

Study on the Contribution of Informal Green Space to Urban Green Space Accessibility in Qingdao

Minghui Li*

Qingdao University of Technology, Qingdao 266011, China

*Corresponding author: Minghui Li, 17852408166@163.com

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Abstract: With the continuous improvement of China's urbanization, the upgrading of the living environment and consumption demand by residents has stimulated the development of green urban spaces. To truly benefit the green ecology of residents and promote the ecologically sustainable development of the city, the investigation of this study found that only focusing on formal green space is not effective enough, and informal green space with high contact frequency and diversified types of green space are often ignored. This study sets up two scenarios of whether or not the informal green space system is considered in Qingdao city, and obtains accessibility under two scenarios by constructing a transportation network through ArcGIS. The results show that the accessibility distribution of urban green space is more uniform when informal green space is considered when compared with no consideration for informal green space, which reveals and emphasizes the contribution of informal green space in improving the accessibility of urban green space.

Keywords: Informal green space; Urban green space; Accessibility

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1. Introduction

With the continuous acceleration of urbanization in China today, the rapid expansion of urban space, and the rapid agglomeration of population, problems such as the tightening of demand and resource constraints of urban park green space growth, insufficient supply, and space mismatch have become increasingly prominent^[1]. Urban residents' demand for urban green space is gradually increasing. As a kind of public social resource, urban green space can not only improve the quality of urban residents' living environment but also play an important role in protecting the urban ecological environment^[2]. Therefore, green space, as a valuable resource, should give everyone equal rights to enjoy it, which is mainly reflected in the fairness of different groups of people and the inclusiveness of applicable groups and functional spaces^[3]. It is of practical significance to transform and excavate the landscape value of some unutilized land in the city^[4]. However, due to the high cost of reconstruction, complex ownership, and other problems, it is difficult to further explore and utilize urban green space in the process of urban development.

At present, there is no unified definition of informal green space (IGS). Zhao Li regards the informal space as the extra functional space derived from the urban spatial elements. Dr. Christoph Rupprecht first proposed the concept of IGS in 2014. Informal green space includes any space that has been subject to intense human disturbance and is now occupied by spontaneous vegetation, which is a definite socio-ecological entity whose ownership and management rights are not clear or unified^[5]. Informal green spaces play a vital complementary role in providing environmental, social, and ecological benefits to cities in the process of urban renewal^[6]. At present, low-density large-scale urban green space makes it difficult to meet the convenience needs and sharing needs of urban residents. As a new type of urban green infrastructure, accessible informal green space can help cities realize the beautiful vision of co-construction, co-governance, and sharing^[7-8].

Accessibility is an important index to measure whether the layout of park green space is reasonable, and it can measure the service efficiency of park green space from the perspective of people^[9]. Accessibility of green space refers to the convenience of residents' access to green space, which is related to factors such as distance between residence and green space, scale of green space, transportation mode and time spent, and so on. It can be used to evaluate the potential and level of residents' access to urban green space^[10]. At present, the research on green space accessibility mainly focuses on the following aspects. Researchers are improving green space accessibility by optimizing urban planning and architectural design. Secondly, researchers are studying how green space accessibility affects urban residents' quality of life and mental health. China's indicators of park green space are mostly considered from the macro level, and the indicators mostly start from the park green space area, number, per capita green space, and so on, which cannot fully reflect the service level of park green space^[11].

Therefore, this study analyzes the important role of informal green space in improving the accessibility of green space, analyzes the characteristics of informal green space in Qingdao, and studies the contribution of informal green space to the accessibility of urban green space by setting two conditions, which is whether there is informal green space or not.

2. Regional overview of informal green space in Qingdao

2.1. Status quo of green space construction in Qingdao District

Qingdao administrative area of 11282 km², located in the coastal hilly area, the terrain is high in the east and low in the west, the north and south sides of the convex, the middle of the concave, rich terrain, mountains, forests, fields, islands, and bays. As a beautiful coastal city, Qingdao has attached great importance to the development of urban green space. In recent years, great achievements have been made in the development of urban green space in Qingdao, which has not only increased in number but also made remarkable progress in design, construction, and management. First of all, Qingdao has intensified the construction of urban green space and built several modern parks, such as May Fourth Square, Trestle Park, Signal Mountain Park, and so on. In general, Qingdao has made remarkable achievements in the development of urban green space, providing residents with good places for leisure and entertainment, and making positive contributions to the livable environment of the city. With the improvement of urban planning and people's living standards, it is believed that the development of urban parks in Qingdao will be more beautiful.

2.2. Data sources and research methods

2.2.1. Data sources of green space in Qingdao

Basic geographic information data includes road network data, administrative boundary data, central urban boundary data, POI data, and so on. Among them, the road network data came from the National Geographic

Information Public Service Platform, the central urban boundary data came from the Master Plan of Qingdao City, and the official green space POI data came from the planning cloud open platform, with a total of 669 data obtained. Based on the visual interpretation of remote sensing images of the Autonavi map, the location and scope of formal and informal green space in the study area were determined by combining POI, and the urban green space information database of Qingdao was established.

2.2.2. The green space situation in Qingdao analyzed by ArcGIS

According to the positioning of informal green space in Qingdao by ArcGIS technology, as some informal green spaces are small and scattered, only the formal green space with integrity and independence is targeted, while small and individual informal green spaces are ignored in the research. If there is small and clustered informal green space, it is regarded as available data. The road network of different levels in Qingdao was sorted out, the traffic network was constructed, service areas were built, formal green space points were loaded into the road network, and then the accessibility of different road types in different periods was calculated. IGS data were added together for the network analysis of the service area, and the accessibility charts with IGS data and those without IGS data were obtained for comparative analysis and summary.

3. Results and analysis

3.1. Distribution characteristics of informal green space and formal green space in Qingdao

In terms of regional distribution, the two scenarios are as follows. Informal green space is mainly distributed in urban communities, streets, and residential areas in the form of small parks, green belts, and street trees; while formal green space is mainly distributed in urban areas or suburbs, with large areas and complete facilities, including a variety of large-scale municipal parks, scenic spots and forest parks. From the functional area division, informal green space mainly serves the nearby residents, provides leisure and entertainment places, and facilitates the daily life of citizens; while the formal green space is more to protect the natural scenery, but also has more recreation, activity areas, and facilities. Informal green space and formal green space complement each other in the urban green space system. Informal green space makes the city more green, while formal green space provides a larger area for leisure activities^[12].

3.2. Accessibility analysis of the two scenarios

There are obvious differences in the accessibility of the two scenarios in the study area. **Figure 1** shows the area in each time region without considering IGS. In the whole study area, most (68.59%) of the formal green spaces have extremely low accessibility, while only a few (1.71%) have high accessibility, and the areas with good accessibility are mainly distributed in the city center. It can be seen that there is an extreme and unfair phenomenon in the accessibility of formal green space. After considering IGS (**Figure 2**), the accessibility within five minutes changed from 1.7% to 5.4%. In other periods, the area with good accessibility increased significantly and gradually diversified, the distribution was more extensive and balanced, and the surrounding areas could be involved, instead of the central area dominating. According to the calculation of the area ratio of accessibility in the two scenarios, it can be seen that considering IGS can effectively increase the accessibility of urban green space and provide green infrastructure services for surrounding and remote areas.

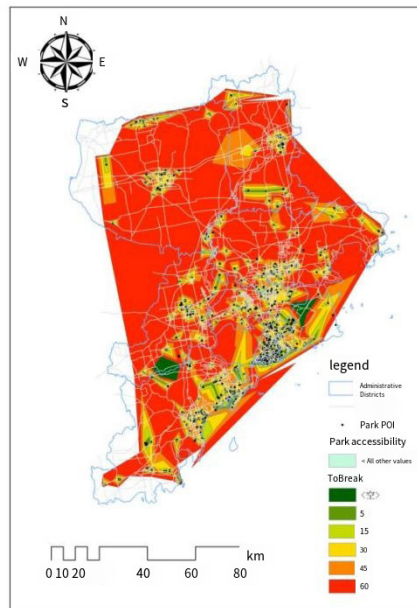


Figure 1. Scenario that does not consider the accessibility of IGS

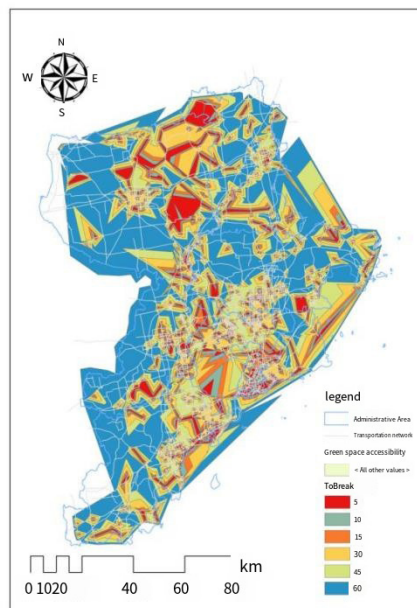


Figure 2. Scenario that considers the accessibility of IGS

3.3. Consider the impact of IGS on the accessibility of urban green spaces

The existence of informal green space increases the supply of green space in the city and fills the shortage of formal green space. These informal green spaces are usually located within the community and closer to residents, making it easier for residents to contact and enjoy green space resources, and improving the accessibility of green space. Informal green space often becomes a place for residents to interact and do activities within the community, such as neighborhood gatherings, leisure walking, and so on. These activities make the community more active, increase residents' demand for green space, and thus improve the accessibility of green space. In conclusion, informal green space has a positive impact on the accessibility of

urban green space. They provide additional green space supply, promote community interaction and activities, improve environmental quality and ecosystem function, and enhance the health and well-being of residents, thus improving the convenience and satisfaction of urban residents in enjoying green space.

3.4. Limitations in the study process

This study is only a shallow study on the contribution of informal green space to urban green space accessibility, and there are still many limitations that need further research and research. The accessibility of informal green space is usually limited by traffic conditions, while management and maintenance are usually undertaken by residents themselves, so there is a lack of unified planning and maintenance process, which will lead to the deficiency of quality in the facilities and equipment of some informal green space, affecting the utilization and accessibility of green space by residents. To sum up, despite some limitations of informal green spaces, they still have a certain positive impact on the accessibility of urban green spaces. To overcome these limitations, it is necessary to strengthen the planning and management of informal green spaces, improve their quality and availability, improve public transportation services in urban fringe areas, public rental housing, residential housing, and urban villages, and reduce social inequity caused by transportation construction ^[13].

4. Summary and outlook

Informal green space is an important carrier to supplement urban green space and improve the equity of green space. It plays many ecosystem service functions such as leisure, recreation, and mitigating storm-flood risk and heat island effect. At the same time, it is necessary to consider the quality of green space construction to better attract and encourage residents to do physical activities, to achieve the goal of improving public health ^[14]. Optimizing the scattered community parks and improving the density and connectivity of the road network can improve the accessibility of green space in Qingdao parks ^[15]. IGS also makes an important contribution to the equity of urban green space accessibility. Its balanced distribution, openness, and freedom, as well as the diversity of landscape design, ensure that all residents can equally enjoy the green space provided by the city. Thus, IGS plays an active role in promoting accessibility and equity in urban green environments.

Disclosure statement

The author declares no conflict of interest.

References

- [1] Wang GJ, 2023, Green Garden, Ecological Civilization: Ecological Garden Construction Contributes to Sustainable Urban Development. *China Forestry Industry*, 2023(8): 26–27.
- [2] Zhang HD, 2022, Research on the Application of Regional Culture in Urban Park Landscape Design. *Green Science and Technology*, 24(13): 44–47.
- [3] Li KY, Lu L, 2021, Spatial Distribution of Urban Green Space Services based on POI Data: A Case Study of Zhengzhou, Henan Province. *Areal Research and Development*, 40(6): 75–80.
- [4] Wu Y, 2023, Discussion on the Comprehensive Renovation Model of “Industrial Transformation to Commercial Transformation” of Old Factories in Guangzhou based on the Perspective of Right Owners. *Research on Urban Construction Theory (Electronic Edition)*, 2023(036): 7–9.
- [5] Feng SS, Kou XL, Chang J, et al., 2022, Urban Informal Green Space: Concept, Type, Value and Renewal Design

Model. *Southern Architecture*, 2022(03): 78–87.

- [6] Yao XJ, Yang SJ, 2023, Research on Comprehensive Evaluation of Green Space System in Urban Built-up Area of Suzhou City. *Journal of Anhui Agricultural University*, 50(4): 649–656.
- [7] Liu S, Fang JJ, Du YX, et al., 2022, Study on Residential Development and Landscape Design of Ecological Town. *Architecture and Culture*, 2022(4): 246–247.
- [8] Zhao NN, Liu YT, Wen H, 2023, Three Action Models for Planning and Coping with Informal Governance in the Renewal of Old Communities. *Urban Planning Forum*, 2023(4): 25–31.
- [9] Zhao XY, 2023, Research on Accessibility of Park Green Space in Harbin City Center based on GIS, thesis, Northeast Forestry University.
- [10] Zhu YY, Wang M, Hu M, et al., 2023, Study on the Accessibility and Optimization Path of Park Green Space in Wuhan. *Journal of Central China Normal University (Natural Science Edition)*, 57(3): 447–456.
- [11] Kou XL, 2023, A Study on the Fairness Improvement Path of Urban Park Green Space based on Informal Green Space: A Case Study of Gulou District, Xuzhou City, thesis, China University of Mining and Technology.
- [12] Zheng Y, 2023, Study on the Utilization Path of Informal Green Space in Mountainous Urban Fringe Area, thesis, Chongqing University.
- [13] Gao XY, 2021, Study on Accessibility of Urban Green Space: A Case Study of Lanzhou, thesis, Lanzhou University.
- [14] Wang S, Cheng LL, Qiu W, et al., 2023, Research on Accessibility of Park Green Space in Jin'an District of Fuzhou City based on Multi-source Data. *Journal of Northwest Forestry University*, 38(1): 257–265.
- [15] Wang YX, 2020, Analysis on the Influence of Road Network Form and Road Network Density on the Accessibility of Urban Park Green Space, thesis, Shenyang Agricultural University.

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