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The basic law of the formation and expansion in urban agglomerations

FANG Chuanglin

Institute of Geographic Sciences and Natural Resources Research, CAS, Beijing 100101, China

Abstract: Urban agglomerations are formed when a country is in the advanced stages of industrialization and urbanization. They are highly integrated groups of cities that form and develop through a natural, gradual process as the relationship between them changes from one of competition to assimilation following law of natural development. China is currently in a new stage of transitional development characterized by its New-Type Urbanization Plan. It has entered a new era in which it is a global leader in urban agglomeration development, and China's research and development models are being imitated and adopted by countries around the world. This paper adopts a theoretical approach to propose the basic law governing the formation, development and expansion of urban agglomerations. This includes the stage-based formation and development law, multi-scale intensive-use transmission law, crystal-structure spatial composition law, egg-shaped expansion evolution law, "saplings-to-forest" natural growth law, and sustainable development incremental increase law. Guided by these law, China has created a hierarchical organizational configuration for optimizing the spatial structure of its urban agglomerations. It has also formulated urban agglomeration development plans and proposed research-based measures to resolve problems specific to urban agglomerations and to promote their sustainable development. The law governing the formation, development and expansion of urban agglomerations play an important role in guiding their development in China and will play a greater role in the future.

Keywords: urban agglomeration; formation and development; expansion; basic law

1 China is leading the new era of global urban agglomeration research and development

An urban agglomeration is a highly integrated urban entity with a compact spatial organization and close economic interconnectivity that relies on an advanced network of transportation and communication infrastructure and consists of three or more metropolitan areas with a megacity or megalopolis at its core (Fang *et al*., 2011; Fang *et al*., 2017). Urban agglomerations are formed when a country is in the advanced stages of industrialization and urbanization, and they are important entities through which countries can participate in global

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Author: Fang Chuanglin (1966–), specialized in urban geography, urban agglomeration development and the impacts of urbanization on resources and the environment. E-mail: fangcl@igsnrr.ac.cn

competition and tap into the shifting world economic center of gravity (Fang, 2014a; 2014b). The real purpose of developing urban agglomerations is to adapt to the multiple shifts that have taken place in the world economic center of gravity. Each shift has caused large-scale industrialization and urbanization, which has resulted in the emergence of more urban agglomerations (Yan, 2005; Wang, 2005; Qi, 2008).

Having identified and analyzed 83,332 research papers on global urban agglomerations from the past 100 years (including 32,231 overseas papers and 51,101 domestic papers), bibliometrics were used to calculate that more than 90% of the literature was by Chinese scholars since the year 2000, and more than 93% of studies focused on Chinese urban agglomerations (Huang, 2003; Wang *et al*., 2007).

After more than a century of development, urban agglomerations in the United States and Europe are in the mature development stage. Due to the minor population, resource and environmental pressures these agglomerations face, they suffer from relatively few development issues. As such, current research tends to be focused on the humanities and social sciences. Conversely, most urban agglomerations in China and other developing countries are in the embryonic and rapid growth stages. Their development period is short and growth rate is rapid. They face severe population, resource and environmental pressures, as well as a correspondingly large number of development issues, so current research tends to be focused on coordinating socioeconomic development with ecological environment (Zeng, 1998; Wu, 2003; Fang, 2015).

In a sense, research on and development of global urban agglomerations has entered the Chinese era in the 21st century, with China serving as the hub of such work. As if to usher in this new era of global research on urban agglomerations and shoulder the historic mission bestowed upon it by a shift in the global economic center of gravity, China's 11th, 12th and 13th Five-Year Plans (covering the period 2006–2020) all identified urban agglomerations as the main spaces for promoting a new type of urbanization; the 17th, 18th and 19th National Congresses of the Communist Party of China, which took place in 2007, 2012 and 2017, identified them as new economic growth poles; the National Major Function Zoning Plan classified them as key development and optimized development zones; and the first Central Urbanization Work Conference held in 2013 and the National New-type Urbanization Plan (2014–2020) classified them as the main spatial entities for promoting the new type of urbanization in China. At the same time, however, the rapid development of urban agglomerations in China has increasingly exposed new "urban agglomerations diseases." To address such "diseases," it is necessary to understand the natural law governing the formation and expansion of urban agglomerations. Using these natural laws, it is then possible to propose plans and methods to solve such issues.

2 Theoretical analysis of the formation, development and expansion of urban agglomerations

The formation and development of urban agglomerations involve a process of integration and urbanization in which competition between cities turns into "coopetition" (cooperative-competition). Long-term research and planning exploration concerning the formation and development processes of urban agglomerations have revealed six main law governing the expansion of urban agglomerations. These are the urban agglomeration stage-based for-

mation and development law, the urban agglomeration spaces multi-scale intensive-use transmission law, the urban agglomeration crystal-structure spatial composition law, the urban agglomeration egg-shaped expansion evolution law, the urban agglomeration "saplings-to-forest" natural growth law, and the urban agglomeration sustainable development incremental increase law. These six laws constitute six basic theories on the formation and development of urban agglomerations. As our knowledge of how urban agglomerations are formed and develop gradually improves, our understanding of the basic law governing the formation, development, and expansion of urban agglomerations will deepen.

2.1 Urban agglomeration stage-based formation and development law

The formation and development of urban agglomerations involves the evolution of three agglomeration components: nodes, matrices and networks. Generally, their formation and development starts from a regional urban system and progresses until network systems (including virtual network systems) with relatively high operational efficiency are formed. This process usually consists of three to four stages. Usually, the first is the "single dominant node stage," the second is the "single node expansion and growth stage," the third is the "urban agglomeration initial formation stage" and the fourth is the "urban agglomeration advanced formation and development stage."

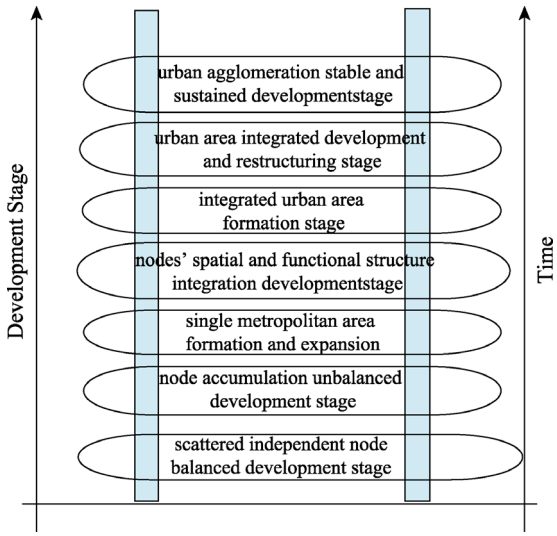

Figure 1 Development stages of urban agglomeration

Relatively speaking, research on the formation and development process of urban agglomerations focuses on nodes. The development process is usually based on the external structure of nodes, including divisions into a hierarchical scale structure and spatial evolution. Bill Scott, for example, divides the expansion of urban agglomerations into three main stages: single center (central city-led stage), multi-center (central city and suburban competition stage) and networked urban agglomeration (complex interdependence and mutual competition stage) (Liu, 2009). Friedman divides expansion into four major stages from the perspective of economic development: pre-industrial (small-scale and relatively dispersed and independent nodes), early industrial (nodes in good locations begin to grow rapidly), mature industrial (intensity of connection between nodes increases and the direction is clear) and late industrial (nodes are growing stably and in a balanced manner) (Friedman J, 1985, 1986, 1995). Yao (2003, 2006) also divides the expansion of urban agglomerations into four main stages: the agricultural economy era, the pre-industrial era, the industrial era and the urbanization era. Guan Wenhua, meanwhile, divides urban agglomeration formation and development into the urban regional, urban agglomeration, urban cluster and megalopolis stages. Whereas, Zhang (2000) divides urban agglomeration expansion into the multi-center isolated expansion, urban space directional spread, inter-urban centripetal

and centrifugal expansion, and metropolitan area compound expansion stages.

Having reviewed the findings of Chinese and overseas scholars, this author recognized that the process of urban agglomeration expansion conforms to a stage-based law and summarized it in seven stages (Figure 1): the scattered independent node balanced development stage, node accumulation unbalanced development stage, single metropolitan area formation and expansion stage, nodes' spatial and functional structure integration development stage, integrated urban area formation stage, urban area integrated development and restructuring stage, and urban agglomeration stable and sustained development stage (Fang, 2010). Wherein, the first three stages correspond to the formation and development of urban economic zones or large metropolitan areas, the fourth, fifth and sixth stages correspond to the development of integrated urbanized areas, which are the relatively advanced stages of urban agglomeration development, and the final stage – the urban agglomeration stable and sustained development stage – is the most advanced stage of urban agglomeration development.

According to the organization and self-organization theories on the evolution of urban systems, the formation and development of urban agglomerations can also be divided into the following five stages: embryonic development stage, rapid development stage, mature development stage, early prosperity stage, and prosperity stage (Fang, 2005).

2.2 Urban agglomeration spaces multi-scale intensive-use transmission law

A multi-scale urban agglomeration space is a spatial whole composed of linked macro-scale agglomerations spaces, meso-scale city spaces and micro-scale city center spaces. It is an organic system with connections between top and bottom, an optimized hierarchy and interlinked elements. Positive and negative transmission law objectively exist in the intensive use of urban agglomeration spaces at different scales and between core and peripheral zones at different levels (Figure 2).

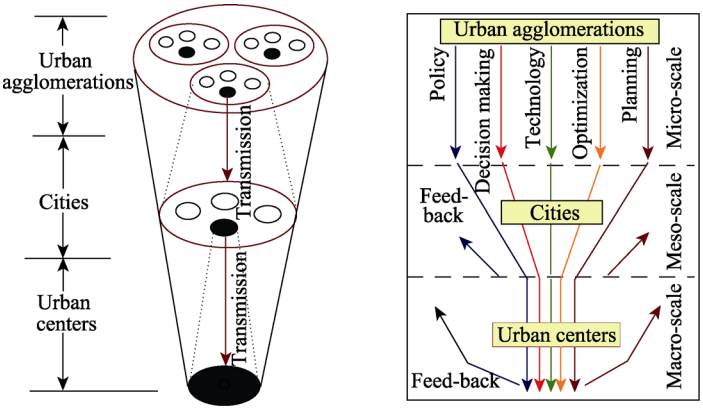

Figure 2 Positive optimization transmission within multi-scale urban agglomeration spaces

Urban agglomeration spaces at different scales have hierarchical links of mutual border delineation, mutually recognized constraints, mutual restraint, mutual feedback and mutual regulation, which gave rise to the urban agglomeration spatial multi-scale intensive use transmission theory consisting of urban agglomeration-cities-city centers and macro-

meso-micro level spatial intensive expansion and optimization (Fang, 2018). By means of forward transmission through the layers, optimization and feedback of hierarchical links between urban agglomeration spaces at different scales, from top to bottom and from outside to inside, can be achieved, thereby improving the efficiency of intensive use of urban agglomeration spaces. Combined decision making on urban agglomeration spaces multi-scale intensive use and spatial intensive use is achieved by transmission through the levels of planning, industry, technology, layout optimization, transport, ecological corridors, allocation of factors of production and policy formulation and implementation, as well as links and feedback, through the three spatial scales of urban agglomeration, cities and city centers. This theory provides support for solving the problem of single-scale optimization but multi-scale non-optimization, as well as single-scale intensive use but multi-scale non-intensive use, in China's urban agglomeration spaces.

2.3 Urban agglomeration crystal-structure spatial composition law

According to crystallographic space group theory and crystal diffraction theory, the process of urban agglomeration expansion conforms to the formation mechanisms of crystal structures in mineralogy. The network structures of nodes in an urban agglomeration are similar to the structure of a crystal, and law exist that govern gradated and hierarchical organic combinations, which form a vertical section crystal structure composition and a plane crystal structure composition. In general, megacities or megalopolises are usually located at the core of the crystal structure and play a central role in guiding its development. Large cities are the key nodes of the crystal structure, medium-size cities are important nodes, and small cities and small towns are connection nodes, with the different nodes connected by transportation networks (Figure 3).

Because the natural and historical conditions behind the formation and development of each urban agglomeration differ, the crystal structure formed by the development process can be either a single-center crystal composition, dual-center crystal composition or multi-center crystal composition (Figure 4). Urban agglomerations with these compositions conform to the following law: their centrality indices are reducing, the stability of their spatial structures is deteriorating, their complexity is growing, their compactness is decreasing and their degree of development is decreasing.

An urban agglomeration with a single-center crystal composition has a single core city that drives the integrated development of surrounding cities, creating the most stable mononuclear crystal structure. This is an ideal advanced urban agglomeration crystal-structure spatial composition. In the course of long-term economic development, because the core city has the irreplaceable advantage of "intercepting intermediary opportunities," or location advantages and cost advantages, it maintains its prominent central position and plays a powerful role in driving the development of surrounding cities. For example, the Beijing-Tianjin-Hebei urban agglomeration is centered on Beijing, the Yangtze River Delta urban agglomeration is centered on Shanghai, and the Tianshan Mountains northern slopes urban agglomeration is centered on Urumqi.

An urban agglomeration with a dual-center crystal composition has two core cities that drive the integrated development of surrounding cities. Because the two core cities have equivalent development strength, they are locked in long-term competition and cooperation,

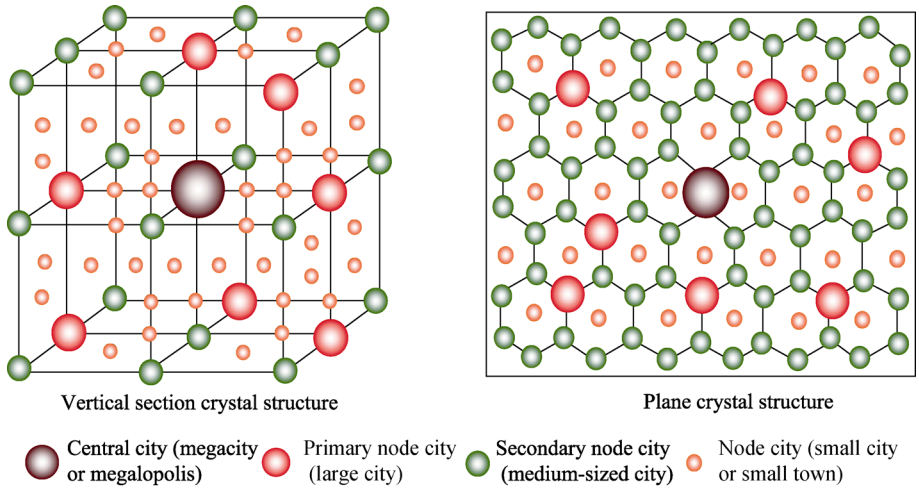

Figure 3 Urban agglomeration crystal-structure spatial composition law

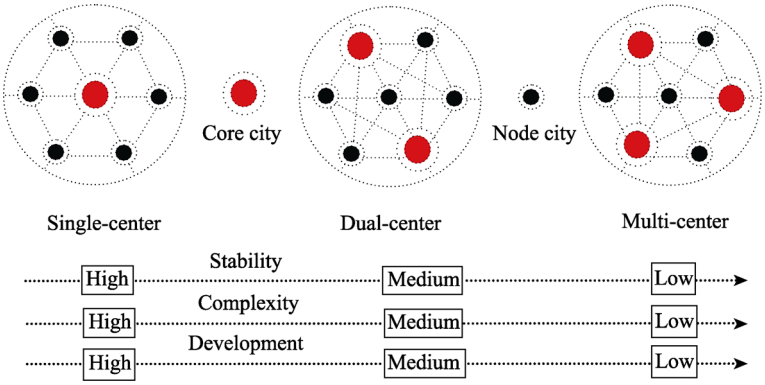

Figure 4 Types of spatial structure compositions of urban agglomerations

their hinterlands overlap, there is obvious reverse development, the instability of the spatial structure is higher (because the dual-core crystal structure it forms is the least stable), and it is extremely unfavorable to the development of the urban agglomeration. It is an unideal urban agglomeration crystal-structure spatial composition, but it is an objectively existing composite form. Examples of this type of urban agglomeration are the Harbin-Changchun urban agglomeration, centered on the cities of Harbin and Changchun, the Chengdu-Chongqing urban agglomeration, centered on Chengdu and Chongqing, the central and southern Liaoning urban agglomeration, centered on Shenyang and Dalian, and the Shandong Peninsula urban agglomeration centered on Jinan and Qingdao.

An urban agglomeration with a multi-center crystal composition has three or more core cities that drive the integrated development of surrounding cities. Uncertainties in the external environment have a significant impact on the variation of urban agglomeration spatial structures, so the complexity of their crystal structure is noticeably higher, the difficulty of optimization increases, their overall development level and compactness are lower, and their centrality is weak, but the degree of equalization in the urban agglomeration network is significantly higher. It is a highly unideal urban agglomeration crystal-structure spatial compo-

sition. Examples are the urban agglomerations in the middle reaches of the Yangtze River, which are centered on Wuhan, Changsha and Nanchang and are China's least developed urban agglomerations.

2.4 Urban agglomeration egg-shaped expansion evolution law

If each city in an urban agglomeration is compared to an egg, then the various means of preparation (cooking methods) represent the processes for expanding the urban agglomerations in different dimensional spaces at different times. In theory, the expansion of urban agglomerations follows a boiled egg-fried egg-scrambled egg evolution path, ultimately forming an organically integrated multi-egg community (see Figure 5). The multi-egg community is represented by the following three progressive evolutionary models:

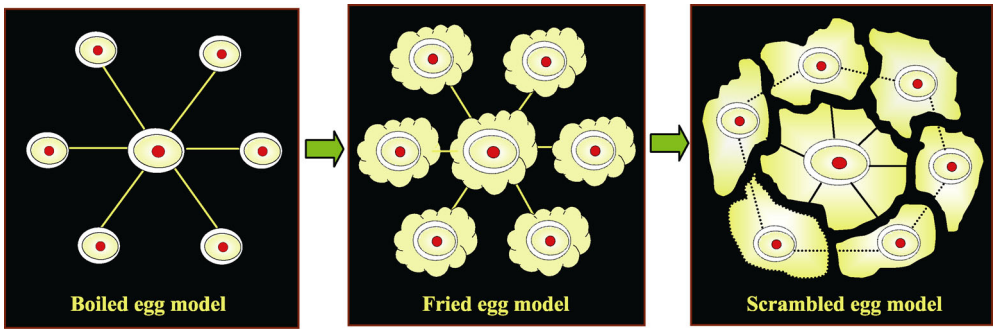

Figure 5 Urban agglomeration egg-shaped expansion evolution mechanism and law

Three-dimensional boiled egg growth model: This model is characterized by three-dimensional growth of multiple eggs that are individually boiled. It occurs during the embryonic stage of urban agglomeration formation and development. During this stage, multiple cities experience three-dimensional growth and are mutually influential. Because of the "egg shells" around each city within the urban agglomeration, there are no economic and technological links between them. Regardless of whether each egg is upright or on its side, the growth spaces of each city are isolated from each other.

Flat-expansion fried egg model: This model is characterized by multiple eggs fried flat and expanding outward. It represents the rapid growth stage in the formation and development of urban agglomerations. During this stage, each city expands into its own development space, like a cracked egg spreading outward on a flat surface, creating a "fried egg" expansion model. If multiple cities spread outward in this disorderly manner, they will inevitably influence each other, eventually extruding each other's living space, causing increased conflict.

Merged and reorganized scrambled egg model: This model is characterized by multiple eggs that have merged and reorganized. It represents the integration stage of urban agglomeration formation and development. During this stage, to address the conflicts between cities from the fried egg stage, the fried eggs are mixed together and "scrambled" to create a new division of labor and achieve organic integration consisting of organic links, interdependence and mutual promotion between cities, which ultimately leads to multiple cities – or multiple fried eggs – in an integrated community. This is the urban agglomeration egg-

shaped evolution law.

2.5 Urban agglomeration "saplings-to-forest" natural growth law

The formation and development of urban agglomerations is similar to the process by which trees grow from saplings into towering trees. Multiple saplings in a certain area are like multiple cities in close geographical proximity, as during their initial growth, each one needs its own nutritional and growing space, and each sapling is independent of each other and does not need to use other saplings to transport nutrients. Once the saplings grow into trees, however, they begin to engage in competitive behavior, vying for nutrients and space. Interventions, such as pruning or redistributing nutrients, are required to ensure that the many towering trees thrive and eventually create a dense forest (urban agglomeration) full of vitality (Figure 6).

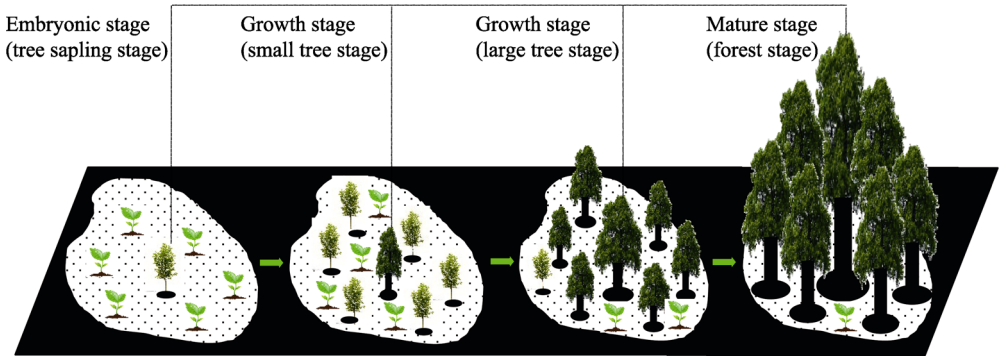

Figure 6 Urban agglomeration "saplings-to-forest" natural growth law

If the growing space of saplings or cities is constant, to ensure the continued development of multiple specimens, it is necessary to coordinate the nutrient intake of and space between them. By giving nutrients to each other, allowing each to give space to others for growth and relying on each other, the saplings (cities) can achieve common growth and become inseparable and important parts of the forest (urban agglomeration). Multiple cities that form a community with a common destiny are like a dense forest. A dense forest requires collective decision-making between trees. Only by ensuring that every tree in the forest is thriving can one create the conditions for the forest to become dense. As such, the health of each tree is closely related to the health of the entire forest, just as the health of each city is closely related to the health of the entire urban agglomeration, and the poor development of cities will result in the poor development of the urban agglomeration. The health of an urban agglomeration is an important guarantee for the healthy development of its constituent cities. This is the "saplings-to-forest" natural growth law of urban agglomerations.

2.6 Urban agglomeration sustainable development incremental increases law

The natural process of an urban agglomeration's formation and development involves multiple cities relying on and cooperating with neighboring cities and increasing their mutual sustainability for their own sustainable development. This process specifically occurs when

a city, City A, cannot develop sustainably by relying on its own capabilities, so it naturally cooperates with a second city, City B, to develop sustainably at a new level through their joint efforts. When City B can no longer develop sustainably, it will naturally cooperate with a third city, City C, to maintain its sustainable development at a higher level. When City C can no longer develop sustainably, it will naturally cooperate with a fourth city, City D, to develop sustainably at a new level through its cooperation with that city, and so on. When *n*–1st city *N*–1 can no longer develop sustainably, it will naturally cooperate with the *n*th city N in order to develop sustainably at a higher level (see Figure 7). By City A cooperating with cities B, C, …N, which promotes unity between City A and the *n*th city, it forms a community with a common destiny for sustainable development, which eventually develops into an urban agglomeration. As the number of cooperating cities increases, the ability of the cities to develop sustainably increases in steps. This is the sustainable development incremental increases law of urban agglomerations (Figure 7).

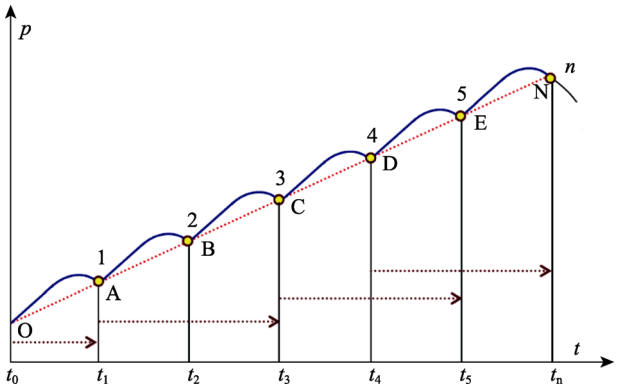

Figure 7 Incremental increases law of urban agglomeration sustainable development

3 The guiding role of the urban agglomeration formation and development law on the development of China's urban agglomerations

3.1 How the law guides the new three-tier urban agglomeration spatial organization configuration in China

The stage-based law of urban agglomeration formation and development clearly reflect the stage-based development of urban agglomerations in China. On the basis of their development level and the stage-based law, China's urban agglomeration development has been divided into three levels, consisting of five national-level urban agglomerations, nine regional urban agglomerations and six local urban agglomerations, which together make up a spatial organization configuration referred to as the "5+9+6" urban agglomeration hierarchy. This three-level organizational configuration was adopted in full by *The 13th Five-Year Plan for Economic and Social Development of the People's Republic of China* (*2016–2020*), and it has become an important basis of national decision-making. In accordance with the "5+9+6" organizational plan, China is currently focusing on the development of five national-level urban agglomerations, namely, the Yangtze River Delta urban agglomeration, the Pearl River Delta urban agglomeration, the Beijing-Tianjin-Hebei urban agglomeration, the Yangtze River middle reaches urban agglomeration and the Chengdu-Chongqing urban agglomeration; steadily developing nine regional urban agglomerations, namely the Harbin-Changchun urban agglomeration, Shandong Peninsula urban agglomeration, central and southern Liaoning urban agglomeration, Western Taiwan Strait urban agglomeration, Central Plains urban agglomeration, central Shaanxi urban agglomeration, Jianghuai (Hefei) urban ag-

glomeration, Gulf of Tonkin urban agglomeration, and Tianshan Mountains northern slopes urban agglomeration; and guiding the development of six local urban agglomerations, namely the Hohhot-Baotou-Ordos-Yulin urban agglomeration, the central Shanxi urban agglomeration, the urban agglomeration centered around the Ningxia section of the Yellow River, the Lanzhou-Xining urban agglomeration, the central Yunnan urban agglomeration and the central Guizhou urban agglomeration (Fang, 2011). The urban agglomeration spaces multi-scale intensive-use transmission law guides China's urban agglomerations in realizing multi-scale top-down and outside-to-inside optimization and feedback of hierarchical links, which plays an important role in improving the efficiency of intensive use of urban agglomeration spaces.

3.2 How the law guides the optimization of the spatial structure model in China

The urban agglomeration spatial crystal structure composition law guides China's urban agglomerations in forming multi-center organically combined spatial structures, and it provides theoretical support for the development, expansion and structural optimization of single-center, dual-center and multi-center urban agglomerations.

The urban agglomeration "saplings-to-forest" natural growth law guides China's urban agglomerations in forming and developing naturally over time into communities of common destiny, rather than mechanically in a process dominated by government, and excessive enthusiasm or mechanical attempts to promote the development of urban agglomerations are considered violations of the law of nature.

The urban agglomeration egg-shaped expansion evolution law guides the formation and development of urban agglomerations according to progressive models of expansion, namely the three-dimensional boiled egg growth model, flat-expansion fried egg model, and merged and reorganized scrambled egg model. It provides a solid theoretical basis for the expansion of urban agglomerations at different levels of development.

The urban agglomeration sustainable development incremental increases law highlights the primary objective of sustainable development in the course of forming and developing urban agglomerations. As long as cities and an urban agglomeration develop sustainably, the agglomeration can encompass countless cities, which means the boundaries of the agglomeration become increasingly uncertain and blurred (Fang and Ren, 2017).

3.3 How the law has guided China to establish urban agglomeration development plans

Guided by the law governing the formation, development and expansion of urban agglomerations as well as the Technical Regulations on Urban Agglomeration Planning, the following 10 criteria for identifying urban agglomerations in China were determined:

(1) There must be no fewer than three metropolitan areas, megacities or megalopolises within the urban agglomeration and at least one megacity (with an urban resident population greater than 10 million) or megalopolis (with an urban resident population of between 5 million and 10 million);

(2) The total population must not be less than 20 million;

(3) The level of urbanization must be greater than 60%;

(4) The economic density must be no less than RMB 15 million/km^2;

(5) The output value ratio of non-agricultural industries must exceed 70%;

(6) Per capita GDP must exceed US$ 10,000, the level of industrialization must be relatively high, and it must be in the middle or late stage of industrialization;

(7) The core city's GDP must be >45% of the agglomeration, and it must have inter-provincial urban functions;

(8) It must have a highly developed integrated transport corridor as well as half-hour, one-hour and two-hour economic (or living) circles;

(9) Economic extraversion must be higher than 30% and it must play a role in the shifting world economic center of gravity;

(10) Regional cultural affinity of the cities within the cluster must be higher than 70%, aided by a similar geographical environment and regional cultural environment (Fang, 2009, 2016).

These standards define spatial boundaries for urban agglomeration planning (Wang and Fang, 2011). They have been used to draw up the development plans of two-thirds of China's urban agglomerations, including the Yangtze River Delta urban agglomeration, Beijing-Tianjin-Hebei urban agglomeration, Chengdu-Chongqing urban agglomeration, Pearl River Delta urban agglomeration, Harbin-Changchun urban agglomeration, central and southern Liaoning urban agglomeration, Shandong Peninsula urban agglomeration, Central Plains urban agglomeration, central Shaanxi urban agglomeration, Tianshan Mountains northern slopes urban agglomeration, and the urban agglomeration centered around the Ningxia section of the Yellow River. The plans for these urban agglomerations are being implemented by the State Council or provincial people's governments, and they have made important contributions to turning China's urban agglomerations into innovative, ecological, low-carbon and intelligent urban agglomerations with compact and intensive development.

3.4 How the law has led China to adopt a scientific approach to sustainable development of urban agglomerations

Undoubtedly, China's developing urban agglomerations have made significant contributions to national economic and social development and the new type of urbanization. Nevertheless, their rapid development has exposed the following problems that require urgent attention: "urban agglomeration diseases" that have existed with the selection and development of urban agglomerations in China over the past 35 years: an over-emphasis on the strategic importance of urban agglomerations to the process of urbanization; violations of the State's basic original intentions for developing urban agglomerations through the constant expansion of urban agglomerations; urban agglomerations becoming sensitive areas prone to environmental problems such as smog; the choice of urban agglomerations excessively accommodating local interests to the point of affecting national strategic security (Fang and Mao, 2015).

Other issues that exist with the development of urban agglomerations are those referred to as the "four lows" (low development, low compactness, low input-output efficiency and low resource and environmental protection) and the "four highs" (high government dominance and administrative intervention, high density of negative agglomeration effects, excessively high development expectations and large development gaps). To help overcome these maladies, scientific prescriptions have been formulated based on the urban agglomeration forma-

tion and development law (Fang *et al*., 2017a). And on the basis of a large volume of practical research, theories such as the urban agglomeration urbanization and ecological environment interactivity coupling circle theory, which has supported decision-making on the sustainable development of urban agglomerations, have been formulated (Fang *et al*., 2016).

4 Conclusions

4.1 The formation and development of urban agglomerations in China is a long and natural process that follows natural development law

Just as with the formation and development of urban agglomerations around the world, the formation and expansion of urban agglomerations in China is a long-term natural process that follows six natural development law, namely the stage-based formation and development law, multi-scale intensive-use transmission law, crystal-structure spatial composition law, egg-shaped expansion evolution law, "saplings-to-forest" natural growth law and sustainable development incremental increases law. These six law are also six basic theories on the formation and development of urban agglomerations. As our knowledge of how urban agglomerations form and develop gradually improves, our understanding of the basic law governing the formation, development and expansion of urban agglomerations will deepen. But because China's urban agglomerations are still in the early stage of development, or the rapid growth stage, orderly government intervention and macro-control are inevitable, which means China's urban agglomerations are subject to stronger government guidance than urban agglomerations in other parts of the world. It is likely, however, that once urban agglomerations in China reach the mature development stage, the market will play the dominant role in their development.

4.2 Global urban agglomeration development has entered the Chinese era in the 21st century, and China is leading global urban agglomeration research

China's urban agglomerations have only been developing for 38 years, and they are still in the rapid growth stage of new-type urbanization and transformational development. The world economic center of gravity has already shifted to the Asia-Pacific region, and there is an urgent need to make urban agglomerations the instruments of this shift. China shoulders this historic mission and duty. As such, it has firmly designated urban agglomerations as the spatial entities for promoting the New-Type Urbanization Plan and important instruments for shifting the world economic center of gravity. China's urban agglomeration development has entered a new era in the 21st century in which it is leading global urban agglomeration development. The rapid development of urban agglomerations, however, has exposed a series of problem that are in urgent need of attention. For instance, there is a pressing need to carry out problem-led research and propose countermeasures, which could turn China into a global leader of urban agglomeration research and development. Indeed, the empirical model of Chinese urban agglomeration research is already being copied and used to develop global urban agglomerations.

4.3 The urban agglomeration formation, development and expansion law play an important role in guiding the development of urban agglomerations in China

Guided by the law governing the formation, development and expansion of urban agglom-

erations, the Chinese government has established five national-level urban agglomerations, nine regional urban agglomerations and six local urban agglomerations (the "5+9+6" urban agglomeration hierarchy). The State has also optimized the spatial structure model, drawn up urban agglomeration development plans and proposed scientific approaches to ameliorate "urban agglomeration diseases" and promote the sustainable development of urban agglomerations. To date, plans have been completed for 19 urban agglomerations in China, most of which have been approved by the State Council or provincial people's governments. It is possible that new situations, new problems and new requirements will arise in the course of implementing these plans, but the urban agglomeration law discussed above can be used as a basis on which to further our understanding in order to formulate sound countermeasures. It can be seen, then, that conforming to the basic law governing urban agglomeration development and acting in accordance with the law of nature are basic standards that China's urban agglomeration development must adhere to.

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