

Research Progress and Prospects of Shrinking Cities

Dongyu Zhao*

School of Tourism & Research Institute of Human Geography, Xi'an International Studies University, Xi'an 710128, China

*Corresponding Author: 18636728070@163.com

ABSTRACT

This Amidst the wave of globalization and urbanization, the phenomenon of urban shrinkage is gradually becoming a "new normal" in urban development, triggering a series of profound questions regarding urban sustainability. With profound changes in the domestic and international socio-economic environment, the phenomenon of urban shrinkage has also begun to emerge in some cities and regions in China, posing a severe challenge in the process of new urbanization. This phenomenon not only challenges the traditional concepts of urban planning and management, but also prompts scholars in the field of economic geography to re-examine and conduct further research. This article aims to summarize the latest progress in the study of shrinking cities, delve into their connotation, identification criteria and type classification, underlying causes and mechanisms, as well as coping strategies. By doing so, we hope to provide theoretical support and practical guidance for the research and practice of urban shrinkage issues in China, and promote sustainable urban development and modernization of governance.

KEYWORDS

Shrinking Cities; Research Progress; Mechanisms; Coping Strategies

1. INTRODUCTION

Under the wave of globalization and urbanization, cities, as important carriers of human social development, are experiencing unprecedented changes. However, not all cities can maintain continuous growth and prosperity during this process. On the contrary, some cities have experienced phenomena such as population loss, economic slowdown, and abandonment of urban spaces due to various reasons. This phenomenon is known as urban shrinkage. In recent years, with the profound adjustment of the global economy and the diversification of urban development, the issue of urban shrinkage has become increasingly prominent, serving as an important topic in urban research.

Firstly, from a global perspective, urban shrinkage is not an isolated phenomenon but a widespread one accompanying the advancement of urbanization. With the deepening development of globalization and informatization, competition among cities has become increasingly fierce. Some cities have gradually lost their attractiveness and competitiveness due to reasons such as a single industrial structure, insufficient innovation capacity, and increasing environmental pressure, leading to population outflows and economic decline. At the same time, with the intensification of global population aging, some cities are facing issues such as labor shortages and decreasing consumption capacity, which have also accelerated the process of urban shrinkage.

Secondly, from the perspective of China's national conditions, the issue of urban shrinkage is also not to be overlooked. Since the reform and opening up, China has experienced a rapid urbanization process, with the continuous expansion of the number and scale of cities. However, during this

process, some cities have suffered from issues such as lack of scientific planning, over-development, and waste of resources, leading to dysfunction of urban functions, environmental degradation, and frequent social problems. At the same time, with the transformation and upgrading of China's economy, some traditional industrial cities are facing pressure to adjust and upgrade their industrial structure, as well as the risk of population loss and economic decline.

Moreover, policy factors have also had a significant impact on urban shrinkage. In the past period, China has implemented a series of urbanization policies aimed at promoting rapid urban development and population aggregation. However, these policies have also exposed some issues during implementation, such as over-pursuit of urban scale expansion and neglect of urban connotative development, resulting in the emergence of "empty cities" and "ghost towns". The shrinkage of these cities has not only affected the sustainable development of the cities but also had a negative impact on social stability and people's livelihood and well-being. As people's demands for urban living quality continue to rise, the issue of urban shrinkage has received increasing attention. Modern urban residents expect not just economic prosperity and material abundance from their cities, but also beautiful environments, rich cultural offerings, and social harmony. However, due to population loss and economic decline in some shrinking cities, issues such as outdated urban facilities, deteriorating environments, and waning cultural vibrancy have emerged, making it difficult to meet the needs of modern urban residents. Therefore, studying the issue of urban shrinkage and exploring paths to sustainable urban development have become crucial tasks for urban planning and policymaking.

In summary, the research background of urban shrinkage involves multiple aspects, including the processes of globalization and urbanization, the characteristics of China's national conditions, the influence of policy factors, and people's pursuit of urban living quality. Against this backdrop, strengthening research on urban shrinkage holds significant theoretical and practical significance. It helps to deepen our understanding of urban development patterns, provides scientific evidence for urban planning and policymaking, and promotes the healthy and sustainable development of cities.

Among them, a noteworthy phenomenon is the emergence of shrinking cities. Shrinking cities refer to the reduction in urban scale and function due to various factors such as population loss, economic recession, or geographical changes. In recent years, this phenomenon has gradually emerged globally, particularly in the old industrial bases and resource-based cities of developed countries and some developing countries. Therefore, the study of shrinking cities not only helps deepen our understanding of the laws of urban development, but also has important practical significance for formulating effective urban planning and policies.

As a newly emerging academic field, the study of shrinking cities has attracted the attention of numerous scholars both domestically and internationally in recent years. These studies have conducted thorough discussions on the causes, mechanisms, and impacts of shrinking cities from multiple perspectives. Therefore, this article aims to systematically summarize and analyze the latest progress in the study of shrinking cities, providing a useful reference for future research and practice. We will explore the connotation, identification, and classification of shrinking cities, as well as their causes and coping strategies, in order to contribute to the deepening and development of shrinking cities research.

2. THE CONNOTATION OF SHRINKING CITIES

The concept of "shrinking cities" originates from the German scholar Philipp Oswald's book "Shrinking Cities." It refers to those cities that have gradually lost their population and economic vitality due to reasons such as de-industrialization, demographic shifts, informatization, urbanization, aging, and social structural transformation. Specifically, these cities exhibit phenomena such as a decrease in the total urban population, vacant development land, and decline of the industrial economy. This concept emphasizes the phenomenon of urban shrinkage in a specific socio-economic

context and reveals the underlying causes behind it. In recent years, with the acceleration of globalization and urbanization, the issue of shrinking cities has gradually garnered attention. Especially in China, as urbanization advances, some cities have begun to experience shrinkage or localized shrinkage. This is mainly due to factors such as resource depletion, ineffective industrial transformation, and population loss. The connotation of shrinking cities is not limited solely to the decrease in population and economy; it also involves the transformation of urban development models and the adjustment of planning ideas. It requires a reexamination of traditional urban growth patterns and a shift towards a development path that focuses more on stock planning and decremental planning. At the same time, shrinking cities also present opportunities for agglomeration development, necessitating policy guidance and market mechanisms to promote urban transformation and upgrading.

The concept of urban shrinkage or shrinking cities originated from the German term "Schrumpfende Städte," which emerged in the 1970s as a result of the German government's concern about population loss. Although research on population loss had existed for some time, there was no clear definition of urban shrinkage in its early stages[1]. Approximately 20 years later, German scholars Häußermann and others formally introduced the concept of "shrinking cities" in a 1988 empirical study on the Ruhr region of Germany. Prior to the emergence of this term, similar research contexts often used terms such as "population decline," "decline or recession," "abandonment," "de-urbanization," and urban crisis. However, at that time, most researchers and policymakers were more inclined to believe that such decline was only temporary. It was not until the late 20th century and early 21st century, when a growing number of cities experienced persistent population loss and vacant housing, that the usage of "shrinking cities" gradually gained acceptance among scholars and policymakers. The focus of research shifted from initially studying population changes to exploring the dynamic mechanisms that drive urban population loss, further investigating the types and trajectories of urban shrinkage, and exploring corresponding response measures[2, 3].

The concept of "shrinking cities" initially proposed by Häußermann was mainly used as a metaphor for cities in Germany that experienced population and economic decline due to deindustrialization. In the field of urban geography, it is generally believed that a shrinking city refers to the process of significant population decline or loss in densely populated urban areas (such as a single city, a specific region within a city, a town, or even a metropolitan area), accompanied by economic transformation difficulties and structural crises [4-5]. The Shrinking Cities International Research Network (SCIRN), established in 2004, defines a shrinking city as a densely populated urban area with at least 10,000 residents that has experienced population loss in most of its areas for more than two years and is undergoing economic transformation characterized by some form of structural crisis[6, 7]. Although there is no consensus among scholars on issues such as the population base for measuring shrinkage, the duration of shrinkage, and the scale of population loss, the concept of shrinking cities emphasizes that population loss is triggered by structural crises, such as the complex interactions of globalization, post-industrialization, economic and social transformation, and other factors in different cities and regions, which disrupt the relative balance of the urban system. This distinguishes it from urban decline or disappearance caused by environmental and climate changes, natural disasters, wars, diseases, and other factors in historical periods.

3. IDENTIFICATION AND CLASSIFICATION OF URBAN SHRINKAGE

Foreign research on the identification of shrinking cities is mainly conducted from two dimensions: narrow and broad. Narrowly speaking, shrinking cities are primarily identified using population data as an indicator. For instance, Beauregard (2003) utilized urban census data to identify shrinking cities in the United States during the 19th century. Subsequent articles on the study of shrinking cities have almost uniformly adopted this data and standard. Broadly speaking, some scholars adopt multiple criteria to define shrinking cities. Martinez (2012) argues that shrinking cities are caused by a

combination of factors, and that using population alone as a single dimension cannot fully reflect the impact of shrinking cities. Therefore, he proposes a multi-dimensional approach to identify shrinking cities, incorporating population, economy, society, space, and other factors [3]. Schetke S (2008) quantified the geospatial indices of shrinking cities using geographic landscape indicators, primarily including the Leaf Area Index (LAI), Shannon's Diversity Index, and the Largest Patch Index, which improved the accuracy of identification. Overall, research on the connotation and identification of shrinking cities still focuses primarily on population factors. However, with the further advancement of research, more scholars are beginning to consider adopting comprehensive factors as indicators for identifying shrinking cities.

In the study of the connotation of shrinking cities in China, Xu Bo (2014) believes that, in a narrow sense, a shrinking city refers to the continuous loss of population in urban areas, while in a broader sense, it represents a comprehensive decline in population, economy, society, environment, and culture across spatial dimensions. Furthermore, the study of shrinking cities should not be confined solely to the cities themselves but should also take into account the combined influence of various economic and social factors within a connected region. Merely discussing shrinking cities from the perspective of the cities themselves is not comprehensive or scientific. Additionally, shrinking cities are one of the manifestations of the objective laws of market development. Under market economy conditions, development factors flow from cities with lower efficiency to those with higher efficiency. Given the scale differences in urban development in China, there are unreasonable distributions of land, capital, high-quality talent, and infrastructure. What is lost is not just high-quality talent and young labor but also investment, enterprises, and other development factors. Therefore, China's shrinking cities are essentially the product of unbalanced factor development reaching a certain stage.

The most common method used for measuring and identifying urban shrinkage abroad is the approach proposed by Alves et al., which involves calculating the population change rate and changes in population density between two different periods of a city. At the same time, population shrinkage exhibits a certain spatial scale, ranging from a single community, built-up area, to an entire city or region [8-9]. As the understanding of the concept of urban shrinkage continues to deepen, some scholars are not only relying on population indicators but also beginning to experiment with combining economic and land use indicators to distinguish the growth and shrinkage of different types of cities [10]. With technological innovation and development, the identification of urban shrinkage has gradually shifted from relying solely on traditional socio-economic indicator data to incorporating methods such as geographic landscape analysis and geospatial measurement [11].

In recent years, with the exploitation of geospatial big data, particularly the access to DMSP/OLS nighttime light data from the official website of the National Oceanic and Atmospheric Administration (NOAA) of the United States, scholars have adopted the methods developed by Elvidge et al. to process the raw DMSP/OLS nighttime light data for use in identifying urban shrinkage. This approach helps to corroborate the rationality of traditional statistical data in identifying urban shrinkage [12-14]. Regarding the classification of urban shrinkage types, Kabisch et al. used cluster analysis methods to select cross-sectional data from multiple years and categorize cities into different types of growth and shrinkage. Based on the morphological characteristics of different shrinking spaces within urban areas, foreign scholars have classified them into two types: "punctuated" shrinkage, represented by European shrinking cities and characterized by localized building vacancies, and "doughnut" shrinkage, represented by North American shrinking cities and featuring hollowed-out inner cities.

Currently, during the process of urbanization in China, there exists a coexistence of growth and shrinkage, with the issue of urban shrinkage becoming increasingly prominent. Additionally, there is a paradoxical phenomenon of decreasing urban population and spatial expansion. The issue of urban shrinkage deserves serious attention, and its processes and problems are worthy of further exploration [15-16]. Regarding research on the current status and identification of urban shrinkage, scholars have mostly relied on traditional economic and social statistical data for analysis. Since the concept of

urban shrinkage was initially used to describe stagnant population growth or population loss, it is relatively common to identify urban shrinkage from a population perspective [17]. However, as understanding of the concept's connotation and extension continues to deepen, scholars have begun to identify urban shrinkage from multiple perspectives, including population, economy, and land use [18-20]. In recent years, with the advancement of remote sensing technology and the rise of big data, some scholars have started to organically integrate traditional socio-economic statistical data with big data such as nighttime light data and POI (Points of Interest), gradually applying them to the identification and determination of urban shrinkage [21-22].

4. THE CAUSES OF URBAN SHRINKAGE

The motivations for urban shrinkage are multidimensional. Since some cities in developed countries have already experienced varying degrees of urban shrinkage, scholars have conducted extensive research on its causes. Although there are many factors that contribute to urban shrinkage, the dominant factors can vary significantly among cities in different development stages, different countries, and even among different types of cities within the same country. Current foreign research on its causes mainly explains it from the perspectives of deindustrialization, aging, suburbanization, political and institutional changes, natural disasters, and globalization [27]. Among them, economic transformation and population loss caused by deindustrialization are the main reasons for the shrinkage of old industrial bases in Europe and America. Since American cities are relatively developed and have seen trends of suburbanization and counter-urbanization earlier, the large cities in the United States are mainly affected by suburbanization and counter-urbanization, leading to shrinkage issues in their downtown areas. The urban shrinkage in Eastern Europe and the former Soviet Union regions is mainly influenced by political situations and institutional changes, resulting in long-term economic and population shrinkage. Structural demographic issues such as low fertility rates and aging are the main factors that have triggered severe population shrinkage in Japanese cities.

In China, Luo Xiaolong has analyzed the impact mechanisms of urban shrinkage in China from multiple perspectives, including the transformation of mining and industrial resource-based cities, urban decline caused by industrial contraction, and urban shrinkage triggered by zoning adjustments [28]. Deng Jiayi and Li Xun conducted an analysis on the impact mechanisms of urban shrinkage in the former East Germany after reunification. Among them, the institutional changes brought about by the reunification of the two Germanies were the main reasons for the urban shrinkage in the former East Germany. Additionally, a series of reactions such as population migration, excessive privatization, suburbanization, and excessive subsidies further exacerbated the urban shrinkage [29-30]. Liu Chunyang and Yang Peifeng compared the causative mechanisms of shrinking cities in China and abroad and found that deindustrialization was the core factor that triggered the early urban shrinkage in Western countries. Currently, the urban shrinkage occurring in regions such as Shanxi in China is closely related to regional deindustrialization.

Globalization has triggered the shrinkage of regions dependent on a single industry in the West, while in China, it manifests as the concentration of capital in coastal areas and the imbalanced regional development leading to population migration. Suburbanization has caused population loss and inner-city shrinkage in central cities and regions in Western countries like the United States, while in China, both urban centers and suburban centers have developed simultaneously under the process of generalized suburbanization. Deng Peiyong and Liu Yihua analyzed the spatial pattern and influencing factors of urban population shrinkage in county-level units in China [31]. Wu Tianci conducted research on the influencing factors of growth and shrinkage in resource-based cities [32]. Domestic scholars have conducted extensive research on the impact mechanisms of urban shrinkage in different regions, including the Beijing-Tianjin-Hebei urban agglomeration, the Yangtze River Delta, the Pearl River Delta, the three northeastern provinces, the Guanzhong urban agglomeration,

and some provincial administrative units. There are also significant differences in the impact mechanisms of urban shrinkage among these different regions.

5. STRATEGIES FOR COPING WITH URBAN SHRINKAGE

Based on the experience and insights gained from foreign research on urban shrinkage, scholars have formed two opposing views when it comes to coping with this issue. Some consider it a manifestation of urban decay, while others argue that it is a normal phenomenon in the process of urban development. Consequently, two distinct approaches have emerged: revitalization planning represented by "urban renewal" and adaptive planning represented by "smart shrinkage". From the perspective of revitalization, a comparative analysis of successful experiences in transforming typical villages and towns from shrinkage to revitalization, as well as failures that still struggle to overcome the dilemma of shrinkage, reveals that capable leadership, public participation, planning guidance, government support, industrial support, and community leadership are the keys to successful transformation. Initiatives based on local communities are more likely to promote the revitalization of settlements. From the perspective of smart shrinkage, a series of funding projects such as Germany's "Stadtumbau Ost" (Rebuilding East Germany) and the United States' "Neighborhood Stabilization Program" have identified the removal of redundant built environments as the most important means and methods to address shrinking cities in recent years.

In terms of addressing the issue of shrinkage, Sousa S and Pinho P conducted a research summary in 2015 on current urban responses and practical strategies to shrinkage. They proposed two main types of response strategies: "resistance" and "adaptation." The resistance strategy emphasizes counteracting and reversing shrinkage through industrial development and attracting population influx to restore urban growth. On the other hand, the adaptation strategy accepts shrinkage and emphasizes functional optimization based on the existing urban scale.

5.1. Reactive strategies

The reactive strategy for shrinking cities mainly encompasses six aspects: downtown revitalization, urban renewal, urban operation, industrial revitalization, technological innovation, and community planning. Downtown revitalization aims to rejuvenate decaying urban centers through measures such as facility construction. For instance, enhancing the attractiveness of urban centers through the construction of commercial facilities and public service facilities is a way to counter the shrinkage of urban centers. Urban renewal involves integrating high-end residential areas with entertainment and dining facilities to form comprehensive urban districts. Accessibility is achieved through diverse transportation options, and public-private partnerships are adopted as a method to promote and implement urban renewal and reconstruction. Urban operation, on the other hand, involves actively managing the city by introducing projects with growth potential to transform areas experiencing urban shrinkage. These strategies work in tandem to address the challenges posed by shrinking cities and promote sustainable urban development.

Industrial revitalization refers to the process of continuously optimizing industrial structure during the decline of industries such as manufacturing, leveraging the urban resource base and surrounding development opportunities. It involves countering urban shrinkage through the development of emerging industries like cultural creativity and convention and exhibition industries, in order to attract and retain high-quality talent. Technological innovation focuses on using technological advancements as a means to counter urban shrinkage. Martinez-Fernandez and Wu (2006, 2007) argue that technological development and innovation are crucial factors in enhancing a city's competitiveness. Therefore, urban revitalization needs to prioritize technological development, enhance the city's technological innovation capabilities, and increase government support and guidance. Community planning, on the other hand, involves development on a community-by-community basis. It achieves urban growth through community development by constructing low-cost projects within communities

and engaging in meaningful exchanges with community residents. These strategies work together to revitalize shrinking cities, attracting and retaining talent, enhancing urban competitiveness, and fostering sustainable urban development.

5.2. Adaptive strategies

Adaptive strategies involve accepting urban shrinkage and actively streamlining the city's scale. The main theory and measures originate from the concept of "smart shrinkage" proposed by Professor Frank Popper and his wife in 2002, which advocates "planning for less: fewer people, fewer buildings, and less land utilization." The specific means primarily encompass the following four aspects: first, green infrastructure construction; second, streamlining the city's scale to concentrate urban residents; third, collaborative planning; and fourth, establishing a land bank. Green infrastructure involves converting abandoned urban land into green ecological spaces. By constructing parks, community gardens, urban agricultural areas, and the like, it activates the connection between people and green spaces while also enhancing the economic value of surrounding plots. Streamlining the city's scale adjusts urban residential areas to adapt to population size. Specific measures include demolishing idle housing, regulating the housing market, and optimizing the residential environment. Collaborative planning refers to pooling ideas and resources from multiple social actors in the urban planning process. It emphasizes public participation and listening to the suggestions of the masses, while also leveraging corporate project investments as a source of funding for urban development. The land bank system involves the government's unified management and planning of urban land, with the aim of centrally recovering and transforming idle land.

Drawing inspiration from international research on shrinking cities, China mainly compares the international experience of studying shrinking cities with its current situation and explores the localization of coping strategies for urban shrinkage in China based on foreign research insights. From the perspective of shrink-smart planning, Liu Chang and Ma Xiaojing, among others, have explored planning paradigms for shrinking urban areas. Zhu Jin and Li Qiang, for instance, have discussed the transformation trends and paths of shrink-smart planning for small towns in the suburbs of megacities, shifting from passive decline to smart shrinkage. Zhao Min and You Lie have explored rural human settlement spatial planning strategies from the perspective of smart shrinkage. Wang Chaoshen and Chen Jian have conducted research on the causes and path breakthroughs of shrink-smart planning based on a theoretical analysis of stakeholders. Zhang Mingdou and his team have proposed approaches such as smart shrinkage, scientific planning, enhancing core competitiveness, and strengthening regional cooperation.

From the perspective of revitalization-oriented urbanization strategies, Zhou Pan and Wu Jiayu, among others, have proposed strategies for renewing shrinking cities based on the construction of green infrastructure. Li Xiang and Chen Keshi, taking the United States and Germany as examples, have explored strategies for revitalizing shrinking cities against the backdrop of a shift in growth-oriented values, starting from an analysis of the different value systems adopted by these countries in addressing urban shrinkage. The occurrence of urban shrinkage often indicates a certain vulnerability in certain aspects. In recent years, with the rise of research on resilient cities, the construction of resilient cities has provided a new perspective for addressing urban shrinkage issues. Enhancing urban resilience has unique advantages in dealing with a series of problems caused by urban shrinkage and is an important approach to solving the problem of urban shrinkage.

6. REVIEW AND PROSPECT OF RESEARCH ON SHRINKING CITIES

In summary, through the collation and summarization of existing domestic and international literature, it can be found that foreign scholars have conducted earlier research on urban shrinkage and have formed a relatively mature research collaboration network. Although domestic research started late, it has shown a significant upward trend in recent years, particularly in the past two to three years.

Scholars at home and abroad have conducted relatively deep research on the definition and phenomena, identification and description, causes and types, countermeasures and suggestions of urban shrinkage, and have guided practice accordingly. However, overall, scholars at home and abroad have not reached a consensus on the definition and connotation of urban shrinkage, and there is a lack of research on the spatial and temporal evolution of urban shrinkage on a large scale. In terms of influencing factors, there is a preponderance of qualitative analysis and a lack of quantitative research. Foreign research on urban shrinkage is gradually becoming more systematic and scientific, while domestic research on urban shrinkage mainly follows the development trajectory of international research. Due to the unique nature of China's urbanization process, which differs from the completed urbanization in the West, the measurement, influencing factors, and driving mechanisms of urban shrinkage in China will be more complex.

Firstly, in terms of the research framework, urban shrinkage exhibits significant global, local, multidimensional, and complex characteristics. There is no unified analytical model, and it is inappropriate to apply Western scenarios and frameworks to Eastern Europe and other countries, including China. It is urgently necessary to establish a localized analytical framework for the study of urban shrinkage in China. Secondly, regarding the research content, although numerous explorations have been conducted around the definition, main types, distribution and evolution, causes and processes of urban shrinkage, as well as responses to sustainable development, most of the research has focused on describing and summarizing the characteristics of shrinkage, with a preponderance of case studies and limited general inference studies. There is still a need for further deepening in areas such as the scientific definition and measurement of shrinkage (which should be based on reliable quantitative indicators and implemented in both time and space), the revelation of the systematic dynamics of shrinkage mechanisms, the simulation of future scenarios of shrinkage, and critical content such as land use, infrastructure renewal, urban resilience, and spatial governance.

Thirdly, in terms of research subjects, Western scholars have systematically studied different types of shrinking cities, including those resulting from deindustrialization and post-socialism. In contrast, research in China has primarily focused on resource-exhausted cities, old industrial cities, and the hollowing out of villages and towns, which have similar or related connotations or extensions to "shrinkage." With the aging of the population and the adjustment of industrial structures, the causes of shrinkage are beginning to emerge in large and medium-sized cities, metropolitan areas, and urban agglomerations of various levels. Therefore, there is a need to strengthen comprehensive and in-depth research on urban and regional shrinkage of different types, sizes, and scales.

Therefore, it is urgently necessary to establish a scientific research framework system for urban shrinkage that is suitable for China's national conditions and strengthen systematic and integrated research across the country. In recent years, with the advancements in internet and remote sensing geographic information technology, it has become possible to obtain large-scale, high-precision spatiotemporal big data that characterizes human activities. Exploring the potential of using such data for spatiotemporal analysis and predictive modeling of urban shrinkage is an important direction for future research, worthy of continuous attempts and exploration by scholars.

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