

Analysis on the Current Situation and Development Problem of China's Sponge City Construction – Case Study on Ningbo Yaojiang-Cicheng Pilot Area

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Abstract: The rapid development of urbanization has brought about increasingly prominent ecological contradictions. Nowadays, flood has become a new urban disease in China's major cities, while storm water management turns to be a top priority for all levels of government. The Ministry of Housing and Urban-Rural Development issued a "sponge city construction technology guide" in November 2014. April 2016, Ningbo was successfully selected as the second batch of national sponge city construction pilot cities. The author investigates the current situation of Ningbo city planning, program construction as well as supervision and protection approach, according to the existing problem on organizational management, retrofit of old industrial area, and the utilization of capital in the construction process of Ningbo sponge city, combined with the relevant experience of domestic demonstration work and the city case, the author puts forward some corresponding recommendations.

Keywords: sponge city; Ningbo City; Policy planning; project construction

INTRODUCTION

In recent years, with the rapid increase in the level of urbanization, ecological contradictions become increasingly prominent. On the one hand, the normalization of the phenomenon of "watching the sea in city" caused by heavy rain in summer, flooding has become a new urban disease that plagues China's major cities, and the solution of waterlogging problem becomes a top priority in front of all levels of government **Error! Reference source not found.**]. "China Climate Bulletin" shows that the north and south floods concurrent in 2016, a total of 26 provinces appeared in varying degrees of different levels of urban waterlogging, causing more than 100 billion yuan of direct economic losses. On the other hand, China is a country shortage of water resources. According to the statistics of the United Nations Environment Program, more than 300 cities in China belong to the "serious water shortage" and "water shortage" cities. Most of these cities are located in temperate and subtropical monsoon regions in China. At present, more than 99% of the cities in China use the rainwater concentration and discharge mode, and the effect of natural precipitation on urban drought are very limited 1.

In order to use water resources rationally, to create a healthy, green, livable urban water environment, China proposed the rules of natural drainage rainwater management system - sponge city. So-called sponge city, as the name implies, is refers to the city like a sponge, adapt to environmental changes and respond to natural disasters with good "flexibility",

When it rains, absorb, permeate, storage and purify rainwater nearby, as well as supplement groundwater and adjust the water cycle. In the drought can release and use water stored water, making the city water cycle close to nature 2? Traditional urban construction takes "fast drain" mode; substantially increase in surface runoff, sponge city construction is to maintain surface runoff unchanged. It is no longer taken by extensive, destructive construction mode, but a low impact mode to the surrounding water ecological environment 3.

In October 2014, the Ministry of Housing and Urban Construction issued a "Sponge City Construction Technology Guide - Low Impact Development Rainwater System Construction (Trial)"4. In March 2015, the first batch of 16 sponge city pilot cities announced. In April 2016, Ningbo was successfully selected as the second batch of national sponge city construction pilot cities 5. Today, sponge city planning and construction is in full swing to carry out throughout the country 6.

Cicheng - Yaojiang Area is the pilot area in Ningbo. At present, the pilot area has identified a total of 153 categories of sponge-type building area, sponge-type roads and squares, sponge-type parks and green spaces, water systems and ecological restoration, flood control and drainage and capacity-building projects.

This paper investigates the construction status of Ningbo sponge city, understand the Ningbo city development model to explore the construction

problems and shortcomings. Then combined with the relevant domestic demonstration work experience and information on a Ningbo's condition, put forward policy advice to promote the construction of the pilot area, alleviate the urban water crisis, protect the city water culture heritage.

II The status of Ningbo's sponge city construction

(1) The basic situation of Ningbo Ningbo is located in the middle of China's coastline, east end of Ningshao plain, moderate latitude, mild and humid climate, which is a typical coastal riverside plain city. Inland river criss-cross and the water system developed in Ningbo. According to statistics, there is more than 6,400 rivers in Ningbo, up to more than 13,000 km, the main rivers are Yuyao River, Fenghua River and Yongjian River. The annual precipitation is 1517.1mm, but the spatial and temporal distribution of rainfall is uneven, that the precipitation in April and September is more than 70% of the whole year. The soil in Ningbo is based to mucky clay, shallow groundwater level is higher. In the past 30 years, with the filling of the river and the cut of the river straight, the city has been under rapid expansion, the built area from less than 100 square kilometers to 321.9 square kilometers in 2015. Meanwhile, water capacity decreased and the drainage capacity of original ecological system has also been destroyed 7. Ningbo winter and summer monsoon alternately obvious, the special natural geographical location, make Ningbo City vulnerable to floods and tide threat, disastrous weather is relatively frequent. Especially in summer and autumn season, alternately influenced by the atmosphere north and south circulation, the typhoon storm is frequent and floods are serious. Since 2000, the urban area of Ningbo has been affected by typhoon and tropical storm 33 times, of which six are of great impact, especially the "sea anemone" typhoon in 2012 and "Fate" typhoon in 2013, of which the heavy rainfall caused by "Fat" leading to the central city traffic paralyzed a large number of residential watered, resulting in a huge economic loss 8.

(2) Sponge city construction situation in Ningbo As early as 2013, the Ningbo municipal government started a project of "strong water governance base", in accordance with the requirements of "three years to be effective, six years to be compliance", government strive to fundamentally reverse the city flood control infrastructures' lagging situation through six years of efforts.

At the end of 2014, the Municipal Planning Bureau completed the "Ningbo city Center City Drainage (Rainwater) Waterlogging Comprehensive Planning (2016-2020)" years. On the basis of full investigation of the status and analysis of domestic and foreign urban waterlogging management program, the government put forward an overall strategy for urban

waterlogging control and carry out key water area drainage planning in old three districts, focusing on the core area of Sanjiangkou, the west of the old haishu railway area, Huangli (in Jiangdong district) and other areas, put forward a small area water level control, drainage system transformation, additional rainwater pumping station along the river and other governance programs. At the same time, Ningbo also began to work out guidance including green rainwater, road rain, construction and residential rain, low impact rainwater development control system to provide design basis for the implementation of sponge city. In 2015, the municipal government set up a special leading group, compile and approval of the sponge city special planning. The zoning planning shows control details to further implement the specific planning to implement the objectives, targets and requirements, develop a series of systems ,including improve water resources protection, water supply and drainage management and the use of unconventional water resources. In the most serious waterlogging urban areas, based on water-sensitive urban design concept, built an area of 2.84 square kilometers of sponge city area, to achieve the annual runoff control rate of more than 75%, and improve the regional drainage and waterlogging capacity.

After successful declare the sponge city pilot cities, Ningbo set up to establish a leadership team, gradually improve the policy system, steadily promote the project construction, and strengthen the regulatory mechanism to promote sponge city construction. Through the combination of "green-gray", "ground-underground" and "infiltration - purification - use - emission", to achieve multiple goals that "good water ecology, water environment improvement, rich in water resources as well as special water security and water culture".

For the project promotion, according to the difference in the main body and the construction conditions, sponge city project is divided into four categories, namely government investment projects, real estate projects, key planning new projects and transformation projects, focusing on 41 government investment construction project, including six model project accepted by Ningbo municipal commission of housing and urban-rural development council, such as the upgrade of west area in Cicheng Guanshan river. In 2016, Ningbo completed the greening project in the north side of Yaojiang and other six government investment sponge transformation projects. Airport Road (Qinglin Bay Bridge to Jiangbei Road) rapid transformation and other housing construction committee project also achieved initial results, also started twenty real estate projects.

Long-term mechanism of sponge city construction is also under construction. In 2016,

beginning of the establishment of pilot area, City housing and urban-rural development council start the progressive level of monitoring system of the "key projects - first area implementation - pilot area overall control". The west land of Guanshan River in Cicheng New District was the first batch which installed the on-line monitoring devices such as liquid level, water quality and rainfall, which realize real-time monitoring feedback of monitoring data. On December, the municipal government organized industry experts to evaluate Ningbo sponge city management and evaluation platform and pilot area monitoring system construction program. At the same time, the sponge city construction project management information service platform established to provide information services for project submission and data summary analysis.

(3) The construction status of CiCheng - Yaojiang area

The pilot area in Ningbo is the Cicheng - Yaojiang Area, which has 30.95 square kilometers with diverse land types. Based on 13 drainage zones, under the technical route of "source reduction, process control and system management", the annual flow is 80% and the designed rainfall is 24.7 mm. Drainage system standard is to achieve 3 to 5 years, the waterlogging prevention and control standards are of not less than 50 years, flood control and moisture standard is 100 years. At present, the pilot area has identified a total of 153 categories of sponge-type building area, sponge-type road and square, sponge-type park and green space, water system and ecological restoration, flood control and drainage and capacity-building projects, and is divided into six demonstration type, namely Cicheng ancient town water ecological protection and the rehabilitation demonstration area, Cicheng new district water-sensitive city comprehensive promotion demonstration area, soil and water conservation demonstration area, urban and rural combined areas pollution prevention and control demonstration area, old city waterlogging prevention comprehensive demonstration area, new area sponge city comprehensive demonstration area.

Pilot area focused on creating a "one core four district" construction, that is, west area of Guanshan river in Cixi District, covering an area of 2.84 square kilometers, meanwhile promoting the completion of sponge transformation in Tianshui home and Xiejia home, the infrastructure ecological environment construction in New Cicheng city ecological zone and Yaojiang New District Reserve area, manage to build "From the point spread to the surface, then extent to area" pilot area sponge city construction pattern.

The implementation of the entire area in "one core" planned to be finished in August 2017, and strive to build it into a sponge city construction example of China. As the committee model project in 2016, the sponge upgrading renovation project in west of

Guanshan River core area of Cicheng New District has started, including soil repair, green update, side stone replacement, pipe repair and other sponge upgrade content, involving twenty roads and central Lake area ecological restoration upgrade. The rain and sewage diversion in built community and sponge transformation is also about to complete.

In the "Four District", Tianshui home and Xiejia district are built area, the project mainly covers sponge transformation of residential quarters, the status road and river network, combined with quality improvement, car park transformation and environmental comprehensive treatment. The Cicheng New City Ecological Zone and the Yaojiang New Area Reserve District plan to adopt the ecological restoration means to carry out the infrastructure ecological environment construction without changing the nature of the construction land. The construction of Cicheng New City Ecological Zone refer to the construction of Lion Rock Ecological Park program, including water remediation and road network upgrade. The area of Yaojiang New District remains a lot of farmland, waters and villages, 73.13% of which are agricultural and forestry land, village construction land accounts for 13.65 %, and owns twenty text security points and historical buildings, majority of them are Qing Dynasty architecture and part of them are the Republic of China building. By the assessment from Land and Resources Bureau, it is recommended to take protective development. In accordance with the "pastoral city" concept of planning, recently mainly is eco-river regulation and rural environmental governance, carry out "1+3" strategy, that is, a sponge city demonstration, plus ecological agriculture, eco-tourism and new rural construction. Long-term development goals are the integration of production, ecology and life ecology, establishing a future pastoral city that city, village, field, water and people organic symbiosis.

Until December 2016, the pilot area has started 61 projects, covering a total construction area of 9.59 square kilometers, accounting for 30.99% of the pilot area, with total investment approved of 4285.78 million yuan. Of which five projects completed, the completion project area accounts for 1.55% of the pilot area, with investment 364.16 million yuan. The government plans to arrange 287.2 million yuan investment funds for sponge city construction in 2017. In accordance with the Ministry of Finance subsidy policy, national financial subsidies 400 million, Ningbo City and Jiangbei District government subsidies 200 million. Meantime, in response to national policy, but also to ease the local financial pressure, PPP mode has been introduced into pilot area.

III. Difficulties and Problems of Sponge City Construction in Ningbo City

(1) High management risk

Sponge urban construction involves multiple departments institutions, in addition to the municipal government, bureau of finance, water conservancy bureau, housing construction committee, Development and Reform Commission, Land and Resources Bureau, Planning Bureau, Urban Management Bureau, Environmental Protection Bureau, new district management committee and other departments are also have participated. Although Ningbo has set up a pilot working group, the composition of the staff is redundant, administrative efficiency is inevitable. Coordination between the various departments takes too much time and effort, while sponge city pilot construction cycle is only three years, the project construction progress is tight, the convergence work of departments is tough and organization and management risk is high.

(2) Trouble in old area rebuilt

The existing construction mode of the old city area is different from that of the sponge city, and the drainage system is not perfect. There are still some problems in the internal rainwater drainage system. Part of the older district still have rain sewage mixed phenomenon, balcony wastewater involved in rainwater riser mixed into the rainwater pipe, causing pollution to the river 9. Solar energy facilities are wildly used in part of the old residential roof, which leave little green roof area, causing difficulty to the transformation and higher cost.

The annual rainfall in Ningbo is abundant, and the groundwater level is high. Poor infiltration capacity in sponge city may be cause ponding in low-lying areas. At the same time, the rainwater infiltration will once again raise the groundwater level, bring negative impact to the building structure even lead to building deformation if serious and is not conducive to the stability of the project.

In addition, due to the large population density in old city, renovation project construction may have a great impact on the lives of residents. Big social resistance increases the difficulty of construction.

(3) Difficult in financing

Sponge city construction is a systematic project, involving large amounts of money, and most of the projects are public welfare and non-profit, which bring greater financial press to the government t. Subject to the central government's management of local land finance and financing platform, now the local government financing capacity has more constraints. The PPP operation model, raised by Ministry of Finance, has a great risk of project financing because of the large scale of the project financing funds, long cycle, complex structure of participants, and difficult

management 10. And the profitability of the PPP project in the sponge city is externally, the public is strong, and is lack of obvious profit point, all of which hinders the participation of social capital.

IV. Suggestions on promotion of the sponge city construction in Ningbo

(1) Strengthen leadership team building, promote coordination and cooperation between ministries Sponge city construction not only involves the coordination and communication of various departments of the government, but also involve coordinate, adjust and unify a number of planning, need a strong organizational management and implementation capacity. To strengthen the organization and leadership, give full play to the leadership role of the Construction Committee and format a joint working mechanism, co-ordinate all departments strictly in accordance with the planning requirements and task division to promote the work, clear the leader, implement specific responsibility, so as to give full play to the leading role of the leading group, promote the convergence of various departments to ensure the efficient operation of the organization.

(2) Transform the old areas according to local conditions to ensure project completed on schedule.

a. Combine the project for the benefit of the people to transform the old areas

Led by the Jiangbei District Government, launched the streets, community leaders to guide the residents to promote the implementation of the transformation of the old city. The transformation of residential areas could simultaneously implement with residential parking spaces transformation, landscape upgrading and other projects, turn the sponge built project into the project for the benefit of the people to win the support of residents.

b. Determine blocks rebuilding indexes as appropriate

Fully consider the difficulty of building blocks construction when planning division indicators, not all in accordance with the standard comprehensive annual runoff control rate of 80%, modify the indicators as appropriate according to different block conditions. For instance, the ground condition of Xiejia area is relatively poor, the total annual runoff control rate can be designed to less than 80%, while the condition in Cicheng New City is better, and the total annual runoff can be controlled above 80%. At the same time, do a good job on regional research feasibility study of transformation facilities to determine the appropriate transformation proportion. For example, there are more houses in old district that are not suitable for green roof renovation. For the high groundwater area, focusing on its geological soil elevation analysis and using water storage and drainage infrastructure construction.

c. Different land use different types of programs

North of Tianshui home is a typical old area with living, commercial public construction, roads, municipal, industrial, park green space, unused land, river and other types of land. Different types of land are supposed to use different technical solutions. old district in good conditional can combine the district's comprehensive renovation and landscape improvement to conduct a comprehensive transformation; while others in a relatively bad condition could considered the end of the rain storage facilities. Based on the actual situation, municipal roads can set the sidewalk pavement, sunken green, grass and other shallow ditch facilities, to control road rainwater runoff and clean up the initial rain. In the process of increasing total runoff control capacity and control rate, Park green space can also consider import other land within the surface runoff.

For non-realignment of river, build ecological revetment, purify the surface runoff water into the river, contact the river ecosystem and the terrestrial ecosystem, thus increase river ecosystem to give full play to the water self-purification and restoration of ecosystem.

d. Improve the mechanism of investment and financing for social capital. On the one hand, accelerate the construction of PPP mechanism, broaden the path of PPP implementation. The first phase of north of Tianshui home sponge city transformation project includes four residential quarters, three green parks, three roads and two riversides. Two of them are greening project sponge city construction projects in the construction that can be integrated into the greening project construction, others can operate single in a EPC general contracting way, then doing overall PPP packaging, through the form of repurchasing stock assets (TOT mode) to put the project into the scope of implementation of PPP, following with operation and maintenance. Other more mature applications of the PPP project, such as the pilot area river network water system comprehensive management and shore slope ecological management, can learn experience from Cixi city river water quality control PPP mode, according to the Combination of short and long term to carry out PPP mode package, implement, operation and pay by stages 11.

On the other hand, from the perspective of the added value of infrastructure efforts to excavate the profit point to attract more social capital participation, make full use of the strong private capital strength in Jiangsu and Zhejiang region, promote the implementation of PPP projects. The real estate may appreciate in old district such as the north of Tianshui home and Xiejia district after the sponge city

transformation. Yaojiang new city reserve district can make full use of local valuable folk culture and beautiful natural landscape, through the cultural industry, agriculture creative industry planning to enhance the green added value of sponge city, establish an ecological network center as well as comprehensive agricultural demonstration effect. Besides, organize all Kind of rural experience activities and construct agricultural town, creative town, fund town to obtain better income.

(3) Improve the assessment and monitoring system to strengthen the supervision of construction results.

Germany is the first country to carry out urban rainwater government regulation, under the guidance of the government, Germany has now formed perfect laws and regulations, technical guidelines, incentive mechanism and high standards of rain and flood utilization technology¹²]. China's sponge city construction should also strengthen the guiding role of the government to speed up the pilot area monitoring system technical program construction, establish and improve the sponge city supervision and inspection mechanism, regularly inform the pilot construction, strengthen the effect of monitoring. In the pilot area, in accordance with the principle of classification, zoning and stratification, set up by big to small from pilot area to the project or site, then to the facilities at different levels of integrated testing system, comprehensive assess sponge city construction results, and timely summary experience to guide the follow-up work. Typhoon weather is frequent in summer and autumn in Ningbo, the Government should strengthen the infrastructure assessment of typhoon-prone areas.

(4) Strengthen propaganda guidance mobilization, popularize sponge city knowledge

Make full use of radio, television, network, newspapers and other propaganda media to popularize sponge concept phased and focused, combined with the typhoon disaster in Ningbo, to strengthen propaganda and guidance to enhance public awareness of the sponge city construction and recognition, create a good atmosphere of public opinion and social environment for the sponge city construction, timely publicity sponge city construction work dynamics and effectiveness, promote the renovation project.

Strengthen the profession training of supervising officer of relevant departments and workers in design, construction, supervision and other units of business, enhance the comprehensive capacity to promote the construction of sponge city. Relying on professional institutions, actively organize exchanges and cooperation, technical seminars, academic forums and other activities related to sponge city construction, provide professional and technical support to the

construction of Ningbo City sponge city, improve the construction and management level.

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