest factory was analyzed for adverse environmental exposure. The average price of secondhand housing within 1km around resettlement housing is analyzed.

4. Analysis and Outcomes

4.1. Regional Traffic Accessibility

4.1.1. Public Transport Convenience

The radius of accessibility measurement is 1000m, and the

target is bus stops and subway stops. The results show that the accessibility is the highest at the junction of Gusu district and the park and then attenuates outward from this area (figure 2 left).

The specific result is that the traffic accessibility of the resettlement community is the strongest in the East of the ancient city area and the west of Jinji Lake. Near Lianhua new village in the East of Dushu Lake in Jinji Lake and around Hanshan Temple, the traffic accessibility on both sides of the Beijing Hangzhou Grand Canal is strong; The traffic accessibility around Shizishan, north of Shihu lake, near Panmen, near Xiangcheng Tianhong, East and Southeast of Dayang, East of Suzhou Taihu Lake National Wetland Park, near Weiting station of line 3, near Suzhou park station is general. The traffic accessibility of other resettlement areas is poor.

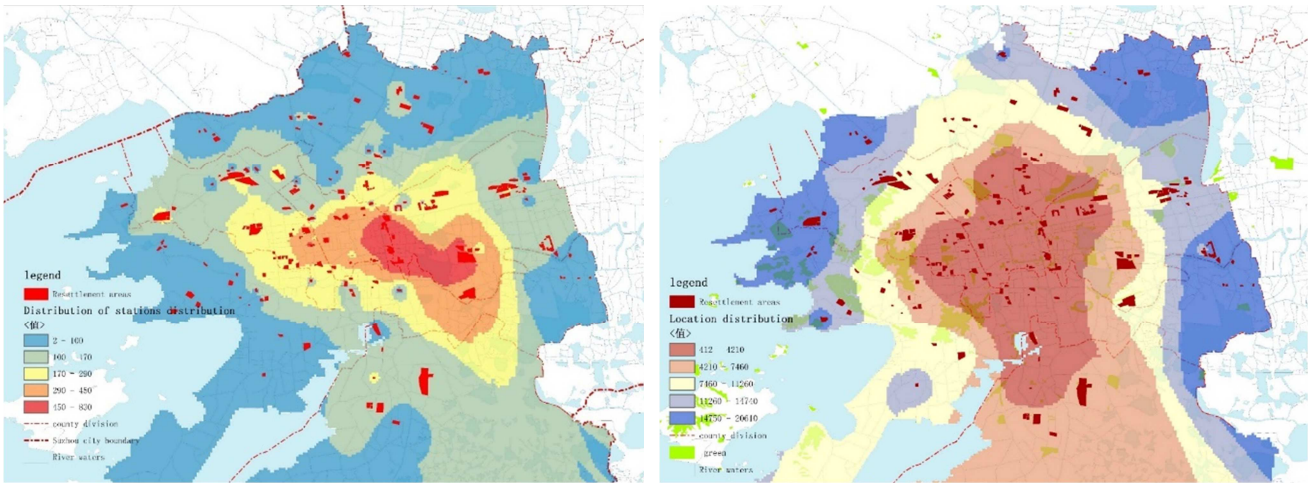


Figure 2. *Analysis results of public transport convenience (left) Proximity to the city center nearby (right).*

4.1.2. Proximity to the City Center Nearby

According to the measurement results of the distance from the selected point to the nearest urban center (Shishan Longhu Tianjie area; Guanqian Street area; Suzhou central area; bustling central area; Nanmen area; Wujiang cultural square area), the more red the color, the higher the proximity of commercial facilities.

The overall distribution is pocket-shaped. In terms of the widespread distribution of resettlement communities, the south side, that is, Wujiang District is short of the urban center because the urban center of Wujiang district is close to this area.

The proximity to the city center is increasing from the central region to the periphery. The gap between each cell and the central area is not apparent. At the boundary of the middle ring road, the increasing trend is noticeable, and the growing trend is uniform.

4.2. Facility Environmental Suitability

4.2.1. Facility Convenience-Number, Accessibility, and Diversity

The relative number of facilities showed that the whole process was centralized, and the gap between the inner and outer circumference was noticeable (figure 3 left). Generally, the middle ring road can be regarded as the dividing line. The relative number of facilities inside the middle ring road decreases from inside to outside. The degree of decline varies - at the junction of the industrial park in Gusu District, on both sides of the Hanshan Temple South Grand Canal (at the intersection of Gusu District and Huqiu District), near the South Gate (at the junction of Wuzhong District and Gusu District) and near the Xiangcheng District Government (at the junction of Gusu district and Xiangcheng District). There are many facilities within one kilometer of facilities; There are still many facilities here.

The overall distribution of facility accessibility (figure 3 right) characteristics is similar to the distribution of facility points. There are some differences between the two due to the different weights of different facility types. Firstly, the accessibility of facilities in the south of the ancient city and near the Xiangcheng District government is the strongest. Secondly, in the south of Hanshan Temple, the accessibility of facilities in Gusu district is more vital than that in Huqiu District, and the accessibility difference in Huqiu is not apparent. The accessibility of facilities in Gusu district near the south gate is still slightly more vital, and the difference in the unified district is not apparent. The accessibility in the south of the junction of Gusu district and industrial park is more substantial than that in the north. Although the accessibility of facilities near the Xiangcheng District government is vital, it is related to Gusu district.

According to the "control requirements for planning and construction of supporting facilities in residential areas", the OD analysis shows that the weight of catering, shopping, medical treatment, education and transportation is 0.5, the weight of life service, sports and leisure, science and education and culture is 0.3, and other weights are 0.2.

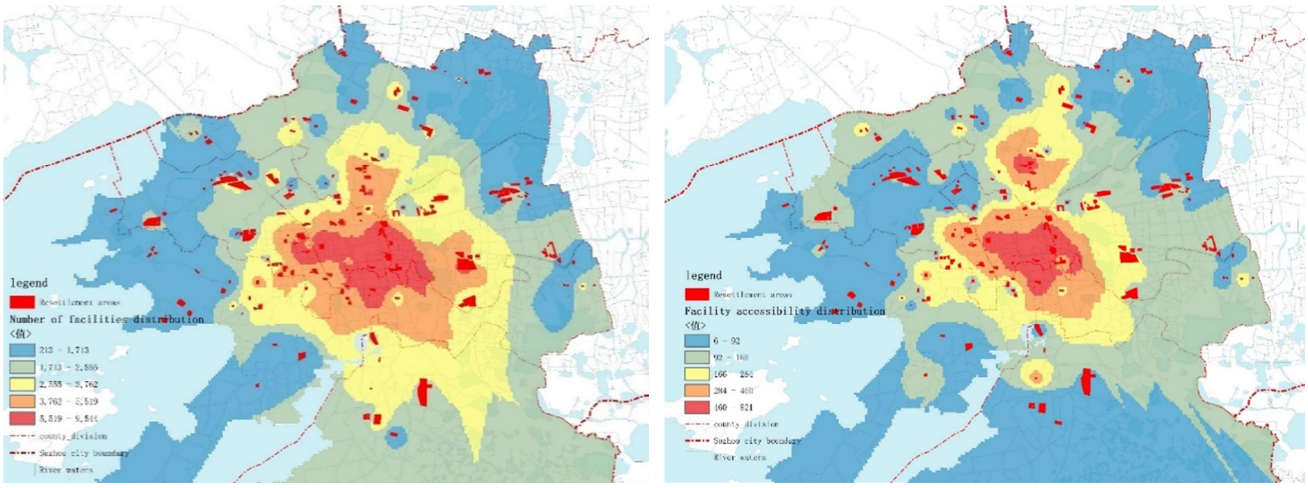


Figure 3. *Analysis results of relative number of facilities (left) facility accessibility (right).*

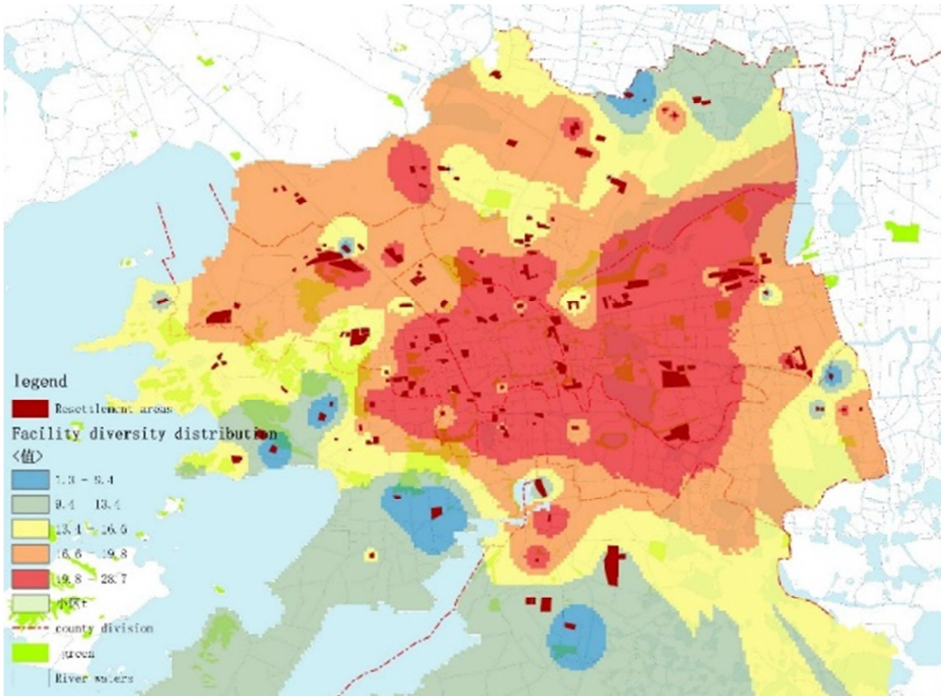


Figure 4. *Analysis results of facility diversity.*

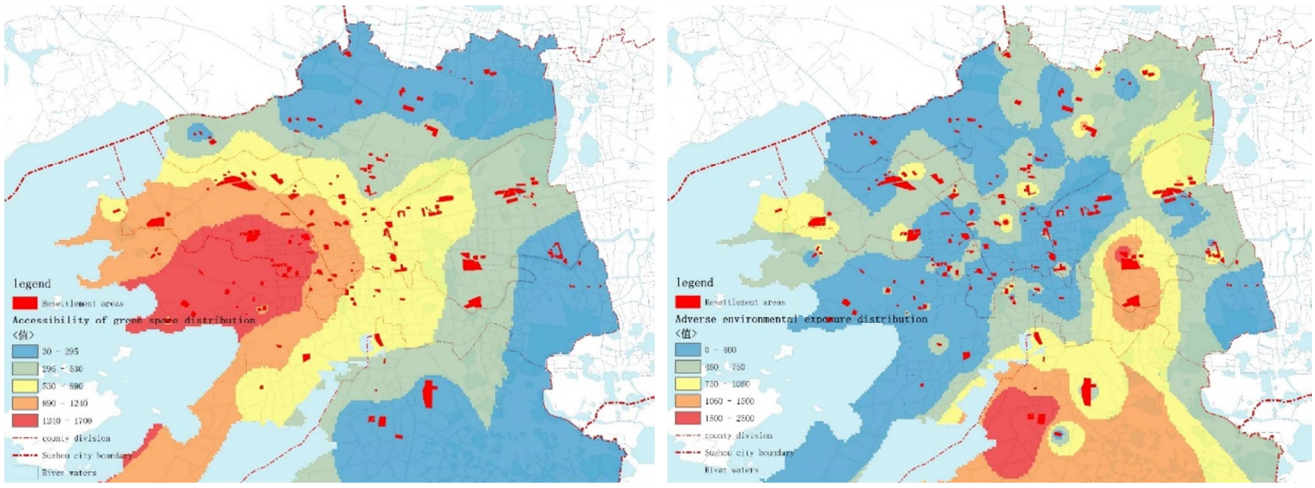
The overall facility diversity (figure 4) distribution characteristics are quite different from those of other parameters, mainly reflected in the fact that there is no centrality, but there is a centrality distribution.

According to the map, the East of Huqiu District, the middle of Wuzhong District, Gusu District, most of the west of the park, the south of Xiangcheng District, and Hushuguan district have the most vital facility diversity and comprehensive coverage, almost completely covering the urban area of Suzhou. Most of the facilities in Xiangcheng District have substantial diversity, and Nanmen district expands southward to Suzhou Bay, showing a decreasing trend.

4.2.2. Environmental Quality

The analysis results of green space accessibility (figure 5) show that, in Huqiu District and Wuzhong District, the access degree of green space adjacent to Taihu Lake is relatively high and even (Tianping mountain, Shangfang mountain, Wangshan mountain, Lingyan mountain, Qionglong mountain, Tianchi mountain, and Dayang mountain contribute a lot). A decreases from the junction of Gusu district and Huqiu District to the East, South, and north; in Gusu District, the contact degree of green space is general, while in Xiangcheng District and Wujiang District, the access degree is relatively low.

In the process of index analysis, there are many water areas and farmland in the industrial park, but the development of green space is less, which can not be included in the green space area. There are many water areas and farmland in Xiangcheng District of Wujiang District, which are all ecological and green but can not be included in the green space. With the unique mountain scenic resources, most Huqiu District and the central and western parts of Wuzhong District significantly improve the green space contact degree.



R = 1000m (walking) / 2000m (bicycle) / 12500m (car), aiming at green space. Gravity (walking: Bicycle: car = 5:3:2) (normalization)

Figure 5. *Analysis results of green space accessibility (left) adverse environmental exposure (right).*

The right of the adverse environmental exposure map (right) shows the linear distance from the selected point to the nearest factory.

The overall distribution is dense and cross. The resettlement communities near Wujiang people's Square, Lotus new village, and Weiting are far from the factory, the first echelon. The second echelon is near the Far East community of the industrial park, Songzejiayuan, Huagang Yingchun Primary School of Wujiang Economic and Technological Development Zone, northeast corner of Shihu lake, north of Tianping mountain, East of Suzhou Taihu Lake National Wetland Park, northeast of Beiyangshan in Guangfu Town, Southeast of Weitang Town, and near Yangchenghu town. The rest are the third echelons close to the factory and have adverse environmental exposure.

4.3. Regional Economic Level

The inverse distance weight method analyzes all the secondhand housing prices (figure 6) in Suzhou, showing the distribution of secondary housing prices in Suzhou. In terms of the overall housing price distribution in Suzhou, there are high housing price areas near the Suzhou center of the industrial park and the East of Jinji Lake, around Hanshan Temple to Shishan road Hushuguan area.

The average price of secondhand houses near Lianhua new village and within one kilometer south of Hanshan Temple is the highest. In contrast, the prices of secondhand houses in the East, northeast, and south of the old town and around the Yushan Road subway station are more elevated.

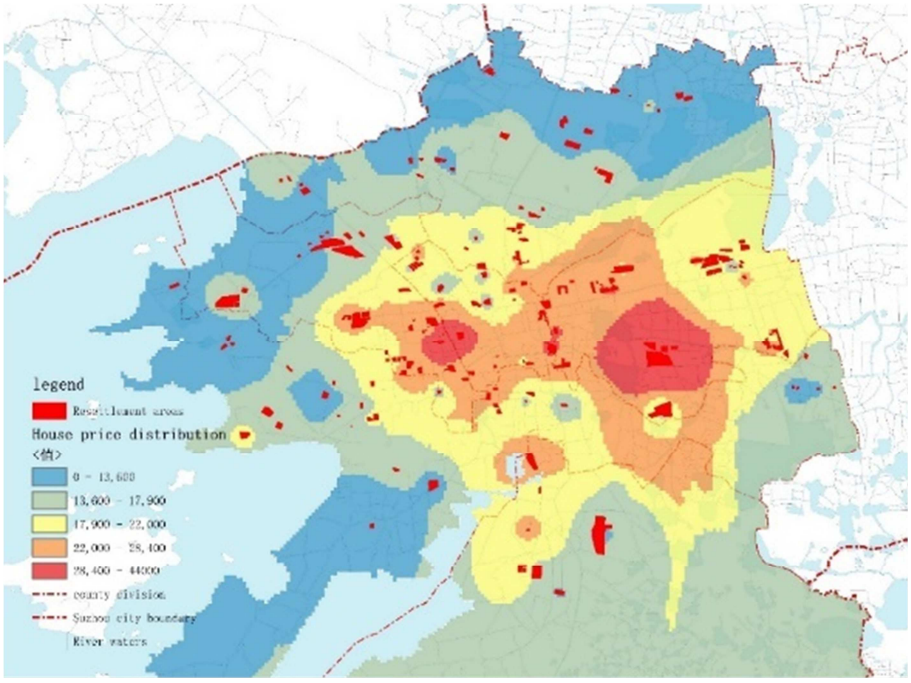


Figure 6. *Analysis results of secondhand housing prices. R=1000M.*

4.4. Social Situation Regional Development Intensity

The FAR map (figure 7 left) shows the floor area ratio of each resettlement house. The overall plot ratio distribution is more homogeneous, far some resettlement areas around the ancient city are significantly higher than that of the peripheral resettlement areas. By analyzing the density parameters of 176 resettlement communities in Suzhou, it is found that there is a slight density trend in time: in the early stage of urbanization, the unit is small and far lower than 1.3; Cases much higher than 1.5 were realized after 1999, but in '00, cases much higher than 2 and points lower than 1.5 coexisted. After 2008, almost no community had an employment rate much lower than 1.5. Since 2016, nearly all cases have far exceeded 2 and 3, and the number is increasing.

The building density (figure 7 right) distribution of the whole city is relatively homogeneous. There is a "high-density corridor" from Hushuguan to the northwest corner of the ancient city. There is a railway passing through the area; besides, the building density of SIP and the resettlement community near Suzhou Bay is slightly higher than that of other regions.

There are several resettlement communities with large population distribution (figure 8): Songze home, Wujiang people's Square, the East of Shihu lake, the East of Taihu Lake National Wetland Park, near Su'an new village, near Caohu garden and the north of Dayang mountain. Songze home has the largest population. This index is closely related to the construction area, building density, and the plot ratio of the community.

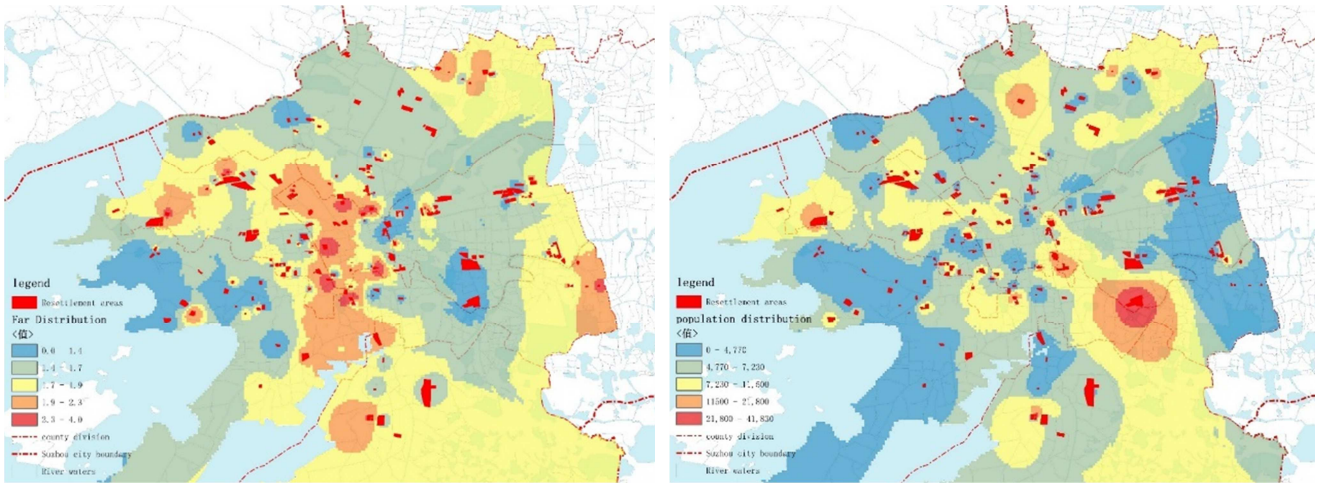


Figure 7. *Analysis results of FAR (left) building density (left).*

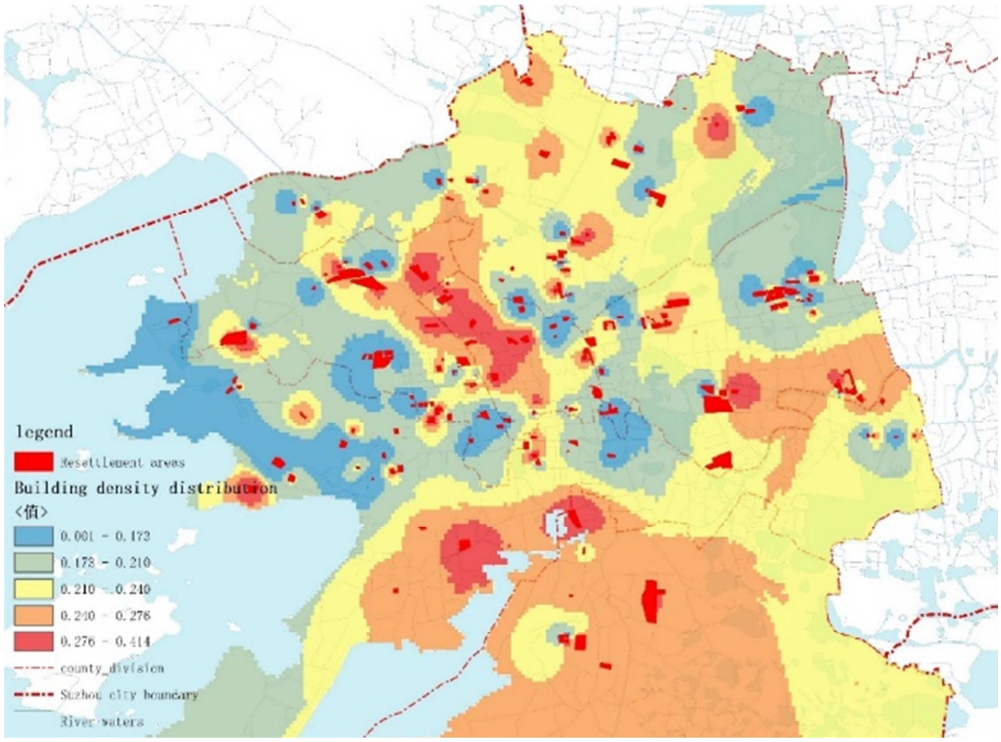


Figure 8. *Analysis results of population aggregation degree.*

4.5. Superposition Analysis Outcomes by Different Weights

Our final evaluation is to update the weight index of different elements concerned according to densification. Therefore, these factors need to be assigned values. If the various indicators are quantified and added together, the indicators need to be "normalized." According to the full score of 1, the regional economic level (house price), regional traffic accessibility (number of facilities, accessibility of facilities, diversity of facilities, green space contact, adverse environmental exposure), regional traffic accessibility (public transport convenience, urban location) should be scored, 0.25, 0.5, 0.75.

Because it is to classify a certain number of residential areas, the relevant indicators determine the classification. There are high and low points, and different indicators are easy to be inconsistent in quantity, so we need to put them under a "standard," so we specify a total score of "1". Due to these communities are some unique individuals blocks, the distribution of indicators is difficult to be balanced, so the relative level of indicators is used as the basis for scoring to ensure the number of samples in each segment and meet the classification of unique sample cells.

According to the score of 0.5 and 1 before and after 2005, the social conditions (floor area ratio, building density, and living volume) in which the floor area ratio is more than 30% and the floor area ratio is less than 1.3 are calculated as 0.6 points, and the final weighting (year: regional traffic accessibility: facility environment suitability: regional economic level: social conditions = 0.7:1:1.2:2:1.5).

After a series of weighted addition, the following results obtained:

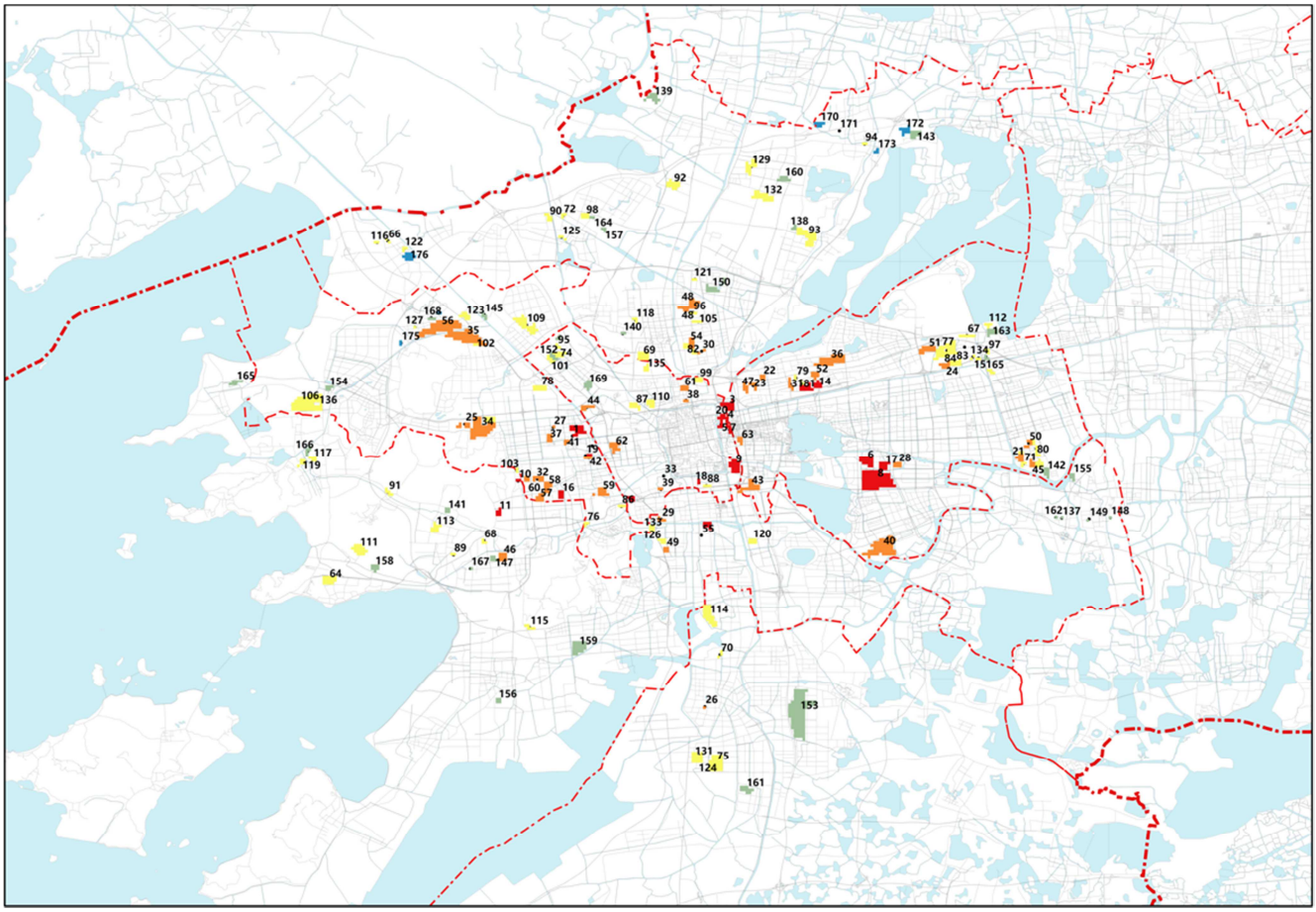


Figure 9. *Map of final assessment results. Category A- red B-orange C-yellow D-green.*

From the image color distribution (figure 9), the areas around Lotus new village in the industrial park, near the high-speed railway station in the park, and the industrial park in Gusu district have higher final scores. Followed by the Middle East of Huqiu District and the south of Xiangcheng District; Almost all the districts with the lowest scores are distributed in the north of Xiangcheng District.

From spatial distribution, the resettlement communities with high scores are generally in the east-west direction in central Suzhou and decrease in the east-west direction.

5. Conclusion

The final four types of resettlement communities are mainly evaluated according to their house prices, facilities, and

density—the Characteristics of these four categories are as below (Table 3). (regeneration is much related to price and density to see if there is potential for rebuilding. Higher land value with less compensation.)

1) Class A is an area with the good overall quality, including building quality and facility conditions. Therefore, demolition and reconstruction will not be carried out in a relatively recent period. In the future, progressive space enhancement can be carried out according to the items with low scores.
2) Class B buildings are generally open and located in high-value blocks. The focus of future renewal is partial or overall densification and redevelopment to create a new resettlement community.
3) Class C, which is located in an area with low land value and supporting public resources, the current building quality is acceptable. Therefore, it is more to tap the potential of internal space, pay more attention to increasing its facility richness, public space and creating better community culture, and pay more attention to the densification of a software level.
4) Class D, compared with Class C, its current building quality also stays very low. Class C and D are also necessary to enhance the densification of material space, strengthen the building, and upgrade the site's infrastructure.

Table 3. *Four categories' characteristics of resettlement communities.*

category	Characteristics	General strategies
A	High price areas (excellent accessibility and public facilities) with medium density, built after 2005	To enhance the vitality of their own and improve the community cultural and sports facilities and the corresponding supporting for the direction of regeneration
B	Medium and high price areas (good accessibility and public facilities), Poor architectural quality, low density, built before 2005	Try to demolish and rebuild communities with higher density and development intensity, one part as resettlement compensation, the other part as commercial housing
C	Low and medium price areas (average accessibility and public service) have better architectural quality, built after 2005	Increase the accessibility of public services and transportation facilities, and increase community vitality and facilities
D	Low and medium price area, the quality is generally poor, low density, built before 2005	The old city reconstruction, demolition and reconstruction should be carried out simultaneously, gradually increasing the density and increasing the accessibility of public services

Compared with the government's regeneration plan in recent years (table 4), we find that the regeneration of resettlement communities involved in the government list (with bold fonts) is concentrated in category D by our analysis. We have reason to believe that the GIS-based urban spatial analysis method of this study is similar to the thinking at the government decision-making level. At the same time, this study proposes a systematic approach to exploring the regeneration opportunities of resettlement communities, which can be classified and evaluated by assigning weights to densification-related factors. Through a set of mechanisms and methods, effectively guide the subsequent regeneration decision-making of relevant resettlement communities. It can also provide more integrated spatial cognitive inspiration for scholars, designers, and developers.

Suzhou is currently included in the first batch of urban regeneration pilot cities [44]. According to the contents of the notice on the implementation of urban renewal action issued by the Ministry of Housing and Urban-rural Development, intensity guidance of regeneration and transformation is on the way [45]. The comprehensive evaluation of the current quality of different objects is mainly based on their building and environmental quality. Using GIS-based urban spatial analysis to discover their potential transformation possibilities by analyzing their characteristics in urban networks as a preliminary reference for updating the regeneration planning, the research has more practical guiding value.

Table 4. *Government implementation plan of resettlement communities regeneration.*

particular year	Administrative Region	Residential quarters
2021	Gusu District	16 old residential areas, involving 416 houses and 7067 households. Fuxing community, 84-87 Qingqing Road, 158 Qingtang Road, Chengzhong garden, Guihua Village 2, Bingchang street, Xinyuan village 2, Xinyuan village, Sanxiang village, Shilin garden, Tongfang garden, building 2-3, 85 Taohuawu street, Daxianli, Changkangli, Caishenli, Jingwenli
	Xiangcheng District	Fuyuan home
	Suzhou New District	No.48, Jinshan Road, Fuyang new village, Tongan town, Yingbin garden, Fengqiao Street, Yushanyuan, Hengtang street, Shishan, Yingbin garden, Fengqiao street, Tongan town
2020	Gusu District	Lihe new village, Fuxing community phase I and II, Huayang Huayuan, No. 92 Laodong Road, No. 49 Dongzhong City, Guangji apartment and Zhujianong community
	Suzhou New District	there are 8 old residential districts in SND. Suhua new village in Tong'an Town, south of Baowei new village in Hushuguan Economic Development Zone, Longhua No.1 village, Caobao warehouse, Longjing Huayuan No.2 District, Longjing Huayuan No.5 District, Longjing Huayuan No.7 district and Longjing Huayuan No.8 district

References

[1] G. Baeten and C. Listerborn, "Renewing urban renewal in Landskrona, Sweden: pursuing displacement through housing policies," *Geogr. Ann. Ser. B, Hum. Geogr.*, vol. 97, no. 3, pp. 249–261, 2015.

[2] M. Zhang, S. Qiao, and A. G. O. Yeh, "Blemish of place: Territorial stigmatization and the depreciation of displaced villagers' resettlement houses in Chengdu, China," *Cities*, vol. 117, no. June, p. 103330, 2021, doi: 10.1016/j.cities.2021.103330.

[3] X. Li, R. Kleinhans, and M. van Ham, "Shantytown redevelopment projects: State-led redevelopment of declining neighbourhoods under market transition in Shenyang, China," *Cities*, vol. 73, pp. 106–116, 2018.

[4] D. Muchadenyika and J. Waiswa, "Policy, politics and leadership in slum upgrading: A comparative analysis of Harare and Kampala," *Cities*, vol. 82, pp. 58–67, 2018.

[5] X. Guan, H. Wei, S. Lu, Q. Dai, and H. Su, "Assessment on the urbanization strategy in China: Achievements, challenges and reflections," *Habitat Int.*, vol. 71, pp. 97–109, 2018.

[6] P. Pellegrini and J. Chen, "Hypothesis of densification for a sustainable urbanization in a wealthy Chinese city," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 588, no. 5, 2020, doi: 10.1088/1755-1315/588/5/052029.

[7] F. Wu, *Planning for Growth: Urban and Regional Planning in China*. 2015.

[8] The State Council, "National New Urbanization Plan of China (2014-2020)," 2014.

[9] M. Chen, W. Liu, D. Lu, H. Chen, and C. Ye, "Progress of China's new-type urbanization construction since 2014: A preliminary assessment," *Cités*, vol. 78, no. AUG., pp. 180–193, 2018.

[10] The State Council, "The Fourteenth Five-Year Plan," 2021. http://www.gov.cn/xinwen/2021-03/13/content_5592681.htm.

[11] B. Chang and L. Chen, "Land Economic Efficiency and Improvement of Environmental Pollution in the Process of Sustainable Urbanization: Case of Eastern China," *Land*, vol. 10, no. 8, p. 845, 2021.

[12] General Office of the State Council, "Guidance of the general office of the State Council on comprehensively promoting the transformation of old urban communities," 2020. http://www.gov.cn/zhengce/content/2020-07/20/content_5528320.htm.

[13] M. M. Fischer, "GIS and network analysis," *Spat. Anal. GeoComputation Sel. Essays*, pp. 43–60, 2006.

[14] H. Jiang, C. Zhou, and R. Xiao, "Spatial differentiation and social equity of public parks in Guangzhou," *City Plan. Rev.*, vol. 4, pp. 43–48, 2010.

[15] G. Aiping and W. Jiangbo, "SD Method Based Street Space Vitality Evaluation," *Planners*, vol. 10, 2011.

[16] I. Franch-Pardo, B. M. Napoletano, F. Rosete-Verges, and L. Billa, "Spatial analysis and GIS in the study of COVID-19. A review," *Sci. Total Environ.*, vol. 739, p. 140033, 2020.

[17] M. Barthélemy, "Spatial networks," *Phys. Rep.*, vol. 499, no. 1–3, pp. 1–101, 2011.

[18] Z. Feng, W. Bo, and C. Yingxue, "China's city network characteristics based on social network space: An empirical analysis of sina micro-blog," *Acta Geogr. Sin.*, vol. 67, no. 8, pp. 1031–1043, 2012.

[19] X. Chen and F. Huang, "Research on Tourism Spatial Structure and Its Optimization: A Network Analysis," *Geogr. Geo-Information Sci.*, vol. 5, 2006.

[20] B. Jiang and C. Claramunt, "Topological analysis of urban street networks," *Environ. Plan. B Plan. Des.*, vol. 31, no. 1, pp. 151–162, 2004.

[21] J. Chen and Z. Chang, "Rethinking urban green space accessibility: Evaluating and optimizing public transportation system through social network analysis in megacities," *Landsc. Urban Plan.*, no. 143, pp. 150–159, 2015.

[22] M. Li, L. Yang, and Y. Wei, "Improved Gaussian based 2-step floating catchment area method: A case study of green space accessibility in Shanghai," *Prog. Geogr.*, vol. 35, no. 8, pp. 990–996, 2016.

[23] A. Van Herzele and T. Wiedemann, "A monitoring tool for the provision of accessible and attractive urban green spaces," *Landsc. Urban Plan.*, vol. 63, no. 2, pp. 109–126, 2003.

[24] Y. Jiang, "A Study on Urban Vitality Measurement and Its Spatial Characteristics—A Case Study of the Main Urban Area of Wuhan," *Urban Manag. Sci. Technol.*, vol. 22, no. 3, p. 4, 2021.

[25] S. Dong and H. Zhang, "Diversity, Richness, Uniformity or Dominance? --A study on the measurement of urban land diversity," 2016.

[26] A. Comber, C. Brunsdon, and E. Green, "Using a GIS-based network analysis to determine urban greenspace accessibility for different ethnic and religious groups," *Landsc. Urban Plan.*, vol. 86, no. 1, pp. 103–114, 2008.

[27] J. Ryan-Collins, T. Lloyd, and L. Macfarlane, *Rethinking the economics of land and housing*. Zed Books Ltd., 2017.

[28] A. Forsyth, J. M. Oakes, K. H. Schmitz, and M. Hearst, "Does residential density increase walking and other physical activity?," *Urban Stud.*, vol. 44, no. 4, pp. 679–697, 2007, doi: 10.1080/00420980601184729.

[29] D. Owen, "Green metropolis: Why living smaller, living closer, and driving less are the keys to sustainability," *Southeast. Geogr.*, 2009.

[30] A. H. Whittemore and T. K. Bendor, "Talking about density: An empirical investigation of framing," *Land use policy*, vol. 72, pp. 181–191, 2018.

[31] N. A. Carbajal Velazco, "New trends in densification projects within the Million Homes Programme areas." Malmö universitet/Kultur och samhälle, 2018.

[32] G. Xu, L. Jiao, M. Yuan, T. Dong, B. Zhang, and C. Du, "How does urban population density decline over time? An exponential model for Chinese cities with international comparisons," *Landsc. Urban Plan.*, vol. 183, pp. 59–67, 2019.

[33] M. Fry, "Green Metropolis: Why Living Smaller, Living Closer, and Driving Less Are the Keys to Sustainability." JSTOR, 2013.

[34] A. Touati-Morel, "Hard and Soft Densification Policies in the Paris City-Region," *Int. J. Urban Reg. Res.*, vol. 39, 2015.

[35] S. Kim, E. Cinn, K. Ahn, S. Kim, I. Chung, and R. Enos, *The FAR Game: Constraints Sparking Creativity: on the Korean Front Line: the Korean Pavilion, Biennale Architettura 2016, May 28-November 27, 2016*. Space books, 2016.

[36] M. Jang and C. D. Kang, "Urban greenway and compact land use development: A multilevel assessment in Seoul, South Korea," *Landsc. Urban Plan.*, vol. 143, pp. 160–172, 2015.

[37] S. Kramer, *Design Solutions for Urban Densification*. Braun, 2018.

[38] D. Broitman and E. Koomen, "Residential density change: Densification and urban expansion," *Comput. Environ. Urban Syst.*, vol. 54, pp. 32–46, 2015.

[39] J. Claassens and E. Koomen, "Housing trends the Netherlands: Urban densification continues," 2017.

[40] K. Hanna, A. Oduwaiye, and P. Redman, "Another Storey: The real potential for estate densification," *Cent. London*, 2016.

[41] E. Denison and G. Y. Ren, "The reluctant architect: an interview with Wang Shu of Amateur Architects Studio," *Archit. Des.*, vol. 82, no. 6, pp. 122–129, 2012.

[42] Li Xinggang, Tan Zeyang, Peng sun, and Fu Bangbao, "Tangshan third space complex," *World Archit.*, vol. 000, no. 003, pp. 150–156, 2017.

[43] C. Meng, "Tendency and Problems of High-rise and High-Volume-Ratio Affordable Housing Construction," 2011.

[44] Ministry of Housing and Urban Rural Development, "Circular on carrying out the first batch of urban renewal pilot work," 2021. http://www.gov.cn/zhengce/zhengceku/2021-11/06/content_5649443.htm.

[45] Ministry of Housing and Urban Rural Development, "China bans 'mass demolition' in urban-renewal projects," *the Xinhua News Agency*, 2021. http://english.www.gov.cn/statecouncil/ministries/202108/31/content_WS612e2a3ac6d0df57f98df726.html.