Regional Water Policy in China – Problems and Approaches in the Taihu und Wuhan Regions

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Abstract This contribution depicts the governance arrangements for water resource management in the regions of the Tai Lake Basin and in the city of Wuhan. As to the Tai Lake Basin, the focus is on pollution control. It is shown that sustainable, integrated water management is strongly impeded by high fragmentation of the administrative competences and that adequate organizational integration and effective coordination instruments are lacking. The city of Wuhan is presented as an advanced example regarding the implementation of the "Sponge City" concept. It is shown that Wuhan has managed to establish a more integrated administrative arrangement for the purpose of water infrastructure development and a complex structure of objectives, standards, and responsibilities for the advancement of the Sponge City project. In order to place these examples of regional water governance into the wider national picture, we firstly provide a brief overview of the factual and institutional backdrop in China.

1 Water Resources in China

There are about 50,000 rivers with an area larger than 100 km^2 in China, among which more than 1500 rivers cover an area larger than 1000 km^2. Most rivers are distributed over the eastern and southern part of China. The total basin area of the rivers flowing into the sea accounts for 2/3 of the total area of Chinese territory, and the remaining 1/3 belongs to the inland river basins (FAO 2016). Seven river basins are considered as the major basins in China: the Yangtze River Basin, Yellow River

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Basin, Hai River Basin, Pearl (Zhujiang) River Basin, Huai River Basin, Songhua River Basin, and Liao River Basin. There are seven River Basin Commissions located in those seven river basins respectively, except Songhua River Basin and Liao River Basin share one commission which named Songliao River Commission. The seventh Commission, i.e., Tai Lake Basin Authority, is stationed in Tai Lake Basin which is a sub-basin of the Yangtze River Basin.

2 Institutional Arrangement of Water Resource Management in China

2.1 Water-Related Authorities and Responsibilities

China's institutional framework for water resource management is often referred to as a "multi-headed dragon" as a number of Ministries are involved. Taking the national level as an example, there are more than 40 departments directly governed under the State Council, among which at least eight are related to water management. The Ministry of Agriculture is responsible for irrigation, fishery environmental water, and nonpoint source pollution control, the Ministry of Health manages the national drinking water safety, while other departments are responsible for different aspects of water use: the Ministry of Transport concerns inland navigation, the Ministry of Housing and Urban-Rural Development is responsible for the construction and management of water supply projects and drainage and sewage disposal projects, the State Forestry Administration protects soil erosion, while the National Development and Reform Commission cooperates with other departments while the comprehensive river basin plans are made (Dai 2012).

Among these departments the Ministry of Water Resources and the Ministry of Environmental Protection play the most important roles. The former is responsible for water resource management with the focus of water quantity management and hydraulic projects across the country; it delegates the management to seven River Basin Commissions which are responsible for the daily administration of water resource management within their own jurisdictions. The Ministry of Environmental Protection is responsible for water quality and the prevention and treatment of water pollution over the country. Corresponding to the distribution of powers between these two Ministries, the local water resource authorities and environmental protection agencies have the same responsibilities within their own prefectures (Dai 2012).

2.2 Legal Framework of Water Resource Management

The Chinese legal system is primarily based on the Civil Law model; the prime source of law is statutes. The National People's Congress is the highest-level legislative body, which is empowered by the Constitution (Article 58). The National People's Congress enacts and amends fundamental national statutes, for example, the establishment, organization, and responsibilities of the National People's Congress, the people's governments, the people's courts, etc. (Ferris and Zhang 2002). The other basic national statutes, like the Environmental Protection Law, the Water Law, the Water Pollution Prevention and Control Law, and so forth, are enacted and amended by the Standing Committee of the National People's Congress (Dai 2015b).

The State Council, as the direct executive authority of the National People's Congress, issues decisions in accordance with the Constitution and other laws. For example, in order to further indicate the implementation of the 1988 version of the Water Law in 2000, the State Council issued detailed rules for the implementation of the Water Pollution Prevention and Control Law. In the meantime, as the highest administrative organ, the State Council also approves and promulgates national administrative regulations (Ferris and Zhang 2002). For example, the Regulation on the Administration of the License for Water Drawing and the Levy of Water Resource Fees is a regulation issued for strengthening water resource management and protection by the State Council.

The Ministries which are directly governed by the State Council have the legal right to make "ministerial regulations" within their areas of competence (Ferris and Zhang 2002) and within the scope of implementing national law, administrative regulations, and decisions or orders issued by the State Council (Article 71). For example, measures for the administration of water abstraction licensing are guidelines issued by the Ministry of Water Resources for implementing the regulation on water drawing licenses and the water resource fee addressed above.

At the provincial level, the provincial people's congresses (and their standing committees) may issue local regulations provided they do not contravene the Constitution, the applicable national statutes, and administrative and ministerial regulations. The provincial people's governments may also issue local regulations provided that they do not contravene any regulations issued by the provincial people's congresses (Ferris and Zhang 2002). The administrative structures in the 34 provinces (including municipalities and autonomous regions) within the country are similar to the central level as the political structure of China is unitary (Dai 2015b).

Since the Open and Reform Policy in 1978, China has promulgated a series of laws and regulations to regulate water management. They cover almost every aspect of water management from strategic planning and water quantity management to water quality control (Peng 2010).

Besides the National People's Congress and the State Council, the Communist Party of China is another principal actor in the field of China's water resources management. It has a profound influence on both the National People's Congress and the State Council. Party policies sometimes are more efficient than formal law.

3 Water Quality Management in Tai Lake Basin: Pollution Control

3.1 Water Challenges in Tai Lake Basin

Tai Lake is the third largest freshwater lake in China. Tai Lake Basin is the sub-basin of the Yangtze River Basin, occupies an area of some 36,500 km^2, and extends across multiple jurisdictions: Jiangsu Province (52.6%.), Zhejiang Province (32.8%), Shanghai Municipality (14%), and Anhui Province (0.6%). As one of the most developed regions in China, with only 0.4% of the land territory but 4.4% of the population, the Tai Lake area produced 10.3% of GDP; per capita GDP in this region was 2.4 times more than the national average in 2012 (Bureau of Taihu Lake Basin Ministry of Water Resources 2011). The lake connects seven large cities across East China, including Shanghai and Hangzhou, which have a population of 23.8 million and 8.8 million, respectively.

Water pollution is the biggest challenge in Tai Lake Basin. The entire lake has suffered from eutrophication since 1993, the most serious crisis coming in 2007 when dozens of centimeter-thick algal blooms covered the entire lake and tap water turned yellow and was foul-smelling. Trans-provincial water pollution problems are persistent issues in this watershed as it extends across three provinces and one municipality (Dai 2014).

The following factors contribute to water pollution in Tai Lake Basin:

- *Industrial development* is the most important contributor. According to the Water Environment Comprehensive Management Plan for the Tai Lake Basin, there are some 2.10 million industries in the Comprehensive Treatment Region of the lake. Of this total, around 1.04 million are in Jiangsu Province and 1.06 million in Zhejiang Province; 0.56 million of these industries belong to the six major pollution industries (textile industry, manufacture of paper and paper products, petroleum processing and coking and nuclear fuel processing industry, manufacture of raw chemical materials and chemical products, manufacture of medicines, and manufacture of chemical fibers), which also contribute significantly to the economic development in the region (Dai 2014).
- *Diffuse source water pollution* is another main contributor to water pollution in the Tai Lake Basin. If the total nitrogen (TN) and the total phosphorus (TP) – two main pollutants in diffuse agricultural pollution – had not been included in the evaluation of the water quality, most of the surface water in Lake Tai would have reached Class III. However, when the TN and TP are taken into account, the

water quality drops to a level worse than Class V, especially in Jiangsu Province. This diffuse pollution is attributed to agriculture – 40 percent of which originates from aquaculture since the lake is most famous for hairy crab and its "three whites": white shrimp, whitefish, and whitebait (Dai 2014). Land-based agriculture also has been a major contributor to water pollution as farmers, fearful of counterfeit chemicals and paper-thin profit margins, regularly over-apply chemical fertilizer and pesticides (Tai and Ellis 2011).

- *Municipal wastewater discharge* has largely increased in the regions as a result of the tremendous population growth. According to a Nanjing Agricultural University study, between 20 and 30 percent of eutrophication in Tai lake is attributed to municipal sewage. Hans Paerl of the Institute for Marine Sciences at the University of North Carolina estimates that 50 percent of the nitrogen in the lake originates in municipal wastewater (Tai and Ellis 2011). This is not surprising given that 33.5 million people live in the area surrounding the lake. There are 127 functioning sewage treatment plants around the Tai Lake Basin, with a combined capacity to treat three million tons of sewage water everyday (Tai and Ellis 2011).

3.2 The Institutional Arrangements of Water Pollution Control in Tai Lake Basin

According to the Water Law, China shall manage water resource by integrating river basin management with administrative management. The fact that multiple causes and transregional nature of water pollution in Tai Lake Basin makes for a great challenge in terms of integrated water resource management in the region. There are several factors involved in the integrated management in Tai Lake Basin, i.e., the Tai Lake Basin Authority, the East China Environmental Supervision Centre, and three main provincial-level governments (Jiangsu, Zhejiang, and Shanghai).

The *Tai Lake Basin Authority* was set up by the Ministry of Water Resources in 1984 to perform water resources coordination and management in the Tai Lake Basin. Its main tasks include:

1. Supervision of the implementation of the Water Law and the law on conservation of water and soil.
2. Water resources development strategy and long- and mid-term planning.
3. Overall water resources management.
4. Overall management of the rivers, lakes, estuaries, and wetlands.
5. Flood control management.
6. Resolution of conflicts among the provinces and municipality.
7. Measures on conservation of water and soil.
8. Review of relevant feasibility studies and design reports.
9. Management of relevant water resources engineering works.
10. Guidance to relevant work in rural and urban water resources management.

However, when it comes to water pollution control, its function is very limited. The *Water Resources Protection Bureau* of Tai Lake Basin, which is jointly guided by the Ministry of Water Resources and the Ministry of Environmental Protection, performs the responsibility of monitoring water quality in trans-administrative areas and reporting to the Tai Lake Basin Authority. However, neither the Water Resources Protection Bureau nor the Tai Lake Basin Authority has the legal power to regulate polluting activities or punish the polluters. These institutions can only provide the monitoring data to the Ministry of Environmental Protection and relevant local governments in the Basin. Ironically, the local governments often rely on their own monitoring data, and therefore, the data provided by the Water Resources Protection Bureau is not always taken into account by the local governments. Arguably, such parallel monitoring creates a great deal of administrative resource waste (Dai 2015a).

The former *Ministry of Environmental Protection* (merged into the Ministry of Ecology and Environment in 2018) was the sector administration responsible for water quality and the prevention and treatment of water pollution. The *East China Environmental Supervision* is a regional agency of the Ministry of Environmental Protection in Tai Lake Basin, established in 2002. This agency is vested with the authority to supervise and inspect the enforcement of national environmental laws and regulations on behalf of the Ministry of Environmental Protection. It focuses on major cross-provincial and river basin issues of environmental protection and emergency events. However, it can neither take any substantial environmental administrative decision – to regulate, reward, or punish – by itself nor mediate as an independent actor between the Ministry of Environmental Protection and the provincial governments. It is not allowed to take any significant action without prior approval of the Ministry of Environmental Protection, and it has no substantial competence as to the environmental issues under investigation by the Ministry of Environmental Protection. Furthermore, it is not allowed to interfere with the environmental protection duties of provincial governments or their responsible departments. As a consequence, it seems very much like a regional information-gathering and consultative agency of the Ministry of the Environmental Protection (Huan 2011).

According to the laws and administrative regulations, the relevant departments of local governments above the county level are in charge of the administration of environmental protection issues in their respective administrative regions. In the case of Tai Lake Basin, three main governments of Jiangsu, Zhejiang, and Shanghai take care of water quality of Tai Lake Basin in their own administrative regions, respectively. The internal institutional arrangements of these governments are not much different from the State Council. This means that, in common with the State Council, a number of sectors are involved in the water resource management within these regional governments, and on this regional level, we find, again, the so-called multi-headed dragon. Although water quality is the main responsibility of environmental protection departments, cooperation with other departments is, of course, necessary as water quality is inseparable from other water issues such as water quantity, irrigation, and sanitation, etc. All in all, the fragmentation of competences is high and has been identified to be the primary weak point in China's institutional

arrangement by previous research (Dai 2015c). The lack of effective coordinating mechanisms has produced multiple conflicting policies and is a major reason for poor results in both national and regional water management.

Effective coordination is also missing with regard to interregional water conflicts which typically occur in catchments like in Tai Lake Basin where waters are shared by several administrative regions. Local governments tend to be inward-looking and regard each other as economic competitors since the Open and Reform Policy in 1978. This is why local governments tend to exploit their local environmental resources and national safeguards are needed in order to ensure sustainable cooperation and a "level playing field" in terms of environmental protection. However, in this regard the Chinese system provides only few formal mechanisms for interjurisdictional cooperation or interest-bargaining between administrative units (Moore 2014). As mentioned above, in the case of water pollution control in the Tai Lake Basin, the Tai Lake Basin Authority is not provided with substantial powers to regulate interregional water issues and curb trans-administrative pollution. Instead, local governments are still playing the main role in water pollution control.

Altogether, the abovementioned institutions are creating a complicated governance system for the Tai Lake Basin. However, the central government has long been aware of this, and many efforts therefore have been made to improve the administrative arrangements as will be reported in the following section.

3.3 Legal, Policy, and Project Instruments in Tai Lake Basin

The following legal, policy, and project instruments have been adopted in order to streamline the governance system and provide better policy coordination:

- *Organizing joint meetings*. In order to control water pollution in the basin, an interprovincial/ministerial joint meeting mechanism was set up by the National Development and Reform Commission in 2008; it has taken place six times up to date. Its round of participants may include parties from the regions around the lake and the entire basin. The tasks of the joint meetings may include studying and discussing key issues of water management; coordinating management activities among regions, departments, and agencies; and strengthening joint enforcement and supervision (Shen and Min 2016). The joint meetings provide institutional support to address the water problems at the basin level; however, they do not imply organizational changes.
- *Setting uniform quality standards in trans-administrative areas*. Quality standards have significant importance as a means of environmental regulation and providing the abovementioned level playing field as a safeguard against contra-environmental competition. In order to enforce this important instrument, a circuit issued by the Ministry of Environmental Protection requires that neighboring provinces shall implement the same water quality standards in their border regions. The provinces involved shall negotiate and make a joint decision. If this

fails, the Ministry of Environmental Protection is competent to set the standards (Ministry of Environmental Protection 2008).

- *Total pollution load control*. Tai Lake Basin Authority is responsible for establishing – together with the water departments of the governments of Jiangsu, Zhejiang, and Shanghai – the pollutant carrying capacity of the lakes and watercourses in the Tai Lake Basin and to put forward suggestions as to restrictions of the total pollutant discharge to the above departments. These departments, on the basis of the national water quality objectives, give full consideration to the suggestions, make plans for the reduction and control of total discharge of major water pollutants, and assign the control to all cities and counties in the Tai Lake Basin. The Ministry of Environmental Protection will then evaluate the relevant governments based on the accomplishment of the assigned quotas. This system of total pollution load control is not only a means to control and reduce water pollution in the basin but also provides a useful tool to divide and evaluate responsibilities between the relevant provinces.
- *Eco-compensation program*. To control diffuse pollution in Tai Lake Basin, the State Council introduced a special regulation (2011) requiring the local governments to take measures such as "constructing an ecological protection forest within a 500-metre area around the shoreline of the lake, a 1,500-metre area around the drinking water source protection zones, and within a 200-metre area along both of the river banks of the shore of the lake" (State Council 2011). It also requires the local county governments to "provide subsidies for farmers whose income has decreased or whose expenditure has increased due to efforts for the reduction of pesticide and fertilizer use" (Dai 2014). This instrument however has not shown immediate effectiveness due to the fact that the diffuse polluting sources in the region are complex, i.e., besides the excessive pesticides and fertilizer usage, intensive aquaculture and domestic sewage also contributed greatly to the pollution. They are, however, not totally covered by this program. Furthermore, existing research has shown that the compensation amount from the government is usually not sufficient to cover the potential loss of the targeted farmers (State Council 2008).
- *Adjusting industrial structure*. Jiangsu, Zhejiang Province, and Shanghai have upgraded their industrial structure since 2008 when the "General Planning of Integrated Water Environment Management in Tai Lake Basin" was issued by the State Council. The emission standards of 13 main industries and paper industries in this region are set stricter than in other regions in view of the serious industrial pollution in the Basin. Jiangsu Province has supported environmental-friendly industries as its strategic emerging industries, which have a total yield of 1.4 trillion Chinese Yuan in 2010 (State Council 2008). However, since these emerging industries are at an early stage of development, the heavily polluting industries such as textiles, chemicals, and metallurgic industry still play the main role, and therefore, industrial water pollution in Tai Lake Basin is still pressing.
- *Water transfer from the Yangtze River to Tai Lake*. Using the Yangtze River water to improve water quality and to reduce the risk of algal blooms in Tai Lake is a project initiated by the state in 2002. The transfer of freshwater from

a comparatively clean source to a more polluted water body is pursued as an effective emergency countermeasure to enhance water exchange, dilute polluted water, and improve water quality. Since 2007, around 5.3 billion cubic meters freshwater have been transferred into Tai Lake from Yangtze River in order to prevent water scarcity in the Lake and maintain the regional water cycle (State Council 2008). However, the effects of this water transfer on nutrient concentration are still debated.

- *Public participation*. Jiangsu Province has initiated environmental roundtable meetings since 2006. Participants were from four cities in the trial period, covering major industries such as chemical, dyeing, power generation, and manufacturing. Although the roundtable meetings could not solve all the environmental issues, they did provide communication platforms for stakeholders and opportunities for the public to engage in dialogues with the government, corporations, experts, and media. However, this roundtable mechanism could only play a limited role in the basin scope as it has only taken place within one administrative region but not at the basin level.

3.4 Section Summary

Water pollution is the main challenge in water management and governance in the Tai Lake Basin and mainly caused by industrial, agricultural, and domestic pollution. The existing governance structure seems insufficient to deal with the multiple and transregional causes mainly because of the high – vertical and horizontal – fragmentation of competences and a lack of effective coordination mechanisms. Some new institutional arrangements have been established in more recent times by either the central government or the local agencies in order to enable better coordination and cooperation of the involved agencies and regions. According to the General Planning, significant achievements have been made in controlling the water pollution especially in industrial sources in the basin, too. However, the water pollution situation remains critical as heavily polluting industries still play a main role in the region, and diffuse pollution becomes more serious (State Council 2008).

4 Urban Water Resource Management in Wuhan: Sponge City Program

4.1 Water Challenges in Wuhan

Wuhan is the capital city of Hubei Province, with a population of just under 8.5 million. It is located in Central China, where Yangtze River and Han River intersect. The urban core is divided into three parts by the Yangtze River and the Han River:

Wuchang, Hankou, and Han Yang. The city occupies a land area of 8500 square km^2, most of which is plain and decorated with hills and a great number of lakes and pools (the water surface area in total was 2117 square km^2 according to the statistics in 2014). The city enjoys the reputation of the "River Town" and the "City of Hundreds Lakes." The abundant water resources have created many development opportunities for Wuhan, but also brought many problems, such as waterlogging issues in the city and water pollution from the urbanization and economic activities (Dai et al. 2017).

The expansion of Wuhan and the expected effects of climate change are increasing the risk of floods in the city. Due to rapid urbanization, the natural wetland area in Wuhan decreased by 18.71 and 50.3% from 1987 to 2005, respectively (Cheng and Zhou 2015; Xu et al. 2010), although the lake surface increased slightly afterward. Wuhan is located in a floodplain area (Jianghan Plain). According to the Asian Development Bank, a weather trend for Wuhan is seeing a significant increase in precipitation due to the climate change. However, Wuhan has yet to take the more frequent and severe climate change impacts, especially increased precipitation, in the planning and design of its urban drainage and flood control program (Asian Development Bank 2013).

Water pollution is also a considerable issue in Wuhan. According to the municipal Water Resource Bureau, 4 out of 11 rivers did not meet the prescribed standards of water quality in 2014 (Yu and Yu 2015). The reasons were that these river areas were historically designed as "discharge control areas" with intensified drain outlets. Incompletely treated industrial and domestic sewage is discharged to the Yangtze River and Han River via these areas. Besides point source pollution, nonpoint source pollution is also serious in Wuhan since the new district invests heavily in agriculture with heavy use of pesticides and fertilizers (Dai et al. 2017).

Wuhan is also vulnerable to water supply shortage. The city is among the few fortunate cities in China that currently have adequate water resource, with 100% coming from the Yangtze River and the Han River. However, climate change has led to runoff reduction in the Yangtze River catchment, and the watershed of the Han River catchment has been experiencing higher frequencies of consecutive years of drought (Asian Development Bank 2013). The city, with its total reliance on these two rivers, is actually vulnerable due to the climate change in terms of water supply.

In the light of the existing issues – flooding, pollution, and water supply shortage risks – the municipal government of Wuhan has decided to build a "Sponge City" (discuss below), and it gives first priority to waterlogging and nonpoint source pollution control supplemented by rainwater collection and reuse.

Table 1 Water-related organizations and their functions before 1998

Name of organizations	Functions and responsibilities
The Wuhan Water Conservancy Bureau	Rural water conservancy construction in the municipal area including reservoir, pumping-station, irrigation, water-soil conservation, embankment in the rural area
The Wuhan Flood Control Headquarters	Flood control and embankment construction in the urban area
The Wuhan Public Utilities Bureau	Water supply, the protection of potable water sources
The Wuhan Municipal Infrastructure Bureau	Urban rain and sewage water drainage and their relevant facility construction, waterlogging mitigation
The Wuhan Mineral Resources Bureau	Groundwater management

Source: Du (2010), p.84

4.2 Institutional Structure and Policy of Water Management in Wuhan

The institutional structure of water management in Wuhan had experienced a large transformation from 1998 to 2001. Before 2001, it was highly fragmented similar to the situation in the Tai Lake region. The turning point happened in 1998 when the central government put forward a new guideline on the water control of the Yangtze River which includes increasing land for reforestation, returning farmland for forestry, resettling people out of river courses to new areas, returning farmland to lakes and rivers, reinforcing main embankments, and dredging the main river courses. These guidelines also required more cooperation among different organizations at the local level. In this context, Wuhan water management initiated institutional reforms in 1998, and its reorganization was finished in 2001 (Du 2010) (Table 1).

The *Wuhan Water Affairs Bureau* was established in 2001; it took over the responsibilities of four former organizations: the Wuhan Water Conservancy Bureau, the Wuhan Flood Control Headquarters, the Wuhan Public Utilities Bureau, and the Wuhan Municipal Infrastructure Bureau. The main task of the Wuhan Water Affairs Bureau is to manage the water resource in Wuhan City in a holistic manner. Therefore, it is in charge of the city's water supply, drainage, and sewage treatment as well as the management of the city's rivers, dikes, lakes, and reservoirs. The water conservancy work in rural areas and the organization and coordination of farmland water conservancy construction are also within the responsibilities of the Water Affairs Bureau. However, water quality issues remain in the competence of the environmental protection sectors.

The *Wuhan Lake Protection Regulation*, issued in 2002, was revised in 2015. The Regulation requires a joint meeting mechanism to protect the lakes in Wuhan and allocates responsibilities to different sectors. As to the use and protection of the

lakes, the Regulation proclaims that "the planning shall be unified, the management shall be regulated by law, the treatment shall be integrated, and the usage shall be based on scientific evidence." This Regulation also establishes an eco-compensation mechanism which provides compensation for people who must sacrifice their benefits from the legal usage of the lake, for example, by giving up the fishing farms. It also encourages the public to participate in the lake protection activities. The Regulation is playing an important role in water management in Wuhan.

Another important regional regulation is the "Wuhan Water Resource Protection Regulation" of 2011. This Regulation is the first local regulation to correspond to the national requirement of "Three Red Lines" (cap control) in 2011, i.e., a red line of water resource development and use, a red line of water use efficiency, and a red line of the total amount of pollutant emissions into rivers and lakes. To implement these Three Red Lines, the Regulation established a new responsibility system, which requires the government officials to take personal responsibility for the implementation. As a part of this system, their performance will be evaluated and administrative sanctions may be imposed if they fail to implement the regulations or to complete the assigned tasks appropriately.

4.3 Sponge City Program

The "Sponge City Program" (SCP) is a new program launched by China's central government. The Sponge City concept is aimed at substantially improving the cities' capability to manage rainwater and prevent flooding in a sustainable manner. It includes integrated appliances of diverse technologies and multifunctional infrastructures for effective drainage, storage, evaporation, treatment, and reuse of rainwater as is discussed in detail in the technical part of this volume. Today, the central Chinese government attaches great importance to the SCP. In order to foster implementation of Sponge City technologies, it issued a "Guiding Opinion" earlier in 2015, which urges cities "to comprehensively take various measures to minimize the influence of urban development and construction on ecological environment via the construction of sponge cities." A major target is to consume and use 70% of rainfall locally. Besides this target, the Opinion sets out the timelines for implementation, i.e., over 20% of urban built-up area should achieve the target requirements by 2020 and over 80% by 2030 (State Council 2015).

Wuhan is one of the pilot cities approved by the central government. When initiating the local SCP, the government of Wuhan, as stated above, gives priority to the issues of waterlogging and nonpoint source pollution prevention and control, and supplemented by rainwater collection and reusing. Specifically, the city will focus on improving toward "sponginess residential districts, public buildings, green infrastructures and roads, building sewerage pipelines and pumping stations, repairing the ecological water systems, and establishing a special monitoring platforms for the SCP" (Dai et al. 2017).

The municipal government of Wuhan, based on compulsory standards, laid down five targets for the SCP in two demonstration areas at the current stage, i.e., Qingshan District and Sixin District. The municipality aims that, by the end of 2017:

- Management of rainwater will achieve the national advanced level.
- Water quality of the city will be effectively improved.
- Anti-waterlogging standards and management level will be enhanced.
- The ecological system of the city will be effectively protected.
- The entire process management of the SCP, i.e., source control, process management, and end-of-pipe treatment, will be established.

All these five targets are supplemented by technical standards in a special implementation plan issued by the municipality. This plan also allocates the responsibilities of the related departments (see Table 2).

Besides allocating the responsibilities, the municipality also provides technical and institutional support for the SCP. For example, it issued the Wuhan Technical Guidelines for the SCP Planning including the preparation of work, special research, and technical constancy of the SCP construction as well as the establishment of two monitoring platforms for the SCP in demonstrative areas. In order to enhance the cooperation and collaboration between the related departments, the municipal government set up a "Headquarter of Pilot Project for Construction of Sponge City in Wuhan," the office of which is attached to the Water Affairs Bureau of Wuhan City. It also provides a coordination platform as a forum to discuss the "major policies and import decisions of the SCP" ("Implementation Plan on Pilots of Sponge City Program in Wuhan City" of 2016). Moreover, the district governments where the SCP demonstrative areas are located are required to set up Task Forces to coordinate and implement the pilot construction of the SCP (Dai et al. 2017).

The municipal government planned to invest 16.3 billion RMB in total in 455 pilot SCP projects within the two demonstrative areas during the year 2015 to 2017. Besides the subsidies from the central government, the municipal government is required to invest 400 million RMB, and the district governments where the pilot projects are located are required to invest no less than 100 million RMB ("Implementation Plan on Pilots of Sponge City Program in Wuhan City" of 2016; see Dai et al. 2017).

The municipal government established a subsidy policy for nongovernmental investment of SCP construction taking October 1, 2015, as a reference time. The investor who initiated the SCP project by social capital before October 1 will get 30% of the total investment amount as the governmental subsidy and 15% if after the time. The government encourages the PPP model of investment and promotes the participation of the social capital via various means, for example, using government purchase of services to repay the loan of local government financing platforms (act as a vehicle to provide off-balance sheet quasi-fiscal support for local governments) and taking advantage of the national supporting polices of SCP to get long-term loan from the bank. Furthermore, the Municipal Planning Bureau and the

Table 2 Responsibilities allocation of SCP in Wuhan

Departments	Responsibilities
Water Affairs Bureau	Daily administrative work of the Wuhan Headquarter of Pilot Project for Construction of Sponge City
Municipal Construction Commission	Comprehensive coordination, supervision on the process management of the pilot SCP
Municipal Development and Reform Commission	Researching on investment channels and mechanisms, integrating the pilot SCP into investment planning of the municipal infrastructure construction, coordinating with other departments
Municipal Planning Bureau	Integrating the pilot SCP into municipal urban and rural planning, coordinating with other departments
Municipal Finance Bureau	Coordinating with the Water Resource Bureau on drafting the SCP funding management methods and the measures of sanctions and incentives
Municipal Gardening and Forestry Bureau	Researching and drafting technical standards of landscaping and greening on pilot SCP
Municipal Department of Environmental Protection	Monitoring and bulletining the water quality of the SCP pilot areas
Municipal Meteorological Bureau	Establishing the platform of storm monitoring and early warning, collecting relevant information in pilot areas
Municipal City Management Committee and Housing Management Bureau	Specifying the management responsibilities of public buildings, roads, and residential districts in SCP pilot areas
Municipal Supervision Bureau	Monitoring the performance of other departments on the implementation of SCP regulations and assigning responsibilities according to law
Legal Office of Municipal Government	Coordinating with Water Resource Bureau to issue SCP-related regulations
Commission for Assessment of Municipal Government	Managing process and performance evaluation in the SCP pilot areas
Pilot Projects District Government	Implementing the SCP-related tasks and regulations in their corresponding administrative areas
Municipal Propaganda Department	Social propaganda and public opinions report

Source: Adopted from Dai et al. (2017)

Municipal Gardening and Forestry Bureau are required to give financial priority to the SCP when reviewing and approving the city planning (Dai et al. 2017).

The government encourages research on theory and application of the construction technology of the SCP and set up "Wuhan Sponge City Construction Technology Alliance" for technology research and extension. Furthermore, the governments at all administrative levels of Wuhan City (more specifically, the Department of Propaganda) are responsible for enlarging the publicity of the SCP, which aim to deepen the public understanding and encourage the public participation of the SCP.

One risk of the SCP is that it requires massive infrastructure investment; it requires an investment of 100 million to 150 million RMB for each square kilometer

under development (Wei 2015). This large amount of required funding will pose great challenges to Wuhan. For example, the city has planned to invest 16.3 billion RMB into its SCP, besides the direct financial support from governments, i.e., 500 million RMB from the central government, 400 million from the municipal government, and 200 million RMB from the (two) district governments, respectively; there is still around a 500 million gap, which needs to raise the social capital.

4.4 Section Summary

Water management in Wuhan gives high priority to waterlogging, storm-water management, water pollution, and water shortage. In order to facilitate integrated management and development of the urban water systems Wuhan Municipality has allocated the responsibilities for SCP implementation to many different departments. However, the success of the SCP still depends on cooperation between the various departments (Dai et al. 2017).

Wuhan has strongly committed to implement the Sponge City concept in order to its waterlogging and pollution issues under the guidance of the national Sponge City Program (SCP). The municipality has issued special regulations and provided various means of institutional and financial support for the project. It is however hard to evaluate the effectiveness of these efforts since the project is still not yet finished.

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