Original Research Article

Econometric study on optimal allocation of regional leisure and recreation space

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Abstract: As urbanization speeds up and social economy booms, leisure and recreation demand soars. Using econometrics, this study examines enhancing regional leisure and recreation space layouts to cater to growing public leisure and recreation needs. Based on the empirical research of several representative cities and the professional application of geographic information system (GIS), this study casts an econometric framework for the allocation of leisure and recreation. The results show that factors such as population density, transportation accessibility and green space area significantly affect the frequency of leisure and recreation use and user satisfaction. In view of this, the paper puts forward specific strategies to optimize the layout of leisure and recreation space, including balanced allocation of leisure and recreation space, improving traffic conditions, increasing green space, providing diversified facilities, extending opening hours, encouraging public participation and establishing continuous monitoring and evaluation mechanism. This research not only draws a solid theoretical foundation for urban management, but also provides a reference for administrative agencies to make decisions, so as to guide the formulation of optimal strategies for leisure and recreation space. Therefore, it is expected to significantly improve the service efficiency and utilization rate of leisure and recreation venues, further ensure that the leisure and recreation needs of urban and rural residents can be fully satisfied, and further promote the balanced development of the city and the gradual growth of social welfare.

Keywords: Regional leisure and recreation space; Optimal configuration; Measurement study; Utilization rate

1. Introduction

With the growth of economy and the improvement of residents' income, leisure and recreation are becoming more and more popular. Leisure and recreation refers to an individual being in a state of freedom, involved in personal interests, and free from any constraint or pressure to experience. Leisure and recreation activities emerge as crucial for stress relief, enhancing quality of life, and preserving public mental & physical well-being. However, in the process of urban expansion, due to the rare nature of land resources and the imbalance of their application, the layout of leisure and recreation sites often fails to meet the expanding expectations of citizens[1]. Therefore, how to properly arrange leisure and recreation areas in the narrow urban geographical scope, in order to meet the dual goals of responding to the needs of citizens' leisure and recreation as well as promoting the coordinated development of urbanization and rural areas has become the core issue to be solved in urban planning and governance.

Urban leisure and recreation space, a key component of the public sphere, actually plays a stage for citizens to relieve pressure and strengthen community interaction. The layout of high-quality leisure and recreation atmosphere plays a significant role in improving the happiness of residents' lives, contributing to the establishment of social harmony and progress, and further consolidating the charm and competitive advantage of the city[2]. However, the layout of leisure and recreation space in China demonstrates the drawbacks of imbalanced distribution, functional restrictions and aging facilities, which significantly constrain the full exertion of leisure and recreation space efficiency and considerably undermine the quality of service.

Based on this background, this paper aims to analyze the core factors that determine the layout of leisure and recreation space by means of quantitative exploration, and develop a set of optimization strategies accordingly. Specifically, this paper intends to investigate the current situation of leisure and recreation space in typical urban suburbs, analyze the allocation of leisure and recreation space by means of geographic information system (GIS), establish a quantitative model to evaluate the efficiency of leisure and recreation space layout, and identify the factors that play a key role in the efficiency of leisure and recreation layout. Finally, this study is anticipated to present a scientific proposition to the Urban Planning Department, with the aim of optimizing the planning of leisure and recreation space, thereby enhancing the satisfaction of citizens' leisure and recreation activities.

2. Literature review

As a form of urban public space, the optimal allocation of leisure and recreation space involves knowledge of multiple disciplines, including urban geography, urban planning, landscape ecology, etc.[3]. Urban geography focuses on the internal spatial structure and its evolution law, and maintains that a reasonable urban spatial layout can promote social and economic development. Urban layout design focuses on the strategic conception and regulation of urban spatial expansion and evolution trend. The field of ecological landscape studies the dynamic overlapping effects between nature and human-built environment, emphasizing the maintenance of harmonious symbiosis of ecological environment in the process of urban evolution. Research has confirmed that quality leisure and recreation areas play a decisive role in improving people's life satisfaction. Specifically, public green Spaces have been shown to be effective in relieving mental tension and enhancing physical well-being. Interactions that are simultaneously integrated into the natural environment have been found to have positive benefits for alleviating cognitive load. In addition, leisure and recreation areas play an indispensable function in social communication, which helps to consolidate the unity of the community.

In the exploration of factors influencing the allocation of leisure and recreation space, numerous researchers concur that elements such as population density, transportation accessibility, and green areas are considered decisive[4]. Areas with a high population density frequently give rise to a more significant demand for the construction of sufficient leisure and recreation facilities to satisfy the escalating leisure and recreation requirements of residents. The convenience of traffic is the regulator of the accessibility and efficiency of leisure and recreation space. The breadth of green space not only affects the number of leisure and recreation sites, but also deeply relates to the level of leisure and recreation quality. On accounting of this, a considerable number of targeted strategies have been put forward to address the challenges in the allocation of leisure and recreation space. For instance, it is advocated to incorporate the establishment of small parks and open plazas in urban planning, and further augment the green space per capita coverage.

Based on the above literature review, this study proposes the following hypotheses:

a) In a densely populated area, there should be more spaces for leisure and recreation.

b) Enhancing traffic accessibility in the vicinity of leisure and recreations can considerably augment the frequency of utilization of leisure and recreation spaces.

c) Increasing green space can significantly improve the quality and attractiveness of leisure and recreation space.

Despite elaborate reports on the layout of leisure and recreation spaces[5], limitations persist. It is notable that prior studies have predominantly focused on prosperous cities, while disregarding systematic deliberations

on developing regions. Additionally, qualitative assessment is abundant, yet quantitative analysis is scarce. The analysis of the distinctive leisure and recreation space requirements of various individuals is inadequate, and there might be a risk of "uniform treatment" allocation that neglects individual distinctions..

Through this study, we will try to fill the above research gaps and provide a more comprehensive and in-depth understanding for the optimal allocation of leisure and recreation space.

3. Research method

3.1. Method

A representative metropolis was studied, collecting data on key indicators. Official stats analyzed social characteristics (population, age, gender). Field surveys & remote sensing mapped leisure and recreation facilities' coordinates, area, types. Traffic infrastructure layer detailed road network. A questionnaire surveyed residents' perception, satisfaction, & suggestions on leisure and recreation space use.

Multiple linear regression model was used to explore the main factors affecting the allocation of leisure and recreation space. The basic form of the model is as follows:

$$Y=\beta 0+\beta 1X1+\beta 2X2+...+\beta nXn+\epsilon$$

$$Y'=\beta 0'+\beta 1'X1+\beta 2'X2+\beta 3'X3+\epsilon'$$

Where Y is the dependent variable. Y and Y' respectively represent the utilization rate and satisfaction of leisure and recreation space. X_i (i=1,2,... n) represents the independent variable, $X1$ represents the population density, $X2$ represents the accessibility of traffic, $X3$ represents the green space area, and$\beta 1$ is the coefficient of the corresponding independent variable, representing the influence strength of the independent variable on the dependent variable. β1 ,(i=0,1,2,3i=0,1,2,3) are the regression coefficients, and ϵand ϵ′ are random error terms that reflect what the model fails to account for.

3.2. Model interpretation

The variable (Y) -- leisure and recreation utilization frequency can be quantitatively evaluated according to the actual use of leisure and recreation by respondents in the past period. Satisfaction was rated using a five-point Likert scale ranging from 1 (extremely dissatisfied) to 5 (extremely satisfied).

Independent variable (X_i) : Population density (X_1), calculating the number of people per unit area, expressed as the number of people per square kilometer. Transportation accessibility (X_2), using the distance from the leisure and recreation to the nearest bus station as an indicator, the shorter the distance, the more convenient the transportation. Green area (X_3), the total area covered by green vegetation in leisure and recreation was measured by GIS software. Other control variables (X_4... X_n), such as the types of facilities and opening hours of leisure and recreation may also affect its use, so these variables are included in the model as control variables.

The coefficients of multivariable linear regression framework were deduced by least squares estimation (OLS), and the significance and good fit of the model were investigated by statistical analysis methods such as t test and F test. At the same time, the application of multicollinearity diagnostic techniques such as variance inflation factor (VIF) detection to explore the degree of correlation between independent variables can ensure the robustness of the stock model.

4. Discuss

4.1. Technical level

Through empirical investigation, this paper illustrates the factors that shape the layout of leisure and recreation and their far-reaching effects on citizens' leisure and recreation. The data reveal that the degree of population agglomeration, the convenience of transportation and the proportion of green open space are the decisive parameters of the utilization frequency of constructed leisure and recreation and user satisfaction. Specific observation shows that high population density areas are often accompanied by more frequent utilization of leisure and recreation, which proves the necessity of adding leisure and recreation facilities in high population settlements, so as to fully respond to the leisure and recreation needs of residents. On the other hand, the lack of traffic accessibility has been proved to significantly weaken the acceptance rate and user satisfaction of leisure and recreation, indicating that when we construct leisure and recreation places, we must consider the existing traffic infrastructure comprehensively, adjust and strengthen the network, so as to enhance the accessibility of leisure and recreation. In addition, the expansion of green space directly benefits leisure and recreation experience. The expansion of green space not only helps to enhance the affinity between people and nature, but also improves the overall quality of leisure and recreation areas and prevents potential impacts on the quality of leisure and recreation.

Although this study has made meaningful findings, there are still some limitations: the selected urban areas may not fully represent the allocation of leisure and recreation across the country or even around the world, so the universality of the research conclusions needs to be further verified. Due to the difficulty and cost of data collection, there may be some biases or omissions, especially the reliability of subjective evaluation data needs to be further strengthened. Although this study adopted a multiple linear regression model, leisure and recreation allocation is a complex systematic project involving more potential influencing factors, such as socio-economic status and cultural background, which were not fully considered in this study.

In order to overcome the limitations of existing research, future research can be carried out from the following aspects:

a)Multi-scale research: In addition to continuing the research on the urban scale, it can also be extended to a wider range of spatial scales, such as urban agglomeration, national and even international comparison, to explore the characteristics of leisure and recreation allocation in different regions and the reasons behind it.

b) Dynamic change analysis: The demand for leisure and recreation changes with time. Future studies can consider introducing a time dimension to analyze the changing trend of leisure and recreation allocation along with social development and technological progress.

c)Interdisciplinary cooperation: Leisure and recreation allocation involves urban planning, geographic information science, social psychology, and other disciplines. Future inquiry depends on deepening multidisciplinary dialogue and collaboration, which will bring together strategies and technical tools to further achieve a more three-dimensional understanding of the phenomenon.

d)The penetration of emerging technologies. Along with the rise of cutting-edge technologies such as big data analytics and artificial intelligence, these innovative tools enable the capture of rich and diverse real-time and accurate information, further significantly improving the accuracy and effectiveness of research.

4.2. Policy suggestion

The principle of balance must be upheld in layout design. When planning leisure and recreation venues, it is necessary to take into account the densely populated areas in each area and ensure that the layout of rest areas is evenly distributed to prevent the situation that there is a lack of leisure and recreation facilities in other areas. The issue of enhanced accessibility cannot be ignored. It is urgent that we focus on upgrading the transport infrastructure around the leisure and recreation areas, especially to promote the improvement of the public transport system, so as to enhance the accessibility of these areas. At the same time, the expansion of green ecology is also key. On the material basis of the existing leisure and recreation places, increase the green space coverage and enhance the environment beautification, which can create a more comfortable and pleasant leisure and recreation micro-environment. Public engagement is crucial to optimizing public space. Encourage the public to participate in the planning and maintenance of leisure and recreation areas, learn their insights and suggestions, and further make the open space more suitable for the actual needs of citizens. Moreover, the establishment and maintenance of a permanent monitoring system for leisure and recreation land, the implementation of periodic reviews of the service quality and resource utilization of the leisure and recreation area, in order to timely calibrate and optimize the allocation of resources, which should not be ignored.

5. Conclusions

After empirical analysis of typical urban leisure and recreation allocation, some key factors determining its use efficiency and user satisfaction are obtained. The study revealed that the utilization rate of leisure and recreation and public satisfaction showed obvious advantages in areas with high population aggregation. At the same time, the improvement of traffic convenience plays a decisive role in strengthening the accessibility and frequency of leisure and recreation. In addition, the expansion of green space in leisure and recreation is proportional to the active use of leisure and recreation and user satisfaction. What should not be ignored are the richness and opening hours of leisure and recreation facilities, both of which are important factors in the evaluation factors. In view of this, urban planning strategies should focus on the fair distribution of public space, especially in densely populated areas, to increase the physical scope and quantity of leisure and recreation. Optimize adjacent transportation infrastructure simultaneously. The increase of greening ratio is also the meaning of the problem. The diversity of facilities and services, as well as the extended opening hours, all contribute to enhancing the user experience. Direct public involvement, including the process of co-designing and maintaining public spaces, is also a strategy worth pursuing. To ensure the lasting effectiveness of these improvements, it is essential to establish a framework for continuous monitoring. Such practice will systematically improve the planning of leisure and recreation, enhance service quality and efficiency, further better respond to the expectations of the public, and enhance the balance and harmony of the city. In the future, it may be possible to follow the exploration method of multi-case in-depth comparison and time lapse, and make good use of emerging technologies to build a scientific optimization path for leisure and recreation allocation.

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