sustainability

MDPI

Article

Green Spaces and the Spontaneous Renewal of Historic Neighborhoods: A Case Study of Beijing's Dashilar Community

Wenhai Zhang [1,*] and Jiang Xin [2,*]

[1] Department of Civil and Environmental Engineering, Graduate School of Creative Science and Engineering, Waseda University, Tokyo 169-8555, Japan
[2] College of Horticulture, Nanjing Agricultural University, Nanjing 210095, China
* Correspondence: zwh@fuji.waseda.jp (W.Z.); jiangxin@njau.edu.cn (J.X.)

Abstract: Renewal projects dealing with public spaces in Chinese historic neighborhoods were mainly dominated by government entities and experts, but their increasing commercialization and standardization did not fully meet the residents' needs. In this context, resident-driven regeneration practices centered on small-scale gardening are becoming more popular as an alternative. However, few studies focused on the strengths and intentions of these informal gardens and the implications for the renewal of public space in historical communities. A case study was carried out in the Dashilar area, a historical community with numerous informal gardens. Specifically, resident-led community gardens were first sampled and investigated. Second, the components of these gardens were identified and classified with multiple indicators. Third, agglomerative hierarchical clustering was applied to distinguish the different types and the resident needs behind them, and two kinds of renewal projects were compared. The results show that the spontaneous actions and participation of residents, drawing on local knowledge, are critical to the popularity of informal community gardens among local residents, which is also supplementary to the current organizational mechanisms of public space renewal in historical communities. Our research is expected to enrich the research contents of urban green spaces and provide theoretical support for the sustainable development and renewal of historic neighborhoods.

Keywords: public space; community gardening; bottom-up planning; historic neighborhood; sustainability

Citation: Zhang, W.; Xin, J. Green Spaces and the Spontaneous Renewal of Historic Neighborhoods: A Case Study of Beijing's Dashilar Community. *Sustainability* **2023**, *15*, 16566. https://doi.org/10.3390/su152416566

Received: 19 October 2023
Revised: 1 December 2023
Accepted: 3 December 2023
Published: 5 December 2023

1. Introduction

Urban regeneration, a phenomenon primarily highlighting the transformation and promotion of urban constructed areas, is a country's main goal as it enters the middle and late stages of urbanization [1]. Urban regeneration has been considered a stepping stone toward sustainable urban development due to its positive significance for major issues such as urban quality, industrial transition and upgrading, and land-use intensification [2]. In this context, many historical communities in urban settings have deteriorated and become one of the target areas for urban renewal in China because they benefit city marketing and imaging strategies [3,4]. Up to now, the regeneration of Chinese historic communities has become increasingly rich in renewal content and has involved a variety of stakeholders, including governmental entities, private sectors, social organizations, residents, etc. Its principal aim is to address the needs of local historical communities from economic, social, cultural, environmental, health, and political perspectives by activating various regeneration schemes and projects [3,5].

The early renewal projects of historical communities were primarily dominated by government entities. Since the reform and opening up of China, commercial companies have begun to be involved. Specifically, more real estate developers have taken on the main renewal projects of historic communities through large-scale demolition and construction

of commercial residences [6]. Although the redevelopment of these historic neighborhoods can rapidly improve the quality of life of the inhabitants, their physical spaces, social networks, and traditional culture are transformed or destroyed accordingly, resulting in the loss of local characteristics and a sense of community identity [7]. However, as the historical and cultural heritage of historic neighborhoods has drawn more and more attention after the 1980s, the newly launched urban regeneration actions in China's 14th Five-Year Plan have become more rational and cautious, especially in Beijing, where large-scale land redevelopment and commercial residential construction are explicitly prohibited, with an attempt to create sustainable historical communities while maintaining the traditional features. In contrast to the past property-led redevelopment model, more private sectors and social groups were involved in the renewal projects. Moreover, the current renewal contents focus on the physical updating alongside the importance of socio-spatial influences on historical communities [8]. As a result, the public spaces of historical communities, which carry the residents' everyday lives, must be promoted not only for the living environment but also for the maintenance and enrichment of community lifestyle and culture. In recent years, there have been many design interventions driven by governmental entities and professional teams targeting the renewal of public spaces in these traditional communities. Nevertheless, some of these renewal projects with increased commercialization and standardization were considered one of the main reasons for the emergence of gentrification and social segregation in historic neighborhoods, which put pressure on local residents to move out of these neighborhoods and caused damage to the elements of the social environment [3]. Therefore, the public space renewal of historical communities still remains a critical issue in China, and the solutions can contribute to increasing urban public interest in both tangible and intangible dimensions.

Based on these facts, there is a growing consensus that the participation of local residents is essential to the sustainable landscape development of historic neighborhoods, especially understanding residents' perceptions and preferences regarding the renewal projects dealing with public spaces [9–12]. Accordingly, participatory regeneration at the community level became the dominant model to incorporate residents' voices and opinions [13], and there are increasing historical communities in which public space renewal driven by governmental entities or professionals was in collaboration with local residents through their coercive or induced participation. Despite these advances, the residents are more or less constrained by the government and the experts and are incapable of fully realizing their abilities, passions, and demands in these regeneration projects. Different from these formal projects, informal regeneration practices centered on community gardening are usually triggered by the spontaneous actions of residents based on sustainability-related motivations. A resident-driven community garden is usually considered to be "an organized, grassroots initiative whereby a section of land is used to produce food or flowers or both in an urban environment for the personal use or benefits of its members [14]", and it can provide individuals with an autonomous environment to make decisions. In practice, these are informal community gardens. In addition, there is a growing interest in small-scale community gardens, especially when it comes to communities with limited space in central urban areas [15,16]. In practice, these informal community gardens have been found to be increasingly common and popular in traditional Chinese communities and can be a catalyst to boost the environmental promotion of these communities [17,18]. Such observations and studies suggested that these informal community gardens are favored and appreciated by the residents and have become an integral part of historical communities. Recent studies by community design scholars seem to support these community-level observations [17]. Nevertheless, their presence has not received much attention [19], not only on account of their neglect by the urban planning policy frameworks but also the lack of first-hand data collection and analysis.

In existing research on urban community gardening, ecological and spatial indices have been used to analyze its impacts on environmental quality, land use planning, local biodiversity, and food safety. However, these studies mainly focus on ecological and healthy

perspectives but ignore residents' preferences and demands for specific attributes and features. Several studies that use interviews and questionnaires to obtain users' preferences for specific characteristics associated with these open green spaces in urban societies generally focus on an important dichotomy and a choice simulation between two design styles of general public parks and individual community gardens [19,20]. Hence, limited efforts are devoted to differences in the composition and intentions between informal community gardens, and these studies lack a typology analysis that differentiates between groups of similar informal community gardens to reflect on their potential heterogeneity. Moreover, existing studies focus on the participatory planning processes of urban community gardens gathered from developed countries but rarely their counterparts in the Global South, especially their implications for future renewal projects dealing with public spaces in their historic neighborhoods. Therefore, there is a pressing need to study the typologies and practices of the resident-driven community gardens in Chinese historic neighborhoods in order to address these scholarly gaps that still remain.

With the increased academic interest in clustering since the 1960s, it has always been tied to the complex issue of classification [21]. To date, diverse cluster analyses, in particular agglomerative hierarchical clustering (AHC) and K-means clustering, have been widely used by academics in the research fields of landscape and urban planning to identify clusters representing common decisions and group similar physical objects containing various shape attributes and spatial information. Shapira et al. (2013) identified a group of experts with similar individual judgments among all experts to reach more than one consensus [22]. Long et al. (2010) used multivariate cluster analysis based on the CLARA algorithm to categorize landscape objects containing information on forest patterns as spatial pattern regions [23]. Yu et al. (2014) applied spatial cluster analysis to discrete urban spatial units to create a higher level of spatial units—urban spatial clusters [24]. Compared with traditional classification based on individual subjective perceptions, the results of clustering analysis are based on statistical data, which are more objective and repeatable [21]. Furthermore, a number of software programs for performing cluster analysis have matured in recent years. Among them, SPSS statistical software 29.0 developed by International Business Machines (IBM) is widely used for its accessibility and convenience [25]. As a result, clustering analysis based on this software program can automatically assign each object to categories in a quick way, especially when dealing with large amounts of data sets. Through this emerging method, it is possible to characterize the various compositions of these informal community gardens and also capture the understanding of the different preferences and needs of residents behind these gardens. In practice, however, it remains difficult to apply this approach to categorize pocket green spaces at the historical community level.

In summary, the principal hypothesis in this research is that there is not only one design style for resident-driven community gardening, which varies with residents' needs and preferences, and that a cluster analysis of these community gardens may identify different types, each with different characteristics and intentions. Accordingly, this study aims to use AHC analysis to identify the landscape typologies of informal community gardens, thereby categorizing and quantifying the various compositions that occur in these pocket green spaces and as a basis for detecting the preferences and needs of residents as end-users. The reason for the use of AHC to identify clusters is that the number of clusters as an input parameter to the algorithm is not required compared to K-means clustering. In addition, our research aims to investigate residents' spontaneous design and construction actions in community gardening, analyze the role of these informal regeneration practices, and hence provide references for the planning and renewal of historical communities and sustainable urban development. In view of the previous absence of landscape planning and management in Beijing's historic neighborhoods and the fact that the design, construction, and management of many small-scale open green spaces is entirely based on the spontaneous actions of the residents, we conducted research in the Dashilar community. First, we selected and investigated 25 samples of informal community gardens triggered by the residents, from which mappings and images targeted to the

residents' community gardens were obtained, and the components of these community gardens were identified and assigned to different categories and subcategories. Second, hierarchical cluster analysis via SPSS Statistic 29.0 software was used to define types of resident-driven community gardens, and the proportions of each type were visualized to analyze the residents' preferences and demands. Third, the current organizational mechanism associated with formal and informal renewal projects dealing with public spaces in the Dashilar community was summarized. On these grounds, our research is expected to provide a bottom-up participatory pathway that integrates local knowledge and willingness for the future renewal of public spaces in Chinese historical communities, which can also have referential value for the sustainable development of historic neighborhoods in developing countries.

2. Literature Review

2.1. Preservation and Revitalization of Historical Community in Urban Settings

To date, the concept of historical community has been developed as the scope of heritage conservation extends from historic buildings to their natural and man-made environments [13]. Simultaneously, these communities in urban settings are composed mainly of residence-use architecture, where many residents live and interact with their neighbors, and this allows intangible heritage to be created and inherited, such as resident lifestyles, customs, knowledge, and expertise of localities. Given its integrated value as a living heritage, intangible heritage that derives from local history, culture, and collective memory should also be integrated into a broader definition of historic neighborhoods in addition to tangible heritage [26]. However, focusing only on heritage preservation is not enough to address the current issues faced by historic communities, especially in developing countries, and the revitalization of social, economic, environmental, and cultural aspects also deserves great attention. Despite their rich heritage value, most of the historical communities in urban areas continue to suffer from deterioration and demolition [3], and the quality and function of the public space in historic quarters have fallen behind the urban average. Thus, urban redevelopment has become another inevitable choice for historical communities to realize preservation and revitalization. Yet tangible and intangible heritage possessed by heritage communities is always vulnerable to urban development and renewal in the context of intertwined globalization, industrialization, and urbanization. In China, the fully government-led land redevelopment model adopted by the Chinese communist government in cooperation with real estate developers over the past four decades, characterized by rapid development, centralized management, and elitism, has resulted in profound changes to historical communities in a short period, destroying territorial characteristics of the public space and generating issues such as displacement of indigenous people, residential segregation, and gentrification, which greatly undermines the actual interests of the residents living in the historic neighborhood.

In this context, how to balance conservation and development at the neighborhood level so that public space renewal projects can be integrated into historical communities in a harmonious way has become one of the critical issues that need to be addressed, especially for emerging countries such as China.

2.2. Community Gardening as a Pathway to Community Collaboration and Co-Creation

A community garden is often considered to be "an organized, grassroots initiative whereby a section of land is used to produce food or flowers or both in an urban environment for the personal use or benefits of its members [14]." Currently, the importance of community gardens is well recognized in several subject areas, and urban community gardening has gained immense popularity worldwide because of its ability to bring both physical and mental benefits to community members. Specifically, community gardening can provide an environment for community members to cultivate fresh vegetables, fruits, herbs, and so on to meet their own edible needs and reduce living expenses, while the production sharing and experience exchange can enable the participants to bond with

each other and enhance the sense of community belonging, ultimately contributing to the harmony of the entire community. Moreover, community gardens are highly adaptable for historical communities with inadequate space in urban settings, and their pocket style can make maximal use of community space for greening in response to the community members' demands for the enhancement of public space in such communities. In China, community gardening, as one of the interventions for the public space renewal of communities, has not been focused on until recent years. A small number of formal community garden projects led by elite groups such as the government and designers were completed and opened one after another, and these small-scale exploratory projects were concentrated in cities such as Beijing, Shanghai, and Chengdu.

Before these, community gardening had already been a lifestyle for community residents to transform and enhance public spaces, especially in historic communities where there are a large number of informal community gardens built by the residents independently. Nevertheless, these resident-driven community gardens would be demolished during the renewal process of public spaces in historic communities since they are more or less flawed, such as unreasonable design, irregular construction, and poor quality, and then the redesign of the vacated space might be handed over entirely to academic researchers, designers, and other professional teams, with the potential problems of not meeting the residents' expectations and eliminating the local identity. Until recently, some studies have focused on private community gardens and showed that these informal landscapes could be more effective in meeting the residents' preferences than formal ones in terms of the physical space aspect, as well as creating a sense of place, forming social networks, and maintaining local culture at the socio-cultural level [19]. In addition, Bae has suggested that the improvement of existing green spaces may yield better social returns than building new ones in urban settings [27]. The Siping community garden project in Shanghai is a recent example of upgrading an under-maintained green space into a community garden by integrating the voiced views of local residents and the ideas of a professional team, which not only met the local willingness but also achieved the government's goals [28]. More importantly, community gardening in Chinese historical communities involves two kinds of sectors: formal and informal, which make it easier to develop two-way communication between the upper and lower classes than questionnaires and interviews and provide a pathway to engage local residents spontaneously in dealing with the renewal of their community's public spaces and thus ultimately realize community collaboration and co-creation. For these reasons, the resident-driven community gardens should be treated with attention rather than one-off removal in the context of urban redevelopment actions undertaken by the Chinese communist government.

However, few studies have focused on these informal community gardens in Chinese historical communities, exploring the reasons why they are adaptive and popular and the implications for design guidelines for community public space renewal projects. It is not conducive for Chinese historical communities to develop community gardening as a participatory pathway for their public space renewal so as to address their general issues based on the residents' spontaneous participation and collective actions.

2.3. Relationship between Resident Participation, Community Needs, and Sustainable Community

As mentioned in the review above, historical communities require not only heritage preservation but also sustainable development and revitalization to change the conditions of deterioration and deprivation. One of the core principles of a sustainable community is to meet the diverse needs of local residents in social, economic, historical, cultural, and environmental dimensions [29]. Based on a review of previous studies, Hempel (1999) and Akkar Ercan (2011) pointed out that although there are four approaches with different objectives to the concept of sustainable communities, each of them largely focuses on environmental improvement [3,30]. However, the reality of China's historic communities is that many formal community renewal projects focused on environmental promotion do not reflect the collective voices and requirements, and the public products and services provided

by these projects do not closely match the actual needs of existing residents, which hinders the realization of community sustainability [31]. There are two reasons: (1) government officials and designers in charge of these formal renewal schemes and projects lack a two-way partnership with local residents, preferring to educate and manage the residents rather than proactively capture their demands and requirements; (2) these top-down renewal projects, constrained by defined aims, budgets, and duration, have no space and time to be adapted to the feedback from the end-users from initiation to completion, without continued participation and support of the residents. According to Sherry Arnstein's description of a ladder of citizen participation [32], although most governments allow public participation and support the residents to express their demands, resident engagement in various forms is typically low, which is far from the actual rights needed for residents to influence the final outcomes. In contrast, the role of citizen participation in sustainable urban development and renewal in many developed countries has been increasingly highlighted since the 1992 Rio Declaration [33], especially at the neighborhood level, and it can contribute to developing balanced and continuous renewal actions that reflect diverse visions and goals by involving agents from governments, residents, entrepreneurs, designers, and social organizations [34] so that they ensure the interests of all stakeholders. Among these social groups, the residents, as the major users, have been recognized as playing an irreplaceable role in both physical space renewal and socio-cultural revitalization at the community level. When considered collectively, resident engagement is one of the significant aspects that influences the future development and renewal of a community, not only in terms of providing more sustainable insights and solutions but also in terms of meeting the various needs of the community members and achieving community sustainability. Hence, the pathways to citizen participation need to be innovated, and resident engagement with community governance should be enhanced so that residents can be more accessible to the processes of consultation, decision-making, and management at the community level and thus build sustainable urban communities with the capacity to meet community needs.

To date, many studies and practices have been conducted around the world to explore the organizational mechanisms of historic community regeneration based on residents' participation, with the ultimate aim of achieving community sustainability, which involves coercive participation, induced participation, and spontaneous participation of residents [35]. In China, fostering the formation of collaboration and co-creation among a broad cross-section of stakeholders, including the residents, has also become one of the key goals in realizing sustainable development and renewal of historic communities. Recent research has focused on government-led participatory regeneration models and projects, but these only involve mandatory or induced participation of the residents and ignore the spontaneous participation of residents. Under the existing participatory regeneration model, the upper class, which mainly includes the government, entrepreneurs, and urban designers, is more powerful in renewal projects dealing with historical communities, while the residents are often in a relatively weaker position to make decisions. In such a situation, the degree of residents' participation cannot be well guaranteed and fully met, which in turn hinders community empowerment and generates conflicts between diverse actors.

In summary, how to explore a pathway to build organizational mechanisms for public space regeneration of historical communities that can take advantage of the role and value of resident engagement, meet the visions and preferences of residents, and cultivate community collaboration and co-creation between groups is still a crucial issue for developing countries such as China to achieve sustainable development of historic communities. Faced with this challenge, community gardening based on residents' spontaneous participation can be considered a good option to achieve sustainable communities, which not only effectively meets the needs of the community but also takes into account environmental enhancement and therefore deserves to be studied and integrated into the whole organizational mechanism of historical community renewal.

3. Methodology

3.1. Study Area

The case study is located in the Xicheng District of Beijing City, China (Figure 1). Taking the entire Dashilar area (1.26 km^2) as a region for context investigation, this study has chosen the section (1.01 km^2) on the west side of Meishi Street as our focus area for data collection. The targeted section covers 80.16% of the total area, which retains many traditional alleys and houses for residential use. Since the year 1420, the Dashilar area has gradually developed into historical neighborhoods with commercial, residential, and recreational functions in the central area of Beijing [19]. There are many rows of one-story traditional residence courtyards along narrow streets, where these courtyards are called Siheyuan and the streets are known as Hutong. After the foundation of the People's Republic of China, most of the housing properties in the Dashilar community were taken into state ownership, and each one-door,-one-family courtyard was rented to more than one household in response to the housing shortage caused by the large growth of the new population and new immigrants at that time. This decision has resulted in the courtyard spaces changing from private to public, which, together with the street public spaces, compose the main body of the public spaces related to the Dashilar area. Meanwhile, Dashilar's residents began to convert traditional one-story buildings into multi-story buildings without permission and illegally occupy public spaces to build residential houses, resulting in high density and overuse that accelerated the aging and deterioration. Thus, similar to many historical communities in China, Dashilar is currently facing the challenge of preservation and development.

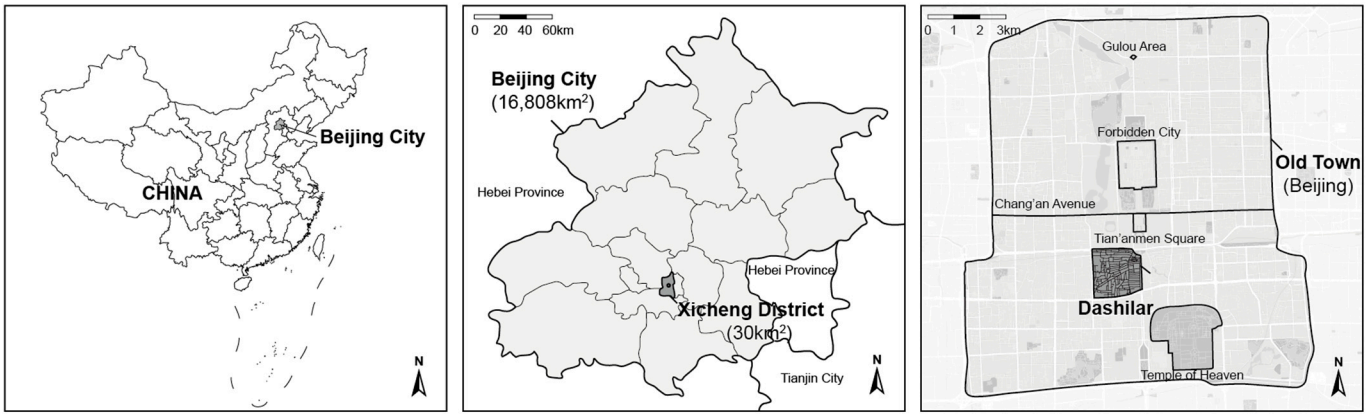


Figure 1. Location of the Dashilar Community, Beijing, China.

To protect and restore urban cultural and built heritage, Dashilar has been undergoing a four-phase renewal process since the 1960s (Figure 2). In the first three phases, the organizational mechanisms of Dashilar regeneration have gone from government-led to government-real estate company cooperation to carry out large-scale land development projects, including residential and commercial buildings, whereas the public spaces that carry the everyday lives of the residents have been neglected. In view of this, the fourth phase of renewal, called the Dashilar Renewal Project, gradually developed into a social movement involving architecture, environment, culture, and lifestyles, which sought to build an organizational mechanism characterized by small-scale renewal and collaborative design. Specifically, this model relies on the Dashilar Investment Company as the implement subject between the Xicheng District Government and the residents, and it organizes professional teams, including academic researchers, designers, development partners, and non-government organizations (NGOs), to participate in the renewal projects targeting to protect and renovate the Dashilar community. In addition, this commercial company develops the cultural and creative industries to achieve the revival of the community's intangible cultural assets. However, the formal renewal projects dealing with public spaces are inclined to be standardized and commercialized, which is often caused by the dominance of

government and professionals and their lack of two-way communication with local residents. Specifically, the government entities and their funded company were impatient with the diverse demands of the residents in the renewal processes, expecting a renewal project to be scalable and replicated across the region; the professionals' obsession with realizing their design concepts led to the overlook of the residents' knowledge and experiences. In contrast, informal renewal projects, especially community gardens driven by the residents, have unexpectedly become more desirable and attracted the attention of urban planners, thus making the Dashilar area a suitable case to figure out the research questions.

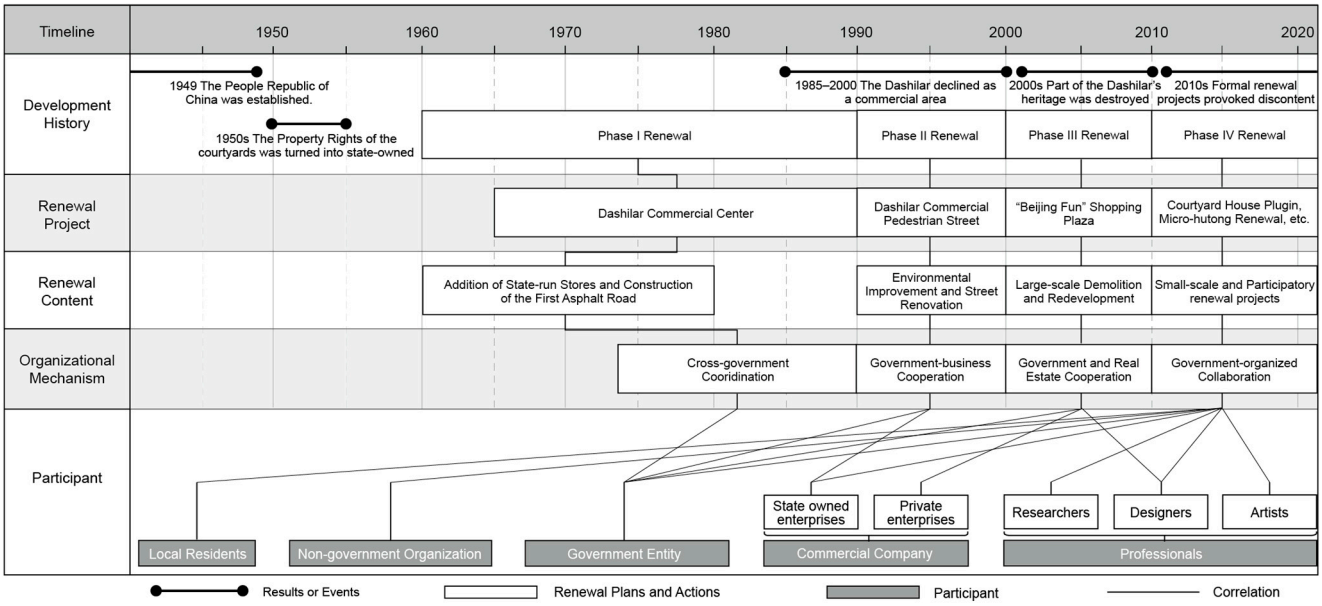


Figure 2. Timeline of the four-phase renewal of the Dashilar community, Beijing, China.

3.2. Methods

The research methods involve integrating sampling of the study area, data collection, and analysis into three sequential phases: intelligence, component, and type (Figure 3). Similar workflows have been introduced to the research of vernacular architecture, such as the framework for ordinary American buildings and landscapes [36].

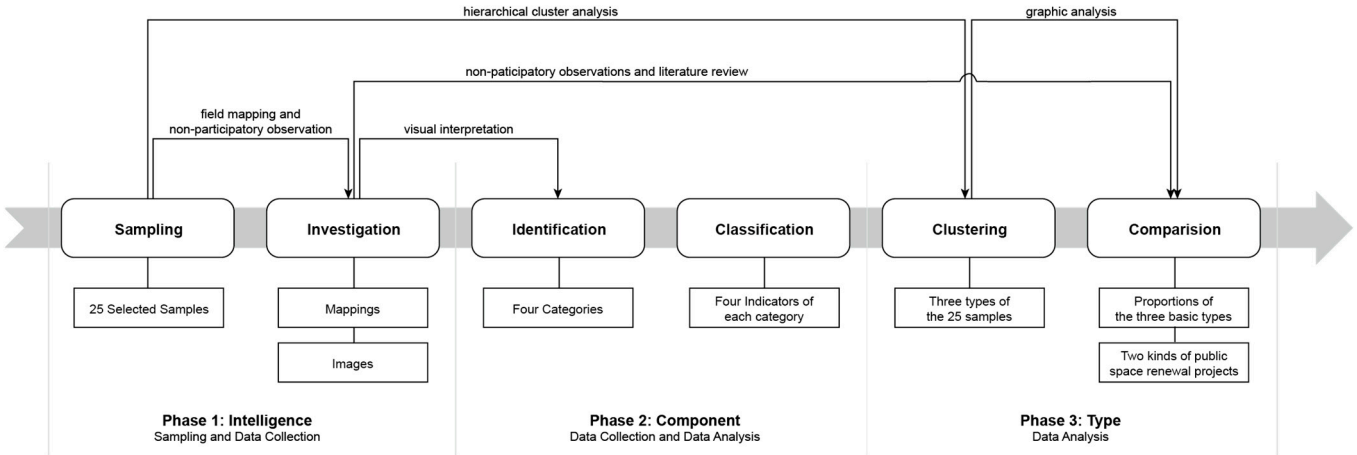


Figure 3. The methods of this research are divided into three sequential phases.

In the "intelligence" phase, the resident-led community gardens of the study area were sampled, and field mapping and non-participatory observation were conducted to investigate those selected samples in order to collect first-hand information for further data

analysis. The "component" phase focused on identifying and classifying the constituent elements of the informal community gardens driven by the residents into four categories, including locational conditions, greenery conditions, vegetation conditions, and material conditions. In the "type" phase, hierarchical cluster analysis via SPSS Statistics 29 software was used to distinguish the types of informal community gardens driven by the Dashilar's residents, and these types were visually characterized and compared in the form of figures.

3.2.1. Sampling and Investigation

Less attention has been paid to the resident-initiative community gardens in the Dashilar community, which has resulted in a deficiency of first-hand materials. Given this situation, this study cannot be carried out based on the previous work, and the top priority is to conduct field investigations on these informal landscapes. In this paper, we considered the courtyard as the basic unit to gather information in response to the scattered and discontinuous distribution of the resident-led community gardens in the Dashilar community (Figure 4). Prior to the fieldwork, we conducted a preliminary survey of the Dashilar region and found that there are more than 2500 traditional courtyards in the study area. Partly a result of the courtyards being under private ownership or formal renewal projects; partly a result of the courtyards being privately transformed into commercial spaces; partly because of the spatial inadequacy of the courtyards to host informal horticultural activities, a total of 200 conventional courtyards could be investigated for this study. Even then, it is unrealistic to collect all their information in the short term. Therefore, simple random sampling of research objects is a preferable approach in this case, which means each one has the same probability of being chosen.

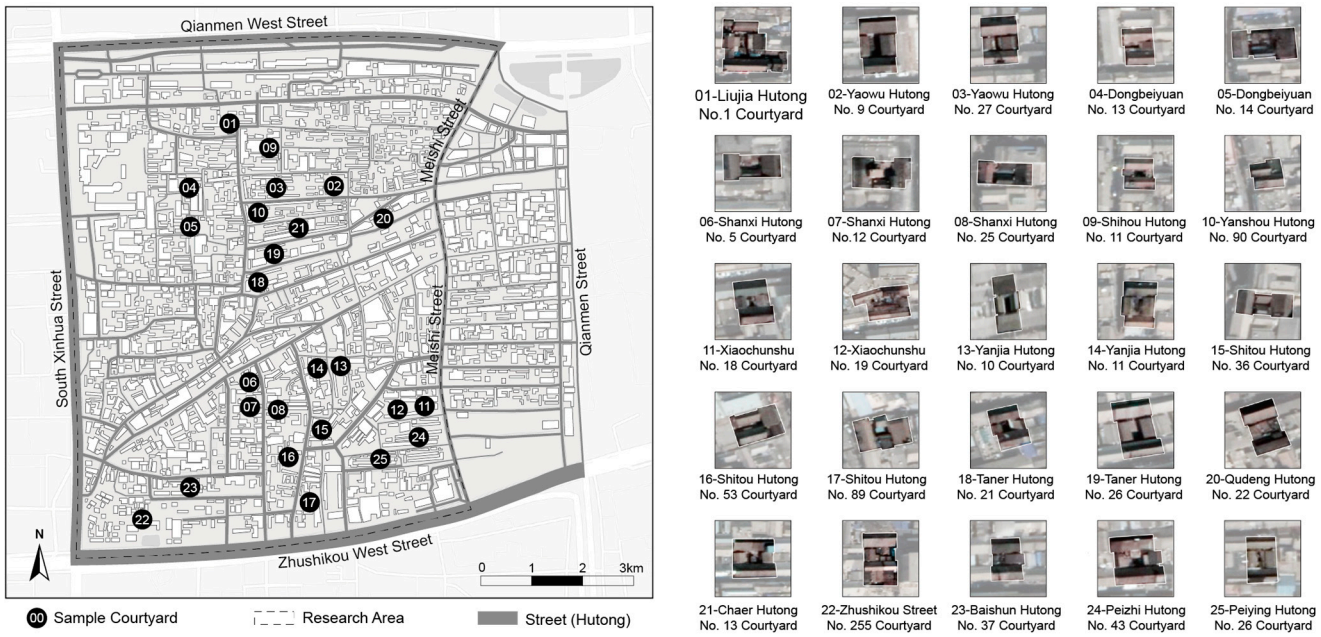


Figure 4. The 25 selected samples in the research area are based on courtyard units.

The purpose of this study was not to gather information about all resident-driven community gardens but rather to verify our hypothesis about these informal gardens and test the feasibility of AHC analysis for identifying informal garden types. In addition, the investigations of informal community gardens need the cooperation of the residents and a substantial amount of time. Given these, conducting a massive sample survey of informal gardens would be unwise and undesirable. Therefore, the sample size of 25 is considered appropriate after taking all factors into account. Finally, the samples were determined. These samples, which range in surface area from 30 to 35 square meters, were distributed over 16 streets that cover more than a quarter of the total. In summary, this

sampling method can not only minimize bias but also ensure the principle of randomness and representativeness of the final samples.

3.2.2. Identification and Classification

According to previous research on the constituent elements of urban space [37] and the attributes of open green space [19], this paper defines components of resident-led community gardens in four categories, including locational conditions, greenery conditions, vegetation conditions, and material conditions. Specifically, locational conditions describe the layout of the resident-initiated community gardens based on the courtyard space as the frame of reference. Structural conditions depict diverse greening methods used to help plants grow in poor-space courtyards. Vegetation conditions refer to the plant species adopted by the residents for their own preferences. Material conditions are related to the hard materials used by the residents in spontaneous construction activities for building spatial facilities and products. In general, this definition can cover the components that can constitute a completed community garden driven by the residents. On this basis, we combined the graphic and visual information collected in the previous phase to use the visual interpretation of the components associated with resident-led community gardens in the 25 samples and counted the number of components in terms of vegetation conditions and material conditions. Visual interpretation is a widely used approach in the field of landscape research, and its application in this study involved not only the use of cognitive skills to view visual information and assign the components to four conditions but also the further subdivision of the four categories into different indicators in conjunction with the characteristics of these components in order to create a class of the components related to the resident-driven community gardens. Notably, the indicators of locational and greenery conditions are difficult to accurately quantify and were only identified as presence (denoted by "●") or absence (denoted by "◎").

3.2.3. Agglomerative Hierarchical Clustering

Hierarchical cluster analysis (HCA) is a general approach to cluster analysis that has two main categories of methods to build a hierarchy of clusters, including divisive and agglomerative methods. In this study, agglomerative hierarchical clustering (AHC) was utilized via SPSS Statistics 29.0 from IBM's software to obtain the clustering results of the 25 samples: first, given that only the vegetative and material indicators were quantified, which extracted from the resident-led community gardens, were taken as the variables and their data of the 25 samples were entered; next, the skewness-kurtosis normality test provided by SPSS Statistics 29.0 software was performed to determine whether these variables follow normal distributions; last, since the surface area of each sample did not differ much, each sample was clustered with the same weight and the clustering results were obtained presented in a hierarchical clustering dendrogram after validation, which is achieved by means of the Euclidean square distance used as the distance measure and the between-group linkage that specifies the distances between two clusters [25]. In addition, the clustering coefficients are calculated to identify the appropriate numbers of clusters. The distance $d(a, b)$ between a point a and a point b in n-dimensional Euclidean space is:

$$d(a,b) = \sqrt{(a_1 - b_1)^2 + (a_2 - b_2)^2 + \cdots + (a_n - b_n)^2} \quad (1)$$

where $(a_1, a_2, \ldots, a_n)$ is the Cartesian coordinates of a point a; $(b_1, b_2, \ldots, b_n)$ is the Cartesian coordinates of a point b;

The distance $d(A, B)$ between a cluster A and a cluster B is:

$$d(A,B) = \frac{1}{|A| \cdot |B|} \sum_{a \in A} \sum_{b \in B} d(a,b) \quad (2)$$

And finally, the types of resident-driven community gardens in the Dashilar community were demonstrated, and their characteristics were compared based on the final clustering results.

4. Results

4.1. Classification System of the Components

Based on the sampling and investigation, the components of community gardens driven by the residents of the Dashilar community were studied from four aspects: location condition, greenery condition, vegetation condition, and material condition, and these components were basically covered in these conditions. Specifically, the non-physical components were included in locational conditions and greenery conditions, which mainly refer to the spatial layouts and forms of these gardens, and these cannot usually be measured precisely; the physical counterparts were assigned in vegetation conditions and material conditions, which largely concern the plants and articles used by the residents to construct these gardens, and these can be counted in quantity. Although some of the components fell under the same condition, our classification results show that distinct differences exist between them, which means that these four categories can be further divided into different indicators in Figure 5.

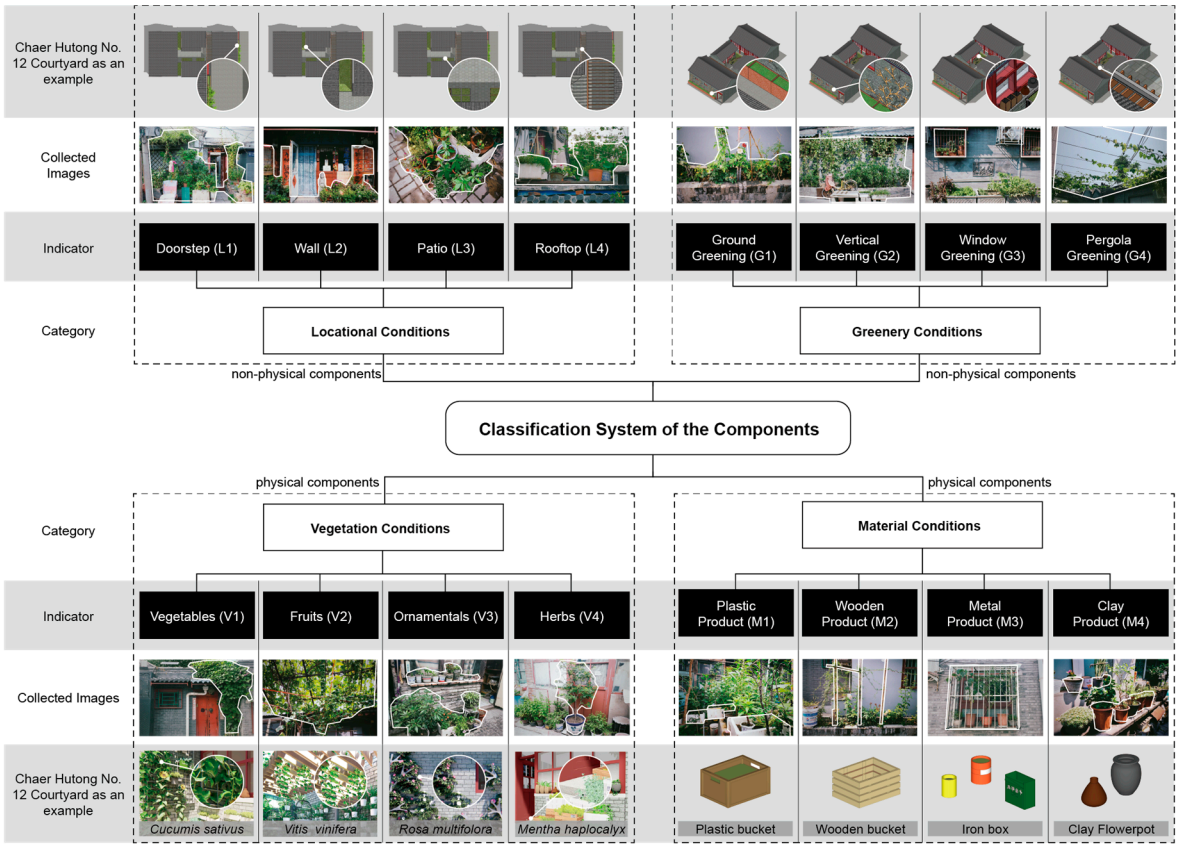


Figure 5. Classification system of the components related to the resident-led community gardens in the Dashilar community.

By summarizing the shape and spatial characteristics of the resident-led community gardens, the locational and greenery conditions were further divided into four indicators; specifically, locational conditions are distinguished according to spatial structures of courtyards by doorstep, wall, patio, and rooftop, and greening conditions are classified according to greening methods as ground greening, vertical greening, window greening, and pergola greening. According to the plant usage and material properties, the physical components were assigned and quantified, with vegetation conditions divided into four

indicators: vegetables, fruits, ornamentals, and herbs, and material conditions into four subcategories: plastic, wood, metal, and clay. It is worth noting that the distinction between plants used by the residents based on the four indicators of vegetation conditions might be controversial in some cases, as some plants may have two or more practical uses. When confronted with such controversy, we classified these plants based on their most common use within the Dashilar community.

In addition, the different indicators for each condition were coded, their characteristics and attributes were illustrated, and the physical components present in the informal community gardens of the 25 samples were enumerated (Table 1). This facilitated the subsequent identification and quantification of the components of the resident-driven community garden on a sample-by-sample basis, as well as further exploration of the reasons and purposes for the choices of these components by local residents in the next section. Specifically, the indicators for the locational, greenery, vegetation, and material conditions are named by combining the initials for each category with Arabic numerals; for example, the indicators for the locational condition are abbreviated as L1, L2, L3, and L4 in order.

Table 1. Indicators and physical components of the resident-led community gardens.

Category	Indicator	Measurement Scale	Code	Illustration	Physical Components
Locational conditions	Doorstep	Surface	L1	It refers to the horizontal distributions of the informal gardens at the entrance of the courtyards with a little more sufficient light time.	None
	Wall	Elevation	L2	It refers to the vertical distributions of the informal gardens in the marginal space along the walls of residents' own buildings in the courtyards.	None
	Patio	Surface	L3	It refers to the spatial distributions of the informal gardens in the central open spaces of the courtyards that are created and shared by the residents.	None
	Rooftop	Elevation	L4	It refers to the vertical distributions of the informal gardens in the space above the courtyard houses with the most sufficient light.	None
Greenery conditions	Ground greening	Height	G1	It refers to a greening method that allows plants to grow on the ground or be distributed on the ground in courtyards.	None
	Vertical greening	Height	G2	It refers to a greening method that increases plants on the exterior walls or other vertical surfaces of the courtyards, including the cultivation of climbing plants and the fixation of containers or hanging pots with plants to the building facades.	None

Table 1. *Cont.*

Category	Indicator	Measurement Scale	Code	Illustration	Physical Components
Greenery conditions	Window greening	Height	G3	It refers to a greening method that cultivates plants near outdoor windows of the courtyards, which includes placing containers for growing plants and hanging plant pots on the security grilles of windows.	None
	Pergola greening	Height	G4	It refers to a greening method of growing plants on the rooftop of courtyard buildings or shade facilities.	None
Vegetation conditions	Vegetable	Number	V1	It refers to the plants that can be used by the residents for vegetable consumption.	*Allium fistulosum*, *Allium scorodoprasum*, *Allium tuberosum*, *Capsicum annuum*, *Cucumis sativus*, *Cucurbita moschata*, *Luffa cylindrica*, *Lagenaria siceraria*, *Momordica charantia*, *Perilla frutescens*, *Raphanus sativus*, *Solanum melongena*, *Zea mays*
	Fruit	Number	V2	It refers to plants with fruits that can be used for edible purposes and have a high water content and sweet taste.	*Diospyros kaki*, *Ficus carica*, *Fortunella margarita*, *Punica granatum*, *Vitis vinifera*, *Zizyphus jujuba*
	Ornamental	Number	V3	It refers to the plants used to decorate the courtyard environment and are appreciated by the residents.	*Coleus scutellarioides*, *Chlorophytum comosum*, *Epipremnum aureum*, *Euonymus fortune*, *Helianthus annuus*, *Hibiscus syriacus*, *Lagenaria siceraria* *Mirabilis jalapa*, *Paeonia lactiflora*, *Pelargonium hortorum*, *Pharbitis nil*, *Rosa chinensis*, *Rosa multifolora*, *Robinia pseudoacacia*, *Salix matsu*, *Quamoclit pennata*, *Syringa oblata*, *Toona sinensis*, *Ulmus pumila*, *Wisteria sinensis*
	Herb	Number	V4	It refers to the plants used by the residents for medicinal purposes, which have medicinal value.	*Cynanchum chinense*, *Dichondra micrantha*, *Eucommia ulmoldes*, *Lonicera japonica*, *Mentha haplocalyx*, *Peperomia tetraphylla*, *Zanthoxylum americanum*
Material conditions	Plastic product	Number	M1	It refers to the spatial facilities and objects, which are mainly composed of plastic materials.	Discarded plastic bowl, obsolete plastic basin, plastic bottle, plastic bucket, plastic flowerpot, atyrofoam box, useless plastic tube

Table 1. *Cont.*

Category	Indicator	Measurement Scale	Code	Illustration	Physical Components
Material conditions	Wooden product	Number	M2	It refers to the spatial facilities and objects, which are mainly manufactured from wood.	Bamboo flower rack, bamboo birdcage, handicrafts with bamboo strips, obsolete cabinet, reed screen, roof pergola, wooden bench, wooden bucket, wood chair, wooden fence, wooden pergola, wood planting bed, wooden table, wood trellis
	Metal product	Number	M3	It refers to the spatial facilities and items, which are mainly composed of metal materials.	Discarded paint bucket, metal pergola, metal trellis, iron security window, waste iron box, useless Bicycle
	Clay product	Number	M4	It refers to spatial items, which are basically composed of clay materials.	Brick planting bed, clay flowerpot, discarded ceramic cup, obsolete sink, useless porcelain, waste earthenware

Based on the components included in each condition of these informal community gardens, we can find that local residents not only take the attributes and features of the components into account but also integrate their preferences and needs into their selection process. In addition, the residents have the ability to combine these components into their community gardens to adapt to natural and environmental situations, which means that the residents have accumulated community-based insights and solutions in their processes of design and construction.

Specifically, considering the locational conditions, the residents are capable of transforming the rooftop spaces that have never been utilized, underutilized spaces against the walls, as well as common spaces around the doorsteps and patios into their community gardens, the utilization of which is often subject to negotiation and collaboration among the residents within a courtyard. In terms of greenery conditions, the residents are skilled at choosing appropriate greening methods depending on specific circumstances. Among them, ground greening is more appropriate for the common spaces around the doorsteps and patios, where the residents can combine various containers and pots with their own plants for efficient and unified management; vertical greening and window greening are more suitable for exploiting the underutilized spaces against the walls, which can realize environmental improvement and reduce the temperature during the summer; and pergola greening is more adaptable to the rooftop spaces, where the residents can turn unused spaces into green spaces by combining pergolas and climbing plants to provide fresh vegetables and fruits as well as shade. Regarding vegetation conditions, the residents give priority to native plants with cultural implications, which can not only be more adaptable to the space-limited community environment without much light but also carry their individual aspirations and community culture, such as *Punica granatum*, holding the desire of the residents in this region for more children and more prosperity [18]. With regard to material conditions, the residents are always proficient in transforming unused and discarded materials into spatial facilities that can support plant growth, which is obviously inexpensive and recyclable; for example, many discarded items are put to use by the residents' hands, and these components can save the residents the expenses of construction and maintenance and make their community gardening retain a strong flavor of everyday life. It is clearly an inexpensive and recyclable practice that not only saves the residents' expenses of construction and maintenance but also makes their community gardening

retain a strong sense of everyday life. Nevertheless, these components are fragile and have poor aesthetic quality.

In summary, the selection and application of the components are usually decided by the residents themselves based on their needs and knowledge, and ultimately, these components are composed of the community gardens triggered by the residents of the Dashilar community.

4.2. Typological Variations between the Samples

Based on the visual interpretation of the images collected from the samples (Table A1), the frequency of the indicators related to the informal community gardens in the 25 samples was obtained (Table 2). Among them, the indicators in terms of vegetation condition and material condition are quantified and counted based on the number of plants and spatial objects, which were considered the variables to run the AHC analysis to distinguish the types of resident-led community gardens in the Dashilar area. However, before that, validation is needed to perform a normality test on the data for these variables.

For a small number of samples, less than 50, the absolute z-scores for either skewness or kurtosis are not larger than 1.96; the distributions can be considered normal (Table A2). Then, the AHC analysis was run by SPSS Statistic 29.0 software. Finally, the clustering results were presented in a dendrogram. To determine the appropriate number of clusters, we calculated and obtained the clustering coefficients for this AHC analysis. As can be seen from Figure 6, when the number of clusters is 3, this curve of clustering coefficients tends to slow down, and the interval between the points becomes larger, which means that heterogeneity between the clusters increases. Therefore, the informal community gardens in the 25 samples were finally classified into three types, named group A, group B, and group C (Figure 7). Among them, group B has the highest number of samples, three times that of group A at 48%, followed by group C at 36%.

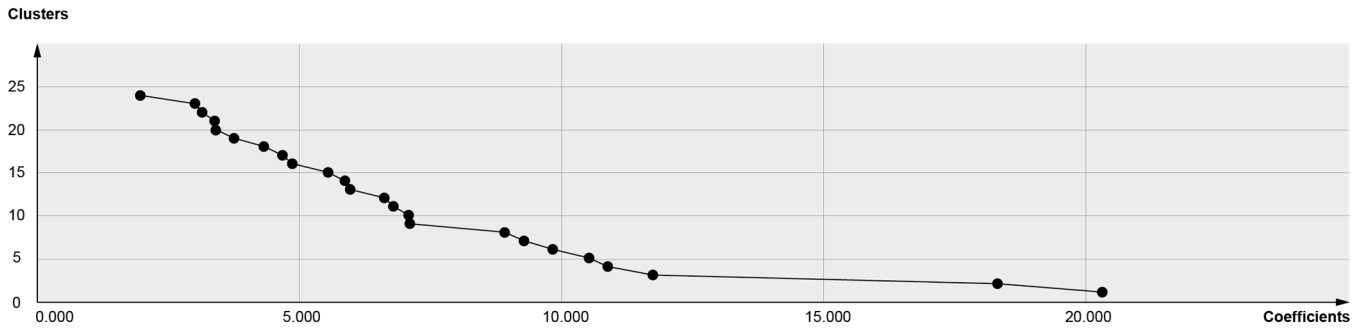


Figure 6. The clustering coefficients of the agglomerative hierarchical analysis.

Although it shows that the residents' needs are taken into account in the selection and application of the components in the previous results, the statistical results on proportions of the indicators in each type further demonstrate the main needs of the target users and the differences in the priority of the residents' needs behind the different types (Figure 7). For example, in terms of vegetative conditions, Group A had more samples of ornamental and fruit plants than others with 29.85% and 26.87%, respectively; Group B had significantly more ornamental and vegetable plants with 40.46% and 32.82%, respectively; Group C had overwhelmingly more vegetable plants with 40.89%. In addition, based on our field mapping and non-participatory observation, three typical samples were analyzed as case studies for supplementary illustration (Figure 8).

Table 2. Frequency of each indicator is related to the selected samples.

Serial Number	Name of Sample Courtyards	Locational Conditions 1				Greenery Conditions 1				Vegetation Conditions				Material Conditions			
		L1	L2	L3	L4	G1	G2	G3	G4	V1	V2	V3	V4	M1	M2	M3	M4
1	Liujia Hutong No. 1 Courtyard	●	●	●	◎	●	●	◎	◎	24	6	12	10	9	15	5	28
2	Yaowu Hutong No. 9 Courtyard	●	◎	●	◎	●	●	●	◎	18	13	24	11	15	8	4	25
3	Yaowu Hutong No. 27 Courtyard	●	◎	●	◎	●	◎	◎	◎	19	7	27	6	18	8	8	27
4	Dongbeiyuan Hutong No. 13 Courtyard	◎	●	●	●	●	◎	◎	●	15	6	18	14	14	21	8	21
5	Dongbeiyuan Hutong No. 14 Courtyard	◎	◎	●	◎	◎	●	◎	◎	21	2	9	18	11	15	10	26
6	Shanxi Hutong No. 5 Courtyard	◎	●	●	◎	●	●	◎	●	18	9	21	12	9	18	8	25
7	Shanxi Hutong No.12 Courtyard	◎	●	●	●	●	●	◎	●	27	6	15	14	13	13	8	29
8	Shanxi Hutong No. 25 Courtyard	●	◎	●	◎	●	◎	●	◎	21	9	24	10	21	11	6	24
9	Shihou Hutong No. 11 Courtyard	◎	◎	●	●	●	◎	◎	●	15	14	15	9	18	21	4	11
10	Yanshou Hutong No. 90 Courtyard	●	●	●	●	●	●	◎	●	21	4	12	7	15	13	8	21
11	Xiaochunshu Hutong No. 18 Courtyard	●	◎	●	●	●	◎	●	●	19	2	17	5	15	8	6	33
12	Xiaochunshu Hutong No. 19 Courtyard	●	●	●	◎	●	◎	●	◎	16	9	31	9	22	12	8	29
13	Yanjia Hutong No. 10 Courtyard	●	◎	◎	◎	●	●	◎	◎	15	4	18	9	17	11	3	19
14	Yanjia Hutong No. 11 Courtyard	◎	◎	●	◎	●	●	●	◎	18	1	21	7	18	8	1	23
15	Shitou Hutong No. 36 Courtyard	●	◎	●	◎	●	●	◎	◎	27	8	6	12	7	13	9	22
16	Shitou Hutong No. 53 Courtyard	●	●	◎	●	●	●	●	●	13	9	17	7	15	15	6	18
17	Shitou Hutong No. 89 Courtyard	◎	●	●	◎	●	●	●	◎	12	14	14	10	17	15	9	18
18	Taner Hutong No. 21 Courtyard	●	◎	●	●	●	●	●	◎	19	8	24	10	15	5	5	31
19	Taner Hutong No. 26 Courtyard	◎	◎	●	◎	●	◎	●	◎	21	8	18	6	15	2	2	30
20	Qudeng Hutong No. 22 Courtyard	◎	●	●	◎	●	◎	●	◎	25	9	13	11	8	15	12	30
21	Chaer Hutong No. 10 Courtyard	◎	●	●	◎	●	◎	●	◎	10	10	28	10	19	9	8	25
22	Zhushikou Street No. 255 Courtyard	●	●	●	●	●	●	◎	●	30	11	12	15	10	16	10	36
23	Baishun Hutong No. 37 Courtyard	●	●	●	◎	●	◎	●	◎	18	6	21	4	13	11	8	24
24	Peizhi Hutong No. 43 Courtyard	◎	●	●	◎	●	●	●	◎	24	12	12	12	5	11	4	23
25	Peiying Hutong No. 26 Courtyard	◎	◎	●	●	●	◎	◎	●	12	17	14	9	15	20	9	18

1 "●" and "◎" represent the presence or absence of the indicator in the sample, respectively.

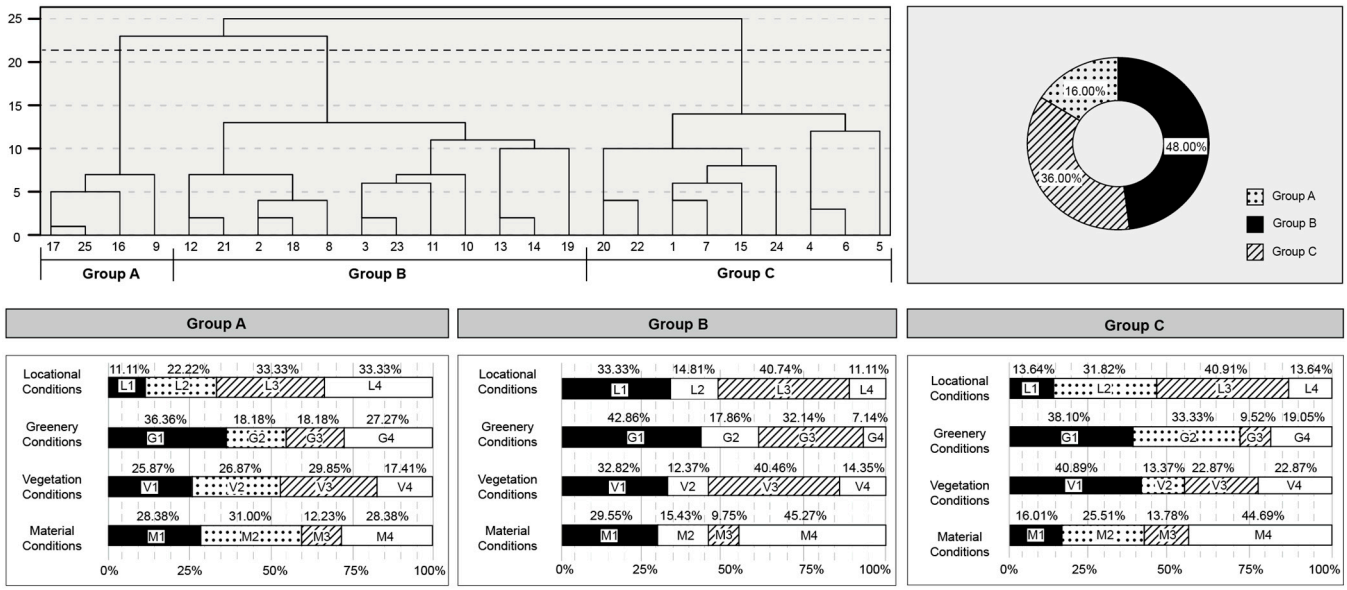


Figure 7. The types of resident-led community gardens in the Dashilar community. Dendrogram (**top left**): the clustering results of the 25 selected samples. Note: The dashed line shows the truncation level. Circle chart (**top right**): the proportion of different types in the selected samples. Bar charts (**bottom**): the proportions of the indicators in four categories for each type.

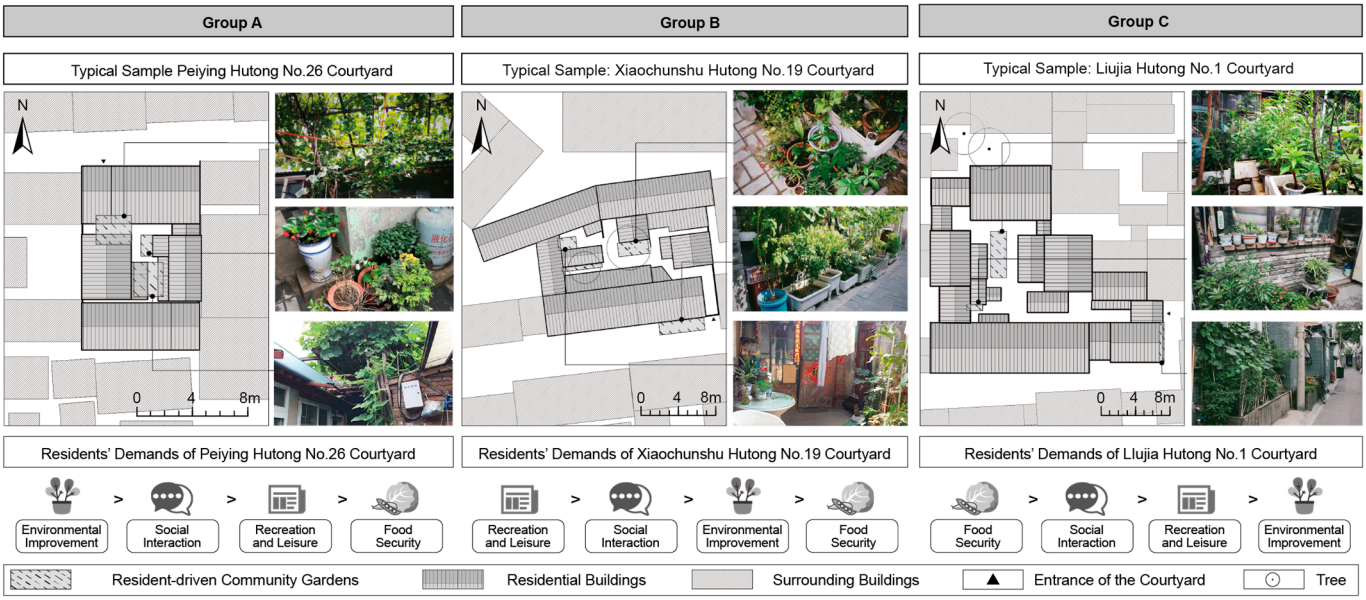


Figure 8. The typical sample of each group related to the resident-led community gardens in the Dashilar community.

Specifically, (1) the most prominent difference of group A is that the proportion of fruit plants is approximately twice as large compared to its two counterparts, the majority of which are climbing plants growing on wooden pergolas and located on the courtyard's patio or rooftop, for example, in the sample of Peiying Hutong No. 26 Courtyard, where the grapes (Latin name: *Vitis vinifera*) grown on wooden pergolas are attached most importance by the residents for the daily needs of sharing fruits and regulating the courtyard microclimate by providing shade; (2) there is the largest proportion of ornamentals in the resident-led community gardens of group B, most of which are carefully cultivated by means of clay products and arranged on the patios and doorsteps, and in the Xiaochunshu Hutong No.19 Courtyard, for instance, the residents prefer to ornamentals with individual

preference and cultural meanings rather than other indicators; (3) and the most striking trait of the samples related to group C is that vegetables and herbs are dominant between the components, which are cultivated by a combination of ground and vertical greening and mainly distributed on the patios and against the wall in their courtyards, for example in the sample of the Liujia Hutong No. 1 courtyard, vegetables and herbs were prioritized by the residents for meeting the demands for foods. In summary, the resident-led community gardens are designed to meet their common demands for food security, environmental improvement, social interaction, and recreation, and the priority of these main needs varies between the different types.

4.3. Formal and Informal Renewal Projects Dealing with Public Spaces

Based on the investigations and literature review, the renewal projects of the public spaces in the Dashilar community were summarized, respectively (Figure 9). The result shows that the renewal projects dealing with public spaces lie on a spectrum, with informal renewal projects driven by the residents' spontaneous participation and action at one end and the formal ones led by the government and the professional teams at the other. The informal regeneration projects focused on community gardening are usually initiated by one or more households in the same courtyard to complete the renewal of the public space around their courtyard through the iterative process of negotiation, design, and construction, in which the residents integrate their preferences, needs, knowledge, experience, and the resources they have without the collaboration of the government, professional teams, or NGOs. Specifically, in the negotiation phase, multiple households within each courtyard would communicate their needs and work together to come up with a blueprint for their community garden. In the design phase, the residents would not only propose solutions that integrate local knowledge but also contribute their own insights, preferences, and needs to the selection of components. During the construction phase, the residents would invest their own time and money and adjust the design based on their feedback in the long run.

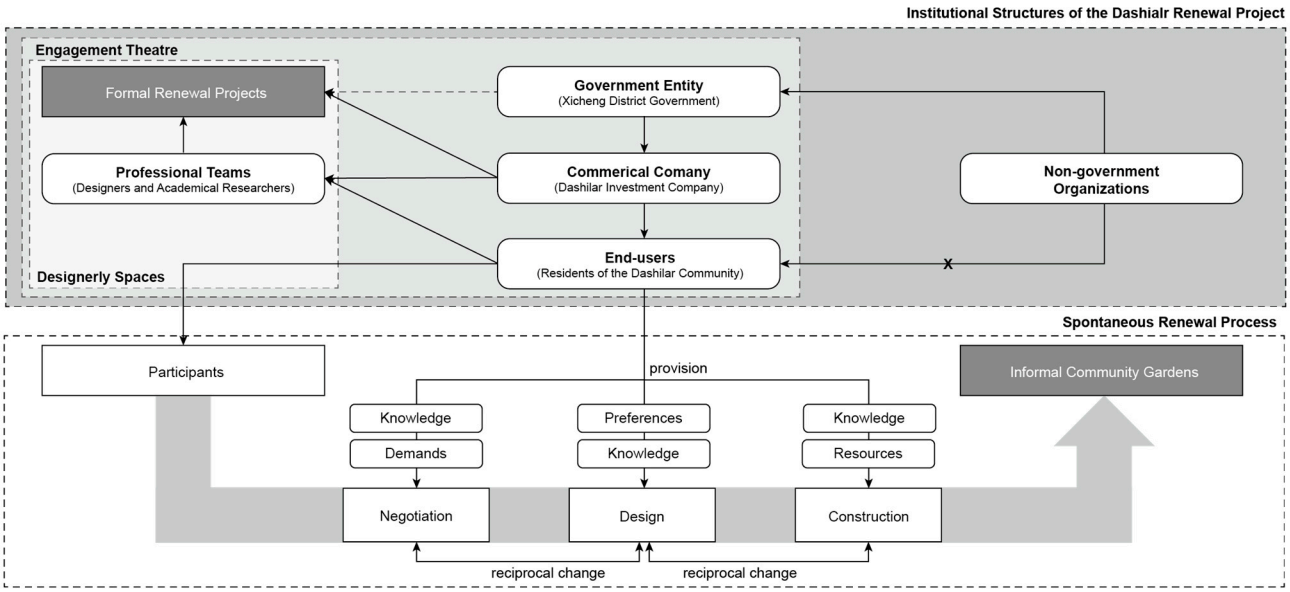


Figure 9. The formal and informal renewal projects dealing with the public spaces in the Dashilar community.

In addition, the formal renewal projects are mainly dominated by government officials and professional teams responsible for the clients and the government, and the residents are unable to be involved in a spontaneous and meaningful way, resulting in their requirements and expectations not being truly reflected in these projects. Specifically, (1) the professional teams might create their own "designerly spaces" by hosting workshops to invite the

residents to participate indirectly in renewal projects [38], where the professionals could take advantage of information asymmetries to establish decision-making hegemony and lack respect for the opinions and thoughts of the residents; and (2) the government entities and their funded company, Dashilar Investment Company, might appear to meet the engagement willingness of the residents by coercive and induced participation to be involved that does not result in any empowerment, in order to achieve the government's goals, which is termed "engagement theatre" [39]. In addition, as intermediation, NGOs prefer to convey the government's goals to the residents rather than assume the function of transmitting residents' opinions to the government. In summary, the residents are not really involved in the formal renewal projects organized by the government and the professions.

5. Discussions

5.1. Strengths and Limitations of Resident Spontaneous Actions

Previous research has shown that informal community gardens and general urban parks have two different design styles [19]. This study also confirms that there are differences in the physical components between informal community gardens and general urban parks, especially in the attributes and quality of the plants and hard materials chosen by the inhabitants. In the Dashilar community, the residents not only cultivate native ornamentals but also often plant local vegetables, fruits, and herbs, which are adaptable to natural conditions and environmental constraints based on their own attributes and characteristics, but these are rarely found in general urban parks. In addition, most of the hard materials used by the residents for informal community gardens are recycled items in their everyday lives, which are cheap to afford and easy to access, and these hard materials are also different from the criteria for the selection of counterparts in general urban parks. The reason for the existence of two design styles is because they have different objectives, budgets, and end-users. Specifically, one of the main objectives of urban parks is to provide high-quality living environments for a wide range of people, and accordingly, priority is given to planting ornamental plants, and more emphasis is placed on aesthetic quality and durability in the selection of hard materials within the budgetary boundaries. In contrast, informal community gardens mainly provide services to local residents, and they attach importance not only to the ornamental value and adaptability of plants but also to their edible and medicinal properties. Furthermore, they emphasize the economic cost and availability of hard materials in order to minimize maintenance costs and time, as well as to make these community gardens retain a unique flavor of everyday life.

Based on the statistical results of this study (Figure 7), it was found that despite all indicators being covered in each type of informal community garden, the proportion of indicators varies from one type to another with the aim of catering to the major needs of the residents. Moreover, the same type of informal community garden may use the various physical components to meet the different preferences of the residents (Table 1). For example, the residents will choose different plants according to their preferences to fulfill their needs for vegetable consumption. Such differences indicate that the residents of different courtyards have diverse priorities for specific indicators and components of their community gardens, and these residents, when choosing the components of informal community gardens, not only consider the attributes and characteristics but will also integrate their own preferences and needs to make their everyday lives easier and more comfortable. The results supported previous studies highlighting the strong relationship of these informal green spaces with the preferences, requirements, and everyday lives of local residents [17,40–42]. When residents live in a historical community with formal regeneration projects that cannot meet their preferences and needs for environmental promotion and everyday life, it is logical for them to address it by spontaneously planning and designing an informal community garden, in which they can make their own decisions about the composition. The residents' preferences and demands derive not only from the accumulated experiences and reflections of their everyday lives but are also influenced by the different social environments in which they are embedded. These are the reasons

why residents integrate their own preferences and needs into their choices of composition, which explains why the composition is not exactly the same for the same type and between different types.

Although residents' autonomous decision-making on the composition of informal community gardens can fulfill their own requirements and increase residents' satisfaction with their community life, full support of such autonomy can undermine the long-term performance of these informal gardens. This is because many residents lack expertise in plant configuration and neglect the durability and aesthetics of hard materials in the construction of informal community gardens. Therefore, design expertise still matters, and financial support is also needed as a supplement to the local actions of the historical community, which is consistent with previous studies [18,43,44].

There are, however, some limitations in our research. The indicators and components proposed and enumerated in this study can hardly cover the whole composition of informal gardens in Chinese historic communities since it is conducted with a random sampling approach and is limited by the scope and number of samples collected. In addition, it will be necessary to expand the scope and number of samples by involving more Chinese historic communities in future studies in order to comprehensively reflect the full range of residents' insights and needs regarding informal community gardens.

5.2. Effectiveness of Resident Spontaneous Participation

This study found that local residents have applied a great deal of their knowledge and experience to the specific design of informal community gardens and developed place-based solutions that can adapt to environmental constraints and explore the spatial potentials, especially in terms of location conditions and greening conditions (Table 1). These solutions have attracted the attention of designers and academics, some of which have been incorporated into formal renewal projects dealing with public spaces in the Dashilar community [18]. These results suggested that disadvantaged residents have creative insights and systematic solutions for the renewal of public spaces in historical communities. As advocates of everyday urbanism argue [45], disadvantaged groups can play a possible transformative role in reshaping traditional place-making practices [18,46]. There are several possible explanations. Compared to governmental officials and professionals, local residents have a deep knowledge of local environments, culture, and community needs. In addition, the residents have conducted many practices in local environments and have learned from both successes and failures. Therefore, this local knowledge can provide adaptive and sustainable design guidelines as a supplement for future renewal projects dealing with public spaces in historical communities.

This study also found that the resident spontaneous actions centering on informal community gardens cover not only the design process but also processes of negotiation and construction (Figure 9), in which the residents collaborate in designing and co-creating informal community gardens. Specifically, in addition to integrating their own knowledge and willingness in the design phase, the residents of a courtyard are usually involved in the generation of concepts and plans during the negotiation phase and adapt the design to their feedback in the construction phase. These results suggested that informal community gardening is an organized and planned local action, the spontaneous processes of which are broadly consistent with the planning, design, and construction of formal renewal projects dealing with public spaces. Even these regenerative practices of reflection-in-action are more responsive to changes in the physical and social environment than one-off formal practices [47,48]. The findings differ from past prejudices that urban informality is chaotic and disorganized but support the previous observations that there is no clear line of demarcation between formal and informal environments in some cities [49].

It is worth noting that the residents' spontaneous behaviors of informal community gardening may undermine the tangible heritage of historical communities due to the lack of third-party intervention with expertise in heritage preservation. Overall, however, the existence of informal community gardens is not exactly a crisis but rather an urban landscape

of opportunities and challenges, and hence, it is recommended that a comprehensive approach be taken to recognize, understand, and deal with them rather than simply deeming them illegal and removing them.

5.3. Implications for the Organizational Mechanisms

Prior research has noted the importance of the spontaneous participation of residents. Rasoolimanesh et al. argued that it is "the highest level of participation" compared to coercive and induced participation by residents [34]. On this basis, this paper found that informal community gardens based on resident spontaneous participation are more effective in meeting their diverse needs, and three types respond to different priorities of residents' needs (Figure 8). Based on the results of the spontaneous processes of informal community gardening (Figure 9), we can infer that the effectiveness of resident spontaneous participation in meeting local willingness could be attributed to the empowerment and full participation of residents. Specifically, resident empowerment allows residents to make their own decisions on the composition of informal community gardens to meet their preferences and needs; resident participation throughout the process of informal community gardening ensures that the plans and schemes reflect the diverse voices of residents and that adjustments can be made based on their willingness to accept specific solutions.

In contrast, this paper found that the empowerment and full participation of residents are undermined by the occurrence of "designerly spaces" and "engagement theatre" in the formal renewal projects (Figure 9), which have a negative impact on their abilities to meet the preferences and demands of the residents. The results further supported the idea proposed by Lee et al. (2014) that the preferences of local residents cannot be reflected in the design of formal renewal projects dealing with public spaces in Chinese cities [19]. A possible explanation for this might be that governmental officials and professional teams in charge of the formal renewal projects could rely more on their own judgment and lack understanding of local knowledge and willingness. Another possible explanation is that the government is the main client of the formal renewal projects, managing their aims, budgets, and construction duration, which may lead to a tendency for those in charge to prioritize the upper-level goals over the local willingness to participate in the processes.

Grassroots innovation refers to bottom-up organizational mechanisms for community development and renewal, which are often initiated by the residents who identify the community's issues and seek solutions with the participation and collaboration of other stakeholders [50]. Currently, grassroots innovation has been considered one of the significant community-based organization mechanisms by the Chinese government to achieve community sustainability for the reason that it can contribute to strengthening relationships between people and their ability to shape more sustainable communities [38]. In this context, informal community gardening is expected to be a stepping stone to inspire the grassroots innovation of historical communities by retaining the empowerment and full participation of residents and further involving diverse actors. Therefore, this bottom-up pathway needs to be integrated with the broader institutional structures of the Dashilar community, which can lead to a combination of top-down and bottom-up approaches to promote the renewal of public space in Chinese historical communities.

6. Conclusions

The Dashilar community, marked by its traditional fabric and numerous resident-driven community gardens, demonstrates how the spontaneous actions of residents can reshape the public spaces of historic neighborhoods. Furthermore, echoes of its informality in pocket green spaces can be found in other urban historical communities. Nevertheless, these informal community gardens outside of the government's regulations have not received much attention. To address this scholarly gap that still exists, we conducted a case study in the Dashilar community by using a mixed-methods analysis. This approach enables us to investigate and analyze small-scale community green spaces, covering

their components, genres, and operational processes to capture local knowledge and the residents' needs behind them.

By investigating and identifying the composition of informal community gardens, this study offers a detailed classification system of the components. It confirms the differences between informal community gardens and general urban parks proposed by Lee et al. (2014) by highlighting the unique attributes and quality of the plants and hard materials applied by informal community gardens [19], and it further found that there are three types with different compositions in response to diverse preferences and needs of the residents. In turn, these analyses revealed the logic of residents' choices of components associated with informal community gardens.

Our research makes several contributions to the deeper and broader understanding of residents' insights and solutions for the public space renewal of historical communities. One is that local knowledge facilitates these informal gardens overcoming environmental and spatial constraints by improving their locational and greenery conditions, and it is needed as a supplement to the design guidelines. Another is that community garden-based solutions proposed by residents can be divided into three interactive and iterative phases, including negotiation, design, and construction, thereby realizing the empowerment and full participation of residents to meet their willingness.

In the face of the current institutional structures, we highlight the underlying issues that hinder resident participation in a spontaneous and meaningful way and the role of residents' spontaneous actions in informal community gardening and illustrate that it is expected to explore a bottom-up pathway that involves agents from different groups while retaining resident empowerment and its full participation, which can combine with the top-down organizational mechanisms of public space renewal related to historical communities to achieve sustainable development of historical communities.

In summary, through detailed research on the Dashilar case study, this paper unravels the logic and underlying rationality of informal community gardening based on spontaneous resident actions and its relationships with broader renewal schemes and projects within the realm of historical communities. Our findings offer valuable insights and nuanced interpretations that not only contribute to our understanding of the structural reasons for the existence of resident-driven community gardens but also provide reference for future explorations and policy-making. This research highlights these community gardens as a bottom-up pathway to achieve participatory design and co-creation of historical communities, which can promote sustainable development and promotion of these communities. In further research, more samples and case studies, applying and advancing qualitative analysis and quantitative interpretation, are needed to shed more light on the strengths and intentions of these informal gardens. Interviews and feedback from local residents are also required to provide additional evidence and capture their needs and preferences.

Author Contributions: Conceptualization, W.Z. and J.X.; Methodology, W.Z. and J.X.; Software, W.Z.; Validation, W.Z.; Formal analysis, W.Z.; Investigation, W.Z. and J.X.; Resources, W.Z. and J.X.; Data curation, W.Z.; Writing—original draft, W.Z.; Writing—review and editing, J.X.; Visualization, W.Z.; Supervision, J.X.; Project administration, W.Z. and J.X.; Funding acquisition, W.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by grants from the Project of Philosophy and Social Science Research of Jiangsu Colleges and Universities (Project Number: 2023SJYB0061) and Fundamental Research Funds for the Central Universities Humanities and Social Science Fund of Nanjing Agricultural University (Project Number: SKYC2023019).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: We thank the residents of the Dashilar community, whose knowledge and support enabled this design research. In addition, our research was supported by the China Scholarship Council (No. 202108050211).

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Image collection of informal community gardens in the selected samples.

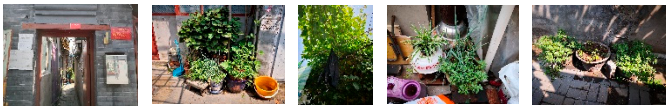
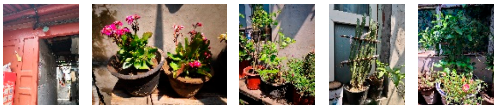
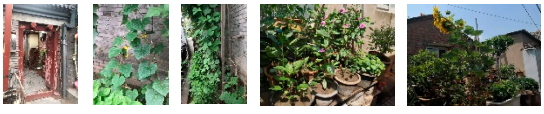
Serial Number	Name of Sample Courtyards	Image Collection
1	Liujia Hutong No. 1 Courtyard	
2	Yaowu Hutong No. 9 Courtyard	
3	Yaowu Hutong No. 27 Courtyard	
4	Dongbeiyuan Hutong No. 13 Courtyard	
5	Dongbeiyuan Hutong No. 14 Courtyard	
6	Shanxi Hutong No. 5 Courtyard	
7	Shanxi Hutong No. 12 Courtyard	
8	Shanxi Hutong No. 25 Courtyard	
9	Shihou Hutong No. 11 Courtyard	
10	Yanshou Hutong No. 90 Courtyard	

Table A1. *Cont.*

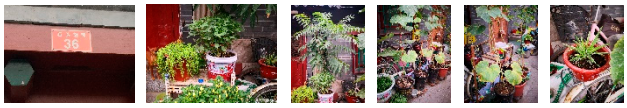
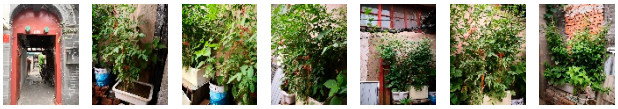
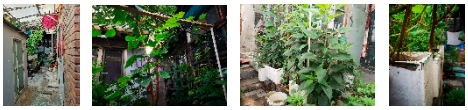
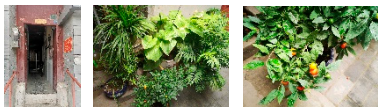
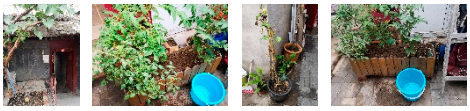
11	Xiaochunshu Hutong No. 18 Courtyard	
12	Xiaochunshu Hutong No. 19 Courtyard	
13	Yanjia Hutong No. 10 Courtyard	
14	Yanjia Hutong No. 11 Courtyard	
15	Shitou Hutong No. 36 Courtyard	
16	Shitou Hutong No. 53 Courtyard	
17	Shitou Hutong No. 89 Courtyard	
18	Taner Hutong No. 21 Courtyard	
19	Taner Hutong No. 26 Courtyard	
20	Qudeng Hutong No. 22 Courtyard	
21	Chaer Hutong No. 10 Courtyard	
22	Zhushikou Street No. 255 Courtyard	

Table A1. *Cont.*

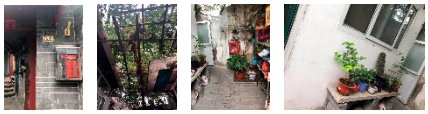
23	Baishun Hutong No. 37 Courtyard	
24	Peizhi Hutong No. 43 Courtyard	
25	Peiying Hutong No. 26 Courtyard	

Table A2. The results of normality tests using skewness and kurtosis.

Variables	N Statistic	Skewness		Kurtosis	
		Statistic	Std. Error	Statistic	Std. Error
V1	25	0.263	0.464	−0.390	0.902
V2	25	0.194	0.464	−0.135	0.902
V3	25	0.340	0.464	−0.392	0.902
V4	25	0.423	0.464	0.318	0.902
M1	25	0.340	0.464	−0.380	0.902
M2	25	−0.067	0.464	−0.081	0.902
M3	25	−0.378	0.464	−0.372	0.902
M4	25	−0.232	0.464	0.352	0.902
Valid N (listwise)	25				

References

1. Yang, J.Q.; Chen, Y. Review on the Development of Urban Regeneration in China from 1949 to 2019. *City Plan. Rev.* **2020**, *44*, 9–19.
2. Zheng, H.W.; Shen, G.Q.; Wang, H. A Review of Recent Studies on Sustainable Urban Renewal. *Habitat Int.* **2014**, *41*, 272–279. [CrossRef]
3. Akkar Ercan, M. Challenges and Conflicts in Achieving Sustainable Communities in Historic Neighbourhoods of Istanbul. *Habitat Int.* **2011**, *35*, 295–306. [CrossRef]
4. Lee, G.K.L.; Chan, E.H.W. The Analytic Hierarchy Process (AHP) Approach for Assessment of Urban Renewal Proposals. *Soc. Indic. Res.* **2008**, *89*, 155–168. [CrossRef]
5. Satterthwaite, D. Sustainable Cities or Cities That Contribute to Sustainable Development? In *The Earthscan Reader in Sustainable Cities*; Routledge: Abingdon, UK, 1999; ISBN 978-1-315-80046-2.
6. Lai, L.W.C.; Lorne, F.T. Sustainable Urban Renewal and Built Heritage Conservation in a Global Real Estate Revolution. *Sustainability* **2019**, *11*, 850. [CrossRef]
7. Zheng, B.; Masrabaye, F.; Guiradoumngué, G.M.; Zheng, J.; Liu, L. Progress in Research on Sustainable Urban Renewal Since 2000: Library and Visual Analyses. *Sustainability* **2021**, *13*, 4154. [CrossRef]
8. Adams, D.; Hastings, E.M. Urban Renewal in Hong Kong: Transition from Development Corporation to Renewal Authority. *Land Use Policy* **2001**, *18*, 245–258. [CrossRef]
9. Ferris, J.; Norman, C.; Sempik, J. People, Land and Sustainability: Community Gardens and the Social Dimension of Sustainable Development. *Soc. Policy Adm.* **2001**, *35*, 559–568. [CrossRef]
10. Ramos, A.K.; Trinidad, N.; Bickford, S.H.; Bickford, N.; Torquati, J.; Mushi, M. Engaging Residents in Planning a Community Garden: A Strategy for Enhancing Participation Through Relevant Messaging. *Collab. A J. Community-Based Res. Pract.* **2019**, *2*, 21. [CrossRef]
11. Buchecker, M.; Hunziker, M.; Kienast, F. Participatory Landscape Development: Overcoming Social Barriers to Public Involvement. *Landsc. Urban Plan.* **2003**, *64*, 29–46. [CrossRef]
12. Anuar, M.I.N.M.; Saruwono, M. Barriers of User's Involvement in the Design Process of Public Parks as Perceived by Landscape Architects. *Procedia-Soc. Behav. Sci.* **2012**, *35*, 253–259. [CrossRef]

13. Zhong, X.; Leung, H. Exploring Participatory Microregeneration as Sustainable Renewal of Built Heritage Community: Two Case Studies in Shanghai. *Sustainability* **2019**, *11*, 1617. [CrossRef]
14. GLOVER, T.D.; SHINEW, K.J.; PARRY, D.C. Association, Sociability, and Civic Culture: The Democratic Effect of Community Gardening. *Leis. Sci.* **2005**, *27*, 75–92. [CrossRef]
15. Nordh, H.; Østby, K. Pocket Parks for People—A Study of Park Design and Use. *Urban For. Urban Green.* **2013**, *12*, 12–17. [CrossRef]
16. Danford, R.S.; Strohbach, M.W.; Warren, P.S.; Ryan, R.L. Active Greening or Rewilding the City: How Does the Intention behind Small Pockets of Urban Green Affect Use? *Urban For. Urban Green.* **2018**, *29*, 377–383. [CrossRef]
17. Hou, X. "Tiny Garden Design": Micro Regeneration of Dilapidated Communities Based on Daily Demands An Analysis of the Design of Rose Fairy Garden in Changying. *Archit. J.* **2022**, *3*, 33–36. [CrossRef]
18. Jiang, X.; Xu, X.; Wang, X.; Lin, Q. Research on Micro-renewal of Green Space in Beijing Hutong from the Per-spective of Residents' Spontaneous Renewal—Exploration in Dashilar Area. *Landsc. Archit.* **2019**, *6*, 18–22. [CrossRef]
19. Lee, B.K.; Sohn, S.Y.; Yang, S. Design Guidelines for the Dashilar, Beijing Open Green Space Redevelopment Project. *Urban For. Urban Green.* **2014**, *13*, 385–396. [CrossRef]
20. Van den Berg, P.; Weijs-Perrée, M.; Dane, G.; van Vliet, E.; Liu, H.; Sun, S.; Borgers, A. A Comparative Study of Urban Park Preferences in China and The Netherlands. *Int. J. Environ. Res. Public Health* **2022**, *19*, 4632. [CrossRef] [PubMed]
21. Blashfield, R.K.; Aldenderfer, M.S. The Literature On Cluster Analysis. *Multivar. Behav. Res.* **1978**, *13*, 271–295. [CrossRef] [PubMed]
22. Shapira, A.; Shoshany, M.; Nir-Goldenberg, S. Combining Analytical Hierarchy Process and Agglomerative Hierarchical Clustering in Search of Expert Consensus in Green Corridors Development Management. *Environ. Manag.* **2013**, *52*, 123–135. [CrossRef]
23. Long, J.; Nelson, T.; Wulder, M. Regionalization of Landscape Pattern Indices Using Multivariate Cluster Analysis. *Environ. Manag.* **2010**, *46*, 134–142. [CrossRef] [PubMed]
24. Yu, B.; Shu, S.; Liu, H.; Song, W.; Wu, J.; Wang, L.; Chen, Z. Object-Based Spatial Cluster Analysis of Urban Landscape Pattern Using Nighttime Light Satellite Images: A Case Study of China. *Int. J. Geogr. Inf. Sci.* **2014**, *28*, 2328–2355. [CrossRef]
25. Yim, O.; Ramdeen, K.T. Hierarchical Cluster Analysis: Comparison of Three Linkage Measures and Application to Psychological Data. *Quant. Methods Psychol.* **2015**, *11*, 8–21. [CrossRef]
26. Vecco, M. A Definition of Cultural Heritage: From the Tangible to the Intangible. *J. Cult. Herit.* **2010**, *11*, 321–324. [CrossRef]
27. Bae, H. Urban Stream Restoration in Korea: Design Considerations and Residents' Willingness to Pay. *Urban For. Urban Green.* **2011**, *10*, 119–126. [CrossRef]
28. Liu, Y. Community Garden Practices in High-Density High-Rise Urban Areas in Shanghai, China. In *Making Green Cities: Concepts, Challenges and Practice*; Breuste, J., Artmann, M., Ioja, C., Qureshi, S., Eds.; Springer International Publishing: Cham, Switzerland, 2023; pp. 97–110. ISBN 978-3-030-73089-5.
29. Agyeman, J. *Sustainable Communities and the Challenge of Environmental Justice*; NYU Press: New York, NY, USA, 2005; ISBN 0-8147-0710-6.
30. Hempel, L.C. Conceptual and Analytical Challenges in Building Sustainable Communities. In *Toward Sustainable Communities: Transition and Transformations in Environmental Policy*; The MIT Press: Cambridge, MA, USA, 1999; pp. 43–74.
31. Li, H. The Lost and Awaken of Publicity: Street Community Renewal Based on Space Justice. *Planners* **2018**, *34*, 25–30.
32. Arnstein, S.R. A Ladder Of Citizen Participation. *J. Am. Inst. Plan.* **1969**, *35*, 216–224. [CrossRef]
33. Declaration, R. *Rio Declaration on Environment and Development*; Centre for Our Common Future: Geneva, Switzerland, 1992.
34. Rasoolimanesh, S.M.; Ringle, C.M.; Jaafar, M.; Ramayah, T. Urban vs. Rural Destinations: Residents' Perceptions, Community Participation and Support for Tourism Development. *Tour. Manag.* **2017**, *60*, 147–158. [CrossRef]
35. Fraser, E.D.G.; Dougill, A.J.; Mabee, W.E.; Reed, M.; McAlpine, P. Bottom up and Top down: Analysis of Participatory Processes for Sustainability Indicator Identification as a Pathway to Community Empowerment and Sustainable Environmental Management. *J. Environ. Manag.* **2006**, *78*, 114–127. [CrossRef]
36. Carter, T.; Cromley, E.C. *Invitation to Vernacular Architecture: A Guide to the Study of Ordinary Buildings and Landscapes*; University of Tennessee Press: Knoxville, TN, USA, 2005; Volume 6, ISBN 1-57233-331-6.
37. Im, S.-B. Visual Preferences in Enclosed Urban Spaces: An Exploration of a Scientific Approach to Environmental Design. *Environ. Behav.* **1984**, *16*, 235–262. [CrossRef]
38. Teli, M.; McQueenie, J.; Cibin, R.; Foth, M. Intermediation in Design as a Practice of Institutioning and Commoning. *Des. Stud.* **2022**, *82*, 101132. [CrossRef]
39. Kamols, N.; Foth, M.; Guaralda, M. Beyond Engagement Theatre: Challenging Institutional Constraints of Participatory Planning Practice. *Aust. Plan.* **2021**, *57*, 23–35. [CrossRef]
40. Sikorska, D.; Ciężkowski, W.; Babańczyk, P.; Chormański, J.; Sikorski, P. Intended Wilderness as a Nature-Based Solution: Status, Identification and Management of Urban Spontaneous Vegetation in Cities. *Urban For. Urban Green.* **2021**, *62*, 127155. [CrossRef]
41. Włodarczyk-Marciniak, R.; Sikorska, D.; Krauze, K. Residents' Awareness of the Role of Informal Green Spaces in a Post-Industrial City, with a Focus on Regulating Services and Urban Adaptation Potential. *Sustain. Cities Soc.* **2020**, *59*, 102236. [CrossRef] [PubMed]

42. Zhou, C. Concept Identification and Planning Strategies of Informal Urban Green Space. *Chin. Landsc. Archit.* **2022**, *38*, 50–55. [CrossRef]
43. Levinthal, D.A.; Warglien, M. Landscape Design: Designing for Local Action in Complex Worlds. *Organ. Sci.* **1999**, *10*, 342–357. [CrossRef]
44. Liu, J.; Zhang, M.; Nikita, N. Agent-Based Design Research to Explore the Effectiveness of Bottom-up Organizational Design in Shaping Sustainable Vernacular Landscapes: A Case in Hailar, China. *Landsc. Urban Plan.* **2021**, *205*, 103961. [CrossRef]
45. Loukaitou-Sideris, A.; Ehrenfeucht, R. *Sidewalks: Conflict and Negotiation over Public Space*; MIT Press: Cambridge, MA, USA, 2011; ISBN 0-262-51741-8.
46. Mukhija, V.; Loukaitou-Sideris, A. Reading the Informal City: Why and How to Deepen Planners' Understanding of Informality. *J. Plan. Educ. Res.* **2015**, *35*, 444–454. [CrossRef]
47. Filor, S.W. The Nature of Landscape Design and Design Process. *Landsc. Urban Plan.* **1994**, *30*, 121–129. [CrossRef]
48. Jiang, L.; Li, L. The Action-Oriented Model and Key Works of Community Environment Construction: A Case Study of the Dashilar Area in Beijing. *Mod. Urban Res.* **2023**, *2*, 84–90.
49. Mukhija, V.; Loukaitou-Sideris, A. *The Informal American City: Beyond Taco Trucks and Day Labor*; MIT Press: Cambridge, MA, USA, 2014; ISBN 0-262-02707-0.
50. Gupta, S. Understanding the Feasibility and Value of Grassroots Innovation. *J. Acad. Mark. Sci.* **2020**, *48*, 941–965. [CrossRef]