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Theory building and technical innovations for spatial planning of China's metropolitan areas: insights from planning of Greater Shanghai Metropolitan Area

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Abstract

Based on limited theoretical applicability of metropolitan area concept under China's circumstances and the planning practice in Greater Shanghai Metropolitan Area, this article proposes a Chinese understanding on the concept of "Metropolitan Area", which extends its core connotation from a commuting area to a multi-functional area. It further proposes to utilize the preparation of spatial plans as means to promote high-quality development of metropolitan areas and to achieve coordinated regional development. Metropolitan area planning takes spatial planning as its basic attribute, and simultaneously embodies the contents of economic and social arrangements. It could become a binding contract based on consensus among member cities. In terms of technical innovations in planning practice, this article firstly suggests using a "problem-based, goal-targeted, action-driven, space-oriented and implementation-guided" approach to form a framework of "objective (indicator)-strategy-action-mechanism" to realize collaborative goals. Secondly, the spatial plan should focus on "bottom line factors" as well as "collaborative factors", establishing a technical framework for regional spatial organization from multiple dimensions such as ecological pattern, city function, spatial structure, and conduction mechanism which drive transformations in regional governance modes.

Keywords Metropolitan area, Spatial planning, Regional integration, Spatial governance

1 Introduction

Entering the "14th Five-Year Plan" period, facing the new international and domestic development environment and the New Development Philosophy, a series of policy documents issued by the central government have elevated the development of metropolitan areas to unprecedented strategic heights. The Proposal of the

14th Five-Year Plan for National Economic and Social Development and the Long-term Vision for 2035 clearly states, "center cities and urban agglomerations should play a leading role, while building Modern Metropolitan Areas". The Report of 20th National Congress of the Communist Party of China further emphasizes "the in-depth implementation of the Coordinated Regional Development Strategy", and indicates that "to build a coordinated development pattern for large, medium and small cities based on urban agglomerations and metropolitan areas". In the critical period of starting a new journey towards a Modern Socialist Country, establishing Modern Metropolitan Areas is an important sub-field to achieve Chinese Modernization (Yin et al., 2023). Metropolitan areas are also spatial carriers for multiple national strategies such as Coordinated Regional Development,

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New Urbanization, and Expansion of Domestic Demand. Compared with large-scale urban agglomerations, the scale of metropolitan areas is more suitable for all stakeholders to effectively carry out coordinated actions.

Under the New Development Pattern, metropolitan areas undertake an important mission of coordinating national development and security. On the one hand, as the basic organizational unit of regional industrial chains and supply chains, metropolitan areas have become the key to promote division of labor and collaboration among cities, participating in domestic and international circulation, and global competition as well. On the other hand, the metropolitan area is also used as a spatial unit to coordinate the allocation of resource factors, improve overall security as well as resilience, and ensure the integrity of regional ecosystem.

In order to promote high-quality development of metropolitan areas, it is suggested to integrate national will with local demands, continuously innovating spatial planning techniques and collaborative governance mechanisms. In this context, Shanghai Municipality, Jiangsu Province and Zhejiang Province jointly prepared the “Spatial Collaborative Plan of Greater Shanghai Metropolitan Area” (hereinafter referred to as the “Collaborative Plan”). The Collaborative Plan was jointly released by the people’s governments of Shanghai, Jiangsu and Zhejiang in January 2022; a meeting to facilitate its implementation was held in September of the same year. The Collaborative Plan can be seen as the development blueprint and cooperation contract between the nine cities of Shanghai, Wuxi, Changzhou, Suzhou, Nantong, Ningbo, Huzhou, Jiaxing and Zhoushan. This article briefly reviews the theoretical connotations of metropolitan areas in China and research on the spatial planning techniques. Then based on the planning practice in Greater Shanghai Metropolitan Area (“GSMA” in short), it expands the theory of China’s metropolitan area and proposes the technical innovations for its spatial planning, with a view to provide guidance for other metropolitan areas in China in terms of plan-making and regional spatial governance.

2 Literature review of metropolitan areas in China

The concept of metropolitan area is originated from the United States and Japan. In response to the growing spatial form beyond city boundaries, the United States established metropolitan areas for the purpose of employment statistics. Japan imitated the United States to propose metropolitan areas for regional planning purposes, intervening in the excessive agglomeration of core cities. Since the introduction of metropolitan area concept to China, the discussion on its connotation has continued to expand. As the theory and planning practice

promote each other, planning techniques of metropolitan areas has continuously been explored.

2.1 Evolution of the connotations of metropolitan area theory

The metropolitan area theory has undergone a process of expansion from functional connotation to spatial connotation, and then to governance connotation in China. Around the 1990s, economic globalization brought huge development opportunities to Chinese cities. Scholars generally believed that the metropolitan area is a functional region concept based on economic connections. To fully activate its potential of regional economic growth pole, functional layout and industrial synergy within the metropolitan area were the focus of research. For example, Shen (1993) proposes that the metropolitan area is a metropolis that extends across city boundaries to neighboring areas, continuously strengthens mutual economic ties, and finally forms an organically combined or even integrated region.

After 2000, Chinese academia began to form the spatial connotation of metropolitan areas, including the internal circle-layered structure and the spatial relationship with other regional concepts. As Zhang et al. (2001) indicate, the metropolitan area has a circle-layered structure composed of one or more core towns and adjacent towns as well as regions with integration tendencies, achieving selective agglomeration and group space optimization through reasonable decentralized development. In terms of the spatial relationship, Fang (2009) states that under the joint action of agglomeration and diffusion, a continuous spectrum of “city-region” development has been formed, namely “city-metropolitan area-urban agglomeration-megalopolis”.

Since the 18th National Congress of the Communist Party of China, the regional policy tool attributes of metropolitan areas have been strengthened, and the study on the governance connotation of metropolitan areas has been increased. Shen et al. (2023) point out that the metropolitan area in China is a cross-city spatial governance unit, with metropolis as the core for organizing production and living in neighboring areas, and its internal factors are highly fluid and widely shared.

For a long time, the biggest controversy around the metropolitan area theory in China has been whether to refer to the United States and Japan and use the commuting rate from peripheral areas to core cities as the basis for defining the spatial scope, and no consensus has been reached yet. One opinion is to determine the scope of a metropolitan area based on the one-hour commuting area. “Guiding Opinions on Cultivating and Developing Modern Metropolitan Areas”, put forward by National Development and Reform Commission in 2019, defines

metropolitan areas as “an urbanization spatial form with mega cities, super cities or large cities which have strong radiation and driving functions as the core, and an one-hour commuting area as the basic scope”. Zhang and Sun (2023) believe that metropolitan areas should return to the essence of commuting circle, and its spatial scope should not be as large as urban agglomerations.

In contrast, another view is to determine the scope by comprehensively considering multiple functional connections, without being limited to the commuting area. “Code of Practice for Territorial Spatial Planning of Metropolitan Areas”, issued by the Ministry of Natural Resources in 2024, defines metropolitan areas as “an integrated region with cities which have strong radiation and driving functions as the core, and an one-hour transit and commuting area as the basic scope; the region has closely linked economic activities, efficient commuting facilities and shared public services”. Zhang and Zhao (2023) point out that China’s metropolitan areas are not a single commuting circle, and the value orientation of separation of work and residence with long-distance commuting should not be overemphasized. Shen et al. (2023) propose that the spatial scope of metropolitan areas should meet one-day business travel need, which means core cities can be reached within one-hour from station to station by using intercity railway, high-speed railway, and other means of transportation.

2.2 Exploration on spatial planning techniques of metropolitan areas

The research on spatial planning techniques of metropolitan areas in the Chinese context mainly focuses on two periods when planning practice was booming. The first was in the early twenty-first century. Planning ideas and the framework of content were initially established, laying the foundation for China’s metropolitan area planning research. The second was after the reform of “establishing a unified national spatial planning system” in 2019, the planning logic for metropolitan areas has undergone a transformation and the technical methods have been further deepened.

Metropolitan area planning in early years was mainly oriented to enhance the competitiveness of core cities, and mainly reflected the will of the upper government. The technical train of thought is to formulate the social, economic and spatial development strategies for metropolitan areas on the basis of regional background analysis. Main contents of planning include functional positioning, development goals, spatial organization, industrial development, social undertakings, infrastructure construction, ecology and environment protection, regional spatial control, etc.; besides, the plan could propose the requirements for recent planning and special

planning preparation (Zou and Wang 2005). In terms of spatial organization, the key is to organize the functional area of core cities and the main corridors of regional development, facilitate spatial integration around the requirements of urban space development and ecological constraints, and put forward targeted control requirements which reflect both mandatory and guiding governance means (Zhang 2003).

With the rapid urbanization progress, the contradictions between cross-border spatial development, resource allocation and environmental protection have intensified. The academia generally believes that the spatial planning of metropolitan areas in the New Era should emphasize the coordinated development, focusing on the overall pattern of development and protection of territorial space, the coordination of the layout of various system factors, and the cross-border governance of adjacent areas. First of all, metropolitan area planning is one kind of cross-border coordination planning at strategic level, which should strengthen bottom-line control and proactive guidance, clarifying the overall pattern of territorial space (Chen et al. 2022). At the same time, metropolitan area planning highlights the important role of space as the foundation and core resource of regional development, leading the high-quality development of regional space with planning goals; spatial indicator system, spatial resource optimization rules, spatial cooperation of cross-border zones are the key content, which should match with departmental responsibilities (Xu et al. 2019). In terms of factor layout coordination, metropolitan area planning guides the cross-border rational allocation of key development factors and important public resources within the metropolitan area (Zhang and Hu 2023), such as regional production space, ecological network, large-scale infrastructure and public service facilities (Chen et al. 2022). Regarding adjacent areas, cross-border zones play the role of suturing spatial gaps and driving the development of the hinterland of metropolitan areas (Fang et al. 2022); metropolitan area planning determines classified control requirements for cross-border area, and cross-border transportation corridors should be negotiated and connected (Nanjing Planning Bureau, Nanjing Urban Planning Compilation and Research Center 2016).

In summary, after about 30 years of development since the metropolitan area introduced to China, a good foundation of theory and planning techniques has been formed. However, there is still no consensus in the academia on its concept and spatial scope definition in China’s circumstances, and the integration of research with planning practice is not close enough. Faced with the new international and domestic development environment and a new round of metropolitan area construction boom, it is urgent to further clarify the concept of China’s

metropolitan areas and sort out the underlying logic of metropolitan area planning, so as to better promote the planning and construction of Modern Metropolitan Areas.

3 Theory of China's metropolitan area

Based on the literature review above, the author integrates the functional connotation, spatial connotation and governance connotation of metropolitan areas, and proposes the attribute of China's metropolitan areas, that is, a spatial unit featured of functional relevance, geographical proximity, and administrative integrity. Through determining the spatial scope, the author proposes a new definition of China's metropolitan area, and then classifies metropolitan areas according to their regional characteristics.

3.1 Attribute: a spatial unit featured of functional relevance, geographical proximity and administrative integrity

Under the New Development Pattern, the metropolitan area has dual responsibilities of development and coordination. First of all, it carries functional value which will enhance the overall regional competitiveness through closer cooperation in multiple fields such as industry, innovation, business, etc. Secondly, adjacent areas are particularly closely related to the core city of the metropolitan area. At the same time, the integrity of the basin system should be considered from the perspective of ecological resilience and security to support regional sustainable development (Sun et al., 2022). Thirdly, it is necessary to combine the demands of upper and lower administrative entities, and to ensure the integrity of important collaborative units of regional resources. Considering future space–time compression effect as technology develops rapidly and continuous changing external environment, the spatial scope of the metropolitan area is not static. Instead, only dynamic adjusted spatial scope can adapt to developments in the New Era.

Taking Greater Shanghai Metropolitan Area as an example, it is based on geographical proximity, focusing on close functional relevance, and taking into account the integrity of administrative governance. It consists of 9 cities, which are Shanghai, Wuxi, Changzhou, Suzhou, Nantong, Ningbo, Huzhou, Jiaxing and Zhoushan (Fig. 1). This area belongs to lower reaches of the Yangtze River, Hangzhou Bay hinterland and Taihu Lake Basin; its development center has shifted from around Taihu Lake to along the Beijing–Hangzhou Grand Canal, along the Yangtze River, and then to the coastal areas, gradually forming a global city-region

with Shanghai Global City as the core. GSMA is also a region with a highly developed economy and close horizontal industrial linkages; relying on the mutual development of multiple centers, the region presents industrial characteristics of large-scale clusters and close-chain organizations. In addition, GSMA also carries local aspirations for regional collaboration. In the process of discussing and formulating the Work Programme for the Collaborative Plan, many surrounding cities expressed their intention to join Greater Shanghai Metropolitan Area, and the definition of the planning scope itself is a result of consensus formed by the bottom-up approach. In the future, the spatial scope of GSMA will also keep open and growable based on the willingness of multiple administrative entities.

3.2 Definition: from a commuting area to a multi-functional area

The author believes that the method of determining the commuting area is not applicable to China's national circumstances, and it is more reasonable to define the spatial scope of metropolitan areas based on one-hour transit area. The definition of "city" in China is different from that of western countries. "City" in China refers to "jurisdictional area", and the city itself is a region. Taking current means of transportation, a commuter basically cannot leave the municipal area within one hour (Zhu et al., 2022). Due to the constraints of administrative divisions, cross-city commuting connections in China are generally limited, but their functions are closely related. For instance, the average daily business trip size in Greater Shanghai Metropolitan Area is twice that of cross-city commuting; and business trips accounted for 40% of the total travel population (including commuters) within one month. There are also significant culture, leisure and tourism connections; cities with superior ecological environment, such as Huzhou, have become major destinations for leisure travel. Therefore, China's metropolitan areas should not stick to "commuting circles", as iterated into future-oriented multi-functional areas represented by business circles, communication circles, leisure circles, and cultural circles.

Based on the discussion above, this article raises the following definition of China's metropolitan area: the metropolitan area is a cross-administrative spatial form of urbanization, which centered around cities with strong radiating functions or cities with great strategic significance, with one-hour transit range as its basic scope; it is composed of large, medium and small cities and small towns which are closely related to the core



Fig. 1 Spatial scope map of Greater Shanghai Metropolitan Area. Source: Spatial Collaborative Plan of Greater Shanghai Metropolitan Area, 2022

city in terms of functional connections such as industries, commerce, public services, recreation, etc.

3.3 Classification: research on the classification of metropolitan areas based on regional characteristics

With a vast territory, resource conditions in different regions of China vary widely. There are obvious differences in the development level, development stage and coordination basis of metropolitan areas. In order to fully explore diverse development paths of metropolitan areas, they can be classified according to regional characteristics from dimensions such as scale, functional level,

development stage and spatial organization. Through classification, it is easier to guide the identification of spatial scope and the formulation of planning strategies in various metropolitan areas, solving their key problems in a targeted manner.

Firstly, the connotative characteristics of greater metropolitan areas and metropolitan areas can be defined based on scale and functional level. To further highlight the radiating influence and service capabilities of greater metropolitan areas, it is recommended that metropolitan areas which contain megacities and supercities (urban permanent population ≥ 5 million), and the functional level of the core city reaches global city level, such as

Beijing, Shanghai and Hong Kong, can be recognized as “greater metropolitan areas”, while others are called “metropolitan areas”.

Secondly, metropolitan areas can be classified according to the diversity characteristics of development stage and spatial organization. From the perspective of development stage, there are mature, developing and nurturing types for classified guidance. From the perspective of spatial organization, metropolitan areas can be divided into multi-core, twin-core and single-core types. For example, Suzhou-Wuxi-Changzhou metropolitan area has three core cities, while Jiuquan-Jiayuguan metropolitan area is twin-core type.

In addition, the cultivation of frontier metropolitan areas with great national strategic security significance should be highly valued, such as Xining metropolitan area and Lhasa metropolitan area. Although the permanent urban population of these core cities is not high, the construction of metropolitan areas has a huge impact on stabilizing the frontier.

4 Spatial planning techniques of metropolitan areas

Entering the twenty-first century, the practice of metropolitan area planning has spread from concentrated in the eastern coastal areas to the central and western regions, with a gradual diversification of types. Due to the lack of top-level design at the national level, these bottom-up plans have not formed a unified paradigm in terms of planning positioning, name of the plan, planning scope and main contents. At the same time, they also lack an effective implementation mechanism, thus the implementation progress is relatively slow.

After 2019, under the requirements of the “multi-plan integration” reform of “establishing a unified national spatial planning system”, traditional metropolitan area planning is facing optimization and transformation. The “Spatial Collaborative Plan of Greater Shanghai Metropolitan Area” is the first cross-provincial spatial plan and the first metropolitan area spatial plan in China in the New Era. Many innovative explorations have been made regarding planning techniques and organizational methods.

4.1 Planning positioning

For a considerable period, the positioning of metropolitan area planning was not clear, dominated by development planning led by the development and reform department. Since 2021, the development plans of Nanjing, Fuzhou, Chengdu, Changsha-Zhuzhou-Xiangtan, Xi’an, Chongqing, Wuhan, Zhengzhou metropolitan areas has successively come out, mainly focusing on goals, functions, strategies, etc., while paying insufficient attention

to spatial coordination and action projects. As for spatial planning of metropolitan areas, in addition to the Collaborative Plan, several practices are under preparation, such as the “Spatial Planning of Wuhan Metropolitan Area”, and the “Spatial Coordinated Plan of Modern Capital (Beijing) Metropolitan Area”.

On the one hand, as an action arrangement made for the future and responding to the uncertainty of the times, metropolitan area planning starts from the regional scale and plans for long-term high-quality development under national strategic requirements and local aspirations, reflecting the strategic guidance role. On the other hand, the scarcity and foundational characteristics of territorial spatial resources determine the important role of spatial coordination. Problems in regional coordination are first reflected in the disharmony, imbalance, and even conflict of spatial development. Therefore, metropolitan area planning also needs to play a role in spatial control, balancing the economic and social development of various regions with the protection of resources and the environment. With consensus achieved through strategic guidance from the spatial plan, strategic and systematic arrangements can be made for spatial development. Through spatial control, it provides support for implementation of strategic arrangements, guides the rational allocation of key development factors and important public resources across different domains, and achieves better development.

Thus it can be seen that the strategic guidance and spatial control roles of metropolitan area planning are indispensable. The author believes that metropolitan area planning should take spatial planning as its basic attribute, while also embodying the characteristics of development planning (Xiong et al., 2022). According to the policy document “Establishing a Spatial Planning System and Supervising its Implementation” released by the Central Committee of the Communist Party of China and the State Council in 2019, metropolitan area planning can be basically classified as special planning for specific regions (river basins) in the Spatial Planning System. It serves as a guiding principle for cross-region spatial collaborative governance, playing a role of connecting the preceding and the following, and making overall coordination. On the one hand, it fully implements national requirements, deepening the content of National Spatial Planning Outline and provincial-level spatial plans. On the other hand, it comprehensively respects the development reality of various places, providing a basis for the preparation or modification of municipal (county-level) spatial plans and related special plans. In addition, spatial planning of metropolitan areas should fully connect with national, regional, and local development plans in the specific work.

4.2 Technical train of thought

Based on the overall requirements of the state for the development of metropolitan areas and combined with local planning practices, it is recommended that the preparation of metropolitan area spatial plans could follow the principles of “problem-based, goal-targeted, action-driven, space-oriented and implementation-guided”. Emphasis should be placed on research and evaluation of current situation, cohesion of a common vision, coordination of multiple system factors, multi-level spatial collaboration, and guarantee mechanism, proposing countermeasures for key issues affecting the future development of the region and formulating actionable and implementable planning outcomes (Xiong et al., 2023). In the plan-making process, a combination of top-level design and action tasks is recommended, forming a logical framework of “goals (indicators)—strategies—actions—mechanisms”, and based on a technical approach that emphasizes both “bottom line factors” as well as “collaborative factors”, spatial planning of metropolitan areas will promote the achievement of common vision.

4.2.1 Forming a logical framework of “goals (indicators) - strategies - actions - mechanisms”

Since multiple administrative entities are involved, spatial planning of metropolitan areas should start with sufficient research and evaluation of current situation, fully respond to national strategic requirements, local aspirations and people’s expectations, formulate a common vision that gathers consensus from all subjects, and promote high-quality, high standard and high-level development of the region. At the same time, a core indicator system should be determined, transforming the qualitatively described vision into perceptible, measurable, and easily comparable quantitative indicators, and by monitoring changes in indicator values, implementation of the plan can be assessed.

For example, the Collaborative Plan proposes the vision of “developing an excellent global city-region, while turning into a more competitive, more sustainable and more integrated metropolitan area”, reflecting the extension and expansion of the value orientation of “Shanghai Master Plan (2017–2035)”. Four sub goals and relevant planning strategies have been made from the four dimensions of innovation, mobility, ecology, and humanities, and core indicators have been identified under these four categories. According to assessment requirements, these indicators can be further divided into bottom line indicators and cooperative indicators. The bottom line indicators evaluate the 9 cities in the metropolitan area individually, requiring each to meet the indicator requirements; the cooperative indicators correspond to the overall level

of the metropolitan area, requiring the 9 cities to work together to meet the indicator requirements.

Secondly, various spatial coordination strategies corresponding to development goals should be clarified in spatial plans, taking action-oriented approach to establish a platform for multi-subject consultation. Responsibilities of each city and department in achieving the goals should be clearly stated, exploring the best path and measures to promote the implementation of the plan.

Finally, in terms of guarantee mechanism, the spatial plan should clarify the mechanism for planning agreement, implementation, evaluation, and maintenance throughout the entire process. It is encouraged to establish an open consultation platform, and explore mechanisms for multiple subjects to participate in implementation.

4.2.2 Establishing a technical approach that emphasizes both “bottom line factors” as well as “collaborative factors”

The content of metropolitan area planning cannot be all-embracing and does not need to involve issues within an individual city. Instead, it is necessary to clarify the key planning content from two dimensions: the overall planning of the metropolitan area and the adjustment of inter-city relationships. Therefore, it is feasible to focus on the control of bottom lines with consensus and the coordination of various system factors (Xiong et al., 2021). On the one hand, with a key responsibility of implementing national and regional strategies, metropolitan area planning should adhere to the bottom line thinking and jointly abide by bottom lines proposed in higher-level spatial plans. On the other hand, individual cities have given sufficient considerations to their own development, but due to administrative jurisdiction limitations, there is a lack of coordination and communication between them, which can easily lead to a large number of system inconsistencies. Therefore, how to promote the coordination of various system factors has become the focus of attention for member cities and a key issue to be addressed in planning.

Bottom line control mainly involves joint control of structural factors and restrict control of important boundaries. For example, in terms of structural control, the Collaborative Plan proposes to implement the positioning of Main Functional Zones, refine the classification of key ecological functional zones, and differentiate control policies. In terms of boundary control, it proposes to control important ecological protection areas and coordinate the boundary of ecological space in critical areas such as the Yangtze River Estuary.

System collaboration mainly focuses on the overall layout and cross-border connection of various system

factors, generally including dimensions like ecological environment, comprehensive transportation, municipal infrastructure, public service facilities, and major security systems. For example, the Collaborative Plan coordinates various collaborative factors through system actions in eight fields, guiding the preparation of special plans in various fields and cities. Specific collaborative objectives, strategies, guarantee mechanisms as well as major projects are put forward for each action and carried out by the responsible departments in each city.

4.3 Spatial organization

The spatial organization method of traditional regional planning in China is centered around the “three structures and one network” theory, raised by Song and Gu in 1988, referring to regional spatial structure, hierarchical scale structure, functional type structure, and network system organization. In the historical context of low levels of industrialization and urbanization, the “three structures and one network” theory has played an important guiding role by clarifying the development order of regions, effectively guiding economic activities to gather in urban spaces, and strengthening the functions of core cities. However, there are several limitations of the theory, i.e. focusing on cities rather than rural areas, focusing on planned economy rather than market economy, and focusing on scale and grade rather than functional characteristics (Zhang and Liu 2014).

Under the influence of globalization and informatization, Castells (1993) proposed the “flow space” theory, which regards cities as “nodes” in the network, and the connection between cities has also shifted from hierarchical to network connection. At the same time, rapid urbanization has exacerbated the contradiction between population growth, resource utilization and environment protection. As a result, the sustainable development coordinating economy, society and environment becomes a worldwide consensus. Therefore, current regional spatial organization ought to match the evolution trend of “becoming multi-centered and networked” (Hall and Pain 2006; Taylor, 2004), guided by the sustainable development-oriented spatial pattern. Spatial planning of metropolitan areas in the New Era will focus on urban, rural and ecological space, emphasize the overall planning of the whole territory, combine protection and development (Ma et al., 2022). The spatial organization technical framework for metropolitan areas can be established from multiple dimensions including ecological pattern, city function, spatial structure, and conduction mechanism, which is called “three systems and one mechanism” (Fig. 2).

4.3.1 Ecological pattern system: Anchoring ecological protection space for security and resilience

When the concept of metropolitan area was introduced into China, it focused on the redistribution of regional

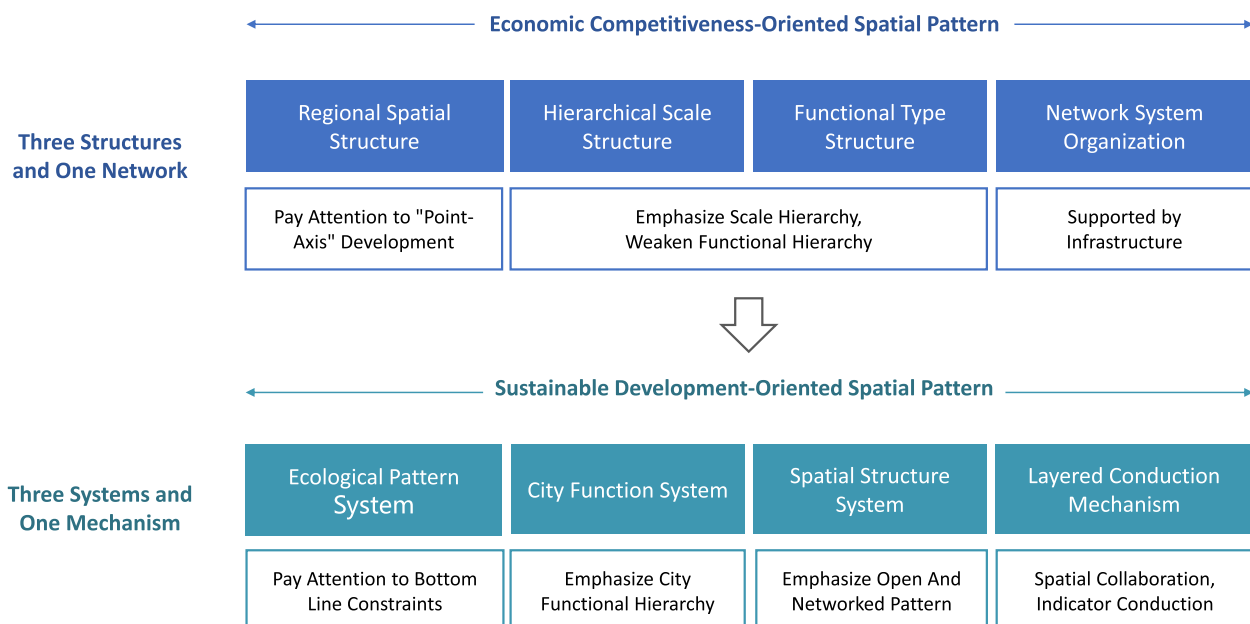


Fig. 2 Schematic diagram of “three systems and one mechanism” technical framework. Source: Ma X., Lin C., Chen Y., et al. (2022). Study on the technical framework of spatial planning at the regional scale based on the planning of Greater Shanghai Metropolitan Area. *Urban Planning Forum*, 2022(2): 65–71

economic space. Urban expansion guided by competitiveness was the main theme (Shen et al., 2023), and urban planning at that time lacked effective protection and utilization of ecological space. In the context of Ecological Civilization Development, lucid waters and lush mountains are invaluable resources for sustainable development. Therefore, it is necessary to change the development mode and prioritize the construction of an ecological security pattern.

Facing the challenge of tight ecological and environmental constraints, Greater Shanghai Metropolitan Area highlights the anchoring of ecological protection

space. First of all, the Main Functional Zones strategy of Shanghai, Jiangsu and Zhejiang has been jointly implemented. The Collaborative Plan builds a regional ecological security pattern to jointly protect the ecological core of Taihu Lake, Yangtze River ecological belt, Qiantang River ecological belt, the coastal ecological belt, and multiple regional ecological corridors connecting mountains, rivers, lakes and seas (Fig. 3). Secondly, the Collaborative Plan pays attention to major strategic issues such as food security, environmental quality improvement, biodiversity protection, and natural disaster risk prevention and control. It proposes rigid constraints on



Fig. 3 Ecological pattern planning of Greater Shanghai Metropolitan Area. Source: Spatial Collaborative Plan of Greater Shanghai Metropolitan Area, 2022

ecological bottom lines of land and sea, coordinates joint ecological protection in critical areas of member cities, and implements ecological restoration of key areas along the coastline.

4.3.2 City function system: Enhancing the functional system with multiple nodes for division of labor

From the perspective of city-region evolution, the emergence of an increasing number of functional nodes represents the advanced form of regional division of labor, and global hubs are supported by the functional scope of global cities with local embeddedness (Scott, 2001). Metropolitan areas are characterized by functional interconnections. Therefore, in terms of city system planning, it should prioritize a multi-node division of labor based on city functions rather than scale and hierarchy-oriented, highlighting the functional advantages and characteristics of each node city.

Drawing lessons from the node composition pattern of mature city-regions such as the British city cluster and Japanese Tokaido city cluster, Greater Shanghai Metropolitan Area has established a division of labor with five levels: 1 top-tier global city leading all sidedly, 3 integrated global cities achieving multi-dimensional balance, 6 specialized global cities excelling in specific fields, 12 global functional nodes with distinctive characteristics, and 19 global function support nodes serving the local community (Fig. 4). This division of labor is organized around five core functions of the global city, namely “productive services, trade and shipping, scientific and technological innovations, intelligent manufacturing, and cultural exchange”, transcending administrative boundaries and taking districts as well as counties as the basic functional units.

4.3.3 Spatial structure system: Building a compact and open-ended spatial structure that is network-based

The metropolitan area is a city-region with dual attributes of “space of places” and “space of flows” (Zhang and Zhao 2023). Regarding spatial structure in the new round of metropolitan area planning, it is important to conform to the basic laws of multi-directional flows of factors and matching of nodes, shifting from “point-axis” planning to the construction of an open-oriented, multi-centered, and networked pattern. A wide range of urban–rural spaces are covered, thereby further promoting the interaction between various functional nodes and urban–rural spaces.

The Collaborative Plan proposes the core concepts of “corridor led” and “networked flow”, which will enable compact development through “corridor led” approaches and achieve efficient cooperation through “networked flow” approaches. Firstly, it focuses on cultivating seven major corridors of regional development as the spatial framework that promotes the aggregation and flow of regional factors (Zheng et al., 2017), forming an interconnected multi-corridor spatial pattern (Fig. 5). Secondly, it aims to densify the multi-level network by cultivating multiple secondary corridors of regional development, matching the multi-node pattern, and incorporating the node areas that were not on the main axis of development into the overall structure. Thirdly, it strengthens the support role of multi-level rail transit, leading to more efficient allocation and flow of factors between nodes through a flatter and more equitable facility layout.

Level	City List	Description
1 Top-tier Global City	Shanghai Downtown Area	World-class city in all respects
3 Integrated Global Cities	Suzhou, Ningbo and Lingang Special Area of China (Shanghai) Pilot Free Trade Zone	Work together with Shanghai on global core functions and move towards the “second tier” of global cities
6 Specialized Global Cities	Wuxi, Changzhou, Nantong, Jiaxing, Huzhou and Zhoushan	Exert their international influence in specialized fields
12 Global Functional Nodes	Jiading, Songjiang, Qingpu and Fengxian in Shanghai; Jiangyin, Kunshan, Changshu and Zhangjiagang in Jiangsu; Yuyao, Cixi, Jiashan and Tongxiang in Zhejiang	Shoulder global special functions
19 Relatively Independent Support Nodes For Global Functions	Jinshan, Chongming in Shanghai; Yixing, Liyang, Taicang, Rudong, Qidong, Rugao and Hai’an in Jiangsu; Xiangshan, Ninghai, Haiyan, Haining, Pinghu, Deqing, Changxing, Anji, Daishan and Shengsi in Zhejiang	Operate locally and provide strong support for global cities and nodes

Fig. 4 City function system of Greater Shanghai Metropolitan Area. Source: Spatial Collaborative Plan of Greater Shanghai Metropolitan Area, 2022



Fig. 5 Spatial structure planning of Greater Shanghai Metropolitan Area. Source: Spatial Collaborative Plan of Greater Shanghai Metropolitan Area, 2022

4.3.4 Layered conduction mechanism: Establishing a multi-level spatial collaborative conduction framework

The metropolitan area has a large spatial scope, and there are multiple levels of cross-border coordination. The problems faced by administrative entities at various levels and the focus of collaboration are different, thus the realization of spatial collaboration requires the joint action of multiple levels of entities. Previous regional planning has relatively lacked attention on key issues in cross-border areas, with relatively weak means of overall coordination (Guo and Wu 2019). To address cross-border

coordination at different levels, this article suggests dividing different spatial scales in spatial planning of metropolitan areas, and establishing a hierarchical spatial collaboration platform to realize layered conduction of spatial factors and the deepening implementation of planning targets and strategies level by level.

The Collaborative Plan explores the establishment of a four-layer spatial coordination framework, i.e., the metropolitan area, strategic cooperation zones, collaborative demonstration areas, and cross-border town clusters. Focusing on four key collaborative elements including innovation, transportation, ecology, and humanities, and

based on the combination of rigid control and flexible development, it proposes differentiated strategies and key actions for collaborative governance. For example, the metropolitan area (regional level) focuses on establishing an overall strategic vision and building an integrated development framework. At the strategic cooperation zone (municipal) level, the emphasis is on coordinating major strategic spaces across municipals, deepening collaborative strategies and actions in key fields through the important ecological resources, such as rivers, lakes, estuaries, and bays. At the collaborative demonstration area (district and county) level, it is important to implement the key tasks and actions of the strategic cooperation zone, deepening cross-border integration projects and coordination in various fields. At the cross-border town cluster (township) level, urban integration is highlighted, promoting the sharing of cross-border public service facilities and the integration of urban–rural infrastructure planning.

5 Conclusion

Spatial planning of metropolitan areas is a new thing under the background of the spatial planning system reform in China. Guided by the national strategies of Coordinated Regional Development and Modernization of the National Governance System, and based on the practice of “Spatial Collaborative Plan of Greater Shanghai Metropolitan Area”, this article comprehensively considers and innovatively applies the theory of China’s metropolitan area, and spatial planning techniques of metropolitan areas. It interprets the connotation of “metropolitan area” in Chinese context, explores the Chinese solution for spatial planning of metropolitan areas, which reflects the core spirit of Chinese Modernization, featured of a huge population, common prosperity of all people, material and cultural-ethical advancement, the harmonious coexistence of humanity and nature, and the path of peaceful development. After the spatial plan is completed and enters the implementation stage, it is also necessary to explore the construction of a regional spatial governance mode with a combination of top-down and bottom-up approaches, a multi-level cross-border negotiation platform, and the continuous operation of collaborative mechanisms. Through joint actions and mechanism innovations, spatial planning of metropolitan areas can be implemented effectively, so as to promote the high-quality integrated development of China’s metropolitan areas.

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Authors’ contributions

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References

- Castells, M. (1993). European cities, the informational society, and the global economy. *Tijdschrift Voor Economische En Sociale Geografie*, 1993(4), 247–257.
- Chen, X., Lv, H., Hu, J., et al. (2022). *Cross-boundary governance: theory, planning and mechanism*. China Architecture and Building Press.
- Fang, C. (2009). Research progress and general definition about identification standards of urban agglomeration space. *Urban Planning Forum*, 2009(4), 1–6.
- Fang, Y., Xu, Y., Sun, W., et al. (2022). Planning for metropolitan area integration: Shenzhen’s experience and its reflections. *Urban Planning Forum*, 2022(5), 99–106.
- Guo, L., & Wu, W. (2019). A study on spatial planning mechanism in the peripheral cross-border areas of megacities from the perspective of spatial governance. *Urban Planning Forum*, 2019(6), 8–14.
- Hall, P., & Pain, K. (2006). *The polycentric metropolis: Learning from mega-city regions in Europe*. Routledge.
- Ma, X., Lin, C., Chen, Y., et al. (2022). Study on the technical framework of spatial planning at the regional scale based on the planning of Greater Shanghai Metropolitan Area. *Urban Planning Forum*, 2022(2), 65–71.
- Nanjing Planning Bureau, Nanjing Urban Planning Compilation and Research Center (2016). *Transformation and collaboration: practical exploration of Urban and Rural Space Collaborative Plan of Nanjing Metropolitan Area*. China Architecture and Building Press.
- Scott, A. (2001). *Global city-regions: trends, theory, policy*. Oxford University Press.
- Shen, L. (1993). Constructing a metropolitan area for Shanghai. *Financial Research*, 1993(9), 16–19.
- Shen, M., Wang, Z., & Cui, G. (2023). Planning metropolitan regions in China: theoretical origins and planning practices. *Urban Planning Forum*, 2023(2), 57–66.
- Song, J., & Gu, C. (1988). Theory and methodology of urban system planning. *Acta Geographica Sinica*, 1988(2), 97–107.
- Sun, J., Tu, Q., Wang, S., et al. (2022). The internal attributes and vision of Greater Shanghai Metropolitan Area based on the concept of global city region. *Urban Planning Forum*, 2022(2), 69–75.
- Taylor, P. J. (2004). *World city network: A global urban analysis*. Routledge.
- Xiong, J., Sun, J., Tu, Q., et al. (2021). A study on territory spatial planning of metropolitan area: Based on practice and exploration of Spatial Cooperative Planning of Great Shanghai Metropolitan Area. *Shanghai Urban Planning Review*, 2021(3), 1–7.
- Xiong, J., Sun, J., Fan, Y., et al. (2022). Innovative collaborative spatial planning in Greater Shanghai Metropolitan Area under the background of regional coordination and spatial governance. *Urban Planning Forum*, 2022(2), 76–82.
- Xiong, J., Sun, J., Tu, Q., et al. (2023). *From Shanghai to Greater Shanghai Metropolitan Area: exploration of metropolitan area planning based on Chinese Modernization*. Shanghai Scientific and Technical Publishers.

- Xu, H., Sun, Z., Hou, B., et al. (2019). Research on the spatial planning method of metropolitan area under the logical transition of planning. *Journal of Natural Resources*, 34(10), 2123–2133.
- Yin, Z., Shang, Y., Cui, Y., et al. (2023). Theoretical framework and practice of modern metropolitan area planning. *Planners*, 2023(4), 5–10.
- Zhang, W. (2003). The basic concept, characteristics and planning of metropolitan regions in Jiangsu. *City Planning Review*, 2003(6), 47–50.
- Zhang, J., & Hu, H. (2023). Innovation in the development, planning and governance of metropolitan areas under the New Development Environment. *Economic Geography*, 2023(1), 17–25.
- Zhang, Q., & Liu, J. (2014). Relationship between the reform and innovation of urban system planning and three-planning integration: three structures and one network in urban system planning. *City Planning Review*, 38(10), 13–27.
- Zhang, T., & Sun, B. (2023). Spatial delineation in China's contemporary metropolitan area planning. *Urban Planning Forum*, 2023(4), 104–109.
- Zhang, Y., & Zhao, M. (2023). Spatial delineation, characteristics analysis, and classification of China's metropolitan regions. *Urban Planning Forum*, 2023(2), 67–76.
- Zhang, J., Zou, J., Wu, Q., et al. (2001). Research on the spatial organization of the metropolitan area. *City Planning Review*, 2001(5), 19–23.
- Zheng, D., Zhu, Y., Chen, Y., et al. (2017). Structure and functional network of Greater Shanghai Metropolitan Area. *Urban Planning Forum*, 2017(5), 41–49.
- Zhu, L., Huang, Y., Ding, Y., et al. (2022). "Commuter Circle" or "Traffic Circle": Re-cognition of the connotation and scope of metropolitan circle in the New Era. *Urban Development Studies*, 2022(10), 78–86.
- Zou, J., Wang, X. (2005). *Metropolitan area planning*. China Architecture and Building Press.