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Research on the Evaluation and Strategies of Aging-Oriented Renovation of Farmers' Markets in Old Communities under the Background of Population Aging

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Abstract. In recent years, China's population aging has accelerated, requiring higher standards for an aging-friendly society. As a key part of urban renewal, supporting farmers' markets in old communities, due to long construction time, aging facilities and poor management, can hardly meet the elderly's demands for safe, convenient and comfortable shopping.Taking these farmers' markets as the research object, this paper constructs an aging-friendly evaluation system with 4 criterion-level indicators (environmental comfort, spatial safety, layout rationality and functional convenience) and 18 indicator-level indicators. Using the analytic hierarchy process (AHP) to determine indicator weights, it conducts empirical analysis on three typical case markets in Guanshan Subdistrict, Hongshan District, Wuhan through field research and questionnaires.Results show that spatial safety and related indicators are the primary dimensions for aging-oriented renovation; indicators such as barrier-free design, acoustic environment and resting facilities perform poorly, revealing shortcomings in current aging-friendly construction. Based on the evaluation, the paper puts forward improvement strategies including acoustic environment control, resting facility allocation and business format optimization, aiming to improve market conditions, enhance aging-friendly level and provide references for aging-friendly practice in urban renewal.

Keywords: Urban renewal, farmers' markets in old communities, aging-friendly evaluation system, analytic hierarchy process (AHP)

1. Introduction

Since the 21st century, China has witnessed a large-scale and rapid development of population aging, which has become a basic national condition. By the end of 2024, the population aged 60 and above exceeded 300 million for the first time, accounting for 22% of the total population; it is projected to surpass 400 million around 2033 [1]. The State Council has issued documents such as the Medium and Long-Term Plan for the National Active Response to Population Aging and the Opinions on Developing the Silver Economy and Improving the Well-being of the Elderly, requiring the construction of age-friendly living environments for the elderly, the expansion of elderly care service scenarios, and the promotion of the construction of age-friendly facilities in communities.

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At present, China's urban construction has shifted to stock renewal [2], with old communities becoming the focus of urban renewal. These communities are generally plagued by problems such as aging facilities and inadequate supporting amenities. As an important venue for the daily activities of the elderly [3], community farmers' markets in old communities often fail to meet barrier-free and age-friendly requirements due to their long construction history and inadequate management, and even pose potential safety hazards.

Taking farmers' markets in old communities as the research object, this paper extracts the evaluation elements of age-friendly renovation, analyzes the interactive relationship between markets and the elderly through field research, and identifies the urgent problems to be solved in the construction of age-friendly environments. With the core goal of enhancing inclusiveness and improving the age-friendly level of services and facilities, targeted improvement strategies are proposed in this paper.

Figure 1. Growth trend of the elderly population in China

2. Construction of an aging-friendly evaluation system for farmers' markets in old communities

2.1. Construction of an aging-friendly evaluation system for farmers' markets

This paper collates and classifies the common concerns of this research topic, forming four research dimensions: environmental comfort, spatial safety, layout rationality and functional convenience. On this basis, it further summarizes the detailed elements, and finally develops an evaluation system consisting of 4 criterion-level indicators and 18 secondary indicators.Within the framework of the analytic hierarchy process (AHP), this paper designs a judgment matrix questionnaire, and distributes it to experts in the major and related fields to collect data on the importance of each indicator in the evaluation system. The weight of each indicator is obtained through calculation, which provides a reference for understanding the importance of each indicator and calculating the subsequent comprehensive satisfaction.

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2.1.1. Calculation of indicator weights in the AHP evaluation method

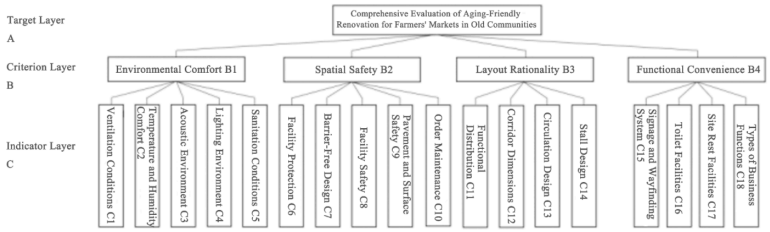

Figure 2. Aging-friendly evaluation system for farmers' markets in old communities

Judgment matrices are constructed based on the indicator system. Experts who completed the questionnaires made importance judgments on the pairwise comparisons of all secondary indicators at the lower level of the same primary indicator in light of their theoretical knowledge and practical experience, and quantified the judgments into the matrices using the 1-9 scaling method.

After the construction of the judgment matrices, the data from the expert questionnaires were analyzed. This paper used the SPSSPRO platform to design, collect the questionnaires and complete the relevant calculations.The specific indicator framework is illustrated in Figure 2.

2.1.2. AHP based indicator weight collation results

Table 1. Rules to format sections

Primary Indicator	Weight of Primary Indicator	Secondary Indicator	Weight of Secondary Indicator
B1Environmental Comfort	23.8203%	C1 Ventilation Conditions	8.5926%
		C2 Temperature and Humidity Comfort	3.5467%
		C3 Acoustic Environment	1.5119%
		C4 Lighting Environment	3.4505%
		C5 Sanitation Conditions	6.7186%
B2 Spatial Safety	48.9877%	C6 Facility Protection	18.8430%
		C7 Barrier-Free Design	4.7661%
		C8 Facility Safety	12.7529%
		C9 Pavement and Surface Safety	8.2111%
		C10 Order Maintenance	4.4147%
B3 Layout Rationality	16.5970%	C11 Functional Distribution	5.8734%
		C12 Corridor Dimensions	2.6409%
		C13 Circulation Design	5.5410%
		C14 Stall Design	2.5327%
B4Functional Convenience	10.5950%	C15 Signage and Way finding System	3.9778%
		C16 Toilet Facilities	4.0437%
		C17 Site Rest Facilities	0.8614%
		C18 Types of Business Functions	1.7121%

Indicator weights are ranked based on the weight summary.

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2.2. Case selection for aging-friendly evaluation of farmers' markets

The research cases are selected from Guanshan Subdistrict, Hongshan District, Wuhan. Founded in 1958, the subdistrict once had numerous industrial enterprises, research institutions, universities and government agencies, which built many supporting residential areas last century—many of these old communities still exist today.

Interwoven with modern urban buildings and lacking sound planning, these old communities make the aging-friendly renovation of supporting facilities like farmers' markets particularly complex. Data from the Seventh National Population Census shows Guanshan Subdistrict has a permanent population of 297,999, with 21,804 people aged 65 and above, accounting for 7.31% of the total—2.35 percentage points higher than 4.96% in 2010, exceeding the aging standard.

The elderly population density is higher and the aging phenomenon is more prominent in these old communities. Traditional community farmers' markets and old communities have always formed an interdependent relationship. Guanshan Subdistrict boasts a large number of community farmers' markets with wide coverage and a high proportion of elderly customers, which provides a solid foundation for the case comparison and selection of this research.

2.3. Basic information of the cases

Huazhong University of Science and Technology (HUST) Farmers' Market is located at No.1037 Luoyu Road, Hongshan District, Wuhan, under Guanshan Subdistrict. Surrounded by HUST communities built in the 1970s and 1980s with a high elderly population ratio, over 70% of its weekday visitors are the elderly (Figure 3) .

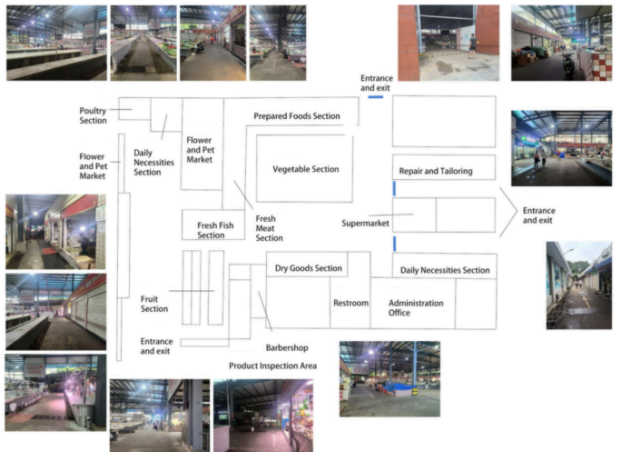

Figure 3. Layout plan and field photos of Huazhong University of Science and Technology Farmers' Market

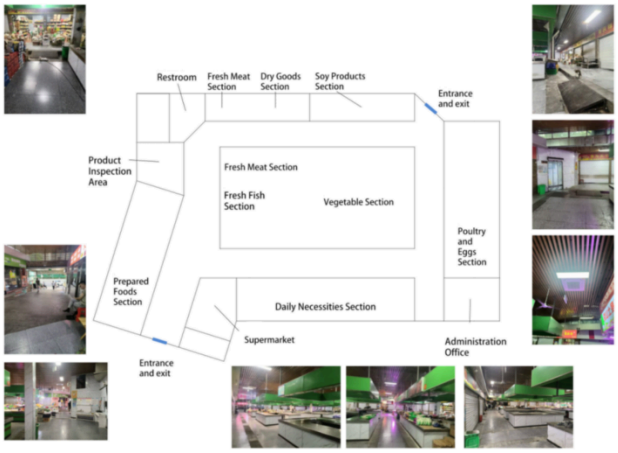

Figure 4. Layout plan and field photos of Luxiang Fresh Produce Market

Luxiang Fresh Produce Market is located at No.718 Luoyu Road, Hongshan District, Wuhan City, under the jurisdiction of Guanshan Subdistrict, serving Community 709, Bishui Community and Zisong Garden Residential Quarter. The surrounding area is an interweaving of new and old residential communities, with over 50% of the visitors being the elderly（Figure 4）.

Guanshan Fresh Food Market is located in Optics Valley Youth City at No.5 Xinzhu Road, the intersection of Xiongzhuang Road and Xinzhu Road, under the jurisdiction of Guanshan Subdistrict. It is surrounded by multi-storey residential quarters, with about 30% of the visitors being the elderly.

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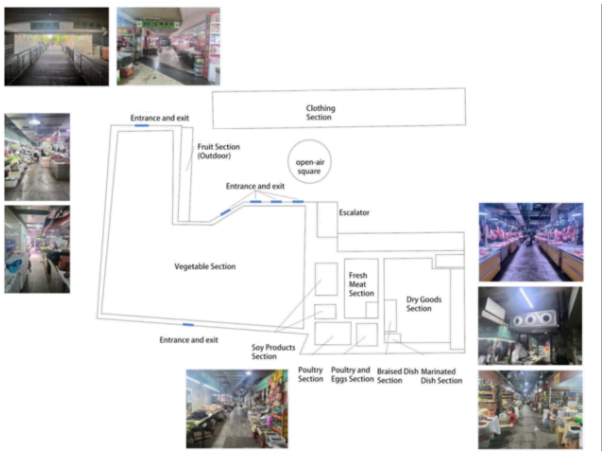

Figure 5. Layout plan and field photos of Guanshan fresh food marketunderground first floor

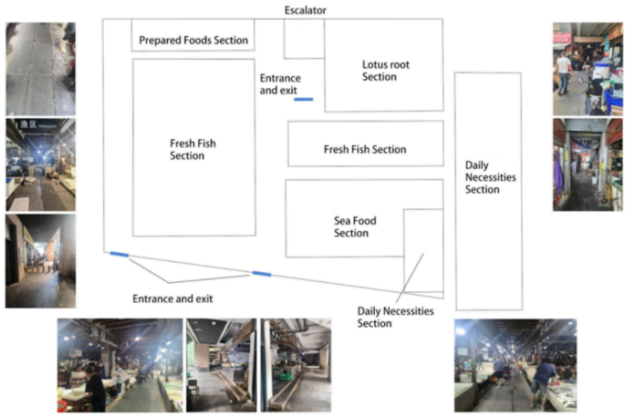

Figure 6. Layout plan and field photos of Guanshan fresh food marketfirst floor

2.4. Questionnaire design

The research was carried out around the aging-friendly evaluation system: the market's spatial pattern, functional zoning, circulation, entrances and exits, pavement, lighting and ventilation, signage, toilet and rest facilities were recorded through field visits, and the activities of the elderly and the obstacles they encountered were observed. A face-to-face interview method was adopted to collect questionnaire information from people aged 60 and above, and their satisfaction with aging-friendly indicators was quantified using a Likert scale. A total of 143 questionnaires were distributed in the survey, with 127 valid ones recovered (an effective rate of 88.81%). Verified by the SPSSPRO platform, the questionnaire had a Cronbach's α coefficient of 0.77 for reliability, a KMO value of 0.734 for validity, and a p-value of 0.000 for the Bartlett's Test of Sphericity, indicating that the data quality was acceptable.

3. Analysis of aging-friendly performance of farmers' markets in old communities

This chapter analyzes the indicator weight and public satisfaction data collected in the previous chapters to obtain the comprehensive scores of each indicator of the cases, thus realizing the combination of the importance of indicator dimensions from the expert perspective and the aging-friendly influencing factors concerned by the public. Based on the comprehensive scores of indicators, this chapter further interprets the data differences of the markets in each case by combining the specific situations learned from field investigations and interviews, laying a foundation for the analysis of aging-friendly renovation strategies in the subsequent chapters.

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3.1. Analysis of basic data

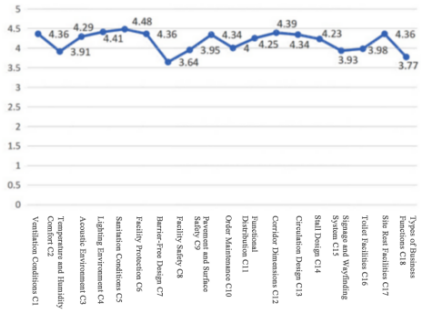

Figure 7. Satisfaction survey results of Huazhong University of Science and TechnologFarmers' Market

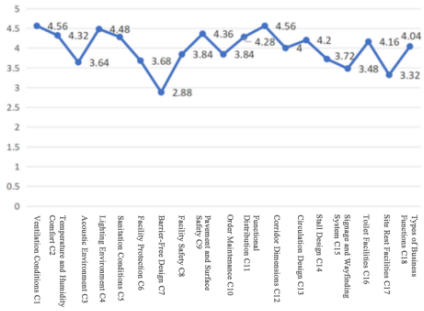

Figure 8. Satisfaction survey results of Luxiang Fresh Produce Market

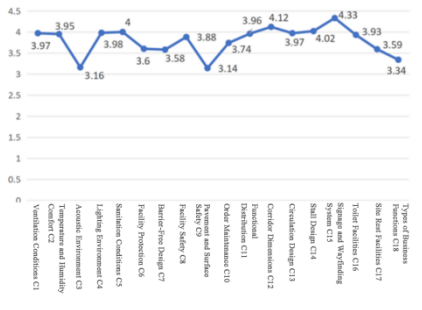

Figure 9. Satisfaction survey results of Guanshan Agricultural and Sideline Products Fresh Produce Market

The satisfaction survey results for the three case markets are presented in Figures 7, 8, and 9 respectively.All three cases scored relatively high in C4 Lighting Environment, whose configuration basically meets the elderly's daily shopping needs. C1 Ventilation Conditions also got high scores overall: the three markets addressed ventilation and air exchange in high-traffic, large spaces through ceiling structures, indoor air conditioners and exhaust fans respectively.

C12 Corridor Dimensions performed well too, with organized circulation and passageways sufficient for peak-hour traffic. The elderly rated C5 Site Sanitation Conditions highly, mainly due to high cost performance and convenience, while sanitation was not their top concern. Sanitation management should be improved within the scope of vendors' affordability and market funding.

C7 Barrier-Free Design performed poorly, showing deficiencies in all case markets and insufficient consideration for the elderly and disabled. C3 Acoustic Environment scored low due to enclosed spaces, equipment noise and lack of sound absorption designs. C17 Site Rest Facilities (corrected per the indicator system) had low ratings, indicating inadequate rest facilities failing to meet the elderly's shopping rest needs. C6 Facility Protection also scored unsatisfactorily, with insufficient protection measures, possibly because market design and operation prioritize functionality over detailed protection.

3.2. Expert weight description

This paper obtains the weights of each indicator in the evaluation system for aging-friendly renovation of farmers' markets in old communities. Through comparative analysis of the weights, the indicator dimensions that need to be focused on in the aging-friendly renovation of farmers' markets can be identified, which provides a basis for distinguishing renovation priorities and optimizing resource allocation.

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3.2.1. Analysis of criterion layer weights

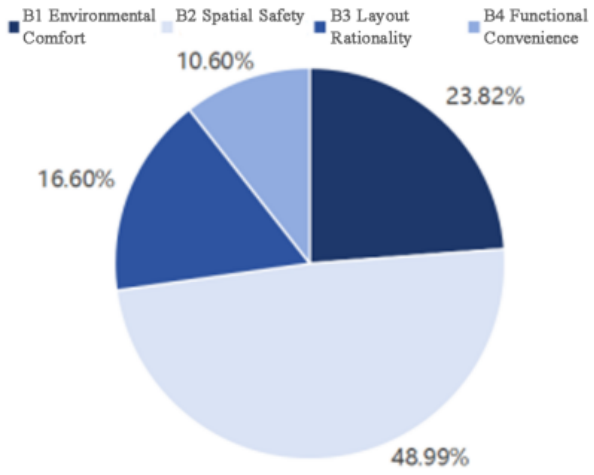

Figure 10. Weights of the criterion layer in the aging-friendly evaluation system for farmers' markets in old communities

The weight of B2 Spatial Safety is significantly higher than that of other indicators, so ensuring the safety of the elderly during shopping and the operational safety of the market is the primary requirement for aging-friendly renovation. B1 Environmental Comfort reflects special consideration for the specific needs of the elderly group. As factors that improve the shopping experience of the elderly, B3 Layout Rationality and B4 Functional Convenience should be considered on the premise that the above two high-weight indicators are satisfied.

3.2.2. Analysis of indicator layer weights

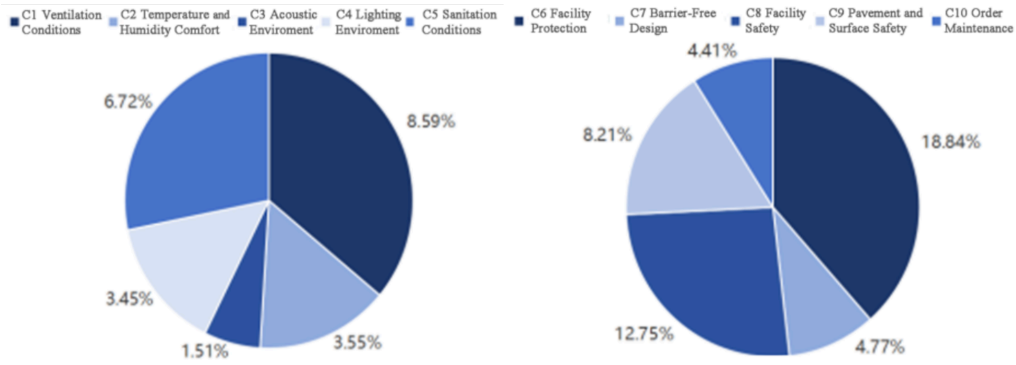

Figure 11. Weights of the indicator layer for environmental comfort and spatial safety

In the dimension of Environmental Comfort, the weights of C5 Site Sanitation Conditions and C1 Ventilation Conditions are significantly higher than those of other indicators. In the dimension of Spatial Safety, the weights of C6 Facility Protection and C8 Facility Safety are significantly higher than those of other indicators. The weight of Pavement and Surface Safety is also relatively high, which reflects the risks of collisions and falls for the elderly due to their poor balance ability, and demonstrates the attention to safety from the expert perspective [4].

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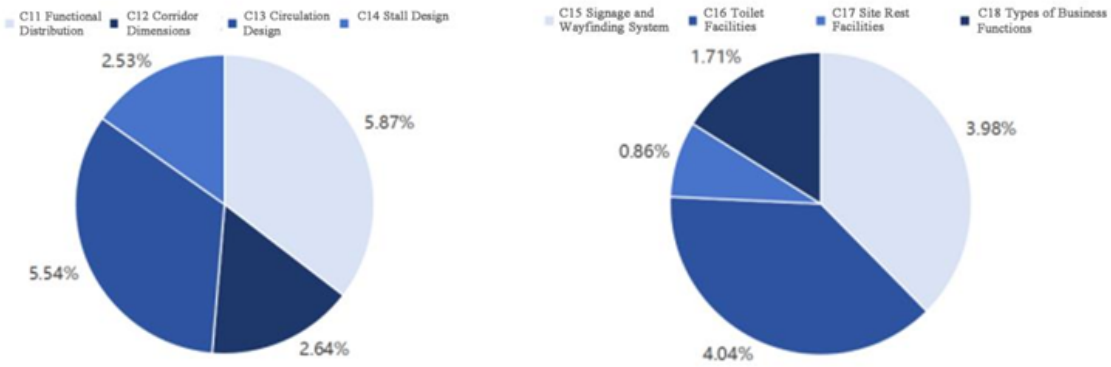

Figure 12. Weights of the indicator layer for layout rationality and functional convenience

In the dimension of Layout Rationality, the weights of C11 Functional Distribution and C13 Circulation Design are significantly higher than those of other indicators. These two indicators jointly form the activity flow of the elderly during their consumption in farmers' markets, reflecting the experts' attention to the exertion of market functionality and the convenience of the elderly's activities.

Among all 18 indicators, the top five in terms of weight are Facility Protection (18.84%), Facility Safety (12.75%), Pavement and Surface Safety (8.21%), Ventilation Conditions (8.59%), and Site Sanitation Conditions (6.72%) in sequence. The total weight of these indicators reaches 55.11%. This result proves that aging-friendly renovation should prioritize the fields such as safety protection and basic environmental quality to ensure the safety of the elderly's activities. Among the remaining indicators, the indicator dimensions that play a role in improving the functional efficiency of the market should have a higher priority than those for maintaining environmental comfort and enhancing the shopping experience.

3.3. Analysis of aging-friendly level of farmers' markets based on comprehensive scores

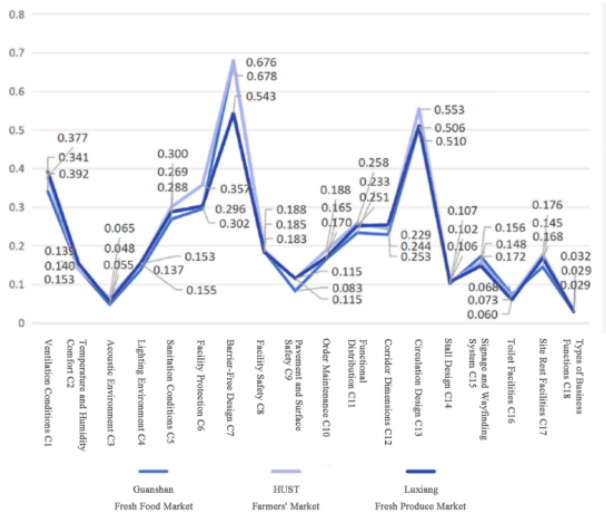

Figure 13. Comprehensive scores of each aging-friendly evaluation indicator

In the Layout Rationality dimension, C11 Functional Distribution and C13 Circulation Design have significantly higher weights than other indicators. These two indicators jointly shape the

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elderly's activity flow in farmers' markets, reflecting experts' focus on market functionality and the elderly's activity convenience.

Among the 18 indicators, the top five by weight are Facility Protection (18.84%), Facility Safety (12.75%), Pavement and Surface Safety (8.21%), Ventilation Conditions (8.59%), and Site Sanitation Conditions (6.72%), with a total weight of 55.11%. This shows aging-friendly renovation should prioritize safety protection and basic environmental quality to ensure the elderly's activity safety.For other indicators, those improving market functional efficiency should take higher priority than those for environmental comfort and shopping experience. Aging-friendly renovation should first eliminate environmental safety hazards, then optimize functional layout and convenience, and finally enhance shopping comfort.

4. Aging-friendly improvement strategies for farmers' markets in old communities

Focusing on the shortcomings exposed in the comprehensive scores, this chapter identifies several indicator dimensions with high renovation value and urgency based on the data analysis results in the previous chapters, conducts specific analysis on them, and proposes improvement strategies.

4.1. Analysis of acoustic environment indicator and improvement strategies

Based on the weighted average method, the comprehensive scores of each case are calculated by combining the satisfaction of the elderly group with the weight of each indicator. The results show that the overall aging-friendly level of the case market is moderate. Among them, the scores of safety indicators are relatively high, while the scores of functional supporting facilities and environmental comfort need to be improved. The specific performance is that the safety protection facilities are relatively complete, but the barrier-free facilities and rest supporting facilities are insufficient, and the environmental hygiene and noise control need to be further optimized.

It should be noted that the above improvement strategies and analysis content are closely combined with the actual situation of the case market, and fully consider the actual operability and economic rationality, so as to ensure that the improvement measures can effectively solve the existing problems and meet the aging-friendly use needs of the elderly group.

4.2. Analysis and strategy of venue rest facilities indicator

Venue rest facilities refer to rest areas and facilities in community farmers' markets. This indicator ranks the lowest in the evaluation system, showing insufficient consideration for the elderly's physical needs and lack of humanistic care in market construction.

The prominent problems of these facilities are: serious shortage in quantity (many markets have none); random layout ignoring the elderly's behaviors and activity routes; non-standard facilities with poor maintenance, unreliable quality, incomplete functions and unreasonable dimensions; and lack of social attributes failing to meet the elderly's rest and communication needs.

Transformation should first focus on spatial layout: consider the elderly's needs and activity routes, set rest facilities at entrances/exits, middle sections of long passages and crowded areas, add seats in aquatic and meat store waiting areas, and open a special rest area with barrier-free design and supporting services like drinking water and medical supplies if possible.

In addition, focus on facility quality and form: design in line with the elderly's physical characteristics with appropriate seat height and comfort; add soft packs or rounded corners to avoid collisions; use soft, durable, non-toxic and anti-slip materials to reduce fall risks [5].

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4.3. Analysis and strategy of corridor dimension indicator

The corridor dimension indicator reflects community farmers' markets' passage width configuration, which should be adjusted per standard specifications based on pedestrian flow density, passage classification and spatial layout.Community farmers' markets often neglect barrier-free design and population aging. In case markets, loose corridor management leads to vendor road occupation, mixed pedestrian and vehicle traffic, and random goods stacking, increasing passage complexity and failing to meet the elderly's travel needs.

Improvement strategies focus on rectifying corridor width per standards. According to the Ministry of Housing and Urban-Rural Development's "Barrier-Free Design Specifications", main passage width should be no less than 2.5 meters (preferably ≥ 3 meters), and secondary passage no less than 1.5 meters (≥ 1.2 meters for barrier-free needs) to meet the elderly and wheelchair users' demands [6]. Waiting areas can be appropriately widened; operators must define business boundaries, eliminate road occupation and stacking, ensure pedestrian-vehicle separation, and reduce safety hazards from corridor occupation.

4.4. Analysis and strategy of business type and functional category indicator

The business type and functional category indicator represents the service capacity of the community farmers' market, and its low score in the comprehensive evaluation reflects insufficient service functions, business types and supply products, which fail to meet the elderly's daily needs. Community farmers' market business types can be divided into basic, auxiliary and additional functions [7]. Basic functions include core sales services (meat, vegetables, fruits, etc.), which all case markets have adapted to their scale and residents' needs. Auxiliary functions involve market operation (management, sanitation, sampling inspection, etc.), which may be inadequate in long-term operation. Additional functions (electromechanical maintenance, tailoring, catering, etc.) improve convenience and space quality but account for a small proportion in case markets, with some markets lacking them entirely. Optimization should focus on the local elderly's needs. Basic functions should align with their consumption habits; auxiliary functions should meet construction standards and focus on the elderly's special needs; additional functions can expand convenience, catering and social spaces based on sales functions to better serve the elderly.

4.5. Analysis and strategy of barrier-free design indicator

The barrier-free design indicator reflects the inclusiveness of the market's space, facilities and services for the elderly with disabilities, which can effectively assist the elderly with limited mobility and should be fully configured [8]. This indicator ranks relatively low in the comprehensive score, showing that all case markets have deficiencies in barrier-free design and insufficient consideration for the needs of the elderly with limited mobility.In terms of spatial layout, the case markets have height differences but lack wheelchair ramps and other barrier-free facilities [9]; internal passages are occupied, failing to meet the travel needs of the elderly with limited mobility, and there are no barrier-free parking spaces or toilets. In terms of service management, the market management lacks barrier-free awareness, with no corresponding measures for communication, service and emergency handling for the disabled.

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5. Conclusions and prospects

5.1. Study conclusions

This study focuses on the aging-friendly construction of farmers' markets in old communities under the background of aging and urban renewal. Based on the construction of an evaluation system, it conducts an empirical study on three cases in Guanshan Subdistrict, Wuhan City. The research finds that safety and basic environmental quality are the fundamental prerequisites for aging-friendly construction, and the renovation should first ensure the personal safety of the elderly and the comfort and cleanliness of the market's physical environment. At present, the farmers' markets have shortcomings in improving the elderly's shopping experience and humanistic care, with insufficient consideration for the special physical conditions of the elderly. The aging-friendly renovation should form a progressive path from safety guarantee to functional improvement, and then to experience enhancement. Under the constraints of management, economy and other practical factors, it should first address the most urgent and high-benefit needs, realizing the transformation and upgrading from meeting basic living needs to improving experience and spatial quality.

5.2. Research limitations and prospects

This paper initially constructs an aging-friendly evaluation system and proposes targeted strategies, but there are limitations. It mainly selects three markets in the same sub-district of Wuhan as cases; although they have certain type differences, they fail to cover diverse scenarios across different regions, climates and community cultural backgrounds. Future research can expand the sample scope and conduct comparative studies to verify and improve the evaluation system's universality and promotability.Through research on urban stock space renewal, this paper proposes strategies to respond to population aging. It is hoped that the aging-friendly renovation of community farmers' markets can provide practical ideas for building an aging-friendly society and attract more social and researcher attention to the aging-friendly construction of urban farmers' markets.

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