

Sponge city construction Practices in China: a novel solution for urban management paradigm

Les pratiques de construction des villes-éponges en Chine : une nouvelle solution pour le paradigme de la gestion urbaine

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RÉSUMÉ

La construction d'une ville éponge (SCC) en Chine, initiée par le gouvernement central national, est le fruit d'énormes efforts et d'un engagement sans précédent du gouvernement pour garantir le développement urbain durable. Ce dernier représente également un défi mondial et exige des solutions efficaces et à faible impact (LID) pour faire face aux catastrophes causées par les eaux pluviales lors d'inondations et réduire la pollution de l'eau en milieu urbain par infiltration, rétention ou retenue, stockage, épuration, réutilisation et rejet des eaux de pluie, tout en augmentant les possibilités de réutilisation des eaux pluviales et en améliorant le milieu urbain et la qualité de vie dans les villes. Cinq ans se sont écoulés depuis son lancement en décembre 2014. 30 villes chinoises ont été sélectionnées comme villes pilotes avec le soutien financier du gouvernement central pour tester les possibilités et les différentes solutions LID. Où en sont-elles à ce jour ? Dans quelle mesure les objectifs sont-ils atteints ? À la lumière de ces expériences, quelles sont les principales réalisations et leçons, ainsi que les recommandations pour la mise en œuvre future ? Le présent article présente un résumé des pratiques de SCC, rassemblant les objectifs politiques, l'approche technique, l'expérience réussie et les défis de la SCC en Chine.

ABSTRACT

China's Sponge city construction (SCC) initiated by the national central government, represents an enormous efforts and unprecedented undertaking by the government for achieving urban sustainability, which presents also a global challenge and demand of efficient and Low Impact Development (LID) solutions to tackling the stormwater induced urban flooding disasters during extreme events and reduction of water pollution problems through infiltration, retention or detention, storage, purification, reuse and discharge of rainwater, while increasing the possibility of stormwater reuse and improving the urban environment and liveability. It has been five years since it was launched in December 2014. 30 Chinese cities have been selected as pilot cities with financial support from the central government to test the possibilities and different LID solutions. What is the implementation status so far? In which levels the goals are achieved? What are the main achievements and lessons, as well as recommendations for the future implementation learning from the practices? This paper presents a summary of the SCC practices, bringing together the political objectives, technical approach, successful experience and challenges during the China's SCC.

KEYWORDS

Low Impact Development, Sponge city, urban management paradigm, Urban Stormwater runoff management.

1 INTRODUCTION

Over the past decade China's urban population has grown to 52.4 percent in 2015 from 42.5 percent in 2005, and the build-up areas have increased by 17,252 km². This roughly equates to an addition of 165 million people dwelling in urban areas in a decade! This rapid urbanization process has led to a worsening "city syndrome" situation such as urban flooding, water pollution, heat-island effects and ecologic deterioration, etc.

To promote a sustainable urbanization strategy, the Chinese government announced in late 2013 a "Sponge City" Initiative in building urban infrastructures.

2 SPONGE CITY CONSTRUCTION PRACTICES IN CHINA

2.1 Concept of sponge city

Deviating from the traditional "rapid-draining" approach, the new paradigm of sponge city calls for the use of natural processes such as soil and vegetation as part of the urban runoff control strategy. The "six-word" principle, which includes infiltrate, detain, store, cleanse, use and drain, forms the guidelines for urban storm water management. These principles are similar to those under the Low Impact Development (LID) paradigm that has been promoted and implemented in many parts of the world. LID technology employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat storm water as a resource rather than a waste product.

2.2 Sponge city plan in China

In October 2014 the China Ministry of Housing and Urban-Rural Construction (MHURC) issued a draft technical manual on Sponge City construction. In October 2015 the State Council of China announced a major expansion of the Sponge City Initiative, which is being implemented nationwide. Recognizing the limitation of Low Impact Development (LID) / Green Infrastructure (GI) facilities in controlling large or less frequent storm events, the government mandates the integration of green and gray infrastructure. The expanded Sponge City Plan (SCP) includes as its goals not only effective urban flood control, but also rainwater harvest, water quality improvement and ecological restoration. The use of LID/GI practices will be required for all new development and retrofit sites, science and commercial parks, green spaces, non-mechanical vehicle roads, pedestrian walkways, etc.

During 2015 and 2016, the China Ministry of Finance (MOF), with support from MHURC and the Ministry of Water Resources (MWR), selected 30 cities (Fig. 1), among more than five hundred applicants, as pilot sites under the SCP. Each city is to receive 400 to 600 million RMB (60 to 90 million US\$) annually from the central government for three years, with the total investment estimated to be about 42.3 Billion RMB or 6.35 Billion US\$. Local matching is required and public-private partnerships (PPP) are encouraged. Cities will receive a 10% bonus from the central government if the PPP contribution exceeds a certain percentage of the overall budget. According to preliminary estimates, the total investment on the SCP is roughly 100 to 150 million RMB (\$15 to \$22.5 million) average per square kilometer or 10 Trillion RMB (\$1.5 Trillion) for the 657 cities nationwide.

China's SCP represents an enormous and unprecedented undertaking by the government for achieving urban sustainability. MHURC officials recognize that the success of the Sponge City construction will require a combined and coordinated effort by many government agencies in areas such as landscape/architectural planning, construction, municipal, water, transportation, finance, environmental protection and input from other stakeholders. In addition, to finance all the sponge city projects is a real challenge. The government has listed some innovative strategies for fund-raising, which includes, in addition to government grants and subsidies, local matching and public-private partnerships. The government is also encouraging participation by financial institutions, and will allow qualified entities to issue construction bonds to finance the sponge city projects.



Fig. 1 Locations of Pilot Sponge Cities

3 CHALLENGES FOR THE SPONGE CITY CONSTRUCTION

Since the initial implementation of LID practices in the United States during the early 2000s, significant barriers and challenges have existed and hindered its progress. The China Sponge City projects are now encountering similar situations. The following is a list that is compiled from experiences in both countries.

- (1) Resistance to change. Inertia of traditional approaches
- (2) Limited technical guidance on planning, design and assessment of LID facilities
- (3) Lack of close coordination among agencies at the local level
- (4) Quantification of LID cost effectiveness
- (5) Finance Sponge city project
- (6) Education and training do not provide skills to design and implement LID

The present paper is aimed at providing a discussion of and recommendations for addressing a number of challenges listed above, with emphasis on the technical aspects of implementing LID/GI practices.

4 FUTURE DIRECTIONS

Based on the sponge city construction practices in China, especially the lessons learned from typical failures, the future directions are discussed.

- (1) The more effective sponge city implementation strategy

The current Sponge City plan scope has been expanded to include not only dealing with the urban water runoff problem, but also with the broader management of urban water. For example, the integration of green and gray infrastructures is required for flood control, water quality improvement and ecological protection and restoration. Local governments will need to adjust their land use planning and storm water infrastructure construction strategies to satisfy Sponge City requirements. Also, to provide a strong

incentive for local government officials, the success of Sponge City implementations could be used as a performance evaluation factor for promotion consideration for local officials.

(2) Developing site-specific regulatory framework and technical guidance

In essence, the construction of LID/GI facilities should be planned as part of the urban overall master planning at the beginning. Moreover, since the level and scope of controlling storm water runoff depends largely on local climate, rainfall, ecology and importantly social and economic factors, it is suggested that localized regulations should be considered under the state's regulatory framework, including detailed technical guidance. Also, an operational and maintenance instruction is needed, plus detailed requirements for monitoring and analysis in order to provide quantitative information on facility performance and cost-effectiveness.

(3) Product innovation and certification

Some of the control practices, such as an underground storm water treatment system, are manufactured by private companies. An evaluation and certification process would be highly desirable before such products are used for public projects. A sustainable development of Sponge City requires a robust industrial base. The central government should consider assisting related industries and establishing a viable sponge city industry chain.

(4) LID/GI project financing

The Sponge City construction represents an urbanization process of an enormous scale that requires a major financial commitment from the government. Innovative financial options, such as appropriate PPP project portfolio, credit support, loan guarantees, special construction funds and bond issuing should be considered and promoted.

(5) LID/GI professional education / training and public outreach

The design, construction and maintenance of LID/GI systems require professionals with appropriate background and training. Therefore, a concerted effort and time is needed for research and development (R/D) in LID/GI technology in order to achieve successes for the Sponge City projects.

In the era of public awareness of the importance of environmental protection, our task is to link the sponge city initiative to a sustainable urban development strategy in a way that the public would clearly understand and fully support. The use of the media, public hearing sessions, comment periods for mandates, training sessions for practitioners, etc. are all viable means of letting people know and gaining their support and even participation. Education at all levels, from kindergarten to college and to adult education, is very important.

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