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A Comprehensive Study on Green Development Pathways in the Renovation of Deteriorated Residential Communities: The Case of Changchun City

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Abstract: This study explores the current status, challenges, and countermeasures of green renovation in old residential communities in Changchun City, focusing on the specific practices and major problems the city faces in its green development pathways. The paper showcases Changchun City's achievements in green renovation in areas such as building energy efficiency, resource recycling, and smart community construction through an analysis of policy backgrounds and case studies. However, challenges such as insufficient funding, limited technical support, low resident participation, and weak enforcement of regulations and policies remain significant barriers to green renovation progress. Therefore, this paper proposes countermeasures such as innovative financing models, enhanced technical support, increased resident participation, improved legal frameworks, and the promotion of intelligent management systems to advance sustainable green development in the renovation of old residential communities in Changchun City. Looking forward, as technology advances and policies are optimized, the green renovation in Changchun City will gradually deepen, achieving more efficient and sustainable development goals.

Keywords: Old residential areas in Changchun City; Housing renewal

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1. Introduction

With the continuous progress of urbanization, the renovation of old residential communities has become an important topic in urban renewal. As a representative of rapid urbanization, Changchun in China faces significant demands for the renovation of old residential communities. These communities generally suffer from aging infrastructure, deteriorating living environments, and low energy efficiency, which not only affect the residents' quality of life but also pose challenges to the sustainable development of the city. Against this backdrop,

the concept of green development has gradually become a key direction in the renovation of old residential communities.

Green development, as a development model emphasizing resource conservation, environmental friendliness, and ecological protection, aligns with modern urban development's sustainability requirements. Integrating green development concepts into the renovation of old residential communities not only helps address existing deficiencies in environmental and resource utilization but also enhances the overall ecological benefits of the communities and the quality of life for residents [1]. However, despite the widespread recognition of green development concepts at the policy level, effectively implementing this concept in practice remains challenging. This study aims to explore how to effectively implement green development pathways in the renovation of old residential communities, analyze the successful experiences and existing problems in the renovation practices in Changchun, and propose optimization strategies. By systematically reviewing relevant domestic and international research and conducting empirical analysis of typical cases, this paper attempts to provide theoretical support and practical guidance for policymakers, urban planners, and practitioners, with the aim of promoting the sustainable development of old residential communities in Changchun, China, and improving the overall ecological environment quality of the city.

2. Literature review

2.1. Research on green development in the renovation of old residential communities

Green development, as a concept emphasizing environmental protection, resource conservation, and social sustainability, was first proposed in the 1987 UN report "Our Common Future" and has gradually evolved into a global consensus. In the theoretical framework of green development, coordinated development between the economy, society, and the environment is considered crucial. In this context, specific pathways such as green buildings, green transportation, and energy efficiency improvements have become important manifestations of the green development concept.

The renovation of old residential communities occupies an important position in China's urban development, and the green development pathway plays an increasingly important role in this process. In recent years, researchers have focused on how to introduce the concept of green development into the renovation of old residential communities to achieve dual goals of resource conservation and environmental protection. At the implementation level, green building technology, smart community management, and energy efficiency optimization have become research focal points [2].

2.2. Green buildings and the renovation of old residential communities

Green buildings are an important manifestation of the green development concept in the renovation of old residential communities. According to the World Green Building Council, green buildings should maximize resource conservation, environmental protection, and pollution reduction during design, construction, and operation (World Green Building Council 2016). In China, green building standards have been gradually promoted, and many scholars have explored how to apply these standards in the renovation of old residential communities. For example, Wang studied the application effects of solar energy utilization and building insulation material updates in the renovation of old residential communities, pointing out that these technologies can not only improve building energy efficiency but also enhance residents' living comfort.

In summary, the application of the green development concept in the renovation of old residential communities has a broad research foundation and practical significance. Although existing research provides valuable references for this study, there is still room for improvement in multidimensional integration and empirical analysis. This study will build on existing research to further explore the specific application and optimization strategies of green development pathways in the renovation of old residential communities, aiming to provide more targeted guidance for practice.

3. Analysis of green renovation status in Changchun's old residential communities

3.1. Policy requirements

In recent years, governments at all levels in China have gradually recognized the importance of renovating old residential communities to improve the overall urban environment and residents' quality of life. As one of the old industrial bases in Northeast China, Changchun City actively responded to the national call for green development in the renovation of old residential communities, introducing a series of policies and measures to promote the application of green development in urban renewal. According to the "Changchun City Urban Renewal Implementation Plan (2021–2025)," the government emphasizes the need to implement green development concepts in the renovation of old residential communities, specifically including energy conservation and emission reduction, resource recycling, and ecological environment improvement.

This policy clearly requires the priority adoption of green building standards and energy-saving technologies in the renovation of old residential communities, promoting the construction of green facilities such as solar energy utilization and rainwater harvesting. Additionally, the policy proposes using financial subsidies, tax incentives, and other means to encourage social capital participation in the green renovation of old residential communities. These policies not only provide institutional guarantees for the green renovation of old residential communities in Changchun but also offer practical operational guidance for implementing green development pathways.

3.2. Implementation case

Taking a renovation project of an old residential community in Kuancheng District, Changchun City, as an example, this project is an important practice case of promoting green development in Changchun City in recent years. This community was built in the 1980s, with aging infrastructure and low energy utilization efficiency, severely affecting residents' quality of life. Since 2020, the Changchun Municipal Government has included this community in the pilot project for green renovation, aiming to improve the community's ecological environment and living comfort by introducing green development concepts.

During the renovation of this community, the external walls of the buildings were first insulated using high-efficiency insulation materials to reduce energy consumption for heating in winter and cooling in summer. The renovation also included green transformation of the roofs and external walls, adding roof greening and vertical greening, which not only beautified the community environment but also further reduced the heat island effect of the buildings.

In terms of energy, the project introduced a solar photovoltaic power generation system to provide lighting for public areas and power for some households. Additionally, the project installed a solar water heating system, significantly reducing residents' reliance on traditional energy sources. These measures effectively increased the community's energy self-sufficiency and reduced carbon emissions, laying a foundation for achieving a low-

carbon community .

In terms of water resource management, the project introduced a rainwater collection and reuse system, with rainwater collection devices installed on the roofs and ground, storing rainwater for irrigation and cleaning purposes in the community. This measure not only reduced the pressure on municipal water supply but also improved water resource utilization efficiency, aligning with the concept of green development.

To further optimize resource allocation and management efficiency, the project introduced a smart community management system. Through Internet of Things (IoT) technology, residents can monitor household energy consumption in real-time and adjust their energy use habits based on system recommendations to save energy. Additionally, the smart management system includes functions such as waste sorting guidance and public resource reservation, enhancing residents' green living awareness and participation [3].

In terms of community greening, the project conducted an overall renovation of the community's public green spaces, increasing the variety of plant species and creating a microecosystem. Additionally, several green recreational spaces were established within the community, providing residents with more comfortable living environments. These measures not only improved the community's ecological environment but also enhanced residents' sense of belonging and community cohesion [4].

Through the implementation of the aforementioned green development measures, the living environment and energy utilization efficiency of this old residential community have been significantly improved. The renovated community not only reduced energy consumption by more than 20% but also improved residents' quality of life, receiving widespread recognition.

3.3. Case analysis

From the above case, it can be found that in the renovation of old residential communities, the core elements of the green development pathway mainly include energy efficiency improvement, resource recycling, green space construction, green transportation systems. These elements work together to build a sustainable urban environment, improve residents' quality of life, the urban renewal of older districts usually has a significant impact on the sense of place and identity [5].

Improving energy efficiency is key to green development. By using insulation for buildings, energy-saving windows, and solar energy utilization, the energy consumption of old residential communities can be significantly reduced. For example, applying high-efficiency insulation materials on external walls and roofs can reduce heat loss and lower energy demand for heating in winter and cooling in summer. Additionally, the introduction of solar photovoltaic power generation and solar water heating systems provides clean energy for the community, reducing dependence on traditional energy sources.

Resource recycling includes the circular use of water resources and waste. In the renovation of old residential communities, rainwater collection and reuse systems are widely applied. After treatment, rainwater can be used for landscaping irrigation and landscape water, reducing pressure on municipal water supply. Additionally, the construction of waste sorting and recycling systems helps reduce landfill waste and promotes secondary use of resources .

Green space construction is an important measure to improve community environmental quality. Increasing green space areas, building roof gardens, and vertical greening can improve the community's microclimate and reduce the heat island effect. Green spaces also provide residents with places for recreation and socializing, enhancing the community's livability and ecological benefits.

The construction of green transportation systems aims to reduce carbon emissions within and around the community. In the renovation of old residential communities, optimizing the layout of pedestrian paths and bicycle lanes can reduce residents' dependence on private cars. In addition, the introduction of electric vehicle charging stations and shared transportation systems provides residents with more environmentally friendly travel options.

Through the integrated application of these core elements, old residential communities can achieve higher resource utilization efficiency and lower environmental impact, laying a foundation for the development of green cities.

4. Challenges and countermeasures in green renovation of old residential communities in Changchun City

4.1. Main challenges in the green renovation of old residential communities in Changchun City

Despite the concept of green development providing an important direction for the renovation of old residential communities, in practice, the green renovation of old residential communities in Changchun City still faces many challenges. This paper will analyze these challenges in detail and propose corresponding countermeasures to provide useful references for green renovation practices in Changchun City.

The green renovation of old residential communities requires a large amount of funding, including building energy-saving renovation, green infrastructure construction, and the introduction of smart management systems. However, insufficient funding is the primary challenge faced by the green renovation of old residential communities in Changchun City. Traditional fiscal appropriation models are difficult to meet the large-scale renovation demands, and the introduction of social capital also faces issues such as long return cycles and high investment risks [6]. Especially in some economically underdeveloped areas, the funding issue is more prominent, directly limiting the progress and quality of green renovation.

Green renovation involves the application of many advanced technologies, such as building energy-saving technologies, solar energy utilization technologies, rainwater recycling technologies, and smart community management systems. However, in Changchun City, especially in some old residential communities, the application of these advanced technologies faces significant challenges due to the lack of technical personnel and limited technical levels. Moreover, although some technologies have been successfully applied in other regions, due to the special climate conditions in Changchun City, the effectiveness of these technologies has not been fully verified, resulting in certain technical bottlenecks in actual promotion.

The green renovation of old residential communities is not only the task of the government and enterprises but also requires widespread participation from residents. However, residents in some old residential communities in Changchun City have low awareness of green renovation and lack a strong willingness to participate. Many residents lack understanding of the specific content of green renovation and even resist the short-term inconveniences that the renovation may bring. This low participation not only affects the implementation effect of the renovation but also reduces the efficiency of post-renovation maintenance and management.

Although Changchun City has issued a series of policy documents supporting the renovation of old residential communities, in actual implementation, there are shortcomings in policy implementation and supervision. Some policies lack clear operational details, making it difficult for grassroots implementation departments to carry out the work. Additionally, a long-term mechanism for green renovation has not yet been established, and the management and maintenance after renovation lack legal protection, making it difficult for some renovation

projects to continue to function effectively after completion.

4.2. Countermeasures for the green renovation of old residential communities in Changchun City

By integrating the current policies and case analyses of the renovation of old residential communities in Changchun City, it can be observed that although there are challenges in the renovation process, they can still be addressed through collaboration among the government, enterprises, communities, and residents.

To solve the problem of insufficient funding, Changchun City can explore diversified financing models. In addition to relying on government fiscal appropriations, funds can be raised through the introduction of social capital, the establishment of green funds, and the issuance of green bonds. At the same time, public participation can be encouraged by involving residents in fundraising through crowdfunding, enhancing their sense of participation and belonging. Additionally, the PPP (PublicPrivate Partnership) model can be considered, allowing the government and social capital to share risks and benefits together, reducing the financial pressure on the government.

To address the problem of insufficient technical support, Changchun City can strengthen cooperation with universities and research institutions to improve local technical levels. A dedicated green renovation technology training center can be established to provide specialized training on key technologies involved in renovation, cultivating a group of professionals proficient in green renovation technologies. Furthermore, external expert teams can be introduced to provide technical guidance and consultation for the renovation of old residential communities in Changchun City, ensuring the effective application of green technologies.

The problem of low resident participation can be solved through enhanced publicity and education. The government and community can educate residents about green renovation knowledge and significance through various forms of publicity activities. For example, through community lectures, promotional brochures, and online platforms, residents can be informed about the specific content of green renovation and its long-term benefits to their lives. Residents can be encouraged to directly participate in the renovation process through opinion collection and renovation planning participation, enhancing their sense of ownership. During the renovation implementation phase, a supervisory mechanism involving resident representatives can also be established to ensure transparency and fairness in the renovation work.

To ensure the smooth progress of green renovation, Changchun City should further improve relevant legal frameworks, especially those that clearly define legal protection for post-renovation maintenance and management. At the same time, supervision of policy implementation should be strengthened to ensure that policies are effectively implemented. A dedicated green renovation supervision agency can be established to oversee and evaluate all stages of renovation projects, ensuring renovation quality and effectiveness. On top of that, the government should establish long-term mechanisms to guarantee post-renovation maintenance and management, such as setting up a post-renovation community management fund for future maintenance and updates.

5. Conclusion

The green renovation of old residential communities in Changchun City is gradually advancing, achieving significant initial results despite facing numerous challenges in terms of funding, technology, and resident participation. Through in-depth analysis of these issues, this study proposes several countermeasures aimed at

providing references for future green renovation practices. In future development, Changchun City should continue to deepen the green development concept, improve policy and legal support, further strengthen technological innovation and resident participation, ensuring the sustainability and long-term effectiveness of green renovation. Looking ahead, with the widespread application of intelligent management systems and the expansion of diversified financing channels, Changchun City is expected to establish a more efficient and environmentally friendly urban environment in the renovation of old residential communities, improving residents' quality of life and achieving long-term sustainable urban development goals.

Disclosure statement

The authors declare no conflict of interest.

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