

PAPER • OPEN ACCESS

## A Study on the Idea of Resilient City and Its Application in Planning and Practice in China

To cite this article: Weichao Gao 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **233** 052046

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

# A Study on the Idea of Resilient City and Its Application in Planning and Practice in China

Weichao Gao<sup>1\*</sup>

<sup>1</sup>School of Civil and Architecture Engineering, Panzhihua University, No.10 Airport Road, Panzhihua 617000, Sichuan, China

\*Corresponding author's e-mail: 1036232253@qq.com

**Abstract.** With the rapid development of urbanization in China, more and more urban problems emerge, so developing the planning and construction of resilient city has been drawn much attention. The paper introduces the idea of resilient city and its basic features, analyzes the process of the planning of resilient city in China, and studies the application of the idea of resilient city in ecological, economic, social and cultural planning. According to the existing problems in the planning and practice of resilient city, the paper gives suggestions to the future development of resilient city in China from three aspects, intelligence, security and experience reference, to explore the practical road of resilient city planning in China.

## 1. Introduction

Since the 20<sup>th</sup> century, urbanization has developed rapidly all over the world. According to the status from the UN, the rate of urbanization in the world in 2011 reached 52.1%. It is predicted that the number will increase to 60% in 2030 and over 70% in 2050[1]. Since the reform and open up, Chinese urbanization has developed quickly, the urbanization rate in 2016 increased to 57.4%.

However, with the population explosion, there are more and more city issues and the risk of disasters occurred. Cities become weaker and weaker. Some natural disasters such as Flood, earthquake, mudslide, and rainstorm, and some crises such as disease transmission, energy depletion, and financial storm seriously threaten to the sustainable development of cities and the well-being of all people. In 2008, a great earthquake occurred in Wenchuan; in 2012, the flood invaded into Beijing, the Chinese capital; in 2015, there was the sudden rainstorm in Wuhan province. All these huge disasters cause serious damage to cities. It's the first task to improve urban robustness and redundancy, reducing damages when we face disasters.

With the increasing awareness of unexpected development and the progress of developing ideas of city, many ideas such as ecological city and sponge city have been put forward to cope with the city crises and existing challenges. Like those ideas mentioned above, the idea of resilient city is put forward to protect and develop cities in a deeper and more reasonable way, as well as prevent the city from facing some sudden crises more efficiently in the future. In 2013, China participated in "Top 100 Global Resilient Cities" which was held by Rockefeller Brothers Fund, and four Chinese cities were selected. In 2014, the Central Economic Working Conference reflected the urban development planning in the period of rapid economic development, setting the new direction of improving economy and efficiency for urban development, laying the foundation of practicing resilient city [2]. The planning and practice of resilient city in China are in the period of exploration and development when it is the best time to popularize the idea to Chinese cities for urban planning.



## 2. The Concept of Resilient City and Its Development Process

### 2.1 The Concept of Resilient City

The word “resilience” comes from the Latin word “resilio” which is transferred as bounce in English. In Chinese, resilience means “Ren” which was annotated by Xu Shen in his famous book *Shuo Wen Jie Zi* in the Han Dynasty, referring to soft but solid. Specifically, things with resilience have bounce and within a certain range, they have resistibility and restoring force, so resilient city is also called elastic city where the needs of biological diversity, economic development and the good quality of life can be satisfied by urban ecosystem.

The important contents focused by resilient city are making scientific planning and disaster management to fit climate change [3] [4]. A Inerti considers that resilient city should have the ability of absorbing and eliminating disasters before the city changes and restructures its main framework [5]. Constructing resilient city is not only to enable cities to protect themselves from crises and resist crises, but also to quickly adjust to changes brought by disasters and recover comprehensive ability for development as soon as possible. Resilient city should learn and make progress from disasters, enhancing the awareness of crisis prevention and improving the decision-making ability to handle accidents.

### 2.2 Basic Features of Resilient City

In 2002, the 16<sup>th</sup> CPC National Congress set the goal of building a moderately prosperous society in all aspects as sustainable development. The idea of resilient city is the important way to promote sustainable development. Resilience Alliance, an international research institute, focuses on studying resilient city [6]. The institute considers that urban resilience is related to the ability of digesting, absorbing external disturbance, keeping the original structure and maintaining key functions of the urban system [7]. Based on the relevant information, basic features of resilient city can be divided into five aspects [8].

**2.2.1 Recovery:** Resilient city can quickly recover to the original condition and maintain the basic functions and the structure of the system when a city is attacked by external uncertain factors. There are many measures enhancing the recovery of the urban system. For example, the government can actively maintain the infrastructure, improve the construction quality of the city itself, set the budget for disaster risks and largely popularize the knowledge of preventing disasters.

**2.2.2 Ability to learn and translate:** It means that resilient city can learn from disasters and make some development by summarizing the lessons and experience. Additionally, resilient city can also find its weaknesses, correcting them and making innovation, developing the city with digital construction and management by innovative ideas and methods. When the State of Queensland in Australia suffered from the flood around 2011, the government and the relevant department quickly formulated *Flood Action Plan* and *Flood Smart Future Strategy 2012-2031*, which shows that Queensland learnt from the flood and made a series of measures to cope with disasters, gaining precious experience for the development of resilient city.

**2.2.3 Redundancy:** Urban functions are not single. Through enhancing the fungibility of urban functions, when cities are threatened by uncertain factors, they can normally operate through the substitutable system which can be copied instead of being paralyzed because of the loss of one single function.

**2.2.4 Robustness:** It also refers to the stability of a city, also the viability of a city when it faces crises and unusual conditions. Improving the infrastructure of a city and enhancing the prediction and prevention of disasters can promote the stability of a city.

*2.2.5 Diversity:* The function of resilient city is multiple. When a resilient city faces crises, it has various techniques and methods to solve problems. With the big data platform, resilient cities can better manage risks and disasters, solving problems from different perspectives, which make urban functions superimposed.

### *2.3 The Developing Process of the Planning of Chinese Resilient City*

The study of resilient city is still in the initial stage in China, so learning from advanced ideas and cases is urgent. Some developed countries such as Britain and America combine the study of resilient city with the study of big data analysis, public participation and social equity, making the idea of resilience concrete and realizing the technological cross in line with local conditions [9]. The government and relevant departments pay more and more attention to constructing resilient city which becomes the important way to solve urban problems accumulated over years.

In 2011, the idea of resilience was first put forward in the Second Global Urban Technological Development Forum and the First Fire Prevention and Disaster Reduction Mayor Summit in Chengdu, Sichuan province. Ten cities including Chengdu joined the movement called “making city more resilient”, and they also discussed and passed the Top 10 Index System of the movement. UNISDR largely affirmed to Chengdu’s performance on the reconstruction of Wenchuan after the earthquake, resource mobilization and the ability to handle uncertain accidents, considering that Chengdu offered a precious experience for the construction of resilient city in China and even in the world.

China attached much attention to the construction of resilient city after Beijing suffered from the flood in 2012. There were four Chinese cities including Huangshi, Deyang, Yiwu, and Haiyan selected as the top 100 resilient cities in the world in 2014, which showed the affirmation to the construction of resilient city in China. Taking advantage of it, these four cities largely optimized the urban management system, improved the layout of land, increased the industrial efficiency, focused on environmental protection and governance, and enhanced the urban resilience by technological methods.

In 2016, UPSC released *Report on Habitat III*, emphasizing on the inclusiveness, equity, and ecology in the process of urban development. The Resilient City and Urban Sustainable Development Summit was held in Huangshi in May, 2018, deeply discussing the weaknesses during the development of resilient city in China and the solutions.

## **3. The Application of Resilient City in Chinese Urban and Rural Planning**

### *3.1 The Application of Resilient City in Eco-environment Planning*

Frequent social and economic activities give rise to the damage of eco-environment in China. Urban expansion aggravates the fragmentation of biological habitats. In addition, the eco-environment support capacity becomes lower, and cities are weaker and weaker. The construction of resilient city offers efficient ideas and methods to the improvement of eco-environmental resilience, lowering the fragility of the environment.

In the commentary on urban fragility, Wang Yan, Fang Chuanglin and some other people [10] point out that the fragility of ecology is related to resource and eco-environment, so enhancing the eco-environmental resilience should make good use of resource and protect the environment. In Pre-Qin period, people considered that in the process of building walls, water will be adequate if people avoid getting close to highlands and drainage channels will not need to build if people avoid getting close to low-lying areas. China gains experience from the idea in Pre-Qin period, protecting and conforming to nature with large energy saving and emission reduction, constructing resilient city based on the top-down planning. Zhuang Guiyang and Chen Ying [11] mentioned the interactional condition of eco-environmental adaption and activity reduction, and put forward the relevant measures to cope with the problem. For example, planting trees and converting cultivated land to forest can reduce the probability of flood and mudslide. The non-environmentally friendly means of governance

such as building dams should be less used. While more exploiting hydroelectric clean energy, relevant departments should less exploit dirty energy, which can enhance the resilience of cities.

Increasing the utilization of resource and energy sources and reducing the damage of eco-environment are objectives of the construction of resilient city and the direction that China strives for in a long term. The Chinese government and the planning departments concentrate on the strategy of adaption and slowing down, adding environmental and resource protection into the urban and rural planning system. In 2016, Development and Reform Commission released Urban Adaption of Climate Change Action Plan to put forward the adaptive strategy for regional development of Chinese resilient city [12]. The plan, paying attention to details, suggests to improve urban infrastructure, enhance the immediate plan to prevent the uncertain changes of eco-environment, increase the utilization of resources and intensify the regulation of relevant departments, making efforts to practice the idea of environmental protection.

### *3.2 The Application of resilient city in economic planning*

China is the economic big power in the world, and maintaining economic resilience is the important content of the construction of resilient city. Since the 18<sup>th</sup> CPC National Congress, many important strategies for opening up such as the Belt and Road Initiative and the construction of free trade zones have promoted the rapid development of Chinese economy [13]. With its more important world status, China has more uncertainty of the international environment for economic development. China solves the domestic problems such as unbalanced and unstable development by constructing resilient city. At the same time, it also feasibly deepens reform, enhance the capacity of enduring the attack by financial crises and trade wars, and offers the basic guarantee for Chinese economic development, which is the capacity of economic recovery after being attacked by the external world and it is also the high-profile capacity that the economic resilience needs during the construction of resilient city [14].

During the construction of resilient city, the economic redundancy should be enhanced. Diversified economic mode and development mode can enhance the resilience of a city, more efficiently resisting the damage made by economic fluctuation [15]. Developing a diversified economy is the only way to developing resilient city. Policy reform is the main guiding principle for promoting economic resilient development. Chinese government actively responses to the reform of resilient city, improving the socialism economic system in China, solving the double contradictions, market failure and government failure. Chinese government also realizes virtuous cycle of the interaction between market and the government while enhancing the market innovation, and constructing skeleton to lower the fragility of economy. The general urban planning should emphasize industrial innovation and industrial integration to build up a resilient economic system in cities with the principle of diversity, interdependence and innovation [16].

### *3.3 The Application of Resilient City in Social Development Planning*

City is the carrier of society and culture, so a livable and cozy urban life stems from a harmonious and stable society. Up to 2017, the population of China is near 1.4 billion and the population distribution is concentrated. Specifically, there are 94% people of China living in 43% of lands in south-east China. However, high population density leads to dramatic losses of living quality. With the huge competitive pressure, the rate of urban unemployment and the crime rate increases. Up to 2016, the aging population of China was over 230 million, and China became the country that the aging population was first over 200 million [17], which made the social welfare and basic guarantee important. All these social problems were great tests for the construction of resilient city.

In April 1<sup>st</sup>, 2017, Chinese government declared that it would set up Xiongan New Area as the bearing area where disperses major functions of Beijing, the capital of China. Cluster arrangement will be largely used in order to increase the sense of belonging of citizens, and the resilience of infrastructure will be improved. Additionally, emerging industries will be introduced to offer employment opportunities for citizens. As the social center, the government offers the superior public service and improves the social basic guarantee on education, culture and service, public health and

social security. Constructing resilient communities in the mode of “community-neighbor”, lowering the urban density, Chinese government makes reform on housing system and lowers the pressure of the social subject to make the city livable and safe. The construction of Xiongan New Area is the important practice of resilient city, playing a demonstrated role in enhancing social resilience.

### *3.4 The Application of Resilient City in urban cultural planning*

As a country with a long history, promoting the inheritance of history and culture, China protects the history and culture, which can help to guarantee the construction of resilient city. Exploring local culture and making adjustment to local conditions can strengthen the urban cohesion. Constructing urban texture and historical civilization can better help to make good use of local advantages and follow the local development direction and construction features to enhance the participation and well-being of citizens. Xiongan New Area keeps the traditional style in the aspect of urban design, strengthening the construction of the traditional culture, creating a cozy public space, and avoiding the same style as other cities.

Some cities in China promote the interactive development among urban culture, society and ecology by cultivating the spirit of humanity, and they also enhance the construction of urban resilience in the aspect of spiritual civilization. Shanghai pays attention to the features of water town culture in Yangtze River Delta and Taihu Lake region, building a new ecological pattern of the city with the idea of river and sea intersection, lake and tree integration, and culture and style inheritance, making greenbelt the important carrier of the city to create Shanghai as a beautiful, friendly and enjoyable home at the core of culture. Chengdu enhances cultural resilience from many respects, aiming at inheriting Ba-Shu civilization, developing Tianfu culture, and constructing the famous cultural city in the world. Based on its leading industry, Sichuan cuisine, Chengdu establishes the industrial parks of Sichuan cuisine in China, deeply explores cultivation culture relying on the Dujiangyan irrigation system, and builds up some new public facilities such as museums. It attaches importance to public participation and cultural integration to civilize people by culture and moisten city by morality.

## **4. Suggestions for the Development of Chinese Resilient City**

### *4.1 Promoting the Intelligence of Urban Planning Management*

When building resilient cities, some methods can be used such as the big data analysis and cloud computing platform to make advanced analysis and evaluation on some problems like unreasonable setting of road net and inefficient usage of lands [18]. Based on the big data platform, collecting and analyzing materials, supervising uncertain factors and intelligent management of a city in emergency circumstances can be fully used in the construction of resilient city, which can depend on the data and follow the scientific methods. Under the intelligent management of resilient city, cities create a unified platform to monitor the sudden crises immediately in cities by perceptive layer such as camera and sensor network. And then the network layer integrates, collects and passes the data to the podium layer to make the uncertain factors in cities digitized. At last, it passes the solutions to the application layer to realize urban safety, social security and safe livelihood with accuracy, cooperativity, scientificity and intelligence.

### *4.2 Strengthening the Security of Practicing Resilient City*

The practice of resilient city starts late in China, but it makes great influence in urban construction of China. Ensuring the practice of resilient city and supporting the construction of resilient city from various aspects are needed to be paid attention by the government and relevant departments. Firstly, it is important to make practical policies of constructing resilient city according to the condition of China, and construct the resilient urban evaluation system to guarantee the medium and long term construction of resilient city [19]. Secondly, the construction of resilient city is a long process, not only needing to invest a large amount of money and a lot of time, but also hard to gain benefit within a

short time. Moreover, it needs to construct the long-term budget framework and revenue budget system to guarantee the practice of constructing resilient city. At last, largely popularizing the idea of resilient city to make citizens know the necessity and feasibility of the construction of resilient city is needed. The long-term practice of resilient city can be ensured by public participation and public supervision.

#### 4.3 Learning from Advanced Planning of Resilient City

Due to the late start of the construction of resilient city, there is still a gap between China and other developed countries. Therefore, China needs to learn advanced planning theories and technologies from other countries, enhancing the perspectiveness of urban planning.

In 2015, Huangshi was successfully selected as one of the Top 100 Global Resilient Cities, gaining more chances for international exchanges. For instance, it attended the Chief Resilience Officer Summit in Mexico and it was invited to join the 21<sup>st</sup> Paris Climate Conference. By learning lessons and communicating with other countries in the conference, the construction of resilient city in Huangshi is faster than many other city members [20]. At the same time, Huangshi shares its experience and communicates with other Chinese cities to shorten the gap between Chinese cities and other international cities in the aspect of constructing resilient city.

Therefore, Chinese cities should more often join some meetings organized by some authoritative organizations and institutes such as UNISDR, WCDR, Rockefeller Foundation, ICLEI, UCLG, IPCC, Resilient Alliance and so on, which can help to enhance the perspectiveness of planning theories and technologies of resilient city [21].

Learning from the cases of resilient cities of foreign countries, and exploring the way of development of Chinese resilient city are direct and efficient methods to improve the construction of resilient city in China. For example, the sound system of Singapore, the strategies used to cope with climate change by Tokyo, the application of the big data by Manisarai, Columbia, and the real-time supervision of uncertain factors in New York can be learnt by China. And then China can combine its conditions with the experience gained from others to make analysis and studies from the aspects of infrastructure, system management, and network data.

## 5. Conclusion

Comprehensively knowing the idea of resilient city, and deeply studying the application of resilient city are the basis of the development of Chinese resilient city. China should adjust measures to Chinese circumstances, applying the advanced idea of resilient city to solving natural, environmental, economic, social and cultural problems. It is necessary to make some targeted arrangements on many aspects such as system management, strategy coordination, big data analysis and supervision, and cultural protection and inheritance. Because of the late start of Chinese resilient city, it needs to enhance the international exchanges and learning the planning of resilient city from others to promote the intelligent management of resilient city and improve the security system of practicing resilient city, which can help to carry out the planning and the construction of resilient city consistently.

## References:

- [1] Department of Economic and Social Affairs. World Urbanization Prospects: The 2011 Revision[R]. New York: United Nations Publication, 2012.
- [2] Li, X& Luo, Y (2017).The Construction of Resilient City and the Consideration of Plan Based on the Public Security. *City*, 10, 41-48.
- [3] Zheng, Y, Wang, W. J. & Pan, J, H. (2013). Low-Carbon Resilient City: Idea, Way and Choice of Policy. *Urban Development Research*, 20 (3), 10-14.
- [4] Davoudi S, Shaw K, Haider L J. Resilience: A Bridging Concept or a Dead End?[J]. *Planning Theory & Practice*, 2012, 13(2):299-333.
- [5] Alberti M. Urban Form and Ecosystem Dynamics: Empirical Evidence and Practical Implications [M]//Williams E, Burton M. Achieving Sustainable Urban Form. London: E & FN Spon, 2000.

- [6] The Resilience Alliance. About. <https://www.resalliance.org/about>.2018-6-08.
- [7] Resilience Alliance. Urban Resilience Research Prospectus [M]. Australia: CSIRO, 2007.
- [8] Beijing, International Urban Observatory, What Is Resilient City? ----Concept Analysis and New Cases Analysis. [http://www.sohu.com/a/155180704\\_651721](http://www.sohu.com/a/155180704_651721).2018-6-15.
- [9] College of Architecture and Landscape of Peking University, the Graduate School of Landscape Architecture of Peking University. Landscape China. <http://www.landscape.cn/Special/2012bimu/Index.html>. 2018-6-15.
- [10] Wang Y, Fang, C. L, & Zhang, Q. (2013). The Research and expectations of urban vulnerability. *Progress in Geography*. 32 (05), 755-768.
- [11] Zhuang, G. Y., & Chen, Y. (2006). *International Climate Regime and China*. Beijing: World Affairs Press.
- [12] Development and Reform Commission, Mistry of Housing and Urban-Rural Development. Notice on Issuing the Action Plan of Climate Change Adaption. [http://www.gov.cn/xinwen/2016-02/17/content\\_5042426.html](http://www.gov.cn/xinwen/2016-02/17/content_5042426.html).2018-6-17.
- [13] Gao, C. Y. (2016). The Resilient Analysis of Chinese Economic Growth. *Modern Economic Research*, 11, 20-24.
- [14] Liu, S. C., Zhang, X. J., & Zhang, P. (2005). Realizing Smoothing of Economic Fluctuation on Moderate High-Order. *Economic Research*, 11, 10-21, 45.
- [15] Minsky H P. Stabilizing An Unstable Economy [J]. *Southern Economic Journal*, 1986, 54(2):502-509.
- [16] Li, T. Y. (2017). An Initial Research in the General Planning of Resilient City. *Modern Urban Research*, 09, 8-17.
- [17] Sun, Y. China Science Popularization, Science Encyclopedia. [https://baike.baidu.com/item/aging\\_of\\_population/1980305?fr=aladdin](https://baike.baidu.com/item/aging_of_population/1980305?fr=aladdin).2018-06-25.
- [18] Wan, X. R. Urban Efficiency Research: Making Resilient City More Willful. <http://www.zhjs.cc/portal.php?mod=view&aid=36710>. 2018-06-25.
- [19] Xu, Z. Q., Wang, Y. N., & Guo, J. X. (2014). The Study on Strategy of Promoting the Planning and Construction of Resilient City in China. *Urban Development Research*, 21(5), 79-84.
- [20] Lu, W. C., & Li, L. (2016). The Investigation and Research of the Construction of Resilient City in Huangshi. *City*, 11, 28-33.
- [21] Wu, Y. J., & Ma, B. Intelligent Resilient City: Learn From Foreign Experience (Excerpt). [http://www.360doc.com/content/18/0624/16/57097834\\_765021399.shtml](http://www.360doc.com/content/18/0624/16/57097834_765021399.shtml).2018-06-28.