Chapter 3
Dynamic Evaluation for the Healthy Development and Potential Issues of China's Urban Agglomerations

Based on a comprehensive analysis of the healthy development status of China's urban agglomerations during the past 35 years, we can draw the conclusion that urban agglomerations are the strategic core areas of China's national economic development, and still exerts powerful "siphon effect" that continues to draw capital and talent to those locations. Urban agglomerations are the main area of implementing China's New Urbanization strategy. Their urbanization levels are increasing every year with the lowest urbanization vulnerability and increasing sustainability. On the other hand, urban agglomerations are also regions with concentrated environmental problems with enormous amount of pollution discharge. Urban agglomerations are regions with the largest amount of carbon emission and concentration of $PM_{2.5}$ discharge. They will continue to bear huge pressure to reduce carbon emission in the foreseeable future. The outstanding problems for China's urban agglomerations in the past 35 years include: the strategic position of urban agglomeration as the main body to promote China's urbanization is overstated; the spatial extents of urban agglomerations over-expand, which violates the basic original intention of the construction of urban agglomeration that is to promote compact and sustainable urbanization; the choice of urban agglomeration is subject to strong governmental preference, which is often different from the basic standard of urban development; the choice of where to develop urban agglomeration has indulged too much the local interests, which has affected the national strategic security; the urban agglomeration has become the sensitive area and the key management area of the ecological environment problems such as haze and other severe environmental problems. In summary, the development of urban agglomeration in China has suffered from four "low" problems, namely, low development degree, low level of compactness, low input and output efficiency, and low level of resources and environment protection; four "overly" problems, namely, the government has overly exerted administrative intervention; the development prospects are overly estimated; negative effects are overly concentrated in urban agglomerations; and development is overly disparate. In some urban agglomeration construction scenarios, there also exist four "ignorance" problems, namely, locations follow blindly the trend of national strategic plans ignoring their own conditions; or locations ignore the Red Line for arable land to force the development

C. Fang and D. Yu, *China's Urban Agglomerations*, Springer Geography,
https://doi.org/10.1007/978-981-15-1551-4_3

of urban agglomerations; or locations repeat one another ignoring in-depth differential development; or locations ignore their fundamental resource and environmental carrying capacity to force the development of urban agglomerations.

3.1 Comprehensive Evaluation of China's Urban Agglomeration Development for the Past 5 Years

The first year of the 12th Five-Year Plan (2011) is also the year when the first book by the research team of Chinese Academy of Sciences, *2010 China's Urban Agglomeration Development Report* (*2010 Report for short*) was published by Science Press [1]. Through the implementation over the 12th Five-Year Plan, the concept of urban agglomerations and the standard of identifying urban agglomeration as proposed in the *2010 Report* has been widely recognized by the political, academic and news media. The *2010 Report* promotes the urban agglomerations as the main body of implementing China's New Urbanization strategy. The proposed 23 urban agglomerations in the *2010 Report* were adopted by relevant national documents until *the outline of the* 13th Five-Year Plan for Economic and Social Development of the People's Republic of China adopted 20 urban agglomerations from the 23. The *2010 Report* plays a key role in promoting the formation and development of China's urban agglomeration and the formation of new urban spatial organization pattern.

3.1.1 The Proposed Concept and Identification Standards of Urban Agglomeration Are Universally Recognized

1. **The concept and definition of urban agglomeration have been widely accepted in the scholarly community and adopted into national policies**

(1) The definition of urban agglomeration is universally recognized and adopted by politicians, academia and the press

In the *2010 Report*, urban agglomeration is defined as: in a specific geographical area, there are one super city serving as the core, at least 3 metropolitan circles (districts) or large cities as the basic units, with well-developed communication and other infrastructure networks, forming a compact spatial configuration, close economic ties, and highly integrated urban groups. Its core content includes the "ten shares" (the shares of master plans, industrial chains, urban and rural planning, transportation network, information, finance, markets, science and technology development, pollution treatment and ecological constructions) and "six major integrations" (integration of regional industrial development layout, infrastructure construction, regional market construction, urban and rural planning and construction integration, environmental

protection and ecological construction, and social development and social security system construction).

Through five years of practice and trial and error, the above definition has been largely recognized and accepted by the political, academic and media communities. In December 2014 in the "First High-level Forum for the Development of China's Urban Agglomeration", the concept was further discussed and accepted by urban planning and administrative practitioners. The concepts of "ten shares" and "six major integrations" were widely accepted. More importantly, these connotations have been adopted and implemented by the Central Government and reflected in the Central Government approved *National New Urbanization Plan (2014–2020)*, the State Council approved *the Outline of Beijing-Tianjin-Hebei Coordinated Development Plan*, *the Middle Reaches of the Yangtze River Urban Agglomeration Development Plan*, *the Harbin-Changchun Urban Agglomeration Development Plan*. Moreover, the integration of social development and social security system construction have been further changed to integration of social development and basic public services.

In the mainstream news community, news agencies such as *Xinhua News Agency, People's Daily, Guangming Daily, Economic Daily, China Economic Herald, China Economic Times, China City Newspaper*, and *Economic Reference*, have adopted the definition of urban agglomeration as proposed in the *2010 Report* in their various news report.

(2) Urban agglomeration identification criteria have been universally recognized and adopted by politicians, academia and the press

In the *2010 Report*, seven urban agglomeration identification standards are presented, those are: there must be at least 3 large cities or metropolitan areas within the urban agglomeration; there must be at least 1 core city with more than 1 million population; the total population of the urban agglomeration shall not be less than 20 million; urbanization level must be more than 50%; per capita GDP shall be over 3000 US dollars; the economic density shall be over 5 million RMB Yuan/km^2; the percentage of exports shall be more than 30%; the area is closely connected with highly developed comprehensive transportation systems with clearly defined half-hour, one-hour and two-hour commuting circles; its non-agricultural industries shall account for over 70% of its total economic volume; the core city/cities' GDP shall be over 45% of the entire urban agglomeration; and the urban agglomeration shall not be constrained by the administrative borders.

These identification standards have been adopted in the preparation of the 12th Five-Year Plan framework, which played an important role in quantitatively promoting China's recognition of the regions that can be developed to be urban agglomerations. These criteria are also adopted in preparing the *Outline of Beijing-Tianjin-Hebei Coordinated Development Plan Development Plan for the Middle Reaches of the Yangtze River Urban Agglomeration*, *Development Plan for the Harbin-Changchun Urban Agglomeration*, *Development Plan for Shandong Peninsula Urban Agglomeration*, and *Development Plan for Central Shaanxi and Tianshui Urban Agglomerations* and other urban agglomerations. They are also widely used in both the relevant academic and news media in China.

During the past five years of implementation, the standards of identifying urban agglomerations is further revised as follows: ① The number of metropolitan areas or large cities in urban agglomerations shall be no less than 3. Among them, there shall be at least 1 super city (with permanent residents over 10 million) or megacity (with 5–10 million permanent residents). ② The total population of an urban agglomeration shall be no less than 20 million. ③ The overall urbanization level within the urban agglomeration shall be more than 60%. ④ Per capita GDP within the urban agglomeration shall be over 10,000 US dollars, and the urban agglomeration shall be at the mature stage of industrialization. ⑤ The economic density of the urban agglomeration shall be over 15 million RMB Yuan/km^2. ⑥ There shall be highly connected comprehensive transportation network with clearly defined half-hour, one-hour and two-hour commuting circles. ⑦ The non-agriculture production in the urban agglomeration shall be over 70%. ⑧ The core city's GDP shall be over 45% of the entire urban agglomeration's GDP and shall be able to serve other regions across the provincial administrative border. ⑨ Export-oriented economy of the urban agglomeration shall be over 30% of the total; the urban agglomeration shall be able to shoulder the transition of the world' economic gravity center. ⑩ At least 70% or above cities within the urban agglomeration shall have strong cultural and locational identity.

2. **The status of urban agglomeration has been elevated to national strategic level**

In the *2010 Report*, it was found that only in the outline of the 12th Five-Year Plan was it proposed to "actively and steadily promote urbanization, adhere to the road of urbanization with Chinese characteristics, follow the objective laws of urban development, rely on large cities, focus on small and medium-sized cities, and gradually form an urban agglomeration with strong radiation function to promote the coordinated development of small and medium-sized cities and towns". The term "urban agglomeration" was only mentioned in two relevant national documents. At the end of the 12th Five-Year Plan, however, the term "urban agglomeration" has been mentioned over 300 times in various documents and plans issued by the Central Government and State Council. Among them, urban agglomerations have been regarded as the primary form for promoting China's New Urbanization in a series of important Central Committee documents, such as the CPC's 18th Congress Report, the Central Urbanization Work Conference in 2013, the *National New Urbanization Plan (2014–2020)* in 2014, the Central City Work Conference in 2015, and the Recommendations of the CPC Central Committee for the 13th Five-Year Plan for Economic and Social Development passed in the Fifth Plenary Session of the 18th CPC Central Committee. Moreover, the *Outline for the National Twelfth Five-Year Plan (2011–2015)* approved in 2011 proposed that urban agglomerations will be the primary form for New Urbanization. The State Council approved (in August 2012) *Some Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central China* proposed the construction of six large urban agglomerations. The State Council approved (in September 2014) *Guidance Opinions of the State Council on the Development of Yangtze River Economic Belt Relying on the*

Yangtze River Golden Waterway also clearly proposed the construction of six large urban agglomerations along the Yantze River. The State Council approved (in March 2015) *Visions and Actions for Promoting and Constructing the Silk Road Economic Belt and 21st Century Maritime Silk Road* also proposes the construction of eight large urban agglomerations. A month later, the State Council issued the *Planning Outline for Coordinated Development in Beijing-Tianjin-Hebei* proposed to build the Beijing-Tianjin-Hebei Urban Agglomeration to be a world-class urban agglomeration. In the same month, the State Council also issued the *Development Planning for the Middle-Reaches of the Yangtze River Urban Agglomeration*. In March 2016, the State Council issued the *Outline of the 13th Five-Year Plan for Economic and Social Development of People's Republic of China (2011–2015)* proposed to construct 19 urban agglomerations. In March 2016, the State Council also approved the *Planning of Development for the Harbin-Changchun Urban Agglomeration*.

As urban agglomerations' strategic position is risking unprecedentedly, as a new regional unit for national participation in global competition and international division of labor, urban agglomeration is also shouldering the shift of the world economic center of gravity and pursuing the Belt and Road Initiative. Urban agglomerations will be important strategic locations for global economic development, important portals for China to participate in global market and competition, leading locations for the pursuit of the Belt and Road Initiative. It is small wonder that urban agglomeration will become increasingly important in global strategic locational hierarchy.

3. **Research of urban agglomeration steps into the new stage of interdisciplinary studies**

The *2010 Report* suggests that the study of urban agglomeration focuses on the identification of the geographic range, driving factors, spatial configuration, degrees of development, and the input-output efficiency of urban agglomerations. Studies of urban agglomeration focus primarily in the fields of social and humanity science and urban geography. After five years of development, many urban agglomerations started to become a "heavily disaster stricken areas" with high density concentration, high speed growth, high intensity operation, high risk threat, and high carbon emission. In view of these problems, taking the national strategic demands as the guidance, studies of urban agglomeration have gradually expanded to other disciplines, and paid more attention to the research of sustainable development in such high density and highly concentrated locations. Traditional Humanities and Social Sciences and Urban Geography have been unable to elaborate fully the new characteristics of urban agglomerations as manifested as cross-cities, cross-borders, cross-research fields, and even cross-national boundaries. The fundamental functions of cities have long expanded beyond the traditional socioeconomic functions and integrating and interacting more with the natural ecological and environmental aspects. Many new urban planning in recent years started to consider more and more the eco-environmental carrying capacity in their narration and suggestions. The development of urban agglomerations has become extremely complex. It becomes increasingly apparent that any single discipline would fail to adequately study urban agglomerations and their development, structure, spatial pattern, driving mechanism, and

future directions. It is hence imperative to promote interdisciplinary studies on urban agglomerations among Sociology, Economics, Demography, Geography, Ecology, Environmental Science, Philosophy, Urban and Rural Planning, and Management Science, and many others. For this purpose, the Chinese National Natural Science Foundation has granted a major program (approval number 41590840) to specifically study "the Interaction Coupling Mechanism and Stress Effect of Urbanization and Ecological Environment in Urban Agglomerations". This project intends to push the study of urban agglomerations to a new milestone. There are two primary research efforts to be undertaken in the future.

First, it will focus on revealing the interaction coupling mechanism and stress effect of urbanization and ecological environment in urban agglomeration areas. This task will theoretically analyze the nonlinear coupling relationship and coupling characteristics of the interaction between natural elements and humanistic elements of the urban agglomeration system, and scientifically identifies the stress intensity, near-far coupling mechanism and law of the interaction of the internal and external elements of the urban agglomeration system under the action of the near-far main control elements. This research effort summarizes the theory of interaction coupling circle between urbanization and ecological environment in mega-urban agglomeration areas, further constructs the spatiotemporal coupling dynamics model of multi-element, multi-scale, multi-scenario, multi-module and multi-agent integration, and develops the optimal intelligent control decision support system for sustainable development in mega-urban agglomeration area. From a methodological perspective, this research effort will treat mega-urban agglomeration area as an open and great complex system, attempt to establish the standardized shared database, apply big data analysis strategy and the interactive urbanization and eco-environment coupling integration approach under the assumption of multi-element, multi-objective, multi-model, multi-scenario, to construct the multi-scale, multi-technology, multi-agent integrated urbanization and ecological environment interaction coupling technology framework. The research pathway follows analysis of the characteristics of spatiotemporal evolution-seeking the coupling relationship-identification of the main control elements-revealing the coupling law-detection of the mechanism-screening the control variables-solving the critical threshold-conducting control test-completing the scenario simulation-promoting the optimization scheme-achieving the national goal. The ultimate goal is to provide solutions for overall optimization among various agents in urban agglomeration development and provide theoretical guidance and methodological support to change urban agglomerations from "problem concentrated areas" to sustainable development areas. This research effort proposes the high-density concentration pathway and high-efficiency growth model for urban agglomeration to develop within local resource and environment carrying capacity. This research effort will provide scientific decision-making support to promote health and sustainable development, resource-saving, environment-friendly, low carbon and ecologically sustainable development of urban agglomerations [2].

The second research effort is to identify the resource and environment carrying capacity of the highly concentrated urban agglomeration areas. It is important to reveal the influential mechanism to urban agglomeration's high density from the

viewpoints of natural factors, including ecological carrying capacity, water resource carrying capacity, land resource carrying capacity and environment carrying capacity, and analyze the constraint effect and comprehensive constraint strength of ecological constraint mechanism, water resource constraint mechanism, land restraint mechanism and environmental capacity constraint mechanism on urban agglomerations. By using the entropy technology supported Expert Democratic Decision model and fuzzy membership function model in information theory, we are able to calculate the urban agglomeration concentration index, resource supporting index, environment capacity index, integration ability index and cultural evolution index. By combining these indices, we can then deduce the resource and environment security status for urban agglomerations and analyze how resource and environment constrain the highly concentrated urban agglomeration. In addition, based on the Energy Value Analysis (EM), Ecological Footprint Analysis (EFFA) and ecosystem service value estimation methods, we can evaluate the ecosystem service value of urban agglomeration region. Through calculating the dynamic changes of per capita ecological footprint, per capita ecological carrying capacity and per capita ecological deficit, we will then be able to evaluate the resource security and ecological environment security status of urban agglomerations. According to the "barrel principle", based on the resource and environment carrying capacity pressure and saturation model, we can construct an integrated urban agglomeration carrying capacity model to evaluate the dynamic carrying capacity in urban agglomeration regions. By comparing the carrying capacity for population and economic development in certain period with the actual population size and economic scale, we will be able to provide solid evidence and support for population growth and economic development goals, provide resource and eco-environment threshold values (risks) for urban agglomerations, so that we can provide scientific basis for sustainable urban agglomeration development. Furthermore, by adapting the scenario analysis model, this research effort designs various scenarios for the interaction of different resources and environmental factors, analyzes the scale, direction and intensity of urban agglomerations under different scenarios, analyzes the influence of different resource and environment combinations on urban agglomeration's hierarchical structure, functional structure, spatial structure and morphology, and then proposes the scenarios of resource and environment to guaranteed sustainable urban agglomeration development, establishes the Resource Environment Early Warning index system and signaling system, the early warning response system, and sets the limits for urban agglomeration development and expansion.

3.1.2 The Proposed Spatial Configuration of China's Urban Agglomerations Is Adopted in Major National Documents and Master Plans

1. **Twenty-two of the twenty-three proposed urban agglomerations are adopted in the Outline of the 13th Five-Year Plan**

The *2010 Report* indicates that there are 23 different urban agglomerations in China with various spatial configurations, scales, and degrees of development (15 of them have satisfied the defined criteria with 8 are in the process of development). The urban agglomeration system is composed of 23 urban agglomerations, 326 cities of various sizes, 173 nodal cities, 31 core cities, and 9,027 townships. The number of cities within these urban agglomerations accounts for 46.9% of the national total, and the number of towns accounts for 47.98% of the national total. The 15 urban agglomerations that meet the defined criteria are the Yangtze River Delta Urban Agglomeration, the Pearl River Delta Urban Agglomeration, Beijing-Tianjin-Hebei Urban Agglomeration, Shandong Peninsula Urban Agglomeration, Eastern Liaoning Peninsula Urban Agglomeration, the Western Coast of the Taiwan Strait Urban Agglomeration, Changsha-Zhuzhou-Xiangtan Urban Agglomeration, Wuhan Urban Agglomeration, Chengdu-Chongqing Urban Agglomeration, Poyang Lake Rim Urban Agglomeration, Central Plains Urban Agglomeration, Harbin-Dalian-Changchun Urban Agglomeration, Jianghuai Urban Agglomeration, Central Shaanxi Urban Agglomeration and the Northern Slope of the Tianshan Mountains Urban Agglomeration. The 8 urban agglomerations that are still in development include the Nanning-Beihai-Qinzhou-Fangchenggang Urban Agglomeration, the Central Shanxi Urban Agglomeration, the Yinchuan Plain Urban Agglomeration, the Hohhot-Baotou-Ordos Urban Agglomeration, the Jiuquan-Jiayuguan-Yumen Urban Agglomeration, the Lanzhou-Baiyin-Xi'ning Urban Agglomeration, the Central Guizhou Urban Agglomeration and the Central Yunnan Urban Agglomeration.

Of these 23 proposed urban agglomerations, 22 except for the Jiuquan-Jiayuguan-Yumen Urban Agglomeration are included into the *Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China* published in March 2016, though they were further combined to become 19 urban agglomerations. These 19 urban agglomerations are the Yangtze River Delta Urban Agglomeration (include the original Yangtze River Delta and Jianghuai Urban Agglomerations), the Pearl River Delta Urban Agglomeration, the Beijing-Tianjin-Hebei Urban Agglomeration, the Shandong Peninsula Urban Agglomeration, the Central and Southern Liaoning Urban Agglomeration, the Western Coast of the Taiwan Strait Urban Agglomeration, the Middle-Reaches of the Yangtze River Urban Agglomeration (include the originally proposed Changsha-Zhuzhou-Xiangtan, Wuhan and Poyang Lake Rim Urban Agglomerations), the Chengdu-Chongqing Urban Agglomeration, the Central Plains Urban Agglomeration, the Harbin-Changchun Urban Agglomeration, the Central Shaanxi-Tianshui Urban Agglomeration, the Northern Slope of the Tianshan Mountains Urban Agglomeration, the Guangxi Beibu Gulf Urban

Agglomeration, the Central Shanxi Urban Agglomeration, the Areas in Ningxia along the Yellow River Urban Agglomeration, the Hohhot-Baotou-Ordos-Yulin Urban Agglomeration, the Lanzhou-Xining Urban Agglomeration, the Central Guizhou Urban Agglomeration and the Central Yunnan Urban Agglomeration (Table 3.1).

2. **The spatial configuration of the 23 urban agglomerations is accepted by many major national master plans**

The State Council issued Number 43 Document in 2012 (August 2012), *Several Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central Region* proposed to emphasize on the development of the Taiyuan Urban Agglomeration, the Yangtze River (Anhui Section) City Belt, the Poyang Lake Ecological Economic Zone, the Central Plains Economic Zone, the Wuhan City Circle, and the Ring of Changsha-Zhuzhou-Xiangtan Urban Agglomeration. The Central Urbanization Work Conference held in December 2013 further put forward to optimize the construction of the three national-level urban agglomerations, namely, the Beijing-Tianjin-Hebei, Yangtze River Delta, Pearl River Delta, and strive to build them to be internationally competitive world-class urban agglomeration. The *National New Urbanization Plan* (2014–2020) issued by the CPC Central Committee also proposed to optimize and promote the development of the Beijing-Tianjin-Hebei, the Yangtze River Delta and the Pearl River Delta Urban Agglomerations, actively develop the Chengdu-Chongqing, the Central Plains, the Middle Reaches of the Yangtze River, and the Harbin-Changchun Urban Agglomerations. In September 2014, the State Council issued Number 39 Document in 2014, *Guiding Opinions of the State Council on Promoting the Development of the Yangtze River Economic Belt by Relying on the Golden Waterways*, proposed to rely on the Yangtze River Delta, the Middle Reaches of the Yangtze River, and Chengdu-Chongqing cross-regional urban agglomerations as the primary locations, the Central Guizhou and Central Yunnan regional urban agglomerations as the secondary locations to actively promote the international competitiveness of the Yangtze River Delta Urban Agglomeration, develop the Middle Reaches of the Yangtze River Urban Agglomeration, strengthen the central city functions of Wuhan, Changsha and Nanchang, promote the integrated development of the Chengdu-Chongqing Urban Agglomeration, and promote the development of the Central Guizhou and Central Yunnan urban agglomerations. In March 2015, authorized by the State Council, the National Development and Reform Commission, the Ministry of Foreign Affairs and the Ministry of Commerce jointly issued the *Promotion of the Silk Road Economic Zone and the Vision and Action of the Maritime Silk Road in the 21st Century*, proposed to rely on the urban agglomerations in the Middle Reaches of the Yangtze River, Chengdu-Chongqing, Central Plains, Hohhot-Baotou-Ordos-Yulin, and Harbin-Changchun regions, to promote regional interactive cooperation and agglomerated industrial development, to actively build Chongqing as the important support pillar for the development and open-up in the Western China, and promote Chengdu, Zhengzhou, Wuhan, Changsha, Nanchang and Hefei as important inland open economic highlands. The State Council issued *Outline of Beijing-Tianjin-Hebei Coordinated Development Plan* in April 2015, proposed to build the Beijing-Tianjin-Hebei Urban Agglomeration to

Table 3.1 How the proposed 23 urban agglomerations in 2010 are adopted in various national documents

File number	Urban agglomeration	2010, *Some Opinions of the State Council of the CPC Central Committee on in-depth Implementation of Western Development Strategy*	2011, the State Council, *Outline of the 12th Five-Year Plan for Economic and Social Development of the PRC*	2012, the CPC's 18th Congress Report	2012, *Some Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central Region*	2013, Central Urbanization Work Conference	2013, Central Economic Work Conference	2014, the State Council, *National New Urbanization Plan (2014-2020)*	2014, State Council, *Guiding Opinions of the State Council on Promoting the Development of the Yangtze River Economic Belt by Relying on the Golden Waterways*	2015, *Promotion of the Silk Road Economic Zone and the Vision and Action of the Maritime Silk Road in the 21st Century*	2015, *Outline of Beijing-Tianjin-Hebei Coordinated Development Planning*	2015, Central City Work Conference	2015, *Proposals of the Central Committee on Formulating the National Economic and Social Development in the 13th Five-Year Plan*	March 2016, The State Council, *Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*	2015, *The Official Reply of the State Council on the Development Planning of the Middle Reaches of the Yangtze River*	2016, *The Official Reply of the State Council on Harbin-Changchun Urban Agglomeration Development Planning*	Number of times appeared in Central Government and the State Council Documents
		Issued by the Central Government 2010, Number 11	The State Council	Central Committee of the CPC	Issued by the State Council, Number 43 (2012)	Central Committee of the CPC	Central Committee of the CPC	Issued by the Central Government 2014, Number 4	Issued by the State Council, Number 39 (2014)	Authorized by the State Council	Central Committee of the CPC	Central Committee of the CPC	The Fifth Plenary Session of the CPC's 18th Central Committee	The Fourth Session of the 12th National People's Congress, and the State Council	National Letter (2015), Number 62	National Letter (2016), Number 43	
1	Yangtze River Delta Urban Agglomeration					🗐		🗐	🗐	🗐		🗐	🗐	🗐			7
2	Pearl River Delta Urban Agglomeration					🗐		🗐		🗐		🗐	🗐	🗐			6
3	Beijing-Tianjin-Hebei Urban Agglomeration					🗐		🗐		🗐	🗐	🗐	🗐	🗐			7
4	The Middle Reaches of the Yangtze River Urban Agglomeration				🗐			🗐	🗐	🗐		🗐	🗐	🗐	🗐		8

(continued)

Table 3.1 (continued)

File number	Urban agglomeration	2010, *Some Opinions of the State Council of the CPC Central Committee on in-depth Implementation of Western Development Strategy*	2011, the State Council, *Outline of the 12th Five-Year Plan for Economic and Social Development of the PRC*	2012, the CPC's 18th Congress Report	2012, *Some Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central Region*	2013, Central Urbanization Work Conference	2013, Central Economic Work Conference	2014, the State Council, *National New Urbanization Plan (2014-2020)*	2014, State Council, *Guiding Opinions of the State Council on Promoting the Development of the Yangtze River Economic Belt by Relying on the Golden Waterways*	2015, *Promotion of the Silk Road Economic Zone and the Vision and Action of the Maritime Silk Road in the 21st Century*	2015, *Outline of Beijing-Tianjin-Hebei Coordinated Development Planning*	2015, Central City Work Conference	2015, *Proposals of the Central Committee on Formulating the National Economic and Social Development in the 13th Five-Year Plan*	March 2016, The State Council, *Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*	2015, *The Official Reply of the State Council on the Development Planning of the Middle Reaches of the Yangtze River*	2016, *The Official Reply of the State Council on Harbin-Changchun Urban Agglomeration Development Planning*	Number of times appeared in Central Government and the State Council Documents
5	Chengdu-Chongqing Urban Agglomeration	🗐						🗐	🗐	🗐		🗐	🗐	🗐			7
6	The Central and Southern Liaoning Urban Agglomeration													🗐			1
7	Shandong Peninsula Urban Agglomeration													🗐			1
8	The Western Coast of the Taiwan Strait Urban Agglomeration									🗐				🗐			2
9	Harbin-Changchun Urban Agglomeration							🗐		🗐			🗐	🗐		🗐	5
10	The Central Plains Urban Agglomeration				🗐			🗐		🗐		🗐	🗐	🗐			6

(continued)

Table 3.1 (continued)

File number	Urban agglomeration	2010, *Some Opinions of the State Council of the CPC Central Committee on in-depth Implementation of Western Development Strategy*	2011, the State Council, *Outline of the 12th Five-Year Plan for Economic and Social Development of the PRC*	2012, the CPC's 18th Congress Report	2012, *Some Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central Region*	2013, Central Urbanization Work Conference	2013, Central Economic Work Conference	2014, the State Council, *National New Urbanization Plan (2014-2020)*	2014, State Council, *Guiding Opinions of the State Council on Promoting the Development of the Yangtze River Economic Belt by Relying on the Golden Waterways*	2015, *Promotion of the Silk Road Economic Zone and the Vision and Action of the Maritime Silk Road in the 21st Century*	2015, *Outline of Beijing-Tianjin-Hebei Coordinated Development Planning*	2015, Central City Work Conference	2015, *Proposals of the Central Committee on Formulating the National Economic and Social Development in the 13th Five-Year Plan*	March 2016, The State Council, *Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*	2015, *The Official Reply of the State Council on the Development Planning of the Middle Reaches of the Yangtze River*	2016, *The Official Reply of the State Council on Harbin-Changchun Urban Agglomeration Development Planning*	Number of times appeared in Central Government and the State Council Documents
11	Jianghuai Urban Agglomeration				🗐											1
12	The Central Shaanxi Urban Agglomeration	🗐										🗐	🗐	🗐			4
13	Guangxi Beibu Gulf Urban Agglomeration	🗐												🗐			2
14	The Northern Slope of the Tianshan Mountains Urban Agglomeration	🗐												🗐			2
15	Jinzhong Urban Agglomeration				🗐									🗐			2
16	Hohhot-Baotou-Ordos-Yulin Urban Agglomeration									🗐				🗐			2

(continued)

Table 3.1 (continued)

File number	Urban agglomeration	2010, *Some Opinions of the State Council of the CPC Central Committee on in-depth Implementation of Western Development Strategy*	2011, the State Council, *Outline of the 12th Five-Year Plan for Economic and Social Development of the PRC*	2012, the CPC's 18th Congress Report	2012, *Some Opinions of the State Council on Vigorously Implementing the Strategy of Promoting the Rise of the Central Region*	2013, Central Urbanization Work Conference	2013, Central Economic Work Conference	2014, the State Council, *National New Urbanization Plan (2014-2020)*	2014, State Council, *Guiding Opinions of the State Council on Promoting the Development of the Yangtze River Economic Belt by Relying on the Golden Waterways*	2015, *Promotion of the Silk Road Economic Zone and the Vision and Action of the Maritime Silk Road in the 21st Century*	2015, *Outline of Beijing-Tianjin-Hebei Coordinated Development Planning*	2015, Central City Work Conference	2015, *Proposals of the Central Committee on Formulating the National Economic and Social Development in the 13th Five-Year Plan*	March 2016, The State Council, *Outline of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China*	2015, *The Official Reply of the State Council on the Development Planning of the Middle Reaches of the Yangtze River*	2016, *The Official Reply of the State Council on Harbin-Changchun Urban Agglomeration Development Planning*	Number of times appeared in Central Government and the State Council Documents
17	Central Yunnan Urban Agglomeration	🗐							🗐					🗐			3
18	Central Guizhou Urban Agglomeration	🗐							🗐					🗐			3
19	Lanzhou-Xining Urban Agglomeration	🗐												🗐			2
20	Areas in Ningxia along the Yellow River Urban Agglomeration	🗐												🗐			1
The number of times of the term urban agglomerations is mentioned		9	2	1	19	2	1	50	40	9	1	7	9	19	51	46	266/72

be a world-class urban agglomeration. The State Council issued Number 62 Letter in 2015 (April 6, 2015) *The Official Reply of the State Council on the Development Planning of the Middle Reaches of the Yangtze River* has pointed out that promoting the development of the urban agglomeration in the Middle Reaches of the Yangtze River is an important support for the Yangtze River Economic Belt, a new economic growth pole of the whole country and an urban agglomeration with certain international influence. In October 2015, the Fifth Plenary Session of the CPC's 18th Central Committee adopted the *Proposals of the Central Committee on Formulating the National Economic and Social Development in the Thirteenth Five-Year Plan* (the Proposal for short). The Proposal suggests optimizing the development of the three world-class urban agglomerations, namely, Beijing-Tianjin-Hebei, Yangtze River Delta and Pearl River Delta Urban Agglomerations, promoting the development of five regional urban agglomerations, namely, the Northeast, the Central Plains, the Middle Reaches of the Yangtze River, Chengdu-Chongqing, and the Central Shaanxi Plain Urban Agglomerations. The Central City Work Conference in December 2015 proposed to improve the development of the Eastern China's urban agglomerations as well as cultivate and develop a group of urban agglomerations in the central and western regions. In March 2016, the State Council issued Number 43 Letter (2016) approved the *Harbin-Changchun Urban Agglomeration Development Plan* (the planning for short). The Planning proposed to construct the Harbin-Changchun Urban Agglomeration centered on Harbin and Changchun, and develop the urban agglomeration to be a green, livable, urban agglomeration with appropriate business environment, important influence and competitiveness.

There are in total 266 times the various urban agglomerations were mentioned in different national documents, 6 times more than at the beginning of the 12th Five-Year Plan (Fig. 3.1). Among them, the Middle Reaches of the Yangtze River Urban Agglomeration has the highest mentioning frequency (8 times). The Yangtze River Delta, Beijing-Tianjin-Hebei and Chengdu-Chongqing Urban Agglomerations were all mentioned 7 times. The Pearl River Delta and the Central Plains Urban Agglomerations were all mentioned 6 times. The Harbin-Changchun Urban Agglomeration was mentioned 5 times. The Central Shaanxi Urban Agglomeration was mentioned 4 times. The Central Guizhou and Central Yunnan Urban Agglomerations were mentioned 3 times. The Western Coast of the Taiwan Strait, the Northern Slope of the Tianshan Mountains, Guangxi Beibu Gulf, Central Shanxi, Hohhot-Baotou-Ordos-Yulin, and Lanzhou-Xining Urban Agglomerations were mentioned twice. The Shandong Peninsula, Central and Southern Liaoning, Jianghuai, and Areas in Ningxia along the Yellow River Urban Agglomerations were mentioned once. We believe the frequency of the mentioning of an urban agglomeration is positively related with how the central government is focusing on the development and future of this urban agglomeration.

3. **More than half of the 23 proposed urban agglomerations have not followed a rational development pattern and expanded blindly**

Among the 23 original urban agglomerations, 9 urban agglomerations have not experienced significant changes in the spatial extent (these are Beijing-Tianjin-Hebei, Pearl River Delta, the Central Yunnan Urban Agglomeration, the Central Guizhou

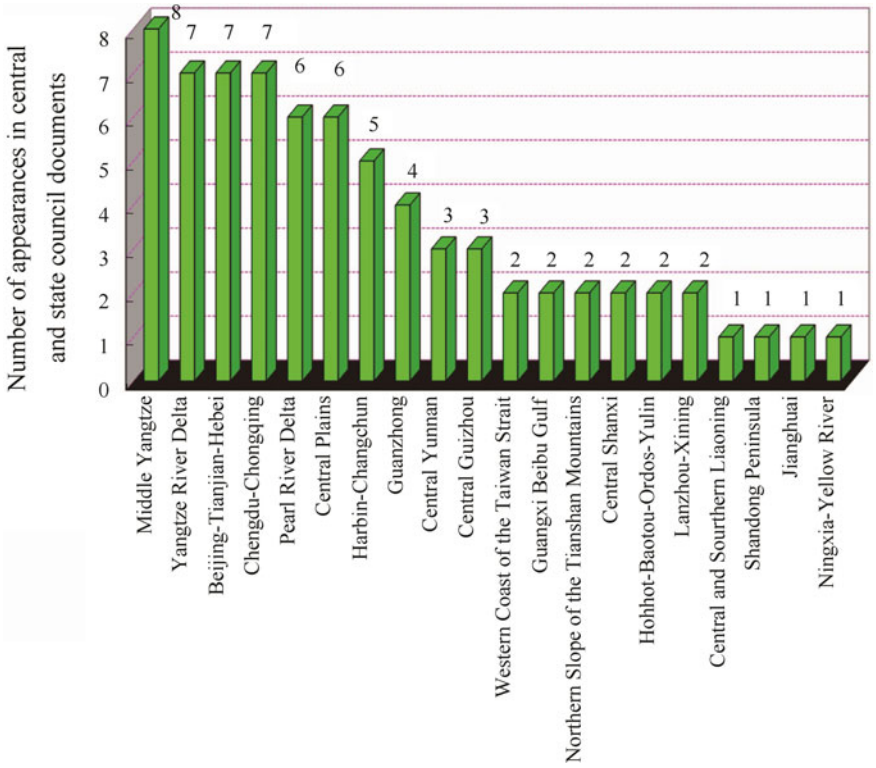

Fig. 3.1 Number of appearances of China's urban agglomerations in the CPC Central Committee and the State Council documents

Urban Agglomeration, Chengdu-Chongqing, Yangtze River Delta, the Yinchuan Plain, the Northern Slope of the Tianshan Mountain. These 9 urban agglomerations contain 45% of the national total. The other urban agglomerations are under the influence of "agglomeration is equivalent to development and expansion", and typically experience significant expansion in geographic extent. For instance, the Nanning-Beihai-Qinzhou-Fangchenggang Urban Agglomeration changed its name to Beibu Gulf Urban Agglomeration. The number of cities in the original urban agglomeration increased from 4 to 6 (Nanning, Beihai, Fangchenggang, Qinzhou, Chongzuo, and Yulin). The original Changsha-Zhuzhou-Xiangtan, Wuhan, and Poyanghu Ring Urban Agglomerations merged to be the Middle Reaches of the Yangtze River Urban Agglomeration. The number of cities increases from 17 to 31 (Wuhan, Huangshi, Ezhou, Xiaogan, Huanggang, Xianning, Xiantao, Qianjiang, Tianmen, Xiangyang, Yichang, Jingzhou, Jingmen, Changsha, Zhuzhou, Xiangtan, Hengyang, Yueyang, Yiyang, Changde, Loudi, Nanchang, Jiujiang, Jingdezhen, Yingtan, Xinyu, Fuzhou, Yichun, Pingxiang, Shangrao and Ji'an). Cities in the Central Shaanxi Urban Agglomeration increased from 6 to 10 (Xi'an, Xianyang, Baoji, Tongchuan, Weinan,

Shangluo, Tianshui, Yan'an, Qingyang, and Pingliang). Cities in the Shandong Peninsula Urban Agglomeration increased from 8 to 13 (Jinan, Qingdao, Yantai, Weihai, Rizhao, Dongying, Weifang, Zibo, Taian, Laiwu, Binzhou, Dezhou, and Liaocheng). Cities in the Western Coast of the Taiwan Strait Urban Agglomeration increased from 6 to 11 (Fuzhou, Xiamen, Quanzhou, Wenzhou, Shantou, Zhangzhou, Putian, Ningde, Chaozhou, Jieyang, Shanwei). Cities in the Hohhot-Baotou-Ordos-Yulin Urban Agglomeration increased from 3 to 7 (Hohhot, Baotou, Ordos, Ulan Qab, Bayannur, Wuhai, and Yulin). After the changes, the number of prefecture level cities in all the urban agglomerations increased from 173 to 198. Although some of the expansion and increase are the results of urban agglomeration development and increased integration, many such expansions, however, are mostly driven by local government's seeking to obtain various benefits by joining an urban agglomeration.

3.2 Fundamental Characteristics of the Healthy Development of China's Urban Agglomerations During the Past 35 Years

From a comprehensive analysis of the development of China's urban agglomerations in the past 35 years, we can see that urban agglomerations are the strategic core areas for China's economic development. The urban agglomerations are still exerting powerful siphon effect over the surrounding hinterlands. In addition, urban agglomerations are the primary locations for implementing China's New Urbanization strategy. The quality of urbanization in urban agglomerations is increasing gradually. On the other hand, urban agglomerations are also locations with most fragile eco-environmental system and locations of concentrated environmental problems and pollution from huge amount of excessive discharge of carbon and $PM_{2.5}$. Urban agglomerations will continue to bear the heavy burden of reducing carbon emissions in the foreseeable future.

3.2.1 Urban Agglomerations Are Strategic Core Regions for National Economic Development with Sustained "Straw-Effects (Gravitational Effects)"

1. **Total economic volume of China's urban agglomerations continues to grow rapidly**

From 1980 to 2014, GDP of China's urban agglomerations grew from 321.895 billion RMB Yuan to 56,427.142 billion RMB Yuan (Table 3.2). This was an annual average growth rate of 16.41%, far faster than the national average. The added-value of the primary industry grew from 80.820 billion RMB Yuan to 3,733.986 billion

Table 3.2 Main economic indicators of China's urban agglomerations, 1980–2014

Year	GDP		GDP growth		Primary industry value added		Secondary industry value added		Tertiary industry value added	
	Total/ (Current price, 100 million RMB Yuan)	Proportion of the country/%	Rate/%	How many times it is of the national average	Total/ 100 million RMB Yuan	Proportion of the country/%	Total/ 100 million RMB Yuan	Proportion of the country/%	Total/ 100 million RMB Yuan	Proportion of the country/%
1980	3,218.95	70.81	8.91	1.14	808.20	58.92	1,734.51	79.13	798.00	71.26
1985	6,550.20	72.65	12.48	0.92	1,700.57	66.31	3,045.64	78.77	1,893.47	73.25
1990	12,438.68	66.63	9.73	2.56	2,843.71	56.18	5,851.38	75.82	3,548.73	60.27
1995	43,459.61	71.49	14.18	1.30	6,697.75	55.19	18,541.76	64.65	14,530.72	72.73
2000	79,325.38	79.95	10.47	1.25	9,949.12	66.57	37,298.90	81.88	31,458.20	81.26
2001	86,615.85	78.99	8.58	1.03	10,450.49	66.22	40,530.77	81.86	35,588.31	80.22
2002	96,015.83	79.79	11.42	1.26	10,904.11	65.94	45,603.65	84.61	39,740.39	79.64
2003	119,513.47	87.99	13.31	1.33	11,567.15	64.89	55,610.27	86.85	44,762.94	77.94
2004	136,114.26	85.14	14.64	1.45	13,508.81	60.02	68,569.97	88.27	53,133.41	78.30
2005	160,985.05	80.81	14.84	1.31	14,552.75	60.26	80,432.70	85.24	65,762.02	81.49
2006	188,356.66	80.73	14.61	1.15	17,666.00	68.13	96,853.69	86.58	73,392.51	76.84
2007	225,708.97	80.69	15.69	1.10	17,655.82	58.61	113,401.42	85.64	92,646.88	79.06
2008	268,652.37	80.60	13.84	1.44	20,610.32	57.62	138,569.72	87.62	109,166.69	78.31

(continued)

Table 3.2 (continued)

Year	GDP		GDP growth		Primary industry value added		Secondary industry value added		Tertiary industry value added	
	Total/ (Current price, 100 million RMB Yuan)	Proportion of the country/%	Rate/%	How many times it is of the national average	Total/ 100 million RMB Yuan	Proportion of the country/%	Total/ 100 million RMB Yuan	Proportion of the country/%	Total/ 100 million RMB Yuan	Proportion of the country/%
2009	299,891.12	82.09	13.35	1.45	22,341.94	59.19	145,555.94	86.17	135,703.87	85.55
2010	356,998.65	81.75	14.71	1.41	25,073.72	56.83	181,092.92	88.79	150,331.53	79.56
2011	427,819.21	82.05	14.50	1.56	29,812.26	56.96	219,092.41	90.19	178,003.20	78.70
2012	476,837.98	82.71	12.54	1.63	33,072.92	56.84	240,636.03	92.10	202,982.89	78.95
2013	523,398.92	83.08	11.17	1.45	35,860.92	56.85	259,603.71	93.88	227,912.90	78.48
2014	564,271.42	82.46	9.00	1.22	37,339.86	59.54	272,829.43	93.51	254,149.81	77.07
Annual average growth rate over the 35 years/%	16.41	4.36	—	—	11.57	0.03	15.55	0.48	17.90	0.22

RMB Yuan, an average growth rate of 11.57%. The added-value of the secondary industry grew from 173.451 billion RMB Yuan to 27,282.943 billion RMB Yuan, an average growth rate of 15.55%. The added-value of the tertiary industry grew from 79.800 billion RMB Yuan to 25,414.981 billion RMB Yuan, an average growth rate of 17.90%. As China's industrialization and urbanization accelerate, various production factors and industries will continue to concentrate to urban agglomerations. Their total economic volume will continue to grow. Such powerful siphon effect will continue for quite some time [3].

From the analysis of economic growth rate, the growth rates of China's urban agglomerations have been higher than the national average growth rate. From 1980 to 2014, GDP of China's urban agglomerations grew at an average rate of 15.91%, while the entire county's average annual GDP growth rate was 15.34% (fastest at 15.69% in 2007, and slowest was 8.91% in 1980). This suggests that urban agglomerations in China have served as a strong engine for China's economic development, ensuring that the national economy maintains an 8–10% annual growth rate for many years, rapidly connecting with the global economy and becoming the second largest economy in the world.

2. **The economic core status of China's urban agglomerations continues to rise**

From the analysis of economic status, GDP of China' urban agglomerations in 1980 only accounted for 70.81% of the national GDP but increased to 82.46% in 2014, with an average annual growth rate of 4.36%. Among them, the ratio of the added value of the primary industry increased slowly from 58.92 to 59.54%, an average annual growth rate of 0.03%. The ratio of the added value of the secondary industry increases from 79.13 to 93.51%, an average annual growth rate of 0.48%. The ratio of the added value of the tertiary industry increases from 71.26 to 77.07%, an average annual growth rate of 0.22%. The economic status of the urban agglomerations continues to grow, even when they are at very high levels (Fig. 3.2).

By 2014, the total area of China's urban agglomerations accounted for 28.17% of China's total land area. Among them, urban construction land accounted for 68.7%. The total population accounted for 68.09% of the national total. The urban population accounted for 73.12%. The total economic volume accounted for 82.46% of the national total. Among them, value added of the primary industry accounted for 59.54%; the value added of the secondary industry accounted for 93.51%; the value added of the tertiary sector accounted for 77.07%. The total retail sales of social consumer goods accounted for 81.59% of the national total. The total fixed investment accounted for 75.14% of the national total. The actual use of foreign investment accounted for 90.53% of the national total. The total import and export accounted for 90.3% of the national total. Local fiscal revenue accounted for 83.39% of the national total. The end of the year financial institutions savings accounted for 84.4% of the national total. The number of local telephone users accounted for 75.19% of the national total. The number of mobile phone users accounted for 83.73% of the national total. The number of Internet users accounted for 95.89% of the national total. The number of university students accounted for 93.79% of the national total. The number of patents licensing accounted for 83.57% of the national total.

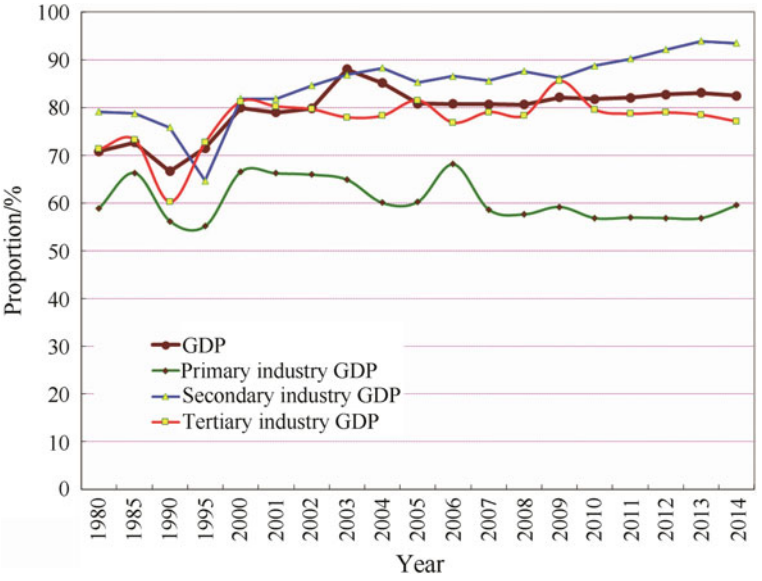

Fig. 3.2 A sketch of the rising economic status of China's urban agglomeration

3. **The economic structure of China's urban agglomerations continues to optimize**

From the analysis of the industrial structure of China's urban agglomerations, we can see from 1980 to 2014, the proportions of the added values of primary and secondary industries in China's urban agglomerations constantly decreased. The proportion of the added value of the primary industry decreased from 24.19% in 1980 to 6.62% in 2014. The proportion of the added value of the secondary industry decreased from 51.92% in 1980 to 48.35% in 2014. On the contrary, the proportion of the added value of the tertiary industry (especially the high-end service industries) increased continuously from 23.89% in 1980 to 45.04% in 2014. The proportion of the added value of all non-agricultural industries in the urban agglomerations increased from 75.81% in 1980 to 93.98% in 2014 (Fig. 3.3 and Table 3.3). This suggests that the industrial structure of China's urban agglomerations continues to optimize with continuously increasing proportion of the tertiary industry and decreasing proportion of the primary and secondary industries.

From the analysis of employment structure of China's urban agglomerations, from 1980 to 2014, the proportion of the labor force in the primary industry in China's urban agglomerations decreased from 54.82% in 1980 to 26.70% in 2014. On the contrary, the proportions of labor force in the secondary and tertiary industries were rising. The proportion of the labor force in the secondary industry increased from 26.77% in 1980 to 33.64% in 2014; the proportion of labor force in the tertiary industry increased from 18.40% in 1980 to 39.66% in 2014; and the proportion of non-agricultural labor force in urban agglomeration was 45.17% in 1980 but went up

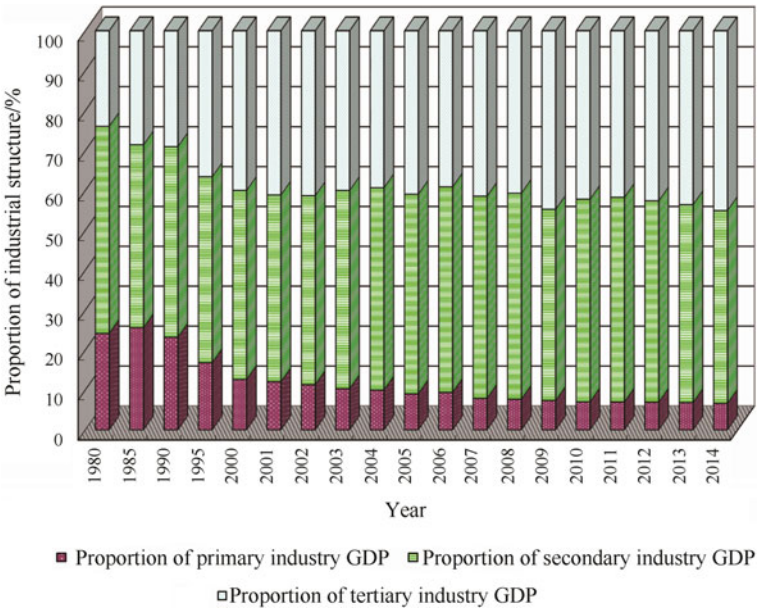

Fig. 3.3 Industrial structure of Chinese urban agglomerations

to 73.3% in 2014 (Table 3.3 and Fig. 3.4). It shows that the employment structure of China's urban agglomeration is continuously optimized. This is mainly manifested as the proportion of the labor force in the tertiary industry continues to increase, and the proportions of labor forces in the primary industry and secondary industry will gradually decrease with the continuous optimization of the employment structure.

3.2.2 Urban Agglomerations Are the Primary Locations for Implementing China's New Urbanization Strategy, and the Quality and Level of Urbanization Within Continues to Improve

1. **Urbanization level of China's urban agglomeration continues to rise**

From the analysis of population agglomeration in China's urban agglomeration, from 1980 to 2014, the total population of China's urban agglomeration increased from 446.7995 million to 931.3558 million, and the average annual growth rate was 2.12%. The total population of urban agglomeration accounted for the proportion of the total population of the country increased from 45.27 to 68.09%, with an average annual increase rate of 1.17% over the years (Tables 3.4 and 3.5), reflecting the further concentration of the total population of urban agglomerations in China in the past

Table 3.3 China's urban agglomeration industrial structure and employment structure change from 1980 to 2014

Year	GDP total /(Current price, 100 million RMB Yuan)	Proportion of primary industry added value/%	Proportion of secondary industry added value/%	Proportion of value added in tertiary industry/%	Labor force in the whole society/10 thousand people	The proportion of labor force in the primary industry/%	The proportion of labor force in the secondary industry/%	The proportion of labor force in the tertiary industry/%
1980	3,218.95	24.19	51.92	23.89	17,187.40	54.82	26.77	18.40
1985	6,550.20	25.61	45.87	28.52	21,210.10	50.94	29.38	19.68
1990	12,438.68	23.23	47.79	28.98	28,674.81	49.09	28.07	22.84
1995	43,459.61	16.84	46.62	36.54	34,717.67	44.49	29.61	25.91
2000	79,325.38	12.64	47.39	39.97	34,502.62	44.89	25.27	29.85
2001	86,615.85	12.07	46.82	41.11	35,054.98	43.67	25.16	31.17
2002	96,015.83	11.33	47.38	41.29	38,113.83	42.06	24.91	33.03
2003	119,513.47	10.33	49.68	39.99	39,654.67	40.82	25.93	33.26
2004	136,114.26	9.99	50.71	39.30	40,479.12	39.25	26.67	34.09
2005	160,985.05	9.05	50.04	40.91	41,607.94	37.67	27.92	34.41
2006	188,356.66	9.40	51.54	39.06	41,891.10	36.31	28.70	34.99
2007	225,708.97	7.89	50.69	41.41	43,240.04	34.42	30.09	35.49
2008	268,652.37	7.68	51.64	40.68	43,826.84	33.49	30.64	35.87
2009	299,891.12	7.36	47.94	44.70	44,923.53	32.37	31.22	36.41
2010	356,998.65	7.03	50.80	42.17	46,365.83	31.37	31.33	37.29
2011	427,819.21	6.98	51.32	41.70	51,596.04	29.35	32.88	37.77
2012	476,837.98	6.94	50.48	42.58	52,537.34	28.39	33.27	38.34
2013	523,398.92	6.85	49.60	43.55	53,606.74	27.43	33.52	39.05
2014	564,271.42	6.62	48.35	45.04	54,291.54	26.70	33.64	39.66

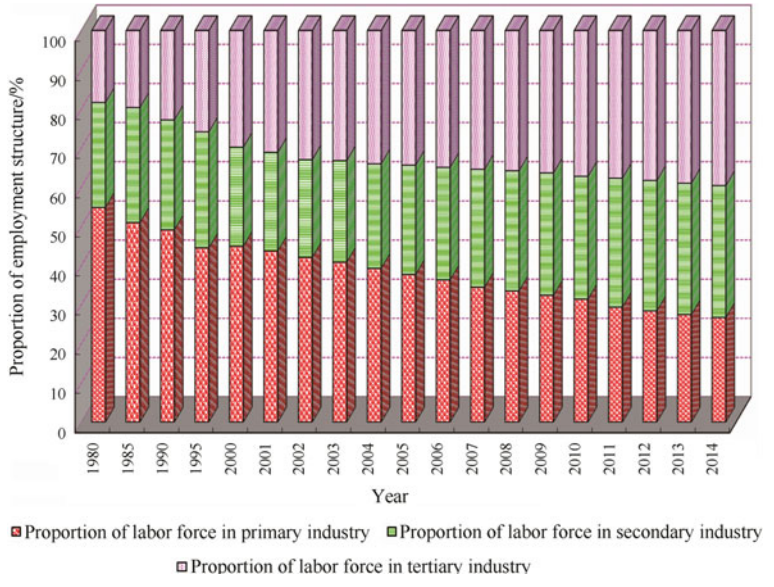

Fig. 3.4 Employment structure of Chinese urban agglomerations

35 years. It is obvious that urban agglomerations will continue to be a high-density in the future [4].

From the analysis of population agglomeration in urban agglomerations in China, from 1980 to 2014, the urban population of China's urban agglomerations increased from 94.0111 million to 547.8017 million, and the average annual growth rate was 5.16%. Urban population in urban agglomerations increased from 57.5% in 1980 to 73.12% in 2014, with an 0.69% average annual rate of increase. This suggests that in the past 35 years, the urban population in urban agglomerations in China is further concentrated in urban agglomeration areas. Urban agglomerations are not only today but also the future of China's high-density agglomerated area of urban population. It is also the primary area of urbanization in China.

From the analysis of the urbanization level of urban agglomeration in China, from 1980 to 2014, the urbanization level of China's urban agglomerations increased from 21.04 to 58.82%, 5.22% higher than the national average level of urbanization in the same period, the average growth rate was 2.98% over the years, and the level of urbanization will continue to rise in the near future.

From the analysis of the number of cities and towns in China's urban agglomerations, the number of cities increased from 183 to 434 from 1980 to 2014, an annual average increase of 2.57%. The number of towns increased from 4,324 to 12,994 in the same period, an annual average increase of 3.74%. There is a clear trend of concentration for both cities and towns in the urban agglomerations.

From the analysis of the increase of urban construction land in China's urban agglomeration, we can see that from 1980 to 2014, the urban construction land of

Table 3.4 Urbanization and social development in China's urban agglomerations, 1980–2014

Year	Total area/km^2	Urban construction land area/km^2	Population /10,000 people	Number of cities	Number of towns	Urban population /10,000 people	Average salary of workers /RMB Yuan	Per capita disposable income of urban residents /RMB Yuan	Per capita disposable income of rural residents /RMB Yuan	Number of college students in school/10,000 people	Number of doctors /10,000 people	Number of patent applications processing	Authorized number of patents
1980	1,244,242	3,581.96	44,679.95	183	—	9,401.11	762	478	191	114.40	115.30	—	—
1985	1,614,656	6,405.02	53,410.35	234	4,324	12,895.23	1,148	739	397	170.30	141.30	14,372	8,138
1990	1,745,271	7,716.08	62,300.12	317	5,217	15,551.57	2,140	1,510	686	206.30	176.30	41,469	22,588
1995	1,767,419	9,878.18	69,265.29	423	6,716	18,989.54	5,500	4,283	1,577	290.60	191.80	83,045	45,064
2000	2,307,037	13,092.44	77,420.96	448	11,694	23,679.71	9,371	6,280	2,253	556.10	207.60	170,682	105,345
2001	2,421,932	14,221.66	76,898.40	446	11,063	24,663.49	10,870	6,860	2,366	719.10	210.00	203,573	114,251
2002	2,473,020	16,335.49	78,137.62	443	12,226	25,917.64	12,422	7,703	2,475	903.40	184.40	252,631	132,399
2003	2,632,561	19,580.26	79,071.96	448	11,990	28,048.87	13,969	8,472	2,622	1,108.60	186.80	308,487	182,226
2004	2,629,809	20,456.98	79,617.73	447	11,905	29,091.00	15,920	9,421	2,936	1,333.50	190.60	353,807	190,238
2005	2,646,419	22,483.86	80,271.17	448	1,1844	31,183.80	18,200	13,083	3,254	1,561.80	193.80	476,264	214,003
2006	2,644,759	23,375.72	80,664.13	447	12,033	32,352.32	20,856	11,759	3,587	1,738.80	199.49	573,178	268,002
2007	2,630,336	24,890.33	81,920.52	447	11,733	34,129.59	24,721	17,189	4,140	1,884.90	204.00	693,917	351,782
2008	2,633,258	26,189.49	85,579.49	447	12,350	35,883.23	28,898	15,780	4,760	2,021.00	208.23	828,328	411,982
2009	2,632,455	27,302.92	86,192.70	446	12,993	38,999.94	32,244	21,502	5,153	2,144.70	232.92	976,686	581,992

(continued)

Table 3.4 (continued)

Year	Total area/km^2	Urban construc-tion land area/km^2	Population /10,000 people	Number of cities	Number of towns	Urban population /10,000 people	Average salary of workers /RMB Yuan	Per capita disposable income of urban residents /RMB Yuan	Per capita disposable income of rural residents /RMB Yuan	Number of college students in school/10,000 people	Number of doctors /10,000 people	Number of patent applications processing	Authori-zed number of patents
2010	2,632,801	29,392.49	87,181.27	446	13,031	43,806.95	36,539	19,109	5,919	2,231.80	241.00	1,222,286	814,825
2011	2,709,564	30,868.19	91,322.63	443	12,946	49,916.50	41,799	21,810	6,977	2,308.50	246.60	1,633,347	960,513
2012	2,697,541	32,103.44	91,896.47	442	12,922	51,553.74	46,769	24,564	7,917	2,391.30	252.00	2,050,649	1,255,138
2013	2,703,868	33,484.88	92,422.38	438	13,008	52,902.89	51,483	26,955	8,896	2,468.10	261.60	2,377,061	1,313,000
2014	2,704,160	34,271.78	93,135.58	434	12,994	54,780.17	56,339	28,844	10,489	2,547.70	282.00	2,361,243	1,302,687
Annual average growth rate/%	2.24	6.66	2.12	2.51	3.74	5.16	13.08	12.43	12.13	9.28	2.59	18.53	18.43

Table 3.5 Urbanization and social development changes in China's urban agglomerations, 1980–2014

Year	Proportion of land area/%	Proportion of urban construction land/%	Proportion of population/%	Proportion of number of cities/%	Proportion of number of towns/%	Proportion of cities' population/%	Urbanization level/%	Average salary of workers/%	Per capita disposable income of urban residents/%	Per capita disposable income of rural residents/%	Number of college students in school/%	Number of doctors/%	Number of patent applications/%	Authorized amount of patents/%
1980	12.96	51.17	45.27	62.06	—	57.50	21.04	103.51	101.83	103.01	88.80	56.66	—	—
1985	16.82	74.66	50.46	72.22	47.31	61.25	24.14	107.07	105.80	107.92	89.83	56.75	65.62	66.23
1990	18.18	66.47	54.49	67.88	43.17	65.10	24.96	101.03	102.97	106.57	89.72	66.73	65.41	68.04
1995	18.41	44.77	57.19	66.09	38.31	66.48	27.42	104.31	101.09	108.27	85.39	63.27	60.37	68.88
2000	24.03	59.20	61.08	67.57	57.57	51.58	30.59	109.84	108.38	132.96	89.58	65.59	63.99	71.22
2001	25.23	58.78	60.25	67.37	54.30	51.31	32.07	109.95	107.24	117.07	90.67	65.96	69.97	68.28
2002	25.76	60.50	60.83	67.12	59.35	51.62	33.17	110.65	107.01	119.90	92.43	67.65	72.16	63.16
2003	27.42	67.52	61.19	67.88	59.28	53.55	35.47	110.01	107.13	141.57	91.63	67.46	65.82	67.34
2004	27.39	65.99	61.25	67.62	59.88	53.59	36.54	110.24	102.06	119.36	88.70	67.84	64.98	65.63
2005	27.57	75.86	61.39	67.78	60.67	55.48	38.85	109.28	104.13	117.24	92.74	68.61	66.70	67.27
2006	27.55	73.05	61.37	68.14	62.13	55.50	40.11	102.16	101.77	118.22	92.83	70.32	68.90	70.09
2007	27.40	68.47	62.00	68.24	60.95	56.29	41.66	109.71	103.26	116.55	91.09	74.65	72.37	73.40
2008	27.43	66.91	64.44	68.24	64.21	57.50	41.93	109.20	108.96	114.74	91.10	78.02	75.24	73.64
2009	27.42	70.01	64.59	68.09	67.24	60.45	45.25	109.88	103.45	118.02	91.33	72.05	76.07	73.70

(continued)

Table 3.5 (continued)

Year	Proportion of land area/%	Proportion of urban construction land/%	Proportion of population/%	Proportion of number of cities/%	Proportion of number of towns/%	Proportion of cities' population/%	Urbanization level/%	Average salary of workers/%	Per capita disposable income of urban residents/%	Per capita disposable income of rural residents/%	Number of college students in school/%	Number of doctors/%	Number of patent applications/%	Authorized amount of patents/%
2010	27.43	73.93	65.02	67.88	67.14	65.40	50.25	109.49	102.43	118.41	91.40	73.24	76.69	79.21
2011	28.22	73.74	67.78	67.33	65.77	72.26	54.66	109.39	102.31	118.32	91.80	76.30	67.55	71.56
2012	28.10	70.17	67.87	67.28	65.00	72.43	56.10	110.07	102.73	118.80	91.10	79.24	80.11	81.67
2013	28.17	71.08	67.92	66.57	64.66	72.36	57.24	109.70	103.03	119.46	92.73	80.75	80.67	81.76
2014	28.17	68.57	68.09	66.87	63.70	73.12	58.82	108.91	109.70	110.72	93.79	79.49	81.20	83.57
Annual average growth rate/%	2.24	0.84	1.17	0.21	1.26	0.69	2.98	0.15	0.23	0.21	0.16	0.97	1.04	0.66

China's urban agglomeration increased from 3,581.96 to 34,271.78 km^2, with an average growth rate of 6.66% over the years. The proportion of urban construction land in urban agglomerations increased from 51.17 to 68.57%, and the average growth rate was 0.84%.

2. **Quality of life in China's urban agglomerations continues to improve**

Using the average salary of workers, the per capita disposable income of urban residents, the per capita disposable income of rural residents and the number of doctors in urban agglomeration area as the primary indicators for residents' quality of life, it is clear that the quality of life in China's urban agglomerations keep rising over the years. Specifically, the average salary of employees in China's urban agglomeration area increased from 762 RMB Yuan to 56,339 RMB Yuan from 1980 to 2014, an average annual growth rate of 13.08%. The average salary of workers in the urban agglomerations were generally higher than the average salary of workers of the entire country (Fig. 3.5).

From 1980 to 2014, the per capita disposable income of urban residents in China's urban agglomerations increased from 478 RMB Yuan to 28,844 RMB Yuan, an average annual growth rate of 12.43%. The per capita disposable income of urban residents in urban agglomerations is generally higher than the average per capita disposable income of urban residents in China. The per capita disposable income of rural residents in China's urban agglomerations also increased from 191 RMB Yuan to 10,489 RMB Yuan, an average annual growth rate of 12.13%. Again, the per capita disposable income of rural residents in urban agglomerations is generally higher than the average per capita disposable income of rural residents in China. The number of doctors in China's urban agglomerations increased from 1.153 million to 2.82 million, an average annual growth rate of 2.59%, the proportion of doctors in urban agglomerations over the entire country also increased from 56.66 to 79.49%, an average annual growth rate of 0.97%.

3. **Innovation level in China's urban agglomerations continues to improve**

Using R&D investment, the number of students in colleges and universities, the number of patent applications and the number of patents authorization, we can build a rough image reflecting the innovation level of urban agglomeration in China. Analyses of these indicators suggest that the overall innovation ability of China's urban agglomeration continues to improve. From 1980 to 2014, the R&D investment of China's urban agglomerations increased from 3.125 billion Yuan to 525.386 billion Yuan, an average annual growth rate of 15.77%. The proportion of urban agglomerations' R&D investment in the national total investment increased from 10.71 to 45.86%, an average annual growth rate of 4.24%. From 1980 to 2014, the number of students in China's urban agglomerations' colleges and universities increased from 1.144 million to 25.477 million, an average annual growth rate of 9.28%. The proportion of college and university students in urban agglomerations of the national total increased from 88.8 to 93.79%, an average annual growth rate of 0.16%. From the analysis of patent applications in China's urban agglomerations, from 1985 to 2014, the number of patent applications in China's urban agglomerations increased

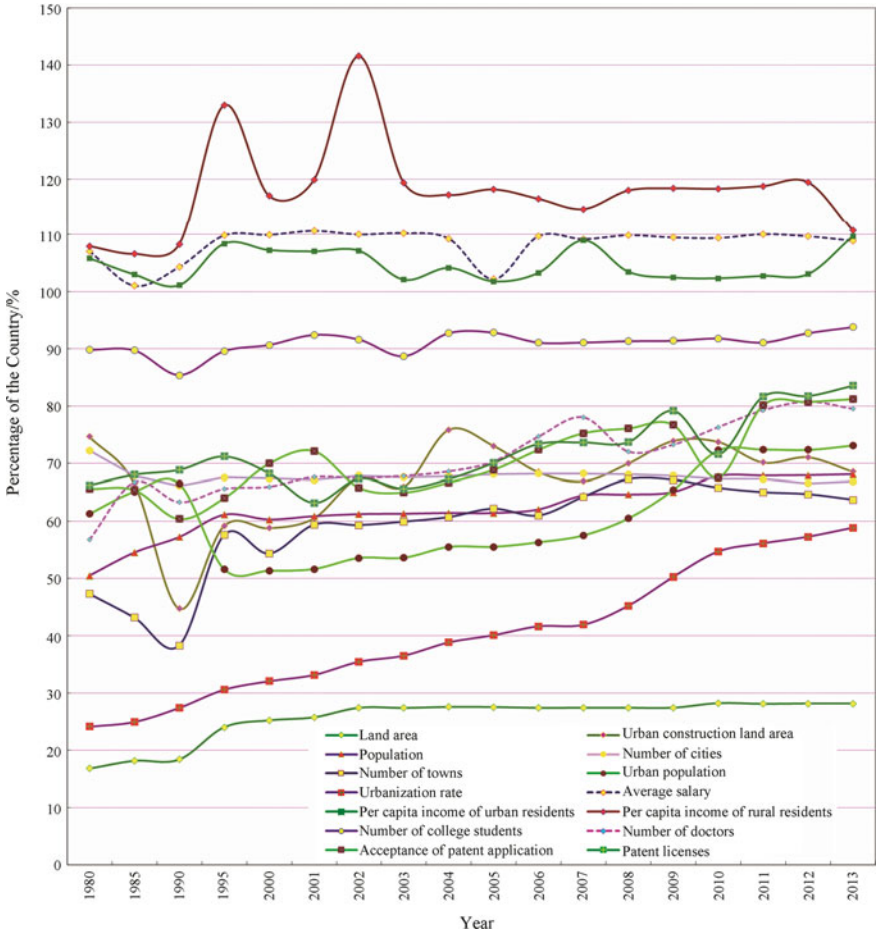

Fig. 3.5 Urbanization and social development level of China's urban agglomerations

from 14,372 to 2,361,243, an average annual growth rate of 18.53%, and the proportion of patent applications in urban agglomerations of the national total increased from 65.62 to 81.2%, an average annual growth rate of 1.02%. In addition, from 1985 to 2014, the number of patent authorizations in China's urban agglomeration increased from 8,138 to 1,302,687, an average annual growth rate of 18.43%, and the proportion of patent authorization in urban agglomerations among the national total increased from 66.23 to 83.57%, an average annual growth rate of 0.66%.

3.2.3 *Urban Agglomerations Are the Least Vulnerable Regions of All Urban Regions; Their Sustainability Continues to Improve*

Urban vulnerability refers to the ability of cities to resist the interference of internal and external natural and human factors, such as resources, ecological environment, economy and social development, in the course of development. When such ability is below a certain critical threshold, the city enters a vulnerable status. Urban vulnerability is a comprehensive concept composing of urban resource vulnerability, ecological environment vulnerability, economic vulnerability and social vulnerability. Studies on the evaluation and regulation of urban vulnerability is of great significance to improve the quality of urbanization and realize the sustainable development of cities in China.

1. **The general urban vulnerability in China is moderate**

Using the system analysis method and the comprehensive index evaluation method, we generate 10 urban vulnerability indexes from resource, eco-environment, economic, and social vulnerability, namely, the vulnerability index of urban resource utilization, the vulnerability index of urban resource security, the urban ecological vulnerability index, the urban environmental vulnerability index, the urban economic structure index, the economic efficiency index, the urban economic innovation index, the urban human development index, the urban infrastructure vulnerability index and the urban social environment vulnerability index. We selected 36 specific indicators for these 10 indexes, constructed a comprehensive measurement indicator system of urban vulnerability in China, and determined the standard value. We then evaluated all prefecture-level cities' urban vulnerability and their spatial pattern in China since 1990. The results suggest that urban vulnerability in China shows obvious "differential" spatial pattern and is generally in a moderate vulnerability status. Based on this analysis, we divided Chinese cities into five different levels of vulnerability, namely, low vulnerability, somewhat low vulnerability, moderate vulnerability, somewhat high vulnerability and high vulnerability [5, 6].

2. **Urban vulnerability in urban agglomerations is generally lower than other regions**

Further analysis shows that China's urban vulnerability has a typical "gradient" and "clustering" spatial pattern. Specifically, urban vulnerability in the eastern region is significantly lower than that in the central and western regions. Urban vulnerability in urban agglomerations is lower than in other regions. We can see from Fig. 3.6 that cities with low urban vulnerability show a clear agglomerated pattern. The areas with low urban vulnerability and concentrated distribution include the areas of urban agglomeration such as Harbin-Changchun, Central and Southern Liaoning, Beijing-Tianjin-Hebei, Hohhot-Baotou-Ordos, Shandong Peninsula, Yangtze River Delta, Pearl River Delta, Middle Reaches of the Yangtze River, Western Coast of the Taiwan Strait, and Chengdu-Chongqing urban agglomerations,

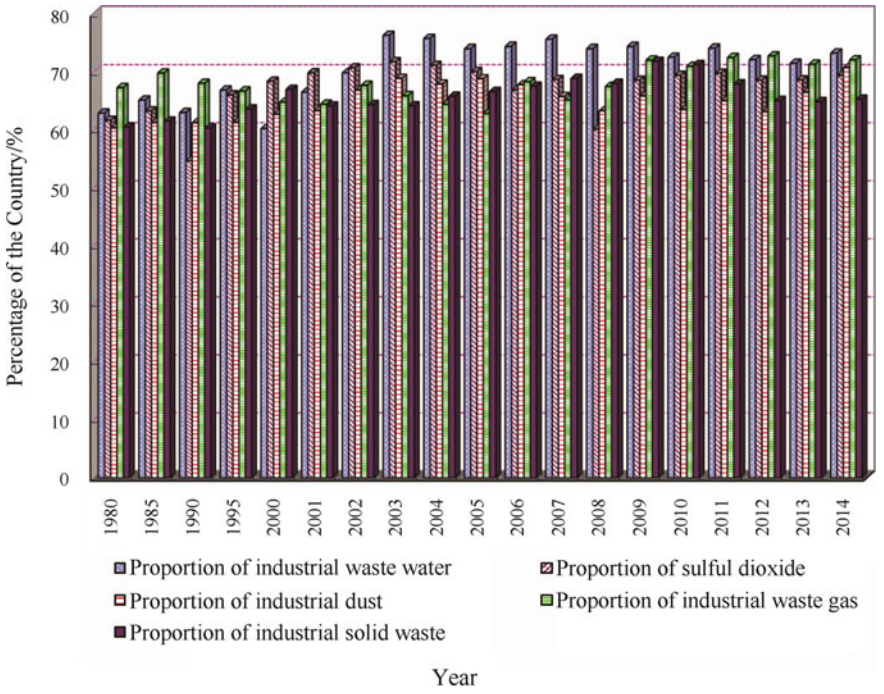

Fig. 3.6 Proportion of environmental pollution in Chinese urban agglomerations

which are consistent with the spatial distribution of China's major urban agglomerations. In the urban agglomeration areas, the cities with low vulnerability index include Changchun and Harbin of the Harbin-Changchun Urban Agglomeration, Shenyang and Dalian of the Central and Southern Liaoning Urban Agglomeration, Beijing and Tianjin of the Beijing-Tianjin-Hebei Urban Agglomeration, Ordos of the Hohhot-Baotou-Ordos-Yulin Urban Agglomeration, Qingdao, Yantai and Jinan of the Shandong Peninsula Urban Agglomeration, Shanghai, Nanjing, Wuxi, Ningbo, Yangzhou, Suzhou, Changzhou, Taizhou, Zhoushan, Zhenjiang of the Yangtze River Delta Urban Agglomeration, Shenzhen, Zhuhai, Xiamen, Guangzhou, Zhongshan, Dongguan of the Pearl River Delta Urban Agglomeration, Wuhan, Changsha of the Middle Reaches of the Yangtze River Urban Agglomeration, Fuzhou, Xiamen of the Western Coast of the Taiwan Strait, Chengdu, Chongqing of the Chengdu-Chongqing Urban Agglomeration. It can be seen that China's low vulnerability cities are mainly concentrated in the eastern urban agglomerations. There are individual cities with relatively low vulnerability scattered in the central and western provinces. They are mainly provincial capital cities and central cities. On the other hand, cities with higher vulnerability are concentrated in the Northeast old industrial bases, the Northwest arid area and the Southwest region. It can be seen that developing urban agglomeration is the main means to reduce urban vulnerability, and also an important way to promote healthy urbanization and improve the level of urbanization development. In the future,

we should build a variety of urban agglomerations with different sizes, guide various production factors to agglomerate orderly, minimize urban vulnerability through the construction of urban agglomerations, improve the quality of urban development, and enhance the sustainable development ability of urban agglomerations.

3.2.4 Urban Agglomerations Are Still Heavily Polluted Regions in China

Influenced by extensive economic development model, China's urban agglomerations are releasing a huge amount of overload pollution while keeping more than 80% of the country's economic output, which makes urban agglomerations at the same time the "key areas" of both economic development and environmental pollution.

1. **China's urban agglomerations discharge the largest amount of waste water, accounting for more than 73% of the national total**

From 1980 to 2014, the total amount of industrial waste water discharge in China's urban agglomerations increased first and then dropped, from 14.684,693 billion tons in 1980 to 17.977 billion tons in 2005, after 2005, with the strengthening of water pollution control and the increase of the utilization rate of sewage recycle in the industrial sector, waste water discharge showed a decreasing trend, reduced to 15.095 billion tons in 2014, the overall trend of the 35 years is still a slow increase with an average annual average growth rate of 0.8%. In the future, with the development of water-saving industries and the upgrading of industrial structures, industrial waste water emissions will be further reduced (Tables 3.6 and 3.7, and Fig. 3.6).

Over the 35 years from 1980 to 2014, the proportion of the amount of industrial waste water discharged from China's urban agglomerations of China's total industrial waste water, also shows rising and dropping pattern. It increased from 62.88% in 1980 to 76.22% in 2003. After 2005, with the strengthening of water pollution control and the increase of the utilization rate of sewage cycle in the industrial sector showed a decreasing trend, by 2014, the proportion decreased slightly to 73.21%, the proportion of the total industrial waste water discharge in the urban agglomerations over the 35 years still increased slightly with an average annual growth rate of 0.08%. In the future, with the development of water-saving industries and the upgrading of industrial structure, the proportion of urban agglomerations' industrial waste water discharge will be gradually reduced (Table 3.7 and Fig. 3.6).

2. **China's urban agglomerations emit the largest amount of waste gases, accounting for more than 72% of the national total**

In 1985–2014, our analysis suggests that the total industrial gas emissions from China's urban agglomerations increased sharply from 516 million m^3 in 1985 to 3.683 billion m^3 in 2010 and 4.017 billion m^3 in 2014, with a maximum of 4.887 billion m^3 in 2011, and an average annual growth rate of 7.07%. This is one of

Table 3.6 Environmental pollution indices of China's urban agglomerations from 1980 to 2014

Year	Total discharge of industrial waste water/10,000 tons	Industrial sulfur dioxide emissions/10,000 tons	Industrial soot emissions/tons	Total industrial emissions/10,000 m^3	Production of industrial solid waste/10,000 tons
1980	1,468,469.30	–	–	–	29,467.20
1985	1,676,136.10	–	–	51,613.20	29,767.49
1990	1,565,836.20	–	–	58,070.43	34,849.99
1995	1,483,043.74	927.35	513.33	71,671.75	40,995.40
2000	1,1695,95.45	1,102.26	597.15	89,484.23	54,636.90
2001	1,347,197.39	1,093.82	539.04	103,623.54	56,933.40
2002	1,446,418.27	1,103.44	537.26	118,578.53	60,791.06
2003	1,617,702.22	1,284.87	582.26	131,018.34	64,416.65
2004	1,673,625.60	1,344.23	601.85	153,044.82	78,938.57
2005	1,797,747.21	1,518.28	652.53	168,921.86	89,533.10
2006	1,785,433.91	1,493.38	586.13	225,990.91	102,269.57
2007	1,863,557.49	1,468.88	506.59	252,863.64	120,910.87
2008	1,786,984.83	1,196.66	424.52	272,418.92	129,295.22
2009	1,741,792.04	1,278.36	397.71	313,951.87	146,397.88
2010	1,721,660.96	1,293.48	382.78	368,260.36	171,620.51
2011	1,710,036.51	1,406.51	388.89	488,683.75	220,805.91
2012	1,597,043.16	1,309.99	356.21	462,166.91	214,022.08
2013	1,529,865.64	1,258.53	360.60	425,314.51	212,495.36
2014	1,509,528.31	1,206.84	368.18	401,650.64	212,488.87
Average annual growth rate/%	0.08	1.32	−1.64	7.07	5.81

the main reasons for the serious air pollution and haze problems in China's urban agglomeration areas.

Of the total industrial emissions from urban agglomerations, industrial sulphur dioxide emissions increased from 9.2735 million tons in 1995 to 12.0684 million tons in 2014, with an average annual growth rate of 1.32%. From 1985 to 2014, the proportion of total industrial waste gas emissions of China's urban agglomerations in the nation increased from 69.77% in 1985 to 72.04% in 2014, an average annual growth rate of 0.11%. Over the same period, the proportion of industrial sulphur dioxide emissions in urban agglomerations increased from 66.0% to 69.35%, the proportion of industrial soot emissions increased from 61.26% to 70.71%, with average annual growth rate of 0.25% and 0.72%, respectively.

Table 3.7 The proportion of environmental pollution of China's urban agglomerations in the national total

Year	The proportion of the total industrial waste water emissions/%	The proportion of industrial sulfur dioxide emissions/%	The proportion of industrial soot emissions/%	The proportion of total industrial emissions/%	The proportion of industrial solid waste/%
1980	62.88	–	–	–	60.48
1985	65.12	–	–	69.77	61.49
1990	62.96	–	–	68.01	60.30
1995	66.84	66.00	61.26	66.69	63.58
2000	60.21	68.36	62.66	64.78	66.95
2001	66.49	69.81	63.27	64.42	64.09
2002	69.81	70.66	66.82	67.66	64.32
2003	76.22	71.72	68.83	65.87	64.14
2004	75.68	71.09	67.85	64.39	65.77
2005	73.95	70.02	68.76	62.80	66.59
2006	74.33	66.82	67.76	68.28	67.49
2007	75.55	68.64	65.71	65.14	68.84
2008	73.95	60.10	63.27	67.45	68.00
2009	74.31	68.51	65.80	72.00	71.78
2010	72.50	69.38	63.46	70.93	71.23
2011	74.03	69.73	64.99	72.45	67.91
2012	72.07	68.52	63.10	72.72	65.04
2013	71.44	68.58	66.46	71.30	64.84
2014	73.21	69.35	70.71	72.04	65.26
Average annual increase rate/%	0.43	0.25	0.72	0.11	0.22

3. **China's urban agglomerations produce the largest amount of solid waste, accounting for more than 65% of the national total**

From the analysis of total industrial solid waste disposal from China's urban agglomerations, from 1980 to 2014, the total amount of industrial solid waste disposal in China's urban agglomerations increased sharply, from 294.6 million tons in 1980 to 2.125 billion tons in 2014, with an average annual growth rate of 5.81%. From 1980 to 2014, the proportion of the total amount of industrial solid waste disposal from China's urban agglomerations in the nation also showed an increasing trend from 60.48% in 1980 to 65.26% in 2014, with an average annual growth rate of 0.22%.

3.2.5 China's Urban Agglomerations Are the Largest Carbon Producer with Pressing Carbon Emission Reduction Responsibility

The CO_2 emission intensity of 343 prefecture-level cities in China was simulated by using the DMSP/OLS-based night lighting data, and after analyzing the spatial and temporal patterns and emission type transfer, 20 urban agglomerations were used as research subjects to calculate their CO_2 emission intensity and the emission reduction potential of urban agglomerations. The results show that China's urban agglomerations, as the core areas for economic development and implementing the new urbanization strategy, have also become the most intense carbon emission area. Since the total economic volume of China's urban agglomerations accounts for more than 80% of the national economic total, China's urban agglomerations also emit more than 80% of the country's carbon. There were also significant differences in the intensity of CO_2 emissions in different urban agglomerations [7] (Table 3.8).

1. **Urban agglomerations are areas with the highest carbon emission, but the total carbon emission is decreasing over the years**

In 1995, the most intense CO_2 emission urban agglomerations were the Hohhot-Baotou-Ordos-Yulin and the Northern Slope of the Tianshan Mountains Urban Agglomerations. Their CO_2 emissions are 15.77 t/10,000 RMB Yuan and 13.37 t/10,000 RMB Yuan, followed by Areas in Ningxia along the Yellow River, the Pearl River Delta, the Central Shanxi, Lanzhou-Xining, and Guangxi Beibu Gulf urban agglomerations. Chengdu-Chongqing and the Middle Reaches of the Yangtze River urban agglomerations had the lowest CO_2 emission intensity with 1.98 t/10,000 RMB Yuan and 2.32 t/10,000 RMB Yuan. Additionally, the central Guizhou, the Yangtze River Delta, and the Western Coast of the Taiwan Strait urban agglomerations all had relatively lower CO_2 emission intensity. The maximum intensity of CO_2 emission is about 7.96 times that of the minimum intensity of CO_2 emission.

In 2000, the Northern Slope of the Tianshan Mountains Urban Agglomeration had the highest intensity of CO_2 emission, followed by the Hohhot-Baotou-Ordos-Yulin, Areas in Ningxia along the Yellow River, and the Central Shanxi Urban Agglomerations. Chengdu-Chongqing, the Middle Reaches of the Yangtze River and the Central Guizhou urban agglomerations had the lowest intensity. The highest intensity was about 10.95 times that of the lowest intensity.

In 2005, the pattern changed quite dramatically. Although the Northern Slope of the Tianshan Mountains still was the region with highest CO_2 emission intensity, it was now followed by Areas in Ningxia along the Yellow River, Lanzhou-Xining, and the Central Yunnan urban agglomeration. The urban agglomerations with lowest CO_2 emissions were still Chengdu-Chongqing, the Middle Reaches of the Yangtze River and the Central Guizhou urban agglomerations. The highest intensity was about 7.10 times that of the lowest intensity.

In 2010, although the Northern Slope of the Tianshan Mountains Urban Agglomeration still had the highest CO_2 emission intensity, its CO_2 emission intensity dropped

Table 3.8 CO_2 emission intensity in different urban agglomerations

(Unit:t/10000 RMB Yuan)

Urban Agglomeration	1995	2000	2005	2010	Urban Agglomeration	1995	2000	2005	2010
Beijing-Tianjin-Hebei	5.40	4.27	2.55	2.18	Central Shanxi	7.11	6.90	3.56	2.48
Yangtze River Delta	3.16	2.73	2.10	1.85	Chengdu-Chongqing	1.98	1.15	1.03	1.00
Pearl River Delta	7.57	5.07	2.42	1.49	Central Shaanxi	4.71	3.88	2.98	2.88
Central and Southern Liaoning	3.56	3.50	2.29	1.86	Guangxi Beibu Gulf	5.45	5.00	3.56	2.64
The Western Coast of the Taiwan Strait	3.57	3.08	2.54	2.06	Hohhot-Baotou-Ordos-Yulin	15.77	11.91	2.97	2.27
Shandong Peninsula	3.61	3.13	2.22	1.88	Central Guizhou	3.09	2.10	1.92	1.67
The Middle Reaches of the Yangtze River	2.32	1.79	1.55	1.24	Central Yunnan	4.23	4.22	3.62	3.40
Central Plains	4.81	4.02	2.67	2.26	The Northern Slope of the Tianshan Mountains	13.37	12.53	7.31	5.68
Harbin-Changchun	5.38	3.51	2.60	2.41	Lanzhou-Xining	6.62	6.12	3.70	3.14
Jianghuai	3.60	2.93	2.12	2.08	Areas in Ningxia along the Yellow River	12.46	7.73	5.41	5.11

from 13.37 t/10,000 RMB Yuan to 5.68 t/10,000 RMB Yuan. This is followed by the Areas in Ningxia along the Yellow River, the Central Yunnan, Lanzhou-Xining, and the Central Shaanxi urban agglomerations. Chengdu-Chongqing still had the lowest CO_2 emission intensity, and also dropped from 1.98 t/10,000 RMB Yuan to 1.00 t/10,000 RMB Yuan. The Middle Reaches of the Yangtze River Urban Agglomeration also had relatively low CO_2 emission intensity. The highest is about 5.68 times that of the lowest.

According to the above analysis, we can see that most of the urban agglomerations with high CO_2 emission intensity are urban agglomerations with low economic development level, such as the Northern Slope of the Tianshan Mountains and the Areas in Ningxia along the Yellow River. The large CO_2 emission intensity is mainly due to the low efficiency of energy use.

There are two types of urban agglomerations with low CO_2 emission intensity. The first type often is relatively more developed with large economic aggregates and high levels of urbanization, such as Chengdu-Chongqing and the Middle Reaches of the Yangtze River urban agglomerations. The other type is areas with less energy consumption and hence CO_2 emissions. From the analysis of the dynamic change trend of CO_2 emission intensity of major urban agglomerations, it can be seen that the CO_2 emission intensity of all the urban agglomerations in China shows a decreasing trend. Specifically, for the 15 years from 1995 to 2010, the carbon emission intensity of Beijing-Tianjin-Hebei Urban Agglomeration decreased from 5.40 t/10,000 RMB Yuan to 2.18 t/10,000 RMB Yuan. The carbon intensity of the Yangtze River Delta Urban Agglomeration decreased from 3.16 t/10,000 RMB Yuan to 1.85 t/10,000 RMB Yuan. The carbon intensity of the Pearl River Delta Urban Agglomeration decreased from 7.57 t/10,000 RMB Yuan to 1.49 t/10000 RMB Yuan. This reflects that the urban agglomeration area is moving in the direction of reducing carbon emissions.

2. **Carbon emission has strong spatial differentiation among China's urban agglomerations with western agglomerations having higher emission than eastern agglomerations**

From the spatial differentiation analysis of carbon emission intensity in urban agglomerations, we can see that the carbon emission intensity of urban agglomerations in Western China is significantly higher than that of urban agglomerations in Eastern China. Geographically speaking, provinces with high CO_2 emission intensity are mainly located in the western region. The CO_2 emission intensity of western urban agglomerations such as the Northern Slope of the Tianshan Mountains, the Hohhot-Baotou-Ordos-Yulin and the Lanzhou-Xining urban agglomerations is closely related to the large amount of coal resources in these urban agglomerations. On the one hand, the industrial structure is focused on the energy-consuming industries; on the other hand, coal is also processed to provide electricity, and coal chemical products for export, which also led to higher the energy consumption and CO_2 emissions.

3.3 Outstanding Issues for Selecting and Developing China's Urban Agglomerations

Based on our review of China's urban agglomeration development in the past 35 years (1980–2014), we summarize the outstanding problems existing in the selection and development of urban agglomerations in China as follows. The fact that urban agglomerations serving as the strategic positions of promoting the national urbanization is overstated and overrated; the spatial extents of urban agglomerations are constantly extended, which violates the initial intention of developing urban agglomerations; the selection of where to develop urban agglomerations is subjected to strong governmental direction, which often goes directly against basic standards of developing urban agglomerations; the selection of where to develop urban agglomerations has accommodated too much local interest, which affects the overall situation of national strategic security; and the urban agglomerations have become sensitive areas and key governance areas where ecological environment problems such as haze are concentrated and inflamed. Specifically, in the development of urban agglomerations in China, there are four "low" problems, namely, low development degree, low compactness, low input-output efficiency and low level of resource and environment security. In addition, there are four "too much" problems, namely, too much government and administrative intervention, too much expectation of developing urban agglomeration, too much negative agglomeration effects, and too much development gaps among urban agglomerations. In some cases of urban agglomeration construction, there also exist the four "regardless" issues, namely, blindly seeking to join an urban agglomeration regardless of local conditions; constantly expand the spatial extent of urban agglomerations regardless of the arable land red lines; repetitive construction regardless of deep cooperation; and development of urban agglomeration regardless of local resources and environmental carrying capacity.

3.3.1 Outstanding Problems in Selecting Where to Develop Urban Agglomerations

1. **The fact that urban agglomerations serving as the strategic positions of promoting national urbanization is overstated and overrated**

Although the Central Urbanization Work Conference, the Central Economic Work Conference, the 11th Five-Year Plan, the 12th Five-Year Plan constantly promoted for 10 consecutive years that urban agglomerations will be the primary spatial form for implementing the national New Urbanization strategy, and the National Development Priority Zoning also listed urban agglomerations as the prioritized and key development zones, in the process of selecting where to construct and develop urban agglomerations and how to define the spatial extent of urban agglomerations, all

levels of governments regards joining an urban agglomeration as a significant political task, and urban agglomerations are regarded as the "only" way to implementing China's New Urbanization strategy. While cities that joined an urban agglomeration often celebrate with the ones that did not join expressing strong intention. Such overrating of urban agglomeration started to seriously affect the healthy and natural development of China's urban agglomeration, seriously impede the implementation of China's New Urbanization strategy.

2. **The spatial extents of urban agglomerations are constantly extended, which violates the initial intention of developing urban agglomerations**

From the theoretical point of view, the expansion process of the spatial extent of urban agglomerations will experience four long expansion processes, namely, from city to metropolitan, from metropolitan to metropolitan areas, from metropolitan areas to urban agglomerations, from urban agglomerations to metropolis [8], and it is by no means possible to achieve artificial expansion overnight. While in reality, with the endorsement of local governments, the news media and some experts' opinions, many urban agglomerations continue to "expand" greedily. This blind expansion practice is in direct contrary to the general laws of urban agglomeration development. Instead of constructing an integrated, healthy, sustainable urban agglomeration, many "platter-like" loosely linked city clusters are formed. Driven by the "joining the urban agglomeration" movement, many provinces are scrambling to include all the cities in the province into the effect spatial extent of urban agglomerations. The result is contrary to the initial intention of the construction of urban agglomerations. The most obvious example is the expansion of urban agglomeration in the Middle Reaches of the Yangtze River. This urban agglomeration grows from the original 25 cities in Hubei, Hunan and Jiangxi to 42 cities in Hubei, Hunan, Jiangxi and Anhui provinces, changed from "the triangle of the middle reaches of the Yangtze River" to "the rectangle of the middle reaches of the Yangtze River". Its land area also grows from 270,000 to 450,000 km^2, becoming one of the world's largest urban agglomeration yet with the weakest degree of development. The development of this urban agglomeration carries from the birth a strong mark of government-intervention [9]. In addition, the Shandong Peninsula Urban Agglomeration was unjustifiably expanded to 13 cities from initially recognized 8 cities. The Central Plains Urban Agglomeration was expanded from 9 recognized cities to 18 cities, but then changed back to 9 cities, and so on. The results of the expansion of major urban agglomerations have seemly formed continuous zones of urban agglomeration in the eastern coastal areas and along the Yangtze River, yet such "continuous zones of urban agglomerations" are but a result of artificial designation without strong integration. As a matter of fact, under the background of strong government intervention in current urban agglomeration development, the spatial extent of many urban agglomerations becomes a result of mindless platters that take as many cities as the local governments see fit. The high degrees of integration and compactness of constructing urban agglomerations were lost in such process [10].

3. **The selection of where to develop urban agglomerations is subject to strong governmental direction, which often goes directly against basic standards of developing urban agglomerations**

Based on our investigation of urban agglomeration development, we contend that the formation and development of urban agglomeration have some fundamental identification criteria, which include the number of metropolitan area or mega-city in urban agglomeration should be no less than 3; at least 1 super or mega-city will serve as the core city; the population size shall be no less than 20 million; the level of urbanization is greater than 60%; the ratio of non-agricultural industry output value is more than 70%; per capita GDP shall be more than $10,000; its economic density should be greater than 15 million RMB Yuan/km^2; its economic extroversion degree should be greater than 30%; the core city's GDP shall be more than 45% of the entire urban agglomeration with cross-provincial urban functions; there should be a highly developed and integrated transport channel to form clear half an hour, 1-hour and 2-hour economic circles [11]. The urban complex that meets the above seven identification criteria will then be regarded as urban agglomeration. According to this standard, the development process of urban agglomeration is a gradual and natural process. The urban agglomeration is a highly homogeneous and highly integrated organization among cities. Using the above seven basic standards to determine urban agglomerations, we found that the urbanization level of the Middle Reaches of the Yangtze River is only 37.6% (less than the 60% minimum standard), GDP per capita is only $4663 (less than $10,000), economic extroversion degree is only 2.72% (less than 30% minimum), non-agriculture output value is only 64.7% (less than 70%), core urban GDP is only 19.9% (less than 45%). For the Middle Reaches of the Yangtze River Urban Agglomeration, all these 5 indicators do not meet the basic criteria for the development of an urban agglomeration.

From the above analysis of urban agglomeration's criteria, the Middle Reaches of the Yangtze River Urban Agglomeration is still in the very early stage of urban agglomeration development. It is necessary to realize that the development of a highly integrated urban agglomeration requires a very long time with constant exploration and experiments. The construction of the Middle Reaches of the Yangtze River Urban Agglomeration cannot and will not be "zoned out", but depends on the market mechanism's "developing", and "integrated" cooperation among different cities. For this matter, we need to fully understand the long-termless and arduous nature of urban agglomeration construction in the Middle Reaches of the Yangtze River. It is necessary to respect and follow the stage law of urban agglomeration development, gradually develop, and continue to integrate to eventually form this urban agglomeration. At the same time, we must realize that the Central Shanxi, Central Yunnan, Central Guizhou, Northern Slope of the Tianshan Mountains, Lanzhou-Xining areas do not really meet the criteria of being fully developed urban agglomerations. Naming them urban agglomerations is mainly an effort to reduce regional inequality, and resources will need to be invested to actively guide their eventual development and integration into local urban agglomerations.

4. **The selection of where to develop urban agglomerations has accommodated too much local interest, which affects the overall situation of national strategic security**

In the process of selecting where to develop urban agglomerations, there often are games and even negotiations between the central and local governments. The central government often relies too much on the development priority zones, while in the meantime, the central government is reluctant to damper the local governments' enthusiasm since the urban agglomerations are the actual places to implement the national New Urbanization strategy, and where more than 75% of the new urban population will be settled.

For instance, when defining the spatial extent of the Middle Reaches of the Yangtze River Urban Agglomeration, local interests become the dominant factor. Such a broad definition of this urban agglomeration will not only bring no significant development benefits for the area, but also might cause the area to suffer from potential threats to its sustainable development and its designated functions in the national New Urbanization strategy. For one thing, the Middle Reaches of the Yangtze River area is the primary location of national grain production and agricultural modernization, shouldering the heavy responsibility of national food and survival security. By blindly accommodating local government enthusiasm and interest demands, and accepting too many cities into the urban agglomeration, the region practically reduces the size of the country's main grain production areas, and affects the overall situation of national strategic security. For another, the Wuhan and Changsha-Zhuzhou-Xiangtan urban agglomerations in the Middle Reaches of the Yangtze River are the pilot areas for experimenting the "resource-saving and environmental-friendly" society building projects; the Poyang Lake Rim Urban Agglomeration is a demonstration zone for the comprehensive development of the great lake watershed. The development of these two urban agglomerations shoulders the important mission of constructing national resource-saving and environment-friendly society. Expanding the spatial extent of this particular urban agglomeration will inevitably squeeze out the arable land space and ecological security space of the main grain producing areas, which will have significant negative impact on the national food security. In addition, the name of the urban agglomeration shall not be named according to the natural geographical homogeneity but named based on the socioeconomic integration among closely connected cities. Urban agglomeration shall be differed from town agglomeration in which the latter is but a group of loosely connected cities while the former defines a strictly integrated groups of well-connected cities.

5. **The urban agglomerations have become sensitive areas and key governance areas where ecological environment problems such as haze are concentrated and inflamed**

Under the background of China's long-term promotion of extensive economic development model in the past, on one hand, urban agglomeration areas are the most dynamic and potential regions of China's economic development now and in the near future; on the other hand, urban agglomeration areas are also sensitive areas

with high concentration and intensification of ecological environment problems. Based on collected environmental statistics, the total amount of discharged industrial waste water, industrial waste gas emission and industrial solid waste production in China's urban agglomerations accounted for more than 67% of the national total. It can be seen that although China's urban agglomerations concentrate more than 3/4 of the country's total economy, at the same time also are areas with more than 3/4 of the country's pollution output. The widespread haze pollution covering all urban agglomerations of the eastern coastal areas and the northeast fully reflects the increasingly urgent environmental pollution problems in China's urban agglomerations. It becomes imperative to use the national development priority zoning as the basis to scientifically measure the regional ecological and environment carrying capacity of urban agglomerations and guide the industrial growth, economic development and spatial reorganization of urban agglomerations based on local carrying capacity [12]. It is necessary to study the dynamic mechanism and ecological support effects of industrial and urban agglomerations and make the urban agglomerations the key areas of comprehensive environmental pollution management and ecological recovery in China, so as to ensure the simultaneous planning, construction and implementation of urban agglomerations' economic development and environmental protection. This is of great practical significance to promote the healthy development of urban agglomeration in China, to improve the ecological environment of urban agglomerations, and to build resource-saving and environment-friendly urban agglomerations.

3.3.2 Outstanding Issues in the Development of China's Urban Agglomerations

1. **The four "low" problems in urban agglomeration development**

In the development of China's urban agglomeration, there are four "low" problems, namely, low development degree, low compactness, low input-output efficiency and low level of resource and environment security.

(1) Urban agglomeration has low development degree

Using the development degree model of urban agglomeration, we find out that the overall development degree of urban agglomeration in China is low. China's urban agglomerations are in the stage of rapid development or initial development. The highest degree of development is found in the Yangtze River Delta Urban Agglomeration, and its development index is 10.579, followed by the Pearl River Delta Urban Agglomeration of 9.924. The lowest degree of development of the Jiuquan-Jiayuguan-Yumen Urban Agglomeration with only a 0.463 development index. Under such low level of development, China doesn't really have a fully developed urban agglomeration. Only the Yangtze River Delta and the Pearl River Delta urban agglomerations are close to be fully developed, but these two only account for 8.7% of the China's urban agglomerations. Urban agglomerations in the maturing stage

include the Eastern Liaoning Peninsula, Shandong Peninsula, Beijing-Tianjin-Hebei, the Western Coast of the Taiwan Strait, Chengdu and Chongqing urban agglomerations, accounting for 21.74% of the national total. Urban agglomerations in the rapid development stage include the Hohhot-Baotou-Ordos-Yulin, the Middle Reaches of the Yangtze River, the Central Shaanxi and the Guangxi Beibu Gulf urban agglomerations, accounting for 21.74% of the national total. Urban agglomerations in the initial stage of development include all the rest urban agglomerations, accounting for 47.83% of the national total. Apparently, China's urban agglomeration development still has a long way to go to be fully developed. Moreover, the development degrees of urban agglomeration shows a gradually reducing trend from the east coastal to inland areas. The three major economic development axes, three major economic core areas, comprehensive transport channels and the economic belt of major rivers and watersheds are both areas with dense urban agglomerations and relatively high urban agglomeration development degrees.

(2) Urban agglomerations have low compactness

The compactness model of urban agglomeration is used to show that the compactness of urban agglomeration in China is low. The overall compactness of China's urban agglomerations is in the medium and low compact level. There are only 3 urban agglomerations with compactness between 0.5 and 1.0. They are the Yangtze River Delta, the Pearl River Delta, and the Beijing-Tianjin-Hebei urban agglomerations, accounting for 13.04% of the national total. Urban agglomerations with medium compactness (with a compactness value of 0.35–0.5) include the Shandong Peninsula, the Central and Southern Liaoning, the Central Plains and the Central Shaanxi urban agglomerations, accounting for 26.08% of the national total. All the other urban agglomerations are in the low compactness category. The compactness of China's urban agglomerations gradually decreases from the north to the south, and east to the west. In addition, it is found that higher level of urban agglomeration development is positively associated with higher level of urban agglomeration compactness.

(3) Low input and output efficiency in urban agglomerations

Using the input-output efficiency model of urban agglomeration, it is concluded that the comprehensive input-output efficiency of China's urban agglomeration in 2002 and 2007 was 0.864 and 0.742 respectively. The average comprehensive input-output efficiency in urban agglomerations actually decreased by 0.122 during these five years. In 2007, only the Yangtze River Delta, the Pearl River Delta, Shandong Peninsula and the Northern Slope of the Tianshan Mountains urban agglomerations' comprehensive input-output efficiency reached the optimal DEA efficiency. There are 7 urban agglomerations which input-output comprehensive efficiency reached more than 80% of the DEA effectiveness, accounting for 30% the national total number of there are 11 urban agglomerations which input-output comprehensive efficiency reached 60–80% of the DEA optimal, accounting for 48% of the total. The rest 5 urban agglomerations have less than 60% of the DEA efficiency, accounting for 22% of the total. Apparently, the majority of China's urban agglomerations still have low input-output efficiency. Such efficiency also decreases gradually from the eastern

region (0.866 efficiency) to the central (0.717) and western regions (0.684) in 2007, showing a spatial gradient development pattern that drops from the east to the central and the western region.

(4) Low level of resource and environment security in urban agglomerations

China has entered the stage of rapid urbanization and the rapid growth stage of urban agglomeration. Most urban agglomerations are still in the stage of extensive economic growth. The proportion of the secondary industry, especially traditional manufacturing industries, is still dominant in the economic structure. The proportion of high-tech industries is low. There is serious environmental pollution problem and the situation of resources and environmental protection is grim. The multi-model prediction approach shows that the level of urbanization in China will increase to 54.5% by 2020 and 61.6% by 2030. This will result in increasingly urgent resources and ecological environment pressure. Specifically, first, the rapid urbanization and the rapid growth of urban agglomeration will lead to the sharp water shortage in urban agglomerations. From 1980 to 2005, every 1% increase in the urbanization level results in 1.7 billion m^3 increase in water demand, including 940 million m^3 urban living water demand and 760 million m^3 industrial water demand. In the next 25 years (2006–2030), it is predicted that every 1% increase in urbanization will require 3.2 billion m^3 of additional urban water consumption, of which more than 2.3 billion m^3 are for urban living needs and 960 million m^3 are for industrial needs, respectively, which is 1.88 times, 2.45 times and 1.26 times over the past 25 years. Apparently, every 1% increase in urbanization level will require increasing amount of water as urbanization progresses. Moreover, getting water will also become even more difficult as urbanization progresses. It is also predicted that by 2020, the national urban development will face at least 15 billion m^3 of water shortage. Urban water security level is constantly decreasing. Second, rapid urbanization and rapid growth of urban agglomerations will lead to increasingly severe urban construction land availability. In the past 25 years (1980–2005), every 1% increase in urbanization level requires 1004 km^2 construction land. For the next 25 years (2006–2020), it is predicted that every 1% increase in urbanization level will require 3460 km^2 construction land, which is 3.45 times over the past 25 years. Apparently, the demand for urban construction land will keep increasing as urbanization progresses and acquiring urban construction land without encroaching the arable land will become increasingly difficult as well. It is predicted that by 2020, the total demand of urban construction land in China will reach 72,550 km^2, and the amount of land available for urban construction is only 64,813 km^2, with a 7740 km^2 gap that cannot be filled easily. Apparently, the situation of construction land acquisition in the process of urbanization will become increasingly serious. Third, rapid urbanization and rapid growth of urban agglomerations will lead to more serious ecological overload, ecological environment quality tends to deteriorate. Based on the 1950–2006 statistical data analysis, we found that in the past 60 years, every 1% increase in urbanization will result in 115 million hm^2 of added ecological footprint, or per capita ecological footprint of 0.08 hm^2. The comprehensive index of ecological environment quality will decrease by 0.0073. In the next 40 years, every

1% increase in the level of urbanization in China, the total ecological footprint will increase by 105 million hm^2, ecological overload will increase by 5.68%, ecological environmental quality index will decline by 0.0064. By 2050, if urbanization and urban agglomerations develop under the existing model, ecological overload will be more serious, ecological environment quality will continue to deteriorate [13].

2. **The four "too much" problems in urban agglomeration development**

In China's urban agglomeration development process, there exist the four "too much" issues, namely, urban agglomeration's development is under too much government and administrative intervention, too much expectation of developing urban agglomeration, too much negative agglomeration effects, and too much development gaps among urban agglomerations.

(1) There is too much government leadership and administrative intervention

China's urban agglomeration development started in the era of planned economy and planned market economic system. Except for Pearl River Delta Urban Agglomeration, the spatial extent and formation of the vast majority of China's urban agglomerations and development bear a strong government-led and planned economy mark. The number of urban agglomeration and integration among cities are not determined by the market, nor are they determined by the economic and technological connections and development needs established between cities but decided rather arbitrarily by government decision-makers as which cities to be included in the urban agglomerations, which leads to a somewhat chaotic and ultimately arbitrary spatial organization of urban agglomerations in China. In particular, when the provinces are developing their own growth poles of economic development, they tend to consciously and arbitrarily bring together a number of cities that are adjacent to each other and are relatively developed as urban agglomerations and assume the growth poles of the provinces' regional development. For example, the Henan provincial government defined the Central Plains Urban Agglomeration to include Zhengzhou, Luoyang, Xinxiang and other 6 cities (9 cities in total), and later artificially decided to include all 18 cities in the province to the urban agglomeration. Such definition is largely due to the proximity of these urban areas instead of being based on economic ties, or the close connection among different industries in urban agglomerations. This urban agglomeration is not really an urban agglomeration in the economic sense, but an artificial designation [14]. Under this high-pressure leadership on all levels of governments, urban agglomeration construction is unfolding throughout the entire country on an unprecedented scale and speed. However, government-led development cannot really build an efficiently functional and integrated high-density urban society. Such arbitrary "construction" of urban agglomeration from a pure administrative perspective is prone to produce social turmoil and cause severe urban diseases. The development of urban agglomeration needs to establish the mechanism that abides by its development and evolution laws, and it needs the citizen to participate in the choice of urban social values such as urban form, community, transportation system and education system, and it also needs the expert groups to transform these choices into urban spatial forms and social mechanisms.

Therefore, the development of urban agglomeration in China needs to change from government-led to government and market dual-guided and market-oriented development. Due to the influence of government dominance and administrative intervention, the basic role of market allocation of resources has not been fully utilized in the fields of urban agglomeration development, population flow and land transfer, and urban construction in China. Most urban agglomerations in China are gradually constructed after prior confirmation, and with efforts from all parties. In fact, the formation of urban agglomerations to a large extent requires the advancement of market forces. It is mainly a spontaneous process. With the expansion of urban scale, urban productivity is bound to exceed its own market capacity, searching for the market outside the borders of the urban areas, especially the neighboring areas has become an inevitable choice. Additionally, the improvement of urban productivity also needs more production factor inputs and supporting industries, which also requires strengthening the links with the nearest hinterland and cities. In this way, the emergence, development and final integration of urban agglomerations can then be naturally established.

Artificial administrative intervention can accelerate the development of urban agglomeration, but it is often counterproductive, especially when the regions are not ready to be developed into urban agglomerations.

(2) There is too much expectation of developing urban agglomeration

In the course of the construction of some urban agglomerations, due to the lack of sufficient understanding of their own resource and environmental carrying capacity, there is a lack of objective estimation of their positions and roles in the national and international division of labor. A series of unrealistic development orientations, development goals, development vision and construction plans are often established. Many urban agglomerations have put forward ambitious goals of doubling, quadrupling, quadrupling and continuously maintaining double-digit growth rate in economic growth, and ambitiously attempt to build a half-hour economic circle, a 1-hour economic circle and a 2-hour economic circle with corresponding highway loop system, rail transit system and other infrastructure. Building new urban district is also a goal that serves as an attempt to create an "integrated" expanded urban agglomeration. Many local governments even proposed to build the fourth or fifth economic growth poles in China. The results, however, often fall far short from the claims.

In the context of overestimation the overall development orientation and goals, most urban agglomerations have aimed to build themselves to be important international portals in the Asia-Pacific region, the world's important advanced manufacturing bases, the pioneer areas for national reform and opening-up, the leading areas for national deepening reform, the national advanced manufacturing industry and modern service bases, the national economic center, the national financial center, the national transportation center, the national information center, the national logistics center, the national science and technology center, the national innovation center, the national information center, and the like. More ironically, they often compete for names, planning, projects and investment with one another for this and that centers. For instance, the Yangtze River Delta Urban Agglomeration proposed to

be China's most comprehensive economic center, an important international gateway in the Asia-Pacific region, the world's important advanced manufacturing base and China's first world-class urban agglomeration. The Pearl River Delta Urban Agglomeration proposed to be a pilot area to explore scientific development, an important international portal for further opening-up, the world's advanced manufacturing industry and modern service base, and China's important economic center. Shandong Peninsula Urban Agglomeration proposed to build an internationalized metropolitan area with strong regional comprehensive competitiveness, one of the important advanced manufacturing production service bases in China and the Yellow Sea economic circle. The Western Coast of the Taiwan Strait Urban Agglomeration proposed to be the first test area for cooperation and exchange between the Mainland and Taiwan, an important base for advanced manufacturing in the eastern coastal areas, an important natural and cultural tourism center in China, and so on. All these goals are fairly similar in terms of wording and action plans, which create a rather chaotic competition scenario and repetitive planning and investment.

(3) There is too much negative agglomeration effects

Through analyzing the population concentration scenarios in urban agglomerations, the average population density of China's urban agglomerations in 2014 was 344.42 people/km^2, which is 201.94 people/km^2 higher than the national average or 2.42 times the national average. The average economic density of urban agglomerations was 20.8668 million RMB Yuan/km^2, which is 14.2368 million RMB Yuan/km^2 higher than the national average or 3.15 times the national average. Urban agglomerations have an average city density of 48.05 cities/10,000 km^2 in 2014, which is 24.44 cities/10,000 km^2 higher than the national average or 2.22 times the national average (Table 3.9). Among the urban agglomerations, the Pearl River Delta Urban Agglomeration and the Yangtze River Delta Urban Agglomeration are the two highly concentrated areas. Their economic densities are 17.86 times and 17.24 times that of the national average; population densities are 3.78 times and 5.63 times that of the national average; and city densities are 2.91 times and 4.81 times that of the national average, respectively. The population density of the Yangtze River Delta Urban Agglomeration (774 people/km^2) far exceeds that of Japan's Pacific Coastal Urban Agglomeration (700 people/km^2), the Northeastern Atlantic Coastal Urban Agglomeration (471 people/km^2) and the French Urban Agglomeration (317 people/km^2) and is close to the highest population density in the London Urban Agglomeration (811 people/km^2). Not only that, the degree of concentration of urban agglomeration continues to deepen. From 1980 to 2014, the average population density of urban agglomerations in China increased from 278.72 to 344.42 people/km^2 in 2014; the city density of urban agglomerations increased from 1.47 to 1.60 cities/10,000 km^2; the town density of urban agglomerations increased from 32.24 towns/10,000 km^2 increased to 48.05 towns/10,000 km^2; the economic density of urban agglomeration increased from 258,700 to 20.8668 million RMB Yuan/km^2 in 2014. It is predicted that this degree of urban agglomeration will further deepen in the next 10–20 years.

There is no doubt that high-degree of concentration is the driving force for the development of urban agglomerations in China, but the result of over-concentration

Table 3.9 Comparison of the changes of urban agglomerations in China in 1980–2014

Year	Population density (people/km^2)	City density/(city/10,000 km^2)	Town density/(town/10,000 km^2)	Economic density/(10,000 RMB Yuan/km^2)
1980	278.72	1.47	32.24	25.87
1985	330.78	1.45	26.78	40.57
1990	356.97	1.82	29.89	71.27
1995	391.90	2.39	38.00	245.89
2000	335.59	1.94	50.69	343.84
2001	317.51	1.84	45.68	357.63
2002	315.96	1.79	49.44	388.25
2003	300.36	1.70	45.54	453.98
2004	302.75	1.70	45.27	517.58
2005	303.32	1.69	44.75	608.31
2006	305.00	1.69	45.50	712.19
2007	311.45	1.70	44.61	858.10
2008	324.99	1.70	46.90	1,020.23
2009	327.42	1.69	49.36	1,139.21
2010	331.14	1.69	49.49	1,355.97
2011	337.04	1.63	47.78	1,578.92
2012	340.67	1.64	47.90	1,767.68
2013	341.82	1.62	48.11	1,935.74
2014	344.42	1.60	48.05	2,086.68

has brought profound negative effects to urban agglomerations. The population size and density of large urban agglomerations in China are among the largest in the world. Problems such as chronic traffic jams caused by high density and large population, the normality of long commutes, the inferior living environments and the heat island effects have begun to seriously plague the development of large urban agglomerations in China. The negative effect of too much concentration is also reflected in the heightened environmental problems in China's urban agglomerations. Although China's urban agglomerations concentrate more than 80% of the total economic output of China, at the same time they also concentrated more than 3/4 of China's pollution output. More importantly, environmental pollution is highly concentrated in urban agglomeration areas, which severely increases the difficulty of environmental protection and governance in urban agglomeration areas. The development of urban agglomerations nowadays is constantly facing severe pollution issues such as water pollution and safety, and air pollution and safety.

(4) There is too much development gaps among urban agglomerations

The gaps between the eastern, central and western regions in China will continue to exist for quite some time into the future. The formation and development of urban

agglomerations have increased the development gaps among the east, central and western regions, and increased the development gaps between urban agglomerations and non-urban agglomeration areas. From the eastern to the central to the western region, the economic aggregates, per capita GDP, economic density, per capita disposable income of urban residents and the per capita net revenue of rural residents show a clear decreasing pattern. The rapid development of urban agglomerations makes the original spatial structure that is based on the premise of self-sufficiency in various regions collapse rapidly. The increasing competition among regions causes population and industries in relatively underdeveloped to be absorbed into urban agglomerations, and the concentration of population and industries to urban agglomerations has brought great development to urban agglomerations. But the other side of the story is not so glorious as the gaps between inland areas and urban agglomerations are rapidly widening. In the absence of a national redistributive mechanism, widening regional inequality is distorting local economies and local administrations, shaking the foundations of China's social economy. Under the rapid economic growth in China, not only the regional gap, the income gap is also expanding rapidly. The result of prioritizing productivity for a long time has formed a social structure of strong government, strong capital but weak labor in China. This social structure suppresses the labor distribution rate and the improvement of workers' rights and interests, especially the rights and interests of migrant workers, which have been constantly ignored for a very long time [15]. The uneven distribution has prevented the large group of workers from fully enjoying the benefits of high-speed economic growth, increased the income gaps and regional inequality, and hindered the expansion of the domestic demand market. Therefore, it is imperative to establish efficient redistributive mechanism, to reduce the gap between regions and groups by this redistributive mechanism, and to promote the equalization of social security and basic public services. Apparently, how to build a harmonious high-density urban society in urban agglomeration area is an urgent and severe challenge in the near future.

3. **There exist the "four regardless" issues in urban agglomeration construction**

In the construction of some urban agglomerations in China, there exist four "regardless" issues, namely, blindly seeking to join an urban agglomeration regardless of local conditions; constantly expanding the spatial extent of urban agglomerations regardless of the arable land red lines; repetitive construction regardless of deep cooperation; and development of urban agglomeration regardless of local resources and environmental carrying capacity.

(1) Blindly seeking to join an urban agglomeration regardless of local conditions, and establishing national experimental areas

Currently, the term "urban agglomeration" has become a hot topic in regional planning literature and practice, even though the overall level of urban development in China is still relatively low. Many provinces and regions have compiled their specific urban agglomeration development planning. It almost becomes a norm for any regional planning to be centered on the term "urban agglomeration", and incorporate

"urban agglomeration" into some sort of national strategic planning. Even the Three Gorges Reservoir Area, which has very fragile ecological environment, is proposing to build the "Three Gorges Urban Agglomeration" in its regional planning and strive to enter this round of national strategy of "urban agglomeration" construction.

This phenomenon reflects the strong desires of the regions in China to get rid of poverty, catch up with the developed regions, and realize potential leapfrogging development. Such desires are understandable, yet we must clearly see the consequences of ignoring the laws of objective urban agglomeration development, seeking only the names instead of the essence of urban agglomeration development, building urban agglomerations not based on integrated development but arbitrary administrative grouping of cities. Such actions will not only fail to create real urban agglomerations, but also will waste limited resources.

Following the integration of the three major urban agglomerations, the Yangtze River Delta, the Pearl River Delta and the Beijing-Tianjin-Hebei, into the national development strategy, many regions of China have overestimated their own development potentials and strategic positions and roles in China's development and tried to compete with the above three relatively established urban agglomerations. It is important to note that the development of these three major urban agglomerations is formed under the long-term consideration of national political, economic and historical factors, the objective need of the central government to deal with economic globalization and China's development in the globalization era. Their development and integration into the national strategy represents the strategic interests of the entire China, and their status and development potentials are far beyond comparison with any other urban agglomerations. Because of the impulsive development enthusiasm and the overestimation of their own development visions, many provinces in China blindly follow the trend to plan and build urban agglomerations regardless of the weak economic ties between cities, arbitrarily group several cities together and call them urban agglomerations, blindly expand the spatial extent of urban agglomerations regardless of the degree of industrial support, and prematurely propose inappropriate integration policy measures in order to expand their own regional interests. These arbitrarily established "urban agglomerations" even become the "performance projects" for some local officials.

For this matter, it is critical that one should understand the development stages and the functions of its own position in the national division of labor, use the overall strategic vision and dialectical point of view to understand the strategic intention of the national construction of urban agglomeration, and build up urban agglomerations based on its actual carrying capacity and local conditions.

(2) Some regions constantly expand the spatial extent of urban agglomerations regardless of the arable land red lines, which triggered a large-scale disguised enclosure movement to create the city.

Under the wave of building urban agglomerations into "national-level experimental zones", many provincial and city governments prepared a variety of urban and rural integration planning with the name of urban-rural integration. Those types of planning often propose to achieve a variety of strategic goals by building state-level

advanced manufacturing bases, national modern service bases and national economic centers so that they can further seek "reasonable justification" for legal access to land for expansion. This overall guiding ideology, which is out of touch with reality, is seriously divorced from the objective law of urban development and does not meet the requirements of the scientific concept of development. Under the background of the increasing calls of eliminating the prefecture administrative units, many prefecture governments, under the guide of promoting urbanization and the name of developing local cities, are not really adopting a scientific and reasonable framework for urban development and urban-rural integration, but by means of the construction of urban agglomerations, using administrative resources to preemptively include the surrounding counties and cities into urban agglomeration construction, blindly expand their own spheres of influence regardless of whether the other counties and cities are willing to do so, so that they will leave enough room for development and profit growth after the prefecture administrative units are eliminated and also obtain land legally. Some prefecture government officials have publicly pointed out that it is through planning to turn hundreds of square kilometers of farmland into urban construction land. This has led to many urban planning with new areas far more than the available areas presented in urban master plans.

Apparently, the continuation of such an "urban agglomeration-building" movement will inevitably lead to low intensity and low efficiency of land use. It is very likely that twenty or thirty years later, many urban agglomerations will face the dilemma of no available land for further development. In the process of urban agglomeration construction, people are accustomed to the fact that the construction of "new urban districts" is the entry point for urban agglomeration construction. Yet looking at the currently building "new urban districts", we found that there is a general lack of in-depth scientific proof of the future development orientation and construction scale of those "new urban districts". The spatial extents planned for those "new urban districts" are generally too large, and the construction of those "new urban districts" has led to the occupation of large quantities of farmland. Numerous "new urban district" construction practices show that the construction of large-scale "new urban districts" has become an important means for some local governments to implement development strategies and display their achievements. As for whether such practices are feasible or not, whether the resources and environment have sufficient carrying capacity, these questions are often ignored. Such disorderly construction of "new urban district" not only seriously affects the relationship between urban and rural areas, exacerbates the conflicts between urban and rural land uses, violates the scientific development law of urban and rural integration, but also hinders the process of urbanization development, which directly leads to falsely high level of urbanization. In order to address such increasingly severe conflicts, and also to ensure that China's arable red line to maintain 1.8 billion mu of arable land will never be breached, in the process of constructing urban agglomerations, it is extremely important to strictly restrict blindly expand the city's spatial extent, and continue to implement the most stringent land management system so as to prevent some local officials from encroaching the development rights of the lower level governments, and occupying other land uses.

(3) There is repetitive construction regardless of deep cooperation and there has been an illusory high degree of integration

Urban agglomeration is not the simple addition of several large cities, nor is it the simple expansion of a few urban areas, but the deep integration among cities, the repositioning of urban functions, the re-integration of urban resources, the complementarity among urban elements, and the complementary advantages among cities. To investigate the development of China's urban agglomerations, we can see that cities within the urban agglomerations in China are often loosely connected and integrated; the cities in the urban agglomerations are often fragmented; the administrative relations among cities are complex, which hinders the free flow of economic factors and cross-regional economic cooperation; the urban development goals are broadly similar; the local protectionism exists for a long time; the industrial structures are similar. This has resulted in a waste of resources throughout the region. The competition among cities is obviously greater than the integration; the friction is more than the fusion. Such a relationship among cities weakens the prosperity and development of the urban agglomeration, causes the integration but an empty term. In addition, many cities within an urban agglomeration often position themselves quite similarly, resulting in repetitive construction, unintegrated resources. While integration is discussed and proposed, the reality often sees more competition than integration. Even today, scholars are still asking questions such as "why Beijing and Tianjin do not integrate", conducting studies of "the difficulty process of integration in the Pearl River Delta", and exploring "who shall be the leader between Chengdu and Chongqing", and many other preliminary development issues. For instance, within the Yangtze River Delta Urban Agglomeration, of 15 relatively close cities, 11 cities choose the automobile parts manufacturing industries as their primary industry; 8 cities choose the petrochemical industries as their primary industry; 12 cities choose the communication industries as their primary industry. More ironically, each city regards attracting investment as the top priority. In order to attract foreign investment, the cities often lower their land prices and promise various preferential policies without any sensible principles. The direct consequence is that the Yangtze River Delta Urban Agglomeration sees very repetitive industrial structures, serious waste of resources, severe lack of differential development, persistent economic barriers, which severely limit the development of both the cities themselves and the urban agglomeration [16].

The ultimate goal of urban agglomeration construction is to achieve a high degree of integration. The key is to promote the deep industrial division of labor and cooperation between cities, especially the manufacturing industry division of labor and cooperation. However, the development orientation of cities in China's urban agglomerations is often very similar; the industrial structures are almost identical; the ecological environment system lacks effective guidance and control; the urban development strategy lacks unified coordination; cities that are supposed to integrate with one another instead compete in attracting investment with various preferential policies, which harm the overall interests of urban agglomeration development. In the Yangtze River Delta Urban Agglomeration, the similarity coefficient of industrial structures

between Shanghai and Jiangsu is 0.82, the similarity coefficient between Shanghai and Zhejiang is 0.76, while the similarity coefficient of industrial structures between Jiangsu and Zhejiang is as high as 0.97 [17]. This is especially true among cities. For instance, Suzhou, Wuxi, Changzhou all set their pillar industries as machinery, textiles, chemicals, metallurgy, food and so on, cities are repeating one another without any clear strategy to integrate and develop differential and complementary industries.

(4) Development of urban agglomerations regardless of local resources and environmental carrying capacity

With the continuous strengthening of economic globalization and regional economic integration, China has spawned dozens of urban agglomerations of different sizes and levels in a very short period of time. Some of the "urban agglomerations" are actually artificial metropolitan areas centered on a few provincial capitals that forcefully include their surrounding cities by administrative means regardless of local conditions and levels of integration in an attempt to enlarge their "sphere of influence". Other non-capital large cities also attempt to join hands with their neighboring cities to create multi-core urban agglomerations without giving much consideration of the local conditions, infrastructure, level of integration and resource and environmental capacity. Those forced "urban agglomerations" often propose quite high level of development goals, implement high-density concentration, high-speed expansion and high-intensity operation measures without detailed understanding or consideration of their local resource and environmental carrying capacity and infrastructure capability. Such unrealistic goals and measure cause the local resource and environment security to constantly drop. In addition, since these urban agglomerations contain large extent of hinterland, they are able to continuously absorb the international and domestic capitals, advanced technology and high-profit industries such as commerce and finance to move in, which enable them to obtain large concentration of capital, technology and human capital, and form the innovation and agglomeration core of their corresponding regions. In such courses of their development, they tend to regard their own development as the standard model that small and medium-sized cities shall follow suit. Under such trends of thoughts, small and medium-sized cities will always be the follower, obedient and accept the "rules of the game" that are most beneficial to large cities. Our investigation reveals that many large cities, mega-cities and urban agglomerations often have arrogant city images due to their monopoly on regional resource control, regional infrastructure construction layout, capital allocation and other aspects of development. Moreover, instead of serving as radiating centers that integrate and benefit the entire urban agglomerations, large cities often act as more of a leaching power that deprives small and medium-sized cities and townships of their development potentials to satisfy their own development goals. While these large cities purchase cheap construction land quotes, environmental capacity quote across border, they inevitably exacerbate the already overloaded resource and environmental carrying capacity in urban agglomeration areas. In China, a very unsettling phenomenon in which core cities leach their surrounding cities; large cities leach medium-sized cities; medium-sized cities leach small cities; small cities leach townships has caused the fundamental foundation for urban agglomeration

development to fumble and shake. This leads to an "onion-peeling" movement that encourages "the rich to be richer while the poor to be poorer [18]."

4. **The planning and implementation of urban agglomeration development suffer from the "five lack-of" problems**

Our investigation suggests that there exist the "five lack of" problems in some of China's urban agglomeration planning, namely, there is a lack of unified urban agglomeration identification standards, lack of norms of statistics, lack of clear management organizations, lack of accepted planning methods and practice system, and lack of authority of urban agglomeration planning.

(1) The lack of unified urban agglomeration identification standards

Although the spatial radiation ranges of urban agglomerations are constantly changing, but a relatively clear extent of urban agglomerations is of great practical significance for the formulation of economic and social development strategy and planning for urban agglomerations. As of the writing of the book, there has not been a set of unified national urban agglomeration identification standards. The research community has put forward several standards for the identification of urban agglomerations from different angles, such as the 5-criterion standard, 7-criterion standard, 9-criterion standard and 10-criterion standard. The consensus of these different standards includes that there must be at least three or more cities; there must be at least 1 mega-city with more than 5 million permanent residents; the total population must be over 20 million; urbanization level must be over 60%; the average per capita GDP must be more than 10,000 US dollars; the economic density must be over 15 million RMB Yuan/km^2; the export-oriented portion of the economy must be over 30%, non-agricultural industries must account for over 70% of the entire agglomeration, and the core city's GDP must accounts for 45% of the entire agglomeration. Such a consensus has facilitated the unified understanding in the academic community but is not officially recognized by the relevant departments in China, which causes many regions blindly establishing their own standards without scientific, practical and operational measures to guide such actions. The end results are often the formation of a group of city clusters that claim to be urban agglomerations without proper and unified planning guidance for coordinated and sustainable development.

(2) The lack of standardized statistical data of urban agglomeration

Urban agglomeration has become the main regional unit of national division of labor, but except for the Yangtze River Delta Urban Agglomeration and the Pearl River Delta Urban Agglomeration that have compiled a few individual years' statistical yearbooks, the remaining urban agglomerations currently do not have any standardized, unified statistics. For instance, the Central Plains Urban Agglomeration lists only a few simple data in the Statistical Yearbook of Henan Province. Since urban agglomerations often contain administrative units of different provinces, the statistical data that is based on county-level administrative units often provides less-than-ideal accuracy due to the different nature of the indicators, different statistical calibers, different length of records, different surveying systems, and different price

factors. The lack of accurate statistical data causes many difficulties to the dynamic studies of urban agglomerations' socioeconomic development in China, also to the accurate position of urban agglomeration in the international and national division of labor, their development function, development goals and development priorities.

(3) The lack of clear management organization

Currently, it is inconclusive whether the urban agglomerations are the results of regional planning, or construction plans or whether they are supposed to be managed by the National Development and Reform Commission, or the Ministry of Housing and Urban-Rural Development. Because of the special nature of urban agglomerations, both departments are generating their independent urban agglomeration planning, which causes repetitive investment, repetitive planning and repetitive approvals with extraordinary waste of various resources. Currently, many urban agglomeration plans are compiled and implemented by different groups of scholars from either the national-level or provincial-level Department of Development and Reform and the Department of Housing and Urban-Rural Construction. Since these two types of departments (at either the national or the provincial level) have different goals and priorities, the plans compiled have different priorities, goals, and spatial extents, so that local governments do not know exactly which goal to achieve, which priority to implement, and which plan to follow. Apparently, the misunderstanding of planning and the ambiguity of multi-level management organization have brought great confusion to the formation and development of urban agglomerations.

(4) The lack of established method of urban agglomeration planning and the absence of practising system

Since Guangdong Province's Urban and Rural Construction Committee prepared and implemented China's first urban agglomeration planning *Pearl River Delta Economic Zone Urban Agglomeration Planning* in 1996, China has completed over 20 different urban agglomeration plans, including plans for the Yangtze River Delta Urban Agglomeration, Beijing-Tianjin-Hebei Urban Agglomeration, Shandong Peninsula Urban Agglomeration, the Western Coast of the Taiwan Strait Urban Agglomeration, the Nanning-Beihai-Qinzhou-Fangchenggang Urban Agglomeration, Wuhan Urban Agglomeration, Changsha-Zhuzhou-Xiangtan Urban Agglomeration, the Central Plains Urban Agglomeration, and the Central Shaanxi Urban Agglomeration. Some of these urban agglomeration plans are compiled by the National Department of Development and Reform, and some are compiled by the Department of Construction, some are compiled by both departments. Unfortunately, as of right now, there is no unified urban agglomeration planning method, which leads to the lack of recognized methods or practices for urban agglomeration planning in terms of planning content, process, methods, qualification, examination and approval authority, implementation methods and implementation effect evaluation. In addition, the lack of a recognized planning practice system of urban agglomeration makes the entry threshold of urban agglomeration planning market too low, even non-qualified private companies can win the planning right of urban agglomeration planning with enough pull of strings among individuals. The lack of established planning methods and

practice system of urban agglomeration has resulted in the chaotic pattern of urban agglomeration planning market in China, which has negative impacts on the overall development of urban agglomeration.

(5) The lack of authoritative legal status of the urban agglomeration planning

The planning, legislation and establishment of the necessary institutional mechanisms of urban agglomerations were proposed at the beginning of the reform and opening up stage, but in practice these good perceptions and ideas have not been implemented. The reason is that there are many obstacles in the implementation process, including, obstacles in the process of urbanization and regional collaboration. As far as the obstacles in urbanization are concerned, it is very hard to break the planning and administrative systems in population management, land system and urban construction. They have long been the restricting factors that affect the harmonious and healthy development between urbanization and urban agglomeration and industrialization in China. As far as obstacles in regional collaboration are concerned, due to the lag in the transformation of local government functions, local governments, in dealing with local interests and national interests, as well as the lack of effective and reasonable institutional arrangements among local interests, can only adopt an individualism attitude and often unduly highlight local interests. In this way, it is difficulty to form effective division of labor among regions, often resulting in difficulty to reach consensus hence effective planning for some cross-regional infrastructure construction projects, especially the formation of intercity fast track and transport network that are crucial for urban agglomeration integration and development. Such obstacles also limit the rational flow of production factors and the formation of a common market, resulting in difficulty to effectively coordinate regional and urban economic and social policies. All these difficulties are the direct consequences of the lack of legal status of the urban agglomeration planning.

In the newly enacted Urban and Rural Planning Act published in January 1, 2008,[1] the urban and rural planning referred to in the second article includes urban system planning, urban planning, town planning, township planning and village planning, but no urban agglomeration planning. In the planning of the provincial urban system planning referred to in the 13th article, it points out that the compilation should include urban spatial layout and scale control, the layout of major infrastructure, areas that need to be strictly controlled in order to protect the ecological environment, resources, etc., but no mentioning of urban agglomeration planning.

It can be seen that currently urban agglomeration has not been given a legitimate development status. In the national urban system planning, urban agglomeration is not treated as the highest level in the planning of the national urban system, nor is given the legal status of urban agglomeration planning. The lack of legal status has greatly weakened the urban agglomeration planning in accordance with the law and the authority of planning implementation.

[1] *The People's Republic of China urban and rural regulation*, October 28, 2007, adopted in the 30th session of the National People's Congress Standing Committee.

References

1. Fang CL, Yao SM, Liu SH et al (2011) China's urban agglomeration development report. Science Press, Beijing, pp 25–33
2. Fang CL, Zhou CH, Gu CL (2016) Theoretical analysis of interactive coupled effects between urbanization and eco-environment in mega-urban agglomerations. Acta Geogr Sin 71(4):531–550
3. Fang CL, Mao QZ (2015) The new exploration of China's urban agglomeration selection and cultivation. Science Press, Beijing, pp 98–122
4. Fang CL, Mao QZ, Ni PF (2015) Discussion on the scientific selection and development of China's urban agglomerations. Acta Geogr Sin 70(4):515–527
5. Fang CL, Wang Y, Fang JW (2016) A comprehensive assessment of urban vulnerability and its spatial differentiation in China. J Geog Sci 26(2):153–170
6. Fang CL, Wang Y (2015) A comprehensive measure of urban fragility in China and spatial differentiation characteristics. Acta Geogr Sin 70(4):233–246
7. Fang CL, Wang SJ, Li GD (2015) Changing urban forms and carbon dioxide emissions in China: a case study of 30 provincial capital cities. Appl Energy 158:519–531
8. Fang CL (2013) Scientifically defining urban agglomerations in the middle reaches of Yangtze River. China Natl Strength 243(10):52–53
9. Fang CL, Lin XQ (2010) Ecological conditions diagnostic of spatial expansion in Wuhan urban agglomeration. Resour Environ Yangtze Basin 19(10):1211–1218
10. Fang CL, Guan XL (2011) Comprehensive measurement and spatial distinction of input-output efficiency of urban agglomerations in China. Acta Geogr Sin 66(8):1011–1022
11. Fang CL (2009) Progress and basic judgments in identifying the spatial extent of urban agglomeration. Urban Plan Forum 3:1–5
12. Fang CL, Song JT, Lin XQ et al (2010) Theory and practice on the sustainable development of China's urban agglomeration. Science Press, Beijing, pp 56–89
13. Fang CL (2009) China's urbanization process and resource and environment protection report. Science Press, Beijing, pp 14–32
14. Li B, Jin Q (2009) Analysis on the present situation and problems of urban agglomeration in China. J Xuzhou Inst Eng (Soc Sci Ed) 5:30–32
15. Zhou MZ (2007) Economic theory of China—the mechanism and subject of high-speed economic growth. Japan Economic Review Society, Tokyo, pp 26–47
16. Ma ZQ (2003) On the development trend and problems of urban agglomeration in China. Bus Econ Manag 7:37–40
17. Wang L (2005) Research on the present situation, problems and countermeasures of urban agglomeration in China. Macroecon Manag 6:40–42
18. Fang CL, Liu HY (2007) Regional deprivation and its regulatory pathway in the process of rapid urbanization. Acta Geogr Sin 62(8):849–860