

What kind of shrinkage differences do urban agglomerations at different stages of development lead to in the era of negative population growth?

Chen Ge, Wang Yuchen, Huang Jianzhong

Tongji University

Email: 1670865568@qq.com

Abstract

Currently, the phenomenon of localized urban contraction has brought challenges to the high-quality development of the region. Based on the study of urban contraction in the Chinese context, we explore the phenomenon and characteristics of contraction in the city clusters of the Yangtze River Delta and the middle reaches of the Yangtze River, comparatively analyse the contraction patterns, temporal and spatial patterns and other changes presented by city clusters with different development processes. It also explores what kind of contraction differences mature and developing city clusters show in their respective development stages, taking the Yangtze River Delta city cluster and the city cluster in the middle reaches of the Yangtze River as examples.

Keywords: negative population growth, urban shrinkage, urban agglomeration, development process, regional differences

0 Introduction

The phenomenon of urban contraction first appeared in Western countries and gradually became a worldwide socio-economic problem (Fernandez C, Audirac I and Fol S, et al., 2012; Döringer S, Uchiyama Y and Penker M, et al., 2020). Currently, in the process of China's rapid urbanization, urban contraction is a phenomenon emerging from urban development mainly characterized by population loss, accompanied by negative externalities such as inefficient use of land resources, housing vacancy, and economic downturn (Guo, Li, 2019), which brings impacts and challenges to the traditional paradigm of growth-oriented thinking (Sun, 2022). China is in the parallel stage of rapid urbanization and urban contraction (Sun, 2022), and in 2019, the National Development and Reform Commission (NDRC) issued the "Key Tasks of New Urbanization Construction in 2019", which mentioned "shrinking cities" for the first time, and explicitly required shrinking small and medium-sized cities to slim down and strengthen their bodies, strictly control incremental growth, and revitalize the stock, which was mentioned in the "New Urbanization Construction and Urban Integration Development in 2020". In the "Key Tasks of New Urbanization Construction and Urban-Rural Integration Development in 2020", the development demands of shrinking cities are also emphasized. The phenomenon of urban contraction has become a key topic of concern at the current stage of emphasizing high-quality development.

Based on the research of foreign scholars, relevant domestic studies start from the introduction of foreign experience to carry out the "China Shrinking Cities Research Network", which researches the connotation (Sun, 2022), identification (Zhang, Shan and Zheng et al., 2019), development path (Zhou, Qian, 2015), and influence mechanism (Sun, Zhang and He, 2022) of shrinking cities. From the perspective of the object, northeastern cities, third-tier cities, resource-based cities are the main ones, and the phenomenon of local contraction within the metropolitan area and city clusters has gradually attracted the attention of scholars. Current research mostly considers the identification of cities with population contraction and the analysis of influencing factors, with less consideration of social and economic factors, and insufficient research on the differences in urban development brought about by contraction. In this paper, we adopt the population census data from the fifth to the seventh census to reflect the population loss of cities in a more comprehensive and real-time manner; at the same time, we select two city clusters of the Yangtze River Delta and the middle reaches of the Yangtze River, and conduct a comparative research on different types of city clusters to better reflect the characteristics and differences in the occurrence of the phenomenon of urban contraction; and based on the different directions and degrees of urban contraction, we will further put forward optimization suggestions.

1 Research Methods

1.1 Research object and data

The study selects the Yangtze River Delta city cluster and the city cluster in the middle reaches of the Yangtze River, considering that both of them have certain types of characteristics in the development of city clusters (Table 1), are located along the Yangtze River Economic Belt, adjacent to each other, the Yangtze River Delta city cluster is in a relatively mature stage of development, and the city cluster in the middle reaches of the Yangtze River is more inclined to be a cultivation period and a developmental type of city cluster, and its comparative study is a reference for the city clusters in different stages of development. Considering the administrative factor of zoning, the phenomenon of city contraction and its causes are analyzed from the prefecture-level city level.

Table 1 Comparison of city clusters in the Yangtze River Delta and the middle reaches of the Yangtze River

Research target	Yangtze river delta city cluster	Mid-Yangtze river city cluster
Geographical position	Yangtze river economic belt (east end)	Yangtze river economic belt (central)
Distributional characteristics	Coastal, open to the outside world	Inland, central hub
Developmental stage	Mature city cluster	Developmental city clusters
Development goal	High-quality integration	Cooperative development

The GIS analysis and visualisation were carried out using the Chinese standard map with review number GS(2020)4619, with the geographic coordinate system GCS_Beijing_1954 and the projected coordinate system China_Lambert_Conformal_Conic. demographic data were the data of the fifth, sixth and seventh censuses from 2000 to 2020, and the resident population of selected prefectural cities was selected for the change trend study; economic data were the GDP data of each city from the statistical yearbook of the local statistical bureau; spatial data were obtained by integrating DMSP-OLS and SNPP-VIIRS data after correction. The population data are the 2000-2020 VP, VIP and VIIP data, and the resident population of prefecture-level cities is selected to study the trend of change; the economic data are the GDP data of each city from the statistical yearbooks of local statistical bureaus; and the spatial data are corrected nighttime lighting data from 2000 to 2020 obtained by integrating the data of DMSP-OLS and SNPP-VIIRS (Chen, Yu and Yang et al., 2021).

1.2 Technical route of research

Starting from the three dimensions of 'population-economy-space', we select the indicators of urban agglomerations in the past years to conduct uni-dimensional, bi-dimensional and multi-dimensional contraction research and judgement, and at the same time analyse the paths and characteristics of urban contraction, discuss the spatial and temporal dynamics of the contraction of different urban agglomerations, and then put forward the corresponding suggestions and optimization strategies for different types of contracting cities, see Figure 1.

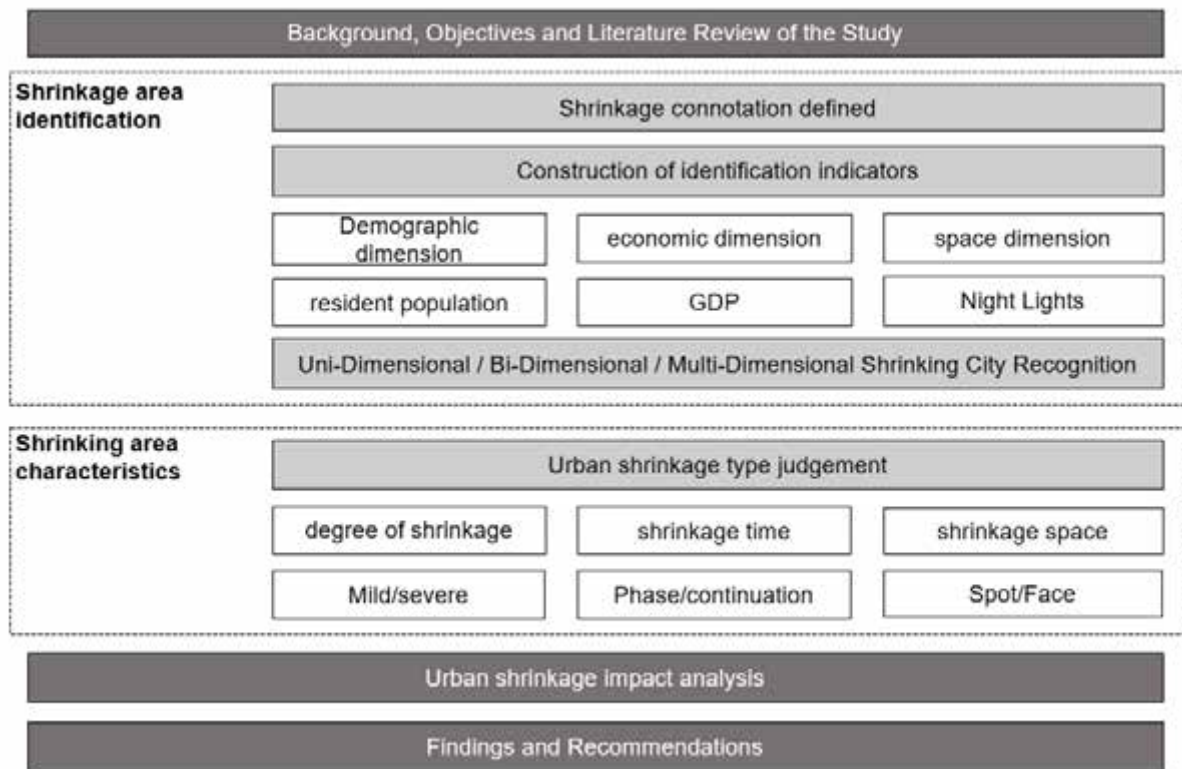


Figure 1 Research pathway framework

2 Shrinkage identification from multi-dimensional perspective

Shrinkage city identification is carried out using prefecture-level cities in city clusters as the division scale; the Yangtze River Delta city cluster includes Shanghai, Jiangsu, Zhejiang and Anhui provinces, totalling 41 cities, and the city cluster in the middle reaches of the Yangtze River includes Hubei, Hunan and Jiangxi provinces, totalling 31 cities. See Table 2 and Table 3 for details.

Table 2 Composition of the Yangtze River Delta Urban Agglomeration

The Yangtze River Delta city cluster contains prefecture-level cities (41)	
Shanghai	Shanghai
Jiangsu Province	Suzhou, Nanjing, Wuxi, Nantong, Changzhou, Xuzhou, Yancheng, Yangzhou, Taizhou, Zhenjiang, Huai'an, Lianyungang, Suqian
Zhejiang Province	Hangzhou, Ningbo, Wenzhou, Shaoxing, Taizhou, Jiaxing, Jinhua, Huzhou, Quzhou, Lishui, Zhoushan
Anhui Province	Hefei, Wuhu, Ma'anshan, Anqing, Chuzhou, Fuyang, Bengbu, Suzhou, Xuancheng, Lu'an, Bozhou, Tongling, Huainan, Huaibei, Chizhou and Huangshan.

Table 3 Composition of urban agglomerations in the middle reaches of the Yangtze River

City cluster in the middle reaches of the Yangtze River including prefecture-level cities (31)	
Hubei Province	Wuhan, Huangshi, Ezhou, Huanggang, Xiaogan, Xianning, Xiantao, Qianjiang, Tianmen, Xiangyang, Yichang, Jingzhou, Jingmen
Hunan Province	Changsha, Zhuzhou, Xiangtan, Yueyang, Yiyang, Changde, Hengyang, Loudi

Jiangxi Province

Nanchang, Jiujiang, Jingdezhen, Yingtan, Xinyu, Yichun, Pingxiang, Shangrao, and some counties (districts) in Fuzhou and Ji'an
(Fuzhou and Ji'an were all delineated at the time of the study)

The term 'urban contraction' is used to emphasise the fact that this social problem exists in multiple economic, demographic, geographic, social and physical dimensions, rather than a simple linear process. Therefore, the study starts from a multi-dimensional perspective, taking demographic, economic and spatial indicators into account, and draws on the concept of 'one body, two wings and three dimensions' put forward by Zhang Wei and others (Zhang, Shan and Zheng et al., 2019). Drawing on the concept of 'one, two wings and three dimensions' of shrinking cities proposed by Zhang Wei and others (Figure 2), the study considers the dominant factors of city shrinkage under different scenarios from a multi-perspective perspective. Through three-dimensional identification and judgement, we can more accurately define the type, degree and status of urban contraction, and provide strategic benchmarks for urban regulation and development response.



Fig. 2 One body, two wings and three dimensions of shrinking city concept

2.1 Population contraction

Population contraction, as the main feature of urban contraction, is a key indicator for defining urban contraction. Classifying the data from the three censuses and calculating the rate of change in the resident population of each region from 2000 to 2010 and from 2010 to 2020 respectively, cities with a rate of change in population of less than -3% are identified as shrinking cities (Sun, Wang, 2021; Zhang, Liu and Lv, 2016; Gong, Zhang and Wang, 2022).

Table 4 shows that in 2000-2010, the Yangtze River Delta urban agglomeration mainly faced light to medium contraction, and the city agglomeration in the middle reaches of the Yangtze River existed in light to heavy contraction; in 2010-2020, the contracting cities of the Yangtze River Delta urban agglomeration decreased but the degree of contraction further deepened, with heavy and medium contraction predominating, and the contracting cities of the city agglomeration in the middle reaches of the Yangtze River increased but shifted to medium contraction more often.

Table 4 Identification of cities with shrinking populations

	2000-2010		2010-2020	
	Yangtze River Delta (12)	Middle reaches of the Yangtze River (8)	Yangtze River Delta (6)	Middle reaches of the Yangtze River(15)
shrinkage strength >20% (severe shrinkage)	—	Xiantao (1)	Anqing, Lu'an (2)	—

10% - 20% (general severe shrinkage)	—	Tianmen, Huanggang (2)	—	Tianmen, Yiyang, Xiaogan (3)
5% - 10% (moderate shrinkage)	Fuyang, Lu'an, Yancheng, Suqian (4)	Jingzhou, Xianning (2)	Huaibei, Yancheng, Huaian (3)	Qianjiang, Changde, Jingzhou, Jingmen, Yueyang, Hengyang, Fuzhou, Ji'an, Yichun (9)
3%-5% (mild shrinkage)	Bengbu, Xuancheng, Nantong, Xuzhou, Lianyungang (8)	Bozhou, Taizhou, Huaian, (3)	Qianjiang, Jingmen, Xiaogan (3)	Chizhou (1)
				Xiantao, Xiangyang, Huanggang (3)

In terms of the number of cities with different degrees of contraction (Figure 3), between 2000 and 2020, the number of cities in the YRD with mild contraction is decreasing, moderate contraction is decreasing, and severe contraction is increasing; and in the middle reaches of the Yangtze River, there are no change in the number of cities with mild contraction, moderate contraction is increasing, more severe contraction is increasing, and severe contraction is decreasing.

Overall, the YRD has more contracting cities during 2000-2010, decreasing but further intensifying during 2010-2020; the middle reaches of the Yangtze River have fewer contracting cities during 2000-2010 and more during 2010-2020, but to a relatively slower extent.

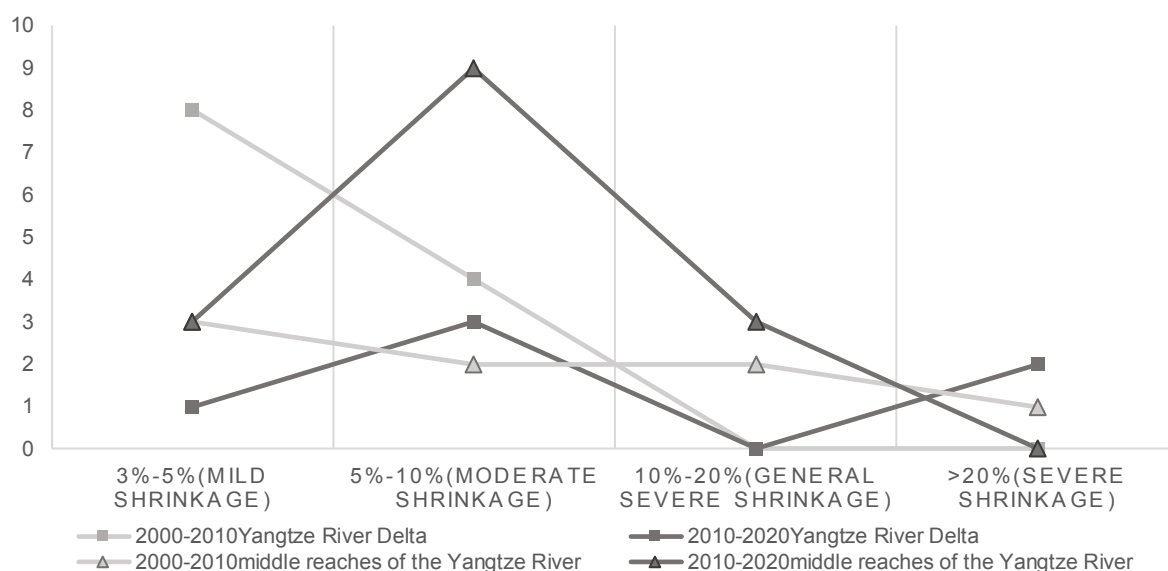


Figure 3 Comparison of cities with shrinking populations

2.2 Economic Contraction

Economic contraction mainly analyses the rate of change of GDP of regional gross domestic product of each city from 2000 to 2020, according to the data of statistical yearbook of each region (Table 5), the Yangtze River Delta has 4 cities with economic contraction phenomenon in the period of 2000-2010, and there are 3 cities in the period of 2010-2020, of which, Huainan is the only city with economic contraction phenomenon in two consecutive years; the middle reaches of the Yangtze River have 5 cities with economic contraction phenomenon in the period of 2000- 2010 period there were five cities that experienced economic contraction, and 2010-2020

excluding the impact of the 2020 epidemic, three cities were considered to have economic decline.

Table 5 Identification of economically contracting cities

Yangtze River Delta		Middle reaches of the Yangtze River	
2000-2010(4)	2010-2020(3)	2000-2010(5)	2010-2020(3)
Fuyang, Ma'anshan (2001) Wuhu (2001, 2006) Chuzhou (2005)	Lu'an (2010) Huainan (2014-2015) Tongling (2019)	Jingzhou, Jingmen, Xianning, Huanggang, Xiaogan (2005)	Pingxiang, Xinyu and Jingdezhen (2018)

2.3 Spatial contraction

Using night lighting data to reflect the spatial vitality of the city, taking into account China's unique 'population loss - land expansion' characteristics and did not choose the built-up area to identify the contraction of the land area, take the city in 2000, 2005, 2010, 2015, 2020 night lighting data to carry out the study in the gis to show the table partition. Statistics, when the average intensity change rate is less than 0, the city will be identified as a spatial contraction city.

The average nighttime light intensity in the Yangtze River Delta region is in a growing trend and basically has no contraction; the cities with contraction in the city cluster in the middle reaches of the Yangtze River are mainly Xiantao, Pingxiang, Yichang, Yiyang, Loudi, Changde, Yueyang, Changsha, Xiangtan, Zhuzhou, Yichun, Huanggang and Xiaogan.

2.4 Multi-dimensional contraction

By integrating the trends of the cities in the city cluster in terms of population, economy, and space, the analysis leads to the shrinking cities under the multi-dimensional perspective. In the Yangtze River Delta city cluster, Fuyang City and Lu'an City belong to the population-economy contraction, because the Yangtze River Delta region basically shows an upward trend in the spatial dimension, and the contraction phenomenon is more in a certain degree of shrinkage in population and economy. In the city cluster in the middle reaches of the Yangtze River, Xiangyang , Jingzhou , Jingmen , Xianning , Huanggang , Xiaogan belong to the population-economic contraction, Xiantao , Yiyang , Changde , Yueyang , Yichun , Huanggang , Xiaogan belong to the demographic-spatial contraction, and comprehensively Huanggang , Xiaogan belongs to the 3D contraction city, and the phenomena of contraction such as a certain degree of population reduction and economic decline exist to a certain extent in many aspects.

3 Evolutionary characteristics of population contraction

From the results of urban contraction research, population contraction is relatively more reflective of the real state of urban contraction, subject to relatively few external uncontrollable factors, based on the population contraction data to analyse the spatial and temporal characteristics of the two major urban agglomerations in the local contraction, and to discuss the contraction of the urban agglomerations in the degree and time of the trend of change.

3.1 Degree of contraction

The contraction of the Yangtze River Delta urban agglomeration in 2000-2010 mainly occurred in the north, Jiangsu and Anhui periphery, presenting a band form; to 2010-2020, the contraction mainly occurred in the east of Jiangsu and the west of Anhui, presenting a relative distribution of points, relatively speaking, the contraction of the city there is a significant reduction, but the degree of contraction from the previous general light to moderate to Medium-heavy. Analysis in the Yangtze River Delta integration to promote more coordinated and balanced development of cities in the urban agglomeration, their own city economy to drive employment growth, reducing

the phenomenon of urban contraction. However, there are also local areas that are relatively lagging behind in development, and neighbouring cities have more attractive resources, leading to a polarisation effect in the degree of contraction and increased wastage.

The city cluster in the middle reaches of the Yangtze River contracted mainly in the centre of Hubei Province in 2000-2010, and in 2010-2020, the phenomenon of piecemeal contraction will occur in the western and southern parts of the entire city cluster, with an increase in the number of contracting cities and a relative slowdown in the degree of contraction. Considering the uneven development of Hubei Province in the early stage, the development of neighbouring cities is relatively lagging behind, the capital city of Wuhan is too high to attract the population of neighbouring cities to gather here, resulting in a high degree of population loss in several neighbouring cities; then, with the gradual development of the neighbouring cities, a number of polarization centres appear in the city cluster in the middle reaches of the Yangtze River, and the economic development of Wuhan, Changsha, and Nanchang, etc., is faster than that of the neighbouring cities, and the resources of these cities are more superior, resulting in the emergence of neighbouring areas. The more superiority of the city leads to a greater range of population movement phenomenon in the peripheral areas, and the contraction further expands at the city level.

3.2 Time of contraction

By considering the overall contraction in 2000-2020, the time characteristics of the contraction of the city cluster are defined, if there is no population loss in both time stages judged as no contraction; if there is a contraction in Stage 1 and none in Stage 2, it is judged as a stage contraction; if there is no contraction in Stage 1 and there is a contraction in Stage 2, it is judged as a potential contraction; and if there is a contraction in both stages, it is judged as a sustained contraction.

Accordingly, comparing the Yangtze River Delta city cluster and the city cluster in the middle reaches of the Yangtze River in terms of contraction time con, it can be seen that from 2000 to 2020, 22% of the cities in the Yangtze River Delta city cluster are in stage contraction, 7% are in potential contraction, and 7% are in sustained contraction; and in the middle reaches of the Yangtze River city cluster, 3% of the cities are in stage contraction, 26% of the cities are in potential contraction, and 23% of the cities are in continuous contraction.

The Yangtze River Delta city cluster has a better advantage in regional integration and coordination, overall the development of each region is relatively balanced, in the face of the problem of urban contraction there is a better basis for coping with the problem, more is to seize the development of local areas to drive, higher quality to achieve regional integration; the middle reaches of the Yangtze River city cluster is still in the stage of cultivation and development, the polarity between the cities is relatively serious, and the differences in regional development are obvious, resulting in the emergence of a large proportion of cities or there is a risk of contraction, and more cities are in the stage of potential contraction. Or there is a risk of contraction, more to regional synergistic development to promote the promotion of the central city to drive the employment and economic development of the surrounding areas, to reduce the phenomenon of underdeveloped areas of the outflow of population.

4 Shrinkage causes and countermeasures analysis

4.1 Causes of contraction

From the current city contraction structure, the Yangtze River Delta city cluster and the city cluster in the middle reaches of the Yangtze River belong to the 'core expansion - peripheral contraction' type of contraction mechanism, in which the core city or the central city of the city cluster is attracted by the international co-operation and policies, and the introduction of resources is constantly growing, and the city governance ability

is relatively high and the advantage of innovation-driven development is obvious, attracting the population and industries of the surrounding small and medium-sized cities to gather in the centre. In the city cluster, the core city or the central city is attracted by international cooperation and policies, and continues to grow and bring in resources, from transportation, industry, facilities and social security, and has relatively high urban governance capacity and obvious advantages in innovation-driven development, which attracts the population and industry of the surrounding small and medium-sized cities to the centre, and all kinds of factors gradually tend to develop in the central region, leading to the contraction of the peripheral cities of the city cluster.

The Yangtze River Delta city cluster is a typical case of integrated development with the metropolis of Shanghai as the core, and the development strength of several leading central cities is very considerable, with more people flocking to the several central cities for further development and livelihood, which brings about a lack of sufficient innovative attraction and industry to retain the population in the surrounding small and medium-sized cities, leading to local contraction problems.

The city cluster in the middle reaches of the Yangtze River has a relatively low degree of integration and development, and is still the central city of several provinces in the driving force, the flow of factors between the region tends to converge to a few central nodes, and the nodes around the urban areas are also prone to the proximity of resources leading to the flow of factors, the essence of the spatial resources to the region of the higher level of energy and more promising areas of the development of the tilt brought about by the demographic tendency to be from the economic tendency to the contraction of the phenomenon as the phenomenon of contraction, as an unavoidable aspect of rapid urban development in the process of urbanisation, and the growth of cities present a situation of mutual pull, and the cities in the region are constantly pulling between 'contraction-growth', and the factors are constantly redistributed in space under the perspective of factor flow, which brings about the dynamic evolution and development of the region.

4.2 Planning Countermeasures

For the Yangtze River Delta and the city cluster in the middle reaches of the Yangtze River, the city contraction is dominated by population contraction, accompanied by economic contraction and slowing down of spatial vitality.

As a mature urban agglomeration, the Yangtze River Delta is now mainly characterised by population contraction, with more cities contracting in the northern region and a high degree of contraction in the western region, and contraction in recent years has mainly focused on some cities in the peripheral regions. The overall development of the Yangtze River Delta city cluster is more powerful and mature, and the contraction is mainly due to the loss of population from the peripheral cities to the core, and the contraction should be considered as the main mitigation, relying on the development of the power to transform the regional competitive relationship into the centre, and improve the configuration of the regional economic factors through the policy and planning (Peng, Luo and Liu et al., 2023), and effectively ease the transfer of the functions of the central urban areas to the periphery.

The city cluster in the middle reaches of the Yangtze River as a developmental city cluster, from uni-dimensional to multi-dimensional contraction type is more diverse, the contraction shows the trend of expansion and spreading, and is dominated by potential contraction and continuous contraction. Compared with the Yangtze River Delta City Cluster, which has a stronger development drive, most of the cities in the Middle Reaches of the Yangtze River cluster are contracting because of the disordered development caused by the loss of labour force and the depletion of resources, the limited role of the central city in radiating and driving the small and medium-

sized cities in the vicinity, and the lack of a regional network hierarchy due to the unbalanced development of the cities, which makes it difficult to form an effective linkage and collaboration. Based on economic activities, it is considered to cultivate secondary cities that are closely connected to each other to buttress the metropolitan area and radiate and drive the population flow and economic development of the contracting cities (Yu, 2024).

In terms of the type of contraction, for the phenomenon of population contraction in the city cluster, it is necessary to resist population loss in the early stage, improve urban development, promote the division of labour and cooperation in order to integrate into the regional development system, and drive its own development with developed cities. When the contraction continues to be severe, we should consider appropriately reducing the size of the city and promoting the development of a leaner and stronger city. For the phenomenon of 'population-economy' double contraction, the development positioning and effective development scale of cities in the urban agglomeration should be clarified, and the support of major industries should be appropriately increased to promote the economic development of the cities, and at the same time, the adjustment and optimisation of the industrial structure should be considered, as well as the comprehensive coordination of the spatial distribution of industries and the development of the population. Facing the phenomenon of 'population-space' double contraction, which mainly lies in the reduction of spatial vitality brought about by population exodus, we should control the scale of cities, optimise the land use structure, and adapt to the needs of urban development. For the multi-dimensional contraction phenomenon of 'population-economy-space', the adaptation contraction strategy is the main one, and the 'small and beautiful' development of the city should be realised through spatial resource integration and redistribution within the limited resources and space. Planning should take into account the type and degree of urban contraction and time, and make differentiated decisions on the response strategies to urban contraction.

From the perspective of urban agglomeration, the analysis of urban contraction strategy suggests that it is necessary to grasp the key points of regional integration and development, strengthen the internal integration and flow of factors such as labour, technology, capital and information within the region, enhance the synergy of regional development, and buttress the external cycle of the region. Taking 'population' as the root, we should guide the matching of population increase and employment, pay attention to changes in population size and age structure, encourage births moderately, and increase the introduction of talents to promote the inflow of young and strong people into the cities. With 'economy' as the driving force, we will optimise the regional industrial division of labour, adjust the industrial structure, introduce high and new technologies to upgrade traditional industries, promote the extension and integration of closely-connected industries, and create competitive alternative industrial clusters. On the basis of 'spatial vitality', the construction of regional spatial networks should be strengthened, and an attractive urban environment should be created to support the coordinated development of the region (Yu, 2024).

5 Summary

This paper identifies the contraction of the two major urban agglomerations of the Yangtze River Delta and the middle reaches of the Yangtze River from 2000 to 2020 through the multi-dimensional perspective of 'population flow - economic output - spatial vitality', and further analyses the spatial and temporal dynamics of urban contraction based on the main population contraction, and explores the spatial characteristics of the two types of urban agglomerations under the background of contraction, with the following main conclusions. The main conclusions are as follows:

Firstly, from the multi-dimensional identification of population-economy-space, it can be seen that the shrinking cities of the Yangtze River Delta urban agglomeration show the spatial characteristics of 'more in the north and less in the south, higher in the west and lower in the east', while the shrinking cities of the city agglomeration in

the middle reaches of the Yangtze River show the characteristics of 'more in the west and less in the east, higher in the north and lower in the south'. In terms of the distribution of bi-dimensional or multi-dimensional shrinkage cities, the Yangtze River Delta region is mainly located in the periphery, while the middle reaches of the Yangtze River tends to be distributed in the vicinity of the regional centre cities.

Secondly, analysing the time dimension, the contraction trends of the YRD urban agglomeration and the city agglomeration in the middle reaches of the Yangtze River show an opposite trend. In the time periods of 2000-2010 and 2010-2020, the number of shrinking cities in the YRD urban agglomeration decreases and intensifies, while the number of city agglomerations in the middle reaches of the Yangtze River increases and decreases, which is related to the fact that the two urban agglomerations are at different stages of development.

Thirdly, in terms of the type of contraction, the Yangtze River Delta Urban Agglomeration shows a 'periphery-core' structure, with population loss from the peripheral areas to the central cities occurring within the scope of the urban agglomeration, which mostly belongs to the type of phased contraction. The city cluster in the middle reaches of the Yangtze River shows a 'point-circle' structure, with the provinces as the scope of the phenomenon of circle contraction around the regional central city, and the population loss from the peripheral areas to a number of node cities, which is more of a potential contraction type.

For the two major city clusters in the context of contraction of different performance, targeted optimisation proposals: the Yangtze River Delta city cluster has basically entered the stage of integrated development, regional synergy is better, the future more consideration for the relative backwardness of the peripheral areas to further pull and boost, tendency to innovation, the introduction of talent and other policy guidance. The city cluster in the middle reaches of the Yangtze River is still in the stage of their own development, the three provinces have not yet reached the regional synergy drive, consider the core city of each province to make joint efforts, from independent development to the regional joint, to strengthen the competitiveness of the differences between the various regions of the city, and promote the balanced allocation of resources. As for the contraction of small cities caused by the overdevelopment of large cities, the governance means are more inclined to optimise the spatial layout of small cities, promote the fine development and smart contraction of small cities, cultivate their own characteristic industries and localisation, improve basic public service facilities, and promote the 'slimming and strengthening' of urban development.

The urban growth model is no longer applicable to the sustainable development of all cities and regions, and the planning discipline needs to reconsider the multidimensional impacts of urban contraction and urban regeneration strategies in practice, as well as the need to expand the current research paradigm of urban planning from 'growth' to 'growth and decline', as interconnected and interrelated. The current research paradigm of urban planning needs to be expanded from 'growth' to 'growth and decline' as interrelated urban development processes (Fernandez C, Audirac I and Fol S, et al., 2012). The phenomenon of city contraction in urban agglomerations brings more thoughts on regional synergy and integrated high-quality development: based on the metropolitan area to control over-concentration of population and inhibit the spread of contraction; shifting from factor accumulation to improving economic efficiency and promoting the implementation of bottom-up security policies; and different cities exploring location advantages and core competitiveness to promote balanced regional development. Urban contraction is a process of continuous change and adjustment, and dynamic assessment of the effectiveness of shrinking cities and the implementation of improvement measures to promote the refined development of cities is the focus of further research on the realisation of urban slimming and strengthening.

References

- Döringer S, Uchiyama Y, Penker M, et al. (2020) A meta-analysis of shrinking cities in Europe and Japan: Towards an integrative research agenda [J]. *European Planning Studies*, 28(9): 1693-1712.
- Fernandez C, Audirac I, Fol S, et al. (2012) Shrinking Cities: Urban Challenges of Globalization[J]. *International Journal of Urban & Regional Research*, 36(2):213-225.
- Guo, Y.Y., Li, Li. (2019) Change in the Negative Externality of the Shrinking Cities in China[J]. *Scientia Geographica Sinica*, 39(1):52-60.
- Sun, P.J. (2022) Urban shrinkage: Connotation-sinicization-framework of analysis, 41(08):1478-1491.
- Zhang, W., Shan, F.F., Zheng, C.G. et al. (2019) Multi-dimensional Identification and Driving Mechanism Analysis of Shrinking City in China[J]. *Urban Development Research*, 26(03):32-40.
- Zhou, K., Qian, F.F. (2015) Shrinking City: On Searching for Urban Development in Non-Growing Scenarios[J]. *Modern Urban Research*, (09):2-13.
- Sun, P.J., Zhang, K.Q., He, T. (2022) Shrinkage effect of urban-rural integration on shrinking cities in the three provinces of Northeast China and mechanism [J]. *Progress in Geographical Sciences*, 41(07):1213-1225.
- Chen, Z.Q., Yu, B.L., Yang, C.S. et al. (2021) An Extended Time Series (2000-2018) of Global NPP-VIIRS Like Nighttime Light Data from a Cross-Sensor Calibration. *Earth System Science Data*. 13(3): 889-906
- Sun, P.J., Wang, K.W. (2021) Identification and stage division of urban shrinkage in the three provinces of Northeast China [J]. *Journal of Geography*, 76(06):1366-1379.
- Zhang, X.L., Liu, Y.B., Lv, C.C. (2016) The Background, Identification of Shrinking Cities in China [J]. *Journal of Southeast University (Philosophy and Social Science Edition)*, 18(04):132-139+148.
- Gong, P., Zhang, S., Wang, W.Z. (2022) The Evolutionary Characteristics and Spatial-temporal Pattern of China's Urban Shrinkage from the Perspective of Population: Based on the Analysis of the Seventh National Census Bulletin Data [J]. *Population and Economy*, (03):1-15.
- Peng, A.Q., Luo, X.L., Liu, X.M. et al. (2023) Shift from Shrinkage to Recovery: The Case of Shrinkage Governance in Chaohu, Anhui Province, after Administrative Division Adjustment [J]. *Urban Development Research*, 30(12):113-121.
- Yu, S.K. (2024) Spatiotemporal differentiation and driving mechanism of urban shrinkage in China based on multi-source data [D]. Shandong Normal University. DOI:10.27280/d.cnki.gsdsu.2024.000004.