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Article

Urban Regeneration Through Circularity: Exploring the Potential of Circular Development in the Urban Villages of Chengdu, China

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Abstract: Research on circular development in China’s urban planning remains limited, particularly regarding marginalized groups’ actions. This study addresses the gap by examining circular practices within informal food systems in Chengdu’s urban villages. It highlights residents’ bottom-up initiatives in food production and consumption and their interactions with the broader urban context. Using street interviews and Research through Design, it develops community-based visions to improve these actions and the needed planning tools for implementation. It also explores how circular development could support urban regeneration by recognizing overlooked resources and practices. Semi-structured expert interviews reveal barriers in China’s planning system to accommodate such visions. Findings indicate that local circular actions—driven by local labor and knowledge and efforts to tackle polluted land and idle spaces—offer valuable opportunities for circular development. However, deficiencies in planning tools for spatial planning, waste treatment, land contamination regulation, and vulnerability recognition create barriers to upscaling these initiatives. This study calls for integrating circular development into China’s spatial planning by strengthening top-down tools and fostering grassroots initiatives to promote sustainable resource flows, ecosystem health, and social equity. It also offers broader insights into promoting circular development by recognizing and integrating informal, bottom-up practices in cities undergoing informal settlement regeneration.

Keywords: circular development; circular economy; social dimension; planning tools; urban regeneration; marginalized communities; well-being; food system



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1. Introduction

The “take–make–dispose” linear economy has led to excessive resource consumption and waste, threatening natural resources and ecosystems amid rapid demographic and economic growth [1]. Over the past decade, the circular economy has gained traction as an alternative framework to address these concerns [2,3].

China was among the earliest countries to establish the circular economy as a national goal. It defines circular economy as “a set of reduction, reuse, and recycling activities conducted throughout production, distribution, and consumption” [4]. Early on, China emphasized its systemic nature, integrating circular strategies into industry, infrastructure, culture, and consumption. Recognizing its potential to balance economic growth and environmental sustainability [5], China saw the circular economy as a response to pollution and resource depletion caused by rapid industrialization and lax environmental regulations [6].

China's implementation follows three levels—micro (small enterprises), meso (industrial parks), and macro (cities). However, efforts at the micro and meso levels have focused mainly on corporate-led cleaner production [6,7], while city-scale efforts to systematically manage urban resource flows remain underdeveloped. Consequently, discussions around the circular economy in China have largely overlooked the urban perspective and a spatial framework for implementation.

In Europe, the circular economy has also garnered substantial attention in the industrial and commercial sectors. The Ellen MacArthur Foundation [8] developed the widely used RESOLVE framework. It is based on three principles: preserving natural capital, optimizing resource circulation, and improving system efficiency by minimizing negative externalities. However, similar to China's challenges, the focus of this approach is limited to the economic dimension of business production without considering the spatial dimension [3]. Recognizing this gap, Williams [9] introduced "circular development", based on the urban ecology perspective [10]. This concept expands the circular economy to include ecological and social dimensions. This framework emphasizes three key processes: resource looping, ecological regeneration, and adaptive action. Based on urban projects, Williams also identified planning tools to support circular development. However, this concept is rooted in Western experiences and has not been tested in the Chinese context.

In low-income sectors, material and resource preservation is common out of economic necessity, with many relying on circular practices for their livelihoods [11]. Examples covered in the literature include, for instance, waste pickers and small private-sector enterprises in Brazil that collect and recycle materials such as plastic, metal, paper, and cardboard [12]; scrap metal scavengers in Spain [13]; scavenger cooperatives in the Philippines that collaborate with households and waste dealers to collect and sell recyclable materials [14]; semi-formal-informal paper recycling businesses in Hong Kong [15]. These informal activities create livelihoods and reduce waste, benefiting both communities and urban waste management. However, such workers are often marginalized, their activities deemed illegal, and they remain excluded from formal circular economy initiatives. Some studies emphasize the need to recognize informal communities as key stakeholders in the circular economy. They advocate for inclusive policies that acknowledge their contributions, improve working conditions, and expand job opportunities to enhance social equity [16,17]. Nevertheless, the main circular economy concepts, in both Western and non-Western contexts, have largely overlooked these social equity concerns and failed to integrate these marginalized groups into circular development frameworks [11,18,19].

Informal circular activities are also prevalent among migrant workers in peri-urban informal settlements in China, such as urban villages. Examples include e-waste recycling [20] and small-scale food production and sales by peri-urban farmers [21,22], which help preserve material value and sustain livelihoods. These informal settlements are often located on the urban periphery, built privately by rural landowners. Due to their low cost and strategic location, they attract large numbers of rural migrant workers seeking urban employment [23]. However, beyond the challenge of their circular practices being unrecognized by the urban authorities, these migrants are also excluded from urban renewal plans due to their outsider status. Past urban renewal actions, focused on demolition and redevelopment, have led to the housing displacement and livelihood insecurity of migrant workers [23–25]. While an increasing number of policy documents and academic studies now advocate for more inclusive urban village regeneration [26,27], alternative strategies remain scarce. Furthermore, few urban regeneration studies have recognized migrants' contributions to the informal circular economy. This lack of recognition not only weakens the livelihood security of migrant workers but also exacerbates social inequalities within urban regeneration. Therefore, integrating circular economy principles into urban village

regeneration and recognizing the value of informal practices could provide a more inclusive approach. This approach would value informal practices, enhance resource efficiency, and better support marginalized communities while fostering greater social equity.

This study aims to bridge these knowledge gaps by recognizing and shedding more light on the circular practices of low-income groups in urban villages within China's peri-urban areas. It explores the opportunities that circular development approaches could offer to promote the regeneration of marginalized areas. Additionally, it examines the necessary implementation tools and the barriers to integrating circular development within China's existing planning system.

The research questions addressed here are as follows. (1) What opportunities do the visions of improving circular activities among low-income groups present for promoting urban regeneration in marginalized areas? And (2) what barriers do current spatial planning systems pose to this process?

To answer these questions, our study conducted a case study on the circular practices of low-income residents within the informal food system of an urban village in Chengdu, China. Through fieldwork, including street interviews and observations, these local practices were recognized and their value and interrelationships were understood and categorized based on Williams' conceptual framework [9]. Subsequently, using the Research through Design method, we proposed circular development visions centered on residents' needs to strengthen their informal circular practices and explored the needed planning tools for implementation, highlighting the potential of circular development. Finally, based on semi-structured interviews with urban planners and scholars, we identified the barriers within China's existing planning system in accommodating circular development visions.

The following section introduces the literature review and research framework. A description of the case study and research methodology follows this. The Results Section presents three types of circular practices identified, their envisioned circular development scenarios, the planning tools needed to improve these practices, the opportunities they create for urban regeneration, and the barriers posed by the current planning system. The final section summarizes the key findings and academic contributions of this study.

2. Literature Review and Research Framework

This study builds upon four categories of the literature: circular development, urban regeneration, studies discussing their interrelations, and the literature on urban planning implementation tools. Together, these inform the research framework of our study.

2.1. Circular Development and Its Social Dimension

The circular economy is inherently tied to urban contexts, as cities play a key role in waste absorption, ecosystem services, and circular activities. This study draws on Williams' circular development framework [9], conceptualizing circular development along three key dimensions and specifying it to the informal food system in marginal communities:

- Resource looping focuses on waste sorting and value retention and closing material flows through recycling and reuse. In this study, this refers to **localizing food production and consumption** and **facilitating community composting**.
- Ecological regeneration focuses on restoring ecosystems and their services, often through developing urban blue-green infrastructure—such as greenways and water networks—or managing urban ecosystems via activities like farming or forestry. This study specifically examines **revitalizing polluted or underutilized land** and **enhancing water and forest ecosystems** linked to agriculture.
- Adaptive actions emphasize strengthening local communities' capacity to cope with urban changes through flexible design, participatory planning, and the development

of local knowledge systems. In marginalized areas, this dimension highlights the informal community's local knowledge network and adaptive practices related to circular development.

Criticism of the circular economy often highlights its lack of consideration of social dimensions [28–30], as governments, businesses, and consumers remain embedded in a high-consumption growth model. For grassroots groups, such as workers in downstream circular value chains or informal communities excluded from mainstream discussions, the benefits of circularity remain unclear [19,29]. In response to this gap, Clube and Tennant [29] propose the human-scale circular economy concept, drawing on human-scale development model of Max-Neef et al. [31]. According to Max-Neef et al., well-being is achieved by fulfilling four dimensions of needs: personal attributes, objective actions, material resources, and external interactions. These correspond to being in a certain state, possessing specific assets, performing certain activities, or interacting with a particular environment. These elements evolve from individual characteristics to external conditions, describing the interplay between subjective and objective well-being, namely the life-ability of the individual and the livability of the environment [32]. They argue that a socially inclusive circular economy should prioritize well-being by addressing fundamental needs, especially for marginalized communities.

While Williams' framework acknowledges the importance of building community adaptation, it does not consider the well-being perspective, which is critical for marginalized communities. Therefore, our study employs the circular development concept to identify and categorize circular actions within informal settlements. Based on the well-being needs of informal communities, it further proposes visions to enhance existing circular practices and considers what it would take to implement these with planning tools.

2.2. Urban Regeneration and Its Social Dimension

Urban regeneration evolved from urban renewal. Urban renewal originally focused on attracting external investment by demolishing aging structures for high-value projects like luxury housing and commercial centers [33]. In informal settlements, such practices have been criticized for causing displacement and gentrification, lacking considerations for social equity and sustainability [25]. Consequently, the concept of urban regeneration emerged, encompassing multidimensional aspects, including economic, environmental, and social redevelopment. In establishing its social dimension, well-being, as a measure of residents' subjective happiness, has frequently been cited in research [34,35]. Unlike macro-level indicators such as employment rates, well-being focuses on the performance of urban regeneration at the community and individual levels, providing deeper insights into the specific conditions of marginalized groups. For marginalized areas such as urban villages, ensuring that urban regeneration also benefits the well-being of long-term marginalized groups—migrant workers—should be a key objective.

This paper conceptualizes urban regeneration based on definitions by Leary and McCarthy [36] and Roberts et al. [37]. Urban regeneration involves area-based interventions that are initiated, funded, supported, or inspired by the public sector. It aims to sustainably improve conditions for local people and communities suffering from deprivation. It maximizes the use of natural, economic, human, and other resources of the community. This includes land and existing built environments, adapting them to the physical, social, economic, and environmental conditions of their cities and regions.

This definition entails a dual relationship, where urban regeneration requires problem communities and public sectors or enterprises that can influence wider structural constraints to jointly seek solutions. Based on this understanding, in this study, urban regeneration is conceptualized as a two-step process:

- **Redistribution of External Resources:** Led by public sectors or large enterprises, introducing external resources like investments and supportive policies to impoverished communities.
- **Reuse of Internal Resources:** Utilizing long neglected and underutilized internal resources of impoverished communities, such as land, idle buildings, local knowledge networks, and labor.

There is no fixed sequence between these two steps. However, in severely disadvantaged communities with extremely poor environmental conditions, external resources often serve as a necessary lever to initiate regeneration. This study aims to explore the potential positive impacts of urban regeneration guided by circular development principles on both the objective and subjective well-being of residents in marginalized communities, as well as the key levers needed to initiate urban regeneration.

2.3. *The Link Between Circular Development and Urban Regeneration*

The existing research has largely explored circular development and urban regeneration separately, with limited focus on their direct interconnections. Berger's drosscapes [38] concept was among the earlier discussions to examine urban land as part of the metabolic system. It highlights how resources like land, water, and energy, shaped by linear economies and urbanization, eventually become waste. Amenta and Van Timmeren [39] further integrated this concept with circular development under the term wastescapes, including polluted and degraded land, degraded water and connected areas, settlements and buildings in crisis, and the dross of facilities and infrastructures. They incorporated transformative strategies into these areas, examining material flows within these wastescapes to explore how circular development could renew them, addressing issues of land scarcity and inefficient use. Other studies have focused on deriving insights from circular principles applied in urban regeneration projects, highlighting the role and benefits of circular development [40,41]. Experimental projects, such as pilot studies and university design studios, have identified the characteristics of abandoned landscapes and have proposed regeneration strategies through co-design with local stakeholders [42,43].

Few studies explicitly discuss the mutual relationship between urban regeneration and circular development. Among these, Cottino et al. [44] argued that urban regeneration can integrate neglected resources—such as land, housing, and community knowledge—into circular pathways, repurposing them to minimize waste and create new value. Although no direct literature explores the benefits of circular development for urban regeneration, some existing projects provide valuable insights. Initiatives like community food cooperatives, sharing centers, and shared cafés demonstrate its impact by repurposing vacant buildings, creating jobs, and strengthening social connections [45–48]. These cases suggest that circular development contributes to urban regeneration, particularly in the reuse of internal resources, while also meeting residents' well-being needs.

Our study conceptualizes urban regeneration and circular development as an interconnected process, referred to as circular regeneration. This approach applies circular development strategies—resource looping, ecological regeneration, and adaptive action—to facilitate urban regeneration by introducing new external resources as levers, while reusing internal resources, including underutilized spaces and land (wastescapes), as well as local labor and knowledge. Circular regeneration also aims to enhance residents' well-being needs. In this research, circular regeneration thus serves as a framework to explore how circular development could support urban regeneration through either leveraging external resources or rediscovering overlooked local assets within urban villages.

2.4. Planning Tools for Circular Regeneration

Planning-related tools play a crucial role in shaping spatial planning and providing leverage to achieve specific urban development goals [49]. Williams identified four key planning tools for circular development, while Heurkens et al. outlined similar categories for urban regeneration. Although their classifications and terminology differ, these planning tools exhibit a similar typology, likely reflecting the inherent structure of existing planning tools. Both frameworks include visioning, which sets priorities and long-term goals; capacity building, which fosters stakeholder collaboration and expertise; regulation, which guides development through policies and restrictions; and financial incentives, which support transitions through funding and subsidies [45,50,51].

Based on Stead [49] and Nadin's [52] classification frameworks for spatial planning tools, this study integrates implementation tools for urban regeneration and circular development. It conceptualizes planning tools for circular regeneration into the following four categories:

- **Visioning:** It is a participatory planning tool that illustrates anticipated urban futures through narratives or visuals [53]. This tool sets clear goals for new urban development directions, such as circular development, and defines the associated spatial functions and required infrastructure [54]. It provides a **unified and clear development goal** and infrastructure for circular regeneration as levers.
- **Capacity Building:** For organizations, it involves attracting more stakeholders to understand and participate in circular development through collaborative planning or co-design processes and establishing reliable partnerships aimed at circular development. For individuals, it refers to promoting the dissemination and exchange of circular knowledge among actors from different backgrounds through training [40,55]. This tool provides resources such as expertise and platforms for cooperation as levers for circular regeneration.
- **Regulation:** This planning tool refers to policy tools within spatial planning that implement regulatory functions, guiding the development and protection of land [49]. In this study, regulation is understood as a tool that relies on strict rules, penalties, and monitoring to prevent environmentally harmful actions, such as the illegal dumping of construction waste, thereby mitigating further degradation. It also includes granting temporary permissions for spaces in land-scarce areas to create multifunctional urban spaces that can adapt to new demands [45]. Regulation provides legal support, monitoring, and flexible management as levers for circular regeneration.
- **Financial incentives:** This tool involves using capital and operational subsidies to encourage transitions to circular business models and infrastructure [45]. For instance, through land use tendering restrictions or financial subsidies, it seeks to attract enterprises with expertise in circular practices and supply chains to support local circular systems. These funds should also be used to sustain local circular practices, such as urban agriculture. Financial incentives provide investments and grants as critical resources for circular regeneration.

Planning tools are also closely linked to residents' well-being, as cities connect human needs with both the built environment and social relationships [56]. By managing land, housing, and infrastructure, urban planning has the potential to improve the objective conditions of residents, specifically the livability of their environment, thereby indirectly influencing their internal well-being [34,57].

While each planning tool has distinct responsibilities, they complement one another to support planning initiatives. However, policymakers tend to favor familiar solutions over innovative tools [49]. As a result, the effectiveness of less commonly used tools is often constrained. For example, in European planning, visioning helps set goals, integrate

community needs, and engage stakeholders, increasing policy adoption [52,58]. In contrast, visioning is rarely used in China, where the top-down, policy-driven system relies on empirical extensions [59] rather than experimentation or public participation [60]. As demolition-led urban village renewal faces criticism, alternative inclusive strategies are needed [26]. Though rarely used in China, visioning is still relevant to urban village regeneration, as bottom-up approaches are key to locally responsive planning.

Our study adopts visioning to develop an improved circular development future for existing local circular actions and explores the needed planning tools and levers for implementing these circular regeneration visions. Additionally, the four planning tools discussed in this section serve as references to understand barriers in China's planning system, which may lack these tools to support circular regeneration visions.

2.5. Research Through Design

In the last century, design has been discussed as a reflective research method in architecture, urban planning, landscape architecture, and industrial design [61]. Unlike traditional empirical research such as statistical modeling and case studies, as a speculative process, design not only interprets past and present trends but also envisions future possibilities. In this context, the design project serves not only as an object of research but also as a research tool. It forms spatial opportunities and assesses their possible impact by certain indicators [62,63]. This method has been applied to urban resilience design [64] and regional circular planning [42], among other emerging fields.

Lenzholzer et al. found that while the process of Research through Design varies across disciplines, it follows structured steps to ensure rigorous academic knowledge production. They summarized these processes based on Creswell's knowledge production framework [65]. To ensure transparency, feasibility, and reproducibility, the Research through Design should follow specific steps [66]:

- a clearly defined research question;
- a structured design process;
- a robust evaluation system.

Among these, design evaluation is crucial for testing design outputs and assessing their contribution to knowledge. Various evaluation methods exist, as summarized by Lenzholzer et al. (Post)positivist approaches favor quantitative assessments, using modeling and simulations to test design hypotheses [67], such as urban design, which can be assessed for climate adaptability using microclimate simulation software [68]. In contrast, constructivist approaches focus on qualitative and context-dependent impacts of design, aiming to generate new insights rather than test predefined outcomes. The outcomes could be intangible, such as assessing the potential impacts of a specific vision on urban space and socio-economic conditions. They could also be tangible, including proposed landscape and urban forms, while testing whether existing policies, technologies, and values can support future visions. Unlike generalizable positivist knowledge, constructivist findings are embedded in specific contexts and evolve with social and physical systems. However, certain elements can be applied to similar contexts or serve as references for comparative studies [61,62,69].

Given that no existing urban regeneration projects in the study area have adopted circular development strategies, this research applies Research through Design to develop circular visions for urban villages. This study explores how strengthening circular practices could enhance migrant well-being and support urban regeneration. Additionally, through visioning, this research critically reflects on whether the current planning system provides the necessary tools to implement these visions, thereby assessing gaps within existing policy frameworks.

2.6. Research Framework

Building on the literature review, this study connects the theories of circular development, urban regeneration, well-being, and planning tools to construct our research framework (See Figure 1). The subsequent research applies a methodology based on Research through Design, using case studies from urban villages in Chengdu to elaborate on this framework.

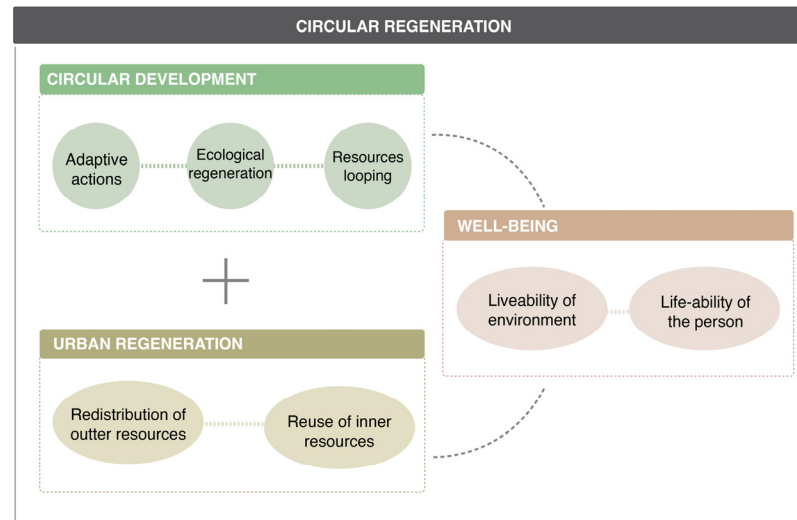


Figure 1. Research framework of circular regeneration. Source: Made by the authors.

Circular development and urban regeneration function as an interconnected system, jointly contributing to regenerative strategies for disadvantaged areas. This process operates from two perspectives: introducing external resources as levers—such as investment, flexible governance, expertise, etc.—and reusing internal resources, including underutilized spaces and land (wastescapes), local labor, community knowledge, etc. It aims to enhance both **the livability of the environment** and **the life-ability of individuals**, addressing residents’ well-being needs. **Planning serves as an implementation tool**, providing levers to support the realization of these goals (See Figure 2).

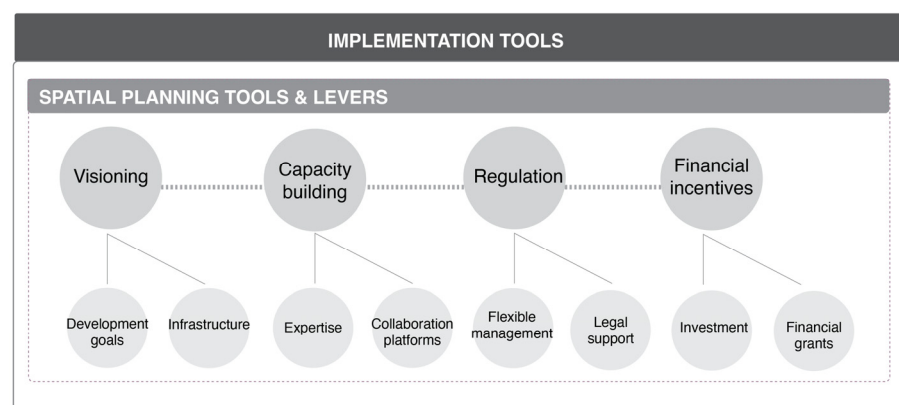


Figure 2. Research framework of implementation tools for circular regeneration. Source: Made by the authors.

Next, Section 3.1 outlines the research methodology, while Section 4 applies the framework to case studies, presenting key findings.

3. Research Design

3.1. Methodology

Based on the research objectives outlined above, our study adopts a mixed-method approach, including document analysis, field trips, street interviews, expert interviews, and Research through Design. The methodology is structured into four phases (see Figure 3):

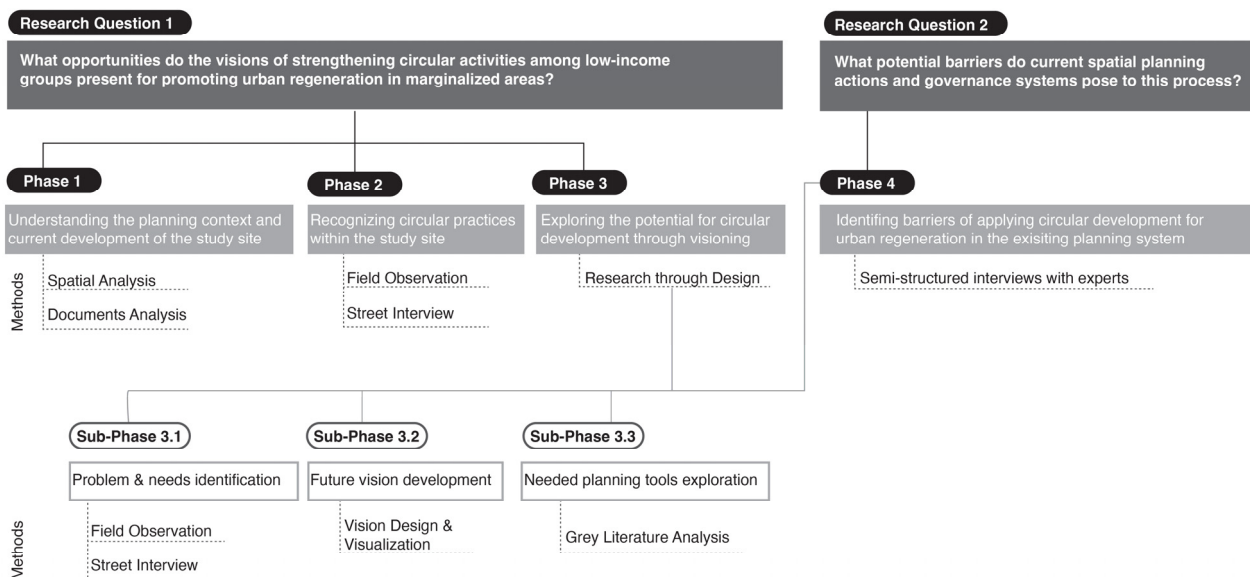


Figure 3. Methodology flow. Source: Made by the authors.

Phase 1—Understanding the planning context and current development of the study site

This step involved collecting land use data for the study site and the surrounding Ring Ecological Zone using publicly available spatial databases. The spatial data were analyzed via QGIS and the exported data from QGIS were further visualized using Adobe Illustrator 29.0.1. Results are shown on maps (See Figures 4 and 5). Additionally, policy documents and local news reports on urban village demolitions and their impact on informal food systems were analyzed. This document analysis identified spatial challenges, planning actions, and their effects on residents, as detailed in Section 3.2.

Phase 2—Recognizing circular practices

Through field trips and street interviews with 13 migrant workers (see Table 1), this study documented and analyzed circular practices within the informal food system using photographs, maps, and field notes. Interviewees were selected based on four key criteria: (1) residing in informal settlements in Yongdu Village, (2) holding household registration from outside the local area, identifying them as migrant workers, (3) engaging in informal food-related industries, and (4) actively participating in circular development-related activities. This phase of the study explored the forms of local circular practices, their value to the community, and their interconnections. The interview questions can be found in Supplementary Materials File S1. The results of this step are discussed in Section 4.1.

Table 1. Street interviews. Source: Made by the authors.

Interviewee Number	Type	Place, Date
Interviewee 1	Farmland reclamer	Chengdu, 4 February 2024
Interviewee 2	Farmland reclamer	Chengdu, 4 February 2024
Interviewee 3	Street vendor	Chengdu, 4 February 2024

Table 1. Cont.

Interviewee Number	Type	Place, Date
Interviewee 4	Customer of street vendors	Chengdu, 4 February 2024
Interviewee 5	Local composter	Chengdu, 5 February 2024
Interviewee 6	Local composter	Chengdu, 5 February 2024
Interviewee 7	Local composter	Chengdu, 5 February 2024
Interviewee 8	Farmland reclamer	Chengdu, 19 September 2024
Interviewee 9	Farmland reclamer	Chengdu, 20 September 2024
Interviewee 10	Street vendor	Chengdu, 19 September 2024
Interviewee 11	Street vendor	Chengdu, 19 September 2024
Interviewee 12	Street vendor	Chengdu, 20 September 2024
Interviewee 13	Customer of street vendors	Chengdu, 20 September 2024

Phase 3—Exploring the Potential of Circular Development and the Required Planning Tools Through Visioning

Since no urban regeneration projects in the study area currently adopt the circular development approach, it is difficult to assess its potential based on existing cases. Therefore, this study applies the Research through Design approach to develop a future vision for urban villages. This vision explores its potential positive impacts on marginalized communities, including how it could contribute to urban regeneration and address the well-being needs of migrant workers. Additionally, this study examines the planning tools required for implementing these visions and reflects on whether the current planning system provides adequate support or lacks the necessary tools to accommodate them.

Based on Research through Design, this study follows three research steps:

- **Problems and Needs Identification:** This study involved two field investigations and migrant worker interviews to identify circular practices and their challenges in urban villages. The initial site survey mapped key circular activities and their locations. Then, interviews provided deeper insights into existing barriers, underutilized community resources, and migrant workers' well-being needs, forming the basis for visioning.
- **Future Vision Development:** Based on the identified challenges and circular development goals, visions were formulated to demonstrate desirable scenarios in which circular practices in urban villages are strengthened and community well-being needs are addressed. The visions were illustrated through drawings and textual descriptions and refined through two iterations. The first iteration, following the February 2024 field study, involved selecting locations for interventions and establishing initial design proposals, primarily aimed at improving migrant workers' living conditions. In the second iteration, semi-structured street interviews with migrant workers (conducted in February and September 2024) helped refine the vision, aligning it more closely with the challenges of existing circular practices and well-being needs.
- **Needed Planning Tools Exploration:** By aligning the vision's requirements with the experiences from the case studies of similar projects in the Chinese context, this step identifies the planning tools required for vision implementation.

The results of this research phase are presented in Section 4.2.

Phase 4—Identification of barriers to applying circular development to urban regeneration in the existing planning system

Then, Section 4.3 includes the final outcomes of Research through Design, reflecting on the current planning system based on the design results. The identified "needed planning tools" in Phase 3 were used as an observational lens in semi-structured interviews with planning experts and scholars (see Table 2). The selection of planning experts was based on an analysis of the key stakeholders involved in urban village regeneration. They cover three main categories: public sector, enterprises, and academia. Public sector experts

included representatives from the **Planning and Natural Resources Bureau**, responsible for urban renewal policy guidance; the **Land Resources Management Bureau**, overseeing land management in urban villages; and the **Design and Research Institute**, responsible for designing renewal plans. Enterprise experts were selected from the **China Construction Group**, the primary entity implementing urban village regeneration projects. Academic experts were chosen from research institutions specializing in urban village studies. This approach to selecting interviewees ensured comprehensive insights into the planning practices and into the potential for promoting circular development in Chengdu from multiple perspectives. It assessed whether the planning practitioners have or lack tools aligned with the circular development vision proposed. The interview questions can be found in Supplementary Materials File S2.

Table 2. Semi-structured interviews with experts. Source: Made by the authors.

Interviewee Number	Type	Institution	Place, Date
Expert 1	Reginal planner	Planning and Natural Resources Bureau	Online, 19 September 2024
Expert 2	Land management planner	Land Resources Management Bureau	Chengdu, 11 September 2024
Expert 3	Urban renewal project implementer	China Construction Group	Online, 11 September 2024
Expert 4	Urban renewal project designer	Design and Research Institute	Online, 18 September 2024
Expert 5	Academic expert	School of Architecture and Environment, Sichuan University	Chengdu, 23 September 2024

Through this research method, vision designs are not presented as conclusive results, as they are influenced by subjectivity in interviewees' perspectives and contextual variations in the collected data. Additionally, researchers' biases may affect how the data are interpreted and translated into the design process. However, the focus of our study is to demonstrate the application of visioning as a Research through Design method and to present the research process and outcomes enabled by this method.

3.2. Case Study: City and Urban Village

This study focuses on Chengdu, a first-tier city in southwest China, with a built-up area of 1331 square kilometers and a population of 21.4 million [70].

Over the past two decades, rapid urban expansion has led to large-scale informal construction in rural areas beyond planning authorities' direct oversight. This has created a fragmented peri-urban landscape of idle farmland and dense informal settlements. Low rents and a convenient location near the city have attracted many rural migrant workers seeking job opportunities. Some run small-scale food systems, reclaim abandoned farmland, or sell homegrown produce on nearby streets for their livelihoods.

In 2020, Chengdu designated the Ring Ecological Zone at the urban expansion boundary to improve land use efficiency (see Figure 4) and released the Chengdu Ring Ecological Zone Master Plan to guide its redevelopment [71]. However, within this planning context, migrant workers' homes and livelihoods face significant threats. These include the government-led consolidation of scattered farmland for industrial-scale food production and real estate-driven urban village renewal, which replaces affordable housing and informal markets. These pressures underscore the urgent need for alternative urban regeneration strategies that recognize and preserve the value of local grassroots food systems.

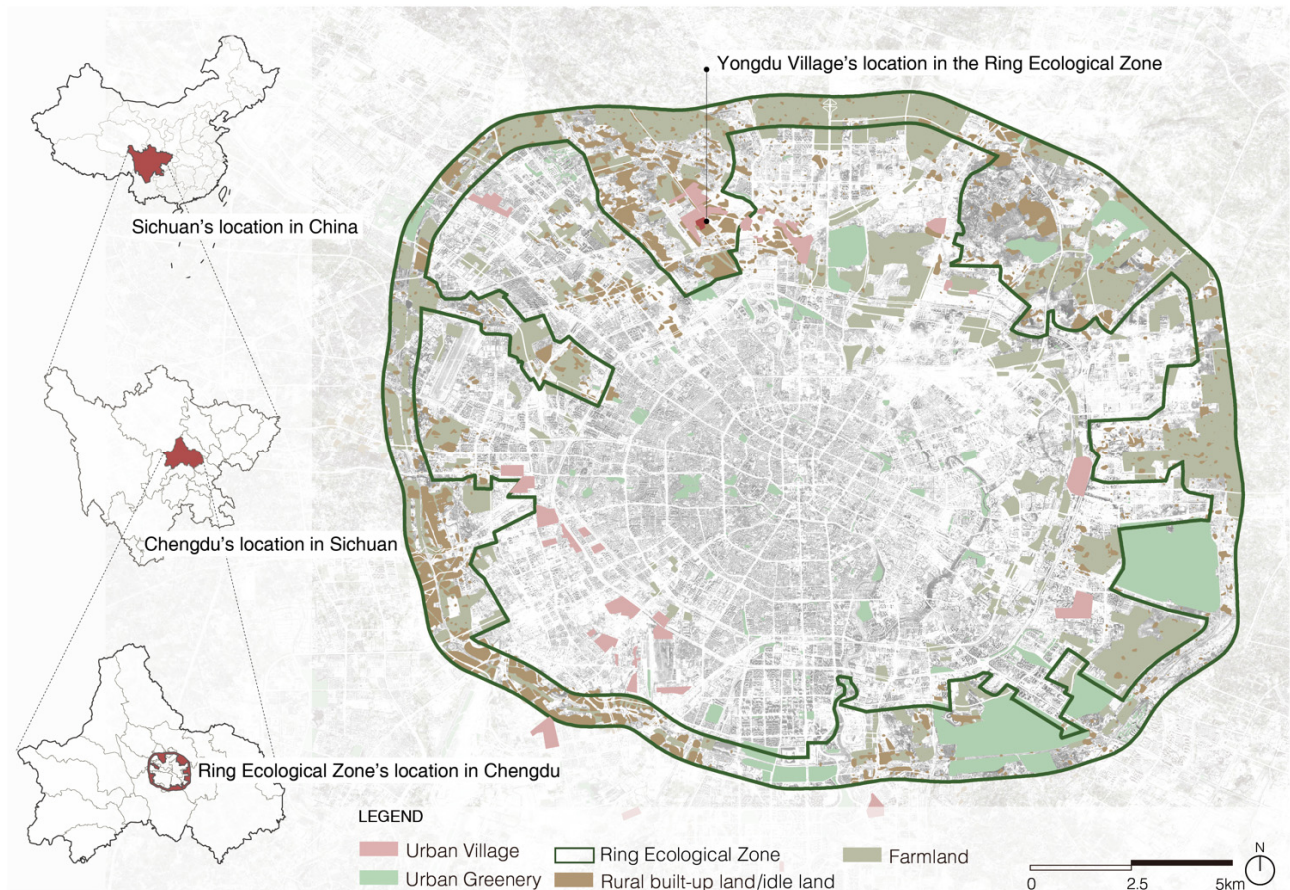


Figure 4. Location and land use map of Chengdu's Ring Ecological Zone. Source: Made by authors based on ESA WorldCover [72].

This research focuses on Yongdu Village, located on the northwest side of the Ring Ecological Zone of Chengdu, as a case study. Yongdu Village is a typical informal settlement, with a migrant population of 28,000—seven times that of local residents, making it the largest urban village in the core built-up area of Chengdu [73]. Yongdu Village was selected as the case study because it represents a comprehensive example of circular development practices. Based on field investigations conducted in multiple urban villages within Chengdu's Ring Ecological Zone, it was found that many villages exhibit circular practices related to the informal food system. However, these practices are often fragmented, with some covering only one or two aspects of circular development. In contrast, Yongdu Village has several favorable conditions for developing a circular food system. These include idle farmland, an irrigation canal from the former village, and proximity to a wet market—a traditional Chinese farmers' market where fresh produce, meat, and seafood are sold (see Figure 5). These factors have already fostered an informal and relatively self-sufficient food system with localized flows of food and food waste, **which provides** the opportunity to examine the interactions among the three dimensions of circular development, making Yongdu Village a highly suitable and exemplary case for this study.



Figure 5. Current map of Yongdu Urban Village. Source: Authors, based on Bing Satellite Map [74].

4. Results

4.1. Recognition of Informal Circular Practices

This section uses Williams' circular development conceptual framework [9] to recognize three types of circular actions in Yongdu Village related to resource looping, ecological regeneration, and adaptive actions. Each dimension describes the specific forms of circular activities conducted by migrant workers, their locations, the value of these actions, and their connections with the other two dimensions of circular actions.

4.1.1. Resources Looping—Localized Composting

Field observations revealed that residents engage in organic waste recycling through on-site composting. These activities primarily occur in two locations (see Figure 6): farmland or narrow spaces between residential buildings, minimizing odor issues.

Residents—primarily low-income migrant workers—collect kitchen waste from households or small food-processing workshops in the community, such as fruit peels, rice-washing water, eggshells, rice bran, and vegetable scraps, to produce compost. They reuse discarded containers, such as water barrels salvaged from nearby construction sites and oil drums from refineries, as compost bins. The resulting organic fertilizer is used in nearby vegetable plots (see Figure 7). Small-scale community composting improves waste management efficiency, reduces reliance on incineration and landfills [75], and supports local agriculture by closing organic material loops.



Figure 6. Locations of local composting sites. Source: Made by the authors, based on Bing Satellite Map [74]. Red lines indicate open alleys between buildings, and the red dots represent small composting spots located within informal farmland.



Figure 7. Compost bins placed in farmland. Source: Authors.

Such resource-looping behavior is linked to two other aspects of circular development: ecological regeneration and adaptive actions. By converting food waste into compost and applying it to nearby abandoned farmland, migrant workers restore soil fertility and promote healthy soil ecosystems. Furthermore, street interviews revealed frequent knowledge-sharing among neighbors on composting techniques and crop suitability. This exchange strengthens local knowledge systems and enhances community adaptation.

4.1.2. Ecological Regeneration—Restoring Polluted Farmland for Cultivation

Field observations revealed that migrant workers have been reclaiming polluted, idle farmland for cultivation. The farmland is a remnant of the old village, now largely abandoned. When informal buildings around the farmland were demolished, construction debris—bricks, cement, and stones—was not fully cleared, contaminating the land. Some of the idle land near the urban village and the irrigation canal has now been converted into small vegetable plots (see Figure 8).



Figure 8. Locations of vegetable plots. Source: Authors, based on Bing Satellite Map [74].

The main reclamation efforts involve residents actively clearing weeds and debris from unused farmland. Some have fenced off small vegetable gardens for personal use, paved narrow pathways, and cultivated crops such as rapeseed and corn (see Figure 9). This process has partially restored the land’s productivity, enabling food production for nearby residents.

This reclamation effort has partly restored farmland productivity and begun supplying food to nearby residents. It supports resource looping by localizing food production and repurposing construction debris, such as using it for field pathways. As Interviewee 1 mentioned: “After the rain, the fields become muddy and slippery, making it easy to fall”. Moreover, ecological regeneration also fosters adaptive actions, as early farmers acted as “pioneers”, attracting more experienced residents. Interviewee 2 remarked, “I saw Interviewee 1 clearing weeds and planting crops, and I thought I could join too. The fields are so large, and one person can’t manage them alone”. Early actors set an example for

others, creating a positive feedback loop for collective participation. Farming activities also shifted behaviors from individualism to community engagement. As Interviewee 3 observed, “Previously, everyone stayed indoors and didn’t know each other. Now that we’re farming, we come out, meet, and get to know one another”. These interactions strengthened trust and cooperation, enhancing the community’s ability to collaborate and adapt to future challenges.



Figure 9. Vegetable plots near informal settlements. Source: Authors.

4.1.3. Adaptive Actions—Street Vendors of Locally Grown Food

Field observations reveal a significant amount of leftover public space in the study area, often occupied by street vendors. Unlike urban villages in other cities, such as Shenzhen [76,77], where narrow vertical spaces dominate, Chengdu’s urban villages typically have wider horizontal gaps between buildings. As a result, informal street markets often emerge in high-footfall areas. They include main roads, intersections between urban villages and surrounding neighborhoods, and streets outside of local wet markets (see Figure 10).

Migrant workers primarily use makeshift setups, such as a simple plastic sheet, to create temporary street stalls where they sell surplus homegrown vegetables to supplement their income (see Figure 11). These unregulated or informally permitted “markets” reflect the residents’ ability to adapt spaces to their needs, assigning new functions to unused areas and using them more efficiently.

These activities are closely linked to **resource looping and ecological regeneration**. In terms of resource looping, interviews revealed that locally grown vegetables are popular in the local food market due to their freshness and use of organic fertilizers. As Interviewee 4 noted, “The pak choi grown by Interviewee 3 might be smaller, but it’s very tender and tastes much better than the vegetables grown with pesticides in greenhouses”. From an ecological regeneration perspective, these markets also raise awareness of **farmland restoration benefits**. The buyers of these vegetables are not only urban village residents

but also residents from newly built modern residential communities constructed after the demolition of nearby urban villages. Increasingly, residents recognize the benefits of farmland restoration, and when such efforts visibly benefit most of the community, more residents are likely to support ecological regeneration and join these initiatives.

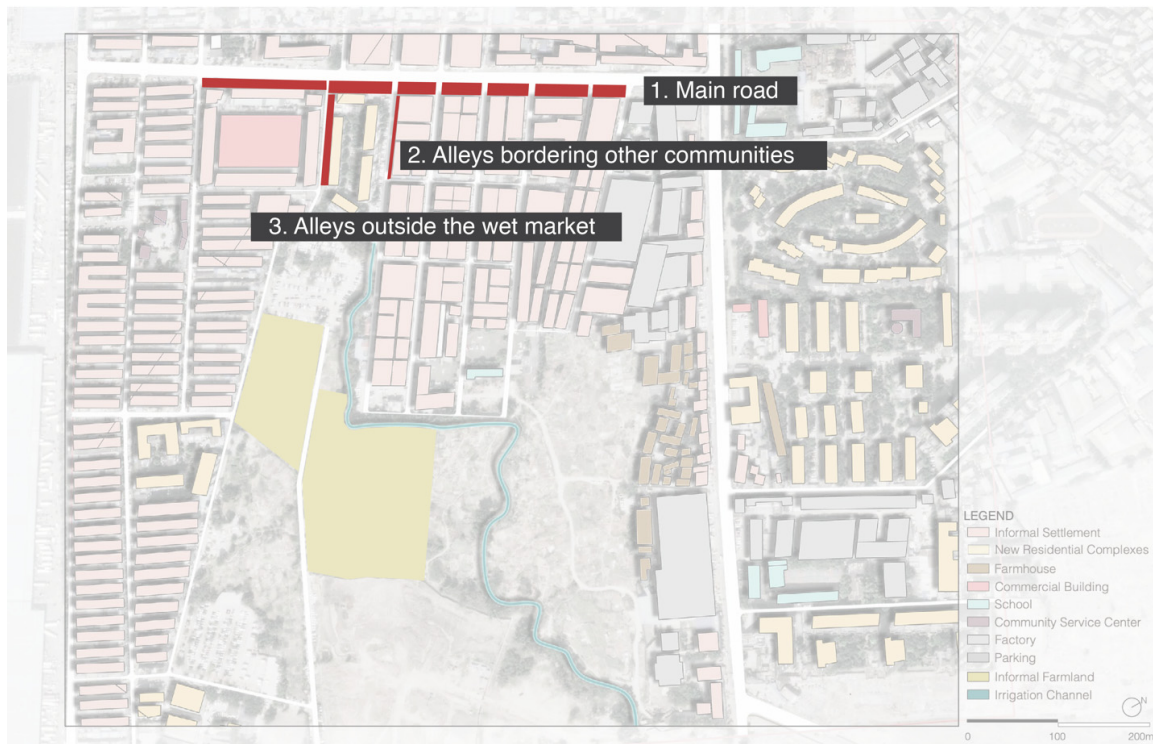


Figure 10. Locations of street vendors. Source: Authors, based on Bing Satellite Map [74].



Figure 11. Street vendors outside of a wet market. Source: Authors.

Section 4.1 introduces the current state, value, and interrelationships of the three types of circular actions, but there is still room for improvement in these informal actions. Next, Section 4.2 will propose planning visions to enhance them.

4.2. Visions for Informal Circular Practices as Drivers of Urban Regeneration

Section 4.2 proposes visions for improving the existing circular actions introduced in the last section. Based on our research framework introduced in Section 2.6, the improved circular actions could function independently to promote circular regeneration while also creating synergies that contribute to the community as a whole. From this perspective, based on field observations and street interviews with migrant workers, we propose visions for each practice in the first three subsections. These visions address three key aspects: tackling current challenges, reusing underutilized resources for urban regeneration, and enhancing well-being while identifying necessary planning tools. The final subsection integrates these visions into an urban village circular food system, examining their synergies.

4.2.1. Vision 1: Optimization of Community Composting

Community composting in urban villages, mainly led by migrants, faces challenges such as inadequate waste collection, low public awareness, and limited processing capacity, leading to agricultural waste being discarded. Despite this, composting reflects valuable agricultural knowledge and surplus labor. As Interviewees 6 and 7 noted, “In our hometowns, every household composts kitchen waste and vegetable scraps to save on fertilizer costs, and vegetables grown with organic fertilizer taste better”. “After the pandemic, it has been difficult to find work, so I do compost as a way to pass the time”. Considering the integration of local resources into urban regeneration and the enhancement of residents’ economic well-being, future community composting should go beyond waste management. It should also create employment opportunities for migrants, particularly those who are unemployed. For example, in many Chinese cities, homeowner associations hire cleaning staff for waste stations—positions currently absent in urban villages.

Based on these considerations, a community composting vision was developed (see Figure 12). The proposed model envisions a system where organic waste from households and farmland is collected in designated enclosed bins managed and maintained by community sanitation workers. Residents would deposit their organic waste into composting bins and complete the composting process under the guidance of experienced community members. The organic fertilizer produced would be used for community farming, with surplus fertilizer sold at nearby wet markets. Organic waste that cannot be processed within the community would be transported to nearby composting facilities for further resource recovery. These facilities would also provide employment opportunities, actively recruiting migrant workers with composting experience from urban villages.

Towards Implementation of Vision 1 in Organic Waste Management

The vision for organic waste composting from households to the community level highlights the need for infrastructure, investment, and the development of broader stakeholder collaboration networks. Drawing from the experiences of multiple community composting pilot projects in China [78], spatial planning, capacity building, and financial incentives have the potential to provide key levers.

Visioning helps identify and utilize existing spatial and community opportunities, visually integrating them into the planning process. In urban villages, it could help determine suitable locations for waste collection and processing, linking local circular activities to larger networks. For instance, Chengdu’s kitchen waste treatment guidelines [79] require communities like Yongdu, which aims to implement community composting, to

coordinate with larger-scale facilities, such as neighborhood-level waste collection and processing stations.



Figure 12. The future vision of community composting. Source: Authors.

Capacity building operates at two levels: (1) within communities, raising awareness and improving composting practices, and (2) across institutions, fostering collaboration to develop circular expertise and supply chains [50]. In Chengdu’s Ring Ecological Zone, where Yongdu Village is located, this may involve groups like the Tianfu Greenway Group, which oversees agricultural management in the area. They could help with integrating agricultural waste into composting facilities while also supporting urban villages in managing surplus organic waste.

Financial incentives could potentially help with attracting interested enterprises and investments into organic waste management. Local governments might implement policies such as tax reductions, special subsidies, or discounted land leases to encourage companies to establish facilities for organic waste recovery.

4.2.2. Vision 2: Formalization and Enhancement of Farmland Reclamation

In urban villages, migrant-run vegetable gardens face challenges such as insufficient land reclamation, poor infrastructure, and ongoing pollution from construction waste. Despite their farming efforts, migrants lack formal land use rights, as farmland is collectively owned and leased to entities like the Tianfu Greenway Group. Due to scattered plots, large-scale mechanized farming is impractical, leaving much land idle, fitting Amenta and Van Timmeren’s concept of **wastescapes** [39]. Even so, ongoing reclamation efforts highlight the value of these fragmented and polluted lands, calling for restoration and reuse in urban regeneration. As Interviewee 8 stated, “People from rural areas can’t stand seeing land go to waste. This land has been idle for too long—it’s a shame to leave it unused. That’s why I came here to clear the waste and plant vegetables”. From a well-being perspective, future farmland regeneration should also incorporate landscape design. This would provide residents with spaces for leisure and social interaction, an essential yet often

lacking resource in urban villages. As Interviewee 9 noted, “There aren’t any parks nearby. I often come to the vegetable garden for a walk—it feels just like strolling in a park”.

Based on these considerations, a vision was developed (see Figure 13). The farmland will be revitalized through infrastructure improvements, the removal of construction debris, and soil remediation using phytoremediation and composted organic fertilizers. The restored irrigation system will support agricultural production, while landscape enhancements will increase visual appeal and recreational opportunities. Residents will be permitted to cultivate, operate, and manage the land, forming a self-sustaining farm that integrates ecological restoration, food production, and community value.



Figure 13. The future vision of community shared farms. Source: Authors.

Towards Implementation of Vision 2 in Farmland Ecological Restoration

The implementation of the shared farm vision requires visioning tools and strict farmland restoration and protection policies to provide development goals, expertise, and financial grants, drawing from the large-scale farmland restoration experience in Chengdu’s Ring Ecological Zone [71].

Visioning tools help shape future development based on community needs, reflecting residents’ strong demand for farmland reclamation and cultivation rights. While its adoption depends on local government interest, visualizing this vision is crucial for effective communication. It allows residents to convey their needs to policymakers and express their perspectives on urban village regeneration.

Farmland restoration and protection policies should address several aspects. First, they should implement strict regulations to prohibit the further illegal dumping and improper disposal of construction waste. Second, they need to also provide guidelines and support for clearing and reclaiming land, enabling large-scale agricultural regeneration. Expanding on the Chengdu Ring Ecological Zone Protection Regulations [80], subsequent policies might detail implementation procedures for enhancing soil fertility, constructing essential infrastructure, and ensuring irrigation water supply, along with penalties for land pollution.

4.2.3. Vision 3: Making Space for Street Vending

Street vendors in urban villages face challenges such as a lack of designated spaces, waste disposal facilities, and legal operating rights, as well as conflicts with traffic. However, existing street markets demonstrate the potential for reactivating underutilized public spaces. Urban regeneration should focus on optimizing these markets, transforming them into vibrant, multifunctional areas that attract more foot traffic and convert streets from mere transit routes into dynamic commercial hubs. From a well-being perspective, street vending is not just a means of livelihood but also fosters social interactions between different groups. These interactions help migrant populations integrate into urban life, reducing marginalization. A vision for circular regeneration should preserve such positive social dynamics. As Interviewee 11 stated, “I used to stay at home taking care of my grandchild. Since I started growing and selling vegetables, I can earn some extra money for my family. My family loves the vegetables I grow, and my customers appreciate them too”.

In this future vision (see Figure 14), urban village streets evolve into self-sustaining food markets. Based on the experiences of street vendors, these food markets could be located in alleyways at the intersection of urban villages and surrounding communities, on streets outside of wet markets, and along wide main roads outside of urban villages. Well-designed streets will accommodate pedestrians, cyclists, and vendors, with designated time slots allowing vendors to sell locally grown organic food from community farms. This local production and local sales model will not only enhance street vibrancy and create a unique commercial atmosphere but also stimulate local economic development and foster frequent social interactions between residents and external customers.

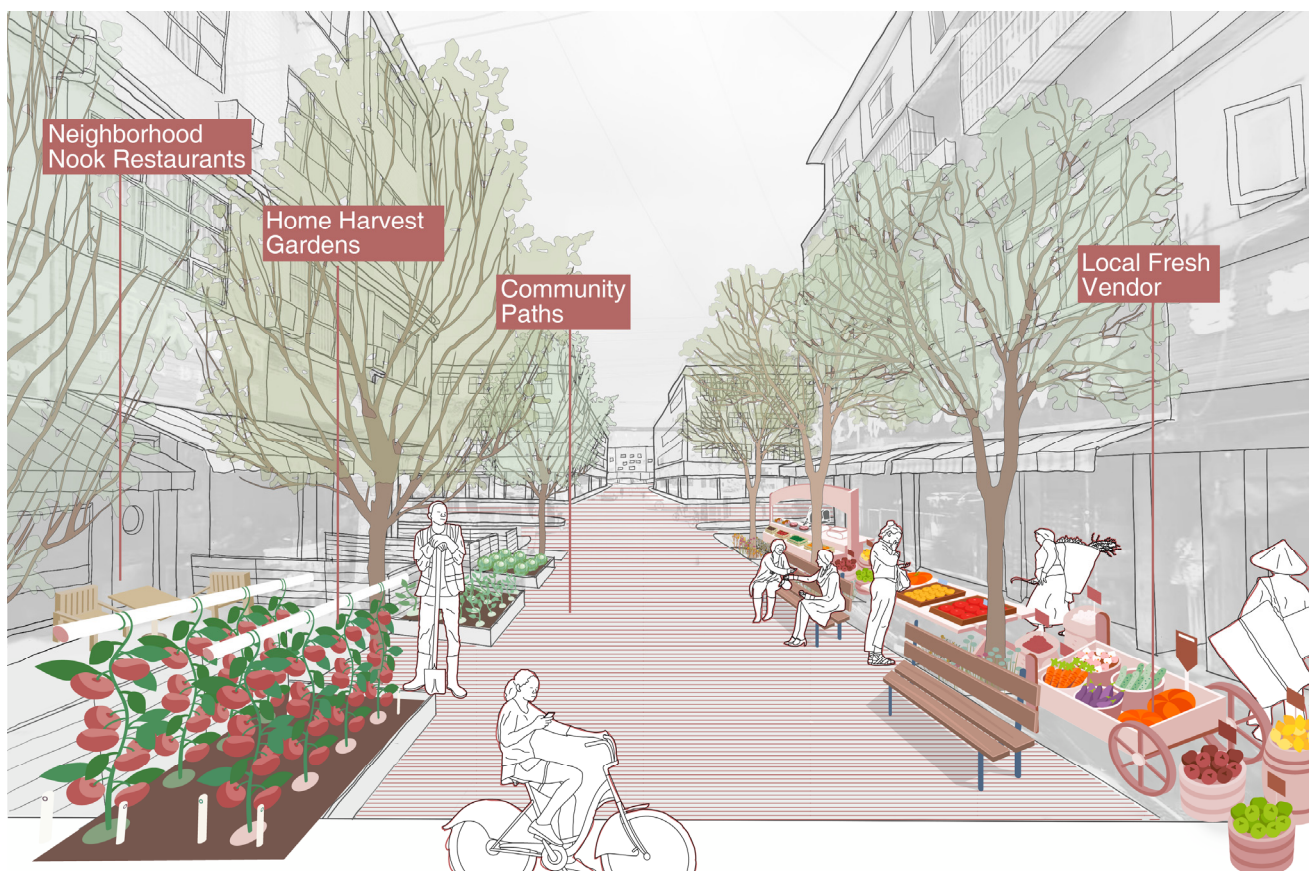


Figure 14. The future vision of street vending. Source: Authors.

Towards Implementation of Vision 3 in Adaptive Street Vending

Street vending is a common phenomenon in urban villages [81,82], and there are many successful examples to make space for informality. For instance, during the COVID-19 pandemic, Chengdu’s “Five Permissions” policy allowed temporary street vending under certain conditions [83]. Building on these successes, this study proposes three key planning tools—spatial planning, capacity building, and regulatory management—to support adaptive street vending through infrastructure, permits, and collaborative planning.

Spatial planning focuses on redesigning street layouts to identify areas suitable for vending. For example, to ensure that stalls do not obstruct pedestrian or vehicle flow, markets along main roads could be placed at wide intersections connecting internal pathways. It also involves identifying essential infrastructure such as formal mobile carts, shading equipment, and waste management facilities to address hygiene and waste accumulation issues.

Capacity building requires government agencies to learn from communities and respect existing social activities rather than relying on top-down reconstruction. As Interviewee 5 said, “The streets outside the wet market are the best for business, and the most street vendors and customers gather there”. Such local knowledge is invaluable for effective planning.

Flexible governance supports temporary vending by granting legal operating rights. Policies should specify vending locations and operational guidelines, such as avoiding peak traffic hours and ensuring economic and social benefits while minimizing street disruptions.

The visions for the three dimensions of circular development are interconnected. The following subsection will describe the holistic vision for circular development in urban villages.

4.2.4. Bringing the Three Visions Together: Towards a Local Circular Food System

The three dimensions of circular development can work synergistically to create a sustainable and resilient future [45]. This section integrates the previously described three separate circular visions to build a collaborative circular food system, exploring their connections and potential impact on urban regeneration. The vision is built on two key aspects: addressing challenges in urban villages’ food systems and linking the three levels of circular development. Street interviews with migrant workers and site observations help identify these connections. They examine which actions are spatially proximate or have the potential to close resource loops within the community.

Yongdu’s existing circular practices face some challenges, such as existing but weak connections between initiatives, limited community participation, and low awareness. Ongoing demolition also generates construction debris, an unintended material flow in the food system that continues to pollute the soil (see Figure 15).

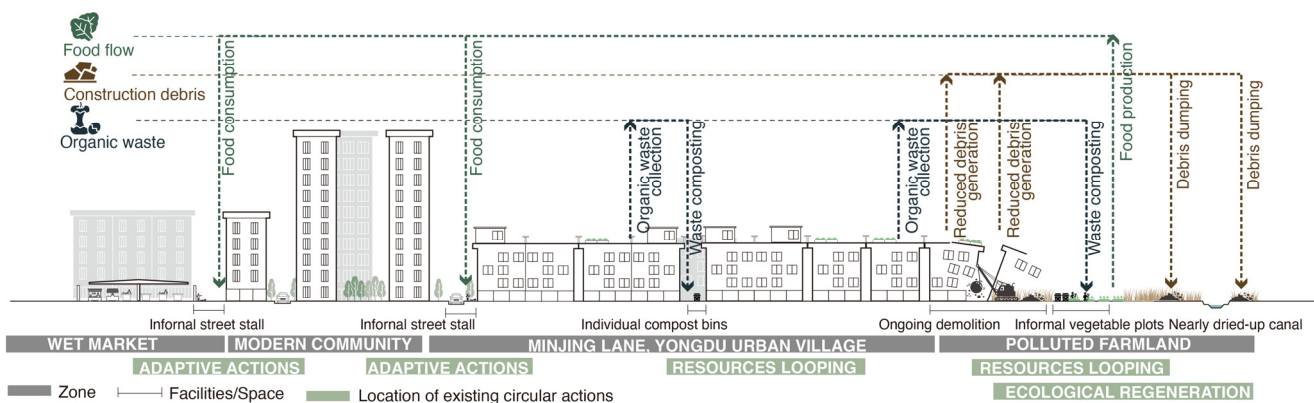


Figure 15. The existing food system of an urban village. Source: Authors.

Thus, we propose the following circular food system vision, illustrated through a systemic section of resource flows (see Figure 16). In this system, organic waste from urban villages is collected at sorting stations managed by community cleaners. Compostable materials are processed into organic fertilizers, which are applied to nearby shared farmland. As urban renewal shifts towards on-site upgrading, demolition decreases, reducing construction debris. Previously idle and polluted land is restored through debris removal, soil enrichment, and irrigation improvements. This enables migrant workers to cultivate vegetables, grains, and oils for local consumption. Surplus produce is sold by street vendors in designated markets, reinforcing a closed-loop food system.

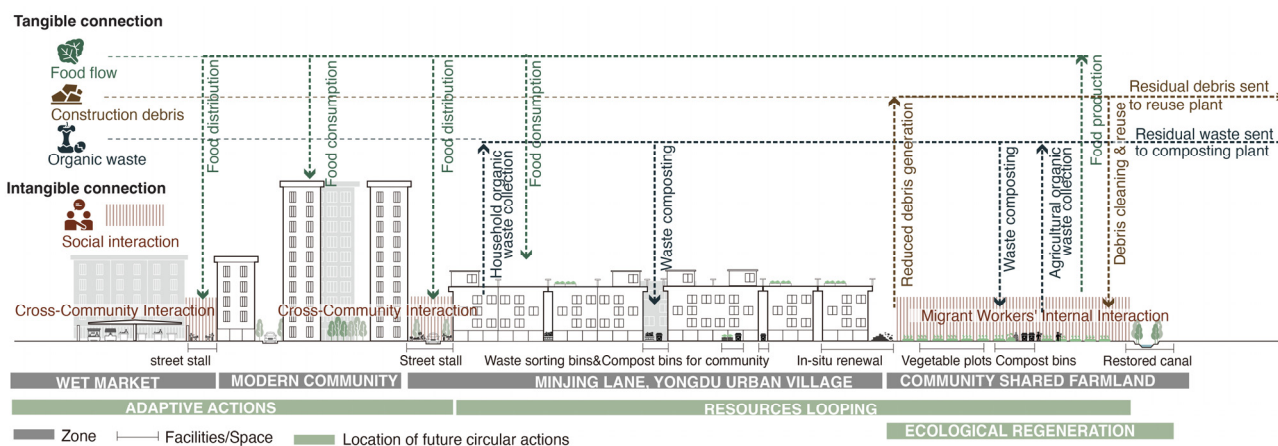


Figure 16. The integrated circular food systems vision of an urban village. Source: Authors.

Tangible and Intangible Interactions Between Circular Development Actions

This vision highlights both tangible and intangible connections that influence material flows and social relationships within the community.

Tangible connections involve the flow of food, construction debris, and organic waste. Farmland restoration removes pollutants, enabling agricultural activities. Resource looping follows, as composted organic waste enhances soil fertility and food production. Finally, surplus produce is sold, activating underutilized spaces.

Intangible connections emerge through community interactions. Internally, collaborative farming and composting strengthen social networks and knowledge sharing among migrant workers. As Interviewee 12 shared, “Every morning, Interviewee 8 picks vegetables and comes to my plot to pick me up on her bike. She knows the vending spots near the wet market better than I do”. Externally, street vending fosters engagement between migrant workers and nearby residents, increasing appreciation for farmland restoration and local composting. As Interviewee 13 noted, “I used to think growing vegetables on abandoned land was pointless. But after buying and tasting them, I realized they’re much fresher than supermarket produce”.

Systemic Benefits of Circular Development Actions in Urban Regeneration

This integrated system closes organic waste loops, restores ecological health, and strengthens social ties. Economically, surplus produce sales revitalize street life and provide income for migrant workers. Ecologically, farmland restoration and composting rehabilitate polluted land and improve soil health. Socially, interactions through farming and vending foster inclusivity and stronger community bonds.

In Section 4.2, the improved circular visions and the planning tools required for implementation were discussed. These findings will serve as a **lens** in Section 4.3 to evaluate Chengdu’s current planning system.

4.3. Barriers Due to Insufficient and Missing Planning Tools

This section takes the needed planning tools identified in Section 4.2 as a lens to examine Chengdu's current planning system's ability to implement these circular development design visions. Our findings indicate that inadequacies in **circular visioning**, **capacity building**, and **regulation** tools, along with the absence of **recognition** tools, create potential barriers to the implementation of circular development visions that could support urban village regeneration.

4.3.1. Lack of Consensus on Circular Development, Specialized Plans, and Visioning

As discussed earlier, the formalization and upgrading of the three circular activities rely on visioning [9,84]. Organic waste management requires regional planning to designate processing sites and establish material flow chains. Farmland restoration relies on spatial planning to define boundaries and on visioning to set future functions and target groups. Adaptive actions like street vending need spatial planning to allocate suitable spaces. This indicates that informal communities and their surrounding areas require a specialized circular development plan and vision to allocate spaces for circular activities and envision their future potential. However, Chengdu's current planning system lacks unified action goals for circular development. This makes it difficult to establish a regional circular development plan.

In China, specialized plans operate independently of broader land use frameworks and focus on specific urban goals, such as Shenzhen's Sponge City Plan [85] for climate adaptation or Chengdu's Park City Plan [86] for ecological public spaces. Their formulation depends largely on local government interest. Although Chengdu's planning documents for the Ring Ecological Zone [71], where Yongdu Village is located, mention circular development concepts like farmland restoration and waste looping, these actions remain fragmented. They are managed by different departments, making coordination challenging. Without interdepartmental consensus, establishing a unified circular development vision is challenging. As Expert 1 noted, "Circular development involves the Agriculture and Rural Affairs Bureau, the Housing and Urban–Rural Development Bureau, and the Planning and Natural Resources Bureau. Coordination among these departments requires leadership from municipal or even provincial governments. In a hierarchical government system, unless the benefits of circular development are conveyed to higher leadership, there won't be meaningful discussions on whether or how to implement it".

4.3.2. Lack of Technical Expertise and Inclusive Upgrading Methods

Enhancing resource looping and adaptive actions in Yongdu Village requires capacity building among residents, public sectors, and enterprises that can have a broader impact on waste management and urban redevelopment in Yongdu Village. Developing a comprehensive organic waste system in the urban village requires collaboration between key stakeholders to develop expertise and supply chains that support circular systems. Key stakeholders include the Chengdu Tianfu Greenway Group (agricultural waste management), the Pidu District Housing and Urban–Rural Development Bureau (urban village redevelopment), the Chengdu Bureau of Planning and Natural Resources (regional planning), and the Chengdu Ecology and Environment Bureau (waste management strategies). The inclusive redevelopment of informal settlements requires the Chengdu Pidu District Housing and Urban–Rural Development Bureau to respect residents' cultural customs and establish a co-design process with migrants. This approach could promote communication between government departments and residents, leveraging local knowledge to create solutions that are acceptable to both actors.

However, significant barriers to capacity building exist in Chengdu's Ring Ecological Zone due to a lack of technical expertise and limited human resources within the city administration. Departments responsible for agricultural organic waste utilization lack systematic knowledge to establish a processing system in the area. After the Chengdu Planning and Natural Resources Bureau designates land for farmland, construction, and forests, the next step is implementation. Responsibilities such as farmland restoration, agricultural production, crop sales, and waste management are handed over to the Tianfu Greenway Group. However, this organization is relatively new, understaffed, and still experimenting with managing the 187-square-kilometer ecological zone. Although sustainability and ecological goals are frequently emphasized in its development plans [71], limited experience and capacity hinder the establishment of a circular resource system. As Expert 2 explained, "Most agricultural waste processing is outsourced to external companies. We don't know how this waste, such as straw, is handled, where it is processed, or whether it eventually returns as nutrients to the farmland within the ecological zone".

Another obstacle is the lack of inclusive upgrading strategies for urban villages in Chengdu. Traditional urban village renewal in China has primarily relied on demolition and reconstruction [23], and Chengdu is no exception. However, with policies discouraging large-scale demolition [87], Chengdu must now explore more inclusive renewal strategies. As Expert 3 noted, "Local governments struggle to adapt. Previous renewal methods were more profitable, but how to upgrade these areas in place remains unclear, with few successful cases to follow". While circular development holds great potential for urban village regeneration, it lacks actionable methods. As Expert 2 stated, "Ideally, the circular economy could create new industries through waste looping, which is welcomed by the government. However, it remains relatively unfamiliar within China's planning system and requires more experimental projects to validate its feasibility".

4.3.3. Insufficient Human Resources and Awareness of Pollution Sources

Farmland ecological regeneration requires strong regulatory tools, including strict monitoring and enforcement policies, to prevent further pollution from construction debris. However, Ring Ecological Zone's regulatory department faces staff shortages, weakening enforcement. Farmland regulation, including monitoring illegal construction and debris disposal, is overseen by the Tianfu Greenway Group. But as Expert 3 noted, "With only about a dozen people, it's challenging to monitor and address violations across such a large area".

Furthermore, an awareness of pollution from improper construction waste disposal is low, making policy development difficult. Most interviewees linked soil pollution to past industrial activities, overlooking the impact of leftover or illegally dumped debris. This is partly due to the early stage of Chengdu's construction waste treatment system. Planning departments remain unfamiliar with construction waste management processes. As Expert 4 explained, "Construction demolition during urban renewal is not the responsibility of planning departments. It is handled by specialized companies that also manage the waste. Others have little knowledge of what happens to the debris".

4.3.4. Lack of Recognition of Informal Communities

Williams' framework for urban circular development lacks recognition tools, which are crucial for identifying vulnerabilities, addressing resource inequalities, and preserving local cultures. Recognition is critical in planning for marginalized areas, as it ensures the participation of vulnerable groups. This allows them to benefit as stakeholders and helps prevent gentrification in urban village renewal.

Currently, Chengdu's planning system lacks tools that would enable recognizing circular activities within urban village communities. Even when academic institutions document these activities, the lack of communication platforms with government departments makes it difficult to convey findings. As Expert 5 explained, "Our research team has conducted studies on urban village and migrant workers' challenges, but we haven't communicated these findings to government departments. Academic research and government priorities often don't align".

Limited research in Chengdu's Ring Ecological Zone, including Yongdu Village, worsens this issue. Government departments often overlook residents' motivations for circular actions and their role in migrant's livelihoods and identity. Even when such actions align with governmental objectives, the lack of recognition by the public sectors and enterprises responsible for planning formulation and implementation makes it difficult to propose measures for their improvement. As Expert 1 pointed out, "Migrant workers' reuse of idle farmland raises awareness of urban agriculture's benefits. Public participation, which is currently lacking in government-led farmland restoration efforts, should be preserved. However, current planning actions overlook the importance of these small vegetable plots to residents, treating it as simply a space for large-scale cultivation or agri-tourism-related public facilities".

5. Discussion

5.1. Contributions to Knowledge and Practice

This study fills the key gaps in scholarly and policy discussions on the circular economy in cities. First, within China's urban planning debates, this study identifies grassroots circular practices in Chengdu's urban villages. Through visioning, it demonstrates their potential to reuse local labor, community knowledge, and underutilized wastescapes for urban regeneration. We also examine whether the planning tools needed to achieve these visions are adequate or missing in the Chinese context, calling for refinements and expansions of the existing tools. These findings highlight the value of bottom-up initiatives and provide insights for policymakers and planners on integrating grassroots actions into formal urban renewal.

Methodologically, this research adopts the Research through Design approach, employing visioning to illustrate how planning strategies can be made more inclusive by catering to local community needs. With limited case studies on this topic, our approach provides urban planners with a method to understand circular development's potential impact on urban space and socio-economic conditions while testing the feasibility of existing policies and values. Additionally, it demonstrates how visioning—rarely used in China's planning system—can help capture community needs. This approach enables the design of more locally responsive planning solutions, offering new tools and references for planners and policymakers involved in innovative urban village regeneration.

Moreover, this study empirically applies Williams' circular development framework within China for the first time. This application has not been explored in previous research. It also expands the framework by examining interactions among its three components—resource looping, ecological regeneration, and adaptive action—while clarifying both tangible (material) and intangible (social) dimensions. In doing so, we illustrate how these dimensions collectively influence a community's potential for ecological, economic, and social regeneration.

Additionally, our study sheds more light on the overlooked social dimension of circular development [28–30]. It particularly emphasizes the recognition of marginalized groups [18,68], which is rarely considered in Western and Chinese discussions on the circular economy. Drawing on Max-Neef et al. and Veenhoven [31,32], this study positions urban village regeneration as a bridge to explore how strengthening the circular prac-

tices of marginalized groups could support urban regeneration, enhance migrants' living environments, and improve their life-ability.

5.2. Implications for Planning and Policy Practice

Additionally, this study not only explores the potential of circular development—still a relatively new concept in China's planning system—for urban regeneration but also provides policy recommendations for its implementation, as discussed in more detail in Section 4.2. In a nutshell, the key takeaway for planning practice is that an integrated approach to spatial planning at the regional scale is essential for embedding circular development into urban redevelopment strategies. However, this must be complemented by recognizing migrant workers as key urban regeneration stakeholders and actively engaging them in the planning process. Finally, fostering collaboration platforms among stakeholders will be necessary to develop capacities and pool the knowledge and resources required to implement such strategies effectively.

5.3. Limitations and Directions for Future Research

Firstly, the social dimension of the circular development framework used in our study focuses on enhancing adaptive actions for resilience but overlooks vulnerabilities and social equity issues during the transition to circular cities. Further research is needed to refine this framework to address these broader social concerns.

Secondly, the framework and planning tools used in this study are based on Western case studies and may not fully align with China's urban planning context. Some tools envisioned by Williams may be absent or take different forms in China. Future research could analyze the Chinese planning system to identify tools tailored to China's conditions.

Thirdly, since no urban regeneration projects in China explicitly use circular development, this study employs the Research through Design method to envision a future where urban village circular actions are strengthened. While this approach explores potential opportunities, it relies on field investigations and resident interviews, introducing some subjectivity. Consequently, the envisioned solution may not be the only or optimal one, and alternative visions could lead to different research outcomes. Therefore, the vision proposed in this study, along with the conclusions regarding the opportunities for circular development derived from it, requires validation through more case studies of urban villages or iterative Research through Design processes. Future research should also aim to generate more in-depth knowledge on well-being in urban villages. This could include quantitative studies based on larger samples and relevant indicators, which could further support the monitoring of circular development impacts and inform planning decisions.

Finally, this study examines circular activities in a single urban village in Chengdu, limiting its generalizability. Urban villages across China vary in type, and residents' circular practices differ accordingly. The potential of circular development also varies across different contexts. Hence, future research should conduct similar studies in other urban villages across various cities to systematically summarize and generalize the opportunities and barriers of circular development.

6. Conclusions

Our study explored the potential and barriers to applying circular development principles to regenerate underdeveloped urban areas and enhance residents' well-being. Focusing on an informal settlement in Chengdu's Ring Ecological Zone, it explored the local circular practices in the informal food sector led by migrant workers. While essential to marginalized livelihoods, these practices remain overlooked by the planners. This research identified these activities, envisioned their future under circular principles, and

explored the planning tools needed for implementation. Through these analyses, we evaluated Chengdu's planning system, revealing barriers that hinder the integration of circular strategies into urban regeneration.

The findings indicate that circular development supports urban regeneration by identifying, valuing, and reusing the overlooked resources within informal settlements. We identified three key circular activities: the local composting of organic waste, farmland restoration, and the street vending of local food. These activities involve both the non-material assets, such as surplus labor and local knowledge, and the material assets of wastescapes, including polluted land and idle spaces. The visions of strengthening these actions through circular development principles present an opportunity to regenerate urban villages by utilizing these long-overlooked internal resources, potentially addressing multiple dimensions of residents' well-being. And the implementation of this process requires planning tools as a lever. Specifically,

- The local composting of organic waste highlights the surplus labor and the local knowledge systems for waste treatment. Its envisioned future includes a structured organic waste management system from households to communities. Achieving this vision requires planning tools such as regional planning, capacity-building initiatives, and financial incentives that support infrastructure investment and labor recognition.
- Farmland restoration reveals the existence of substantial idle agricultural land, which, if guided by ecological regeneration principles, could be transformed into a community-shared ecological farm. Realizing this vision requires spatial planning and farmland restoration regulations as planning tools to strengthen the activity, as well as economic grants and technical expertise to revitalize the productivity of polluted land.
- The street vending of local food demonstrates the presence of underutilized public spaces, such as wide pedestrian streets. Its envisioned future is a vibrant street market, which depends on flexible governance, improved street design, and legal recognition through temporary permits. Without these planning tools, the benefits of these informal circular practices are hard to be realized.

Despite the potential of circular visions, Chengdu's planning system lacks the needed tools for implementation. Key challenges include the absence of a unified understanding of circular development, limited technical expertise in resource-looping networks, and a reliance on reconstruction over alternative redevelopment strategies. Weak soil pollution regulations and the failure to recognize vulnerable communities further exacerbate these issues. As a result, significant gaps remain within the existing planning systems in integrating circular development into urban regeneration and improving migrant workers' well-being.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/land14030655/s1>, Supplementary Materials File S1: Street Interview; Supplementary Materials File S2: Expert Interview.

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