Exploration on Investment of Sponge City Construction in China

Author's Details:
[(1)]**Jikun Liu** - Lake Forest Academy, IL, United States-[(2)]**Yanhan Li** - Worcester Academy, MA, United States

1. Introduction
In 2015, the Central Government of China has announced its plan of investing 86,500,000,000 Chinese Yuan(approx. $13.4 billion) in 3 years on the project "Sponge City" in 16 selected cities, approximate construction area being 450 kilometer square. These 16 cities are selected due to their urgency, necessity, and construction probability. With rough calculation, 0.2 billion per kilometer square is a huge investment; what is the corresponding criteria for this selection of 16 cities? In the future 15 years, how many more cities are going to be engaged in this project? What is the volume for investment in a comprehensive perspective? For such large scale of funds, what type of system has to be developed in order to interest enterprises and inspire them to engage in this process? What kind of legislations and policies regulating the behavior of participants are to be established so that this long-benefiting project can profit the people as long as it could be? This article will expand its discussion revolving around these questions.
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2. The Change of City Developing Ideology and Methodology of Construction Needs "Sponge City"
According to one survey done by the Ministry of Construction of China, between 2008 and 2010, with 351 cities being surveyed, approximately 290 of them suffered from water logging, which comes to be interesting when thinking whether the reason for all of them was excessive rainfall. The truth is that, according to the statistics released by Xinhua News, the water resources capita ownership is only 28% of the world average, and 2/3 of all cities are insufficient of water in different degrees. The reason that in cities that are suffering from scarcity of water floods still take place is that the infrastructure of the city is outdated, insufficient, and inefficient when facing short-time but high-frequency rainfall; when it fails to conduct certain amount of rainfall into proper discharging tubes, there comes the city inundation.

Sponge City is to make full use of original landscape which stores rainfall, of the natural surface and ecological background of rainwater infiltration, and of the natural cleansing effect from vegetation, soil, wetlands and etc. so that the city is functioning like sponge: when there is rainfall, there is strong capacity to absorb; when there is need for water, there is also ability to release, enabling the city to face natural disaster with high flexibility. In city development and construction, Sponge City is to enhance the planning of deducing tubes, to reduce the current from the origin, to gain control during the process, to manage the situation systematically, and to adopt the establishment of roof greening, permeable pavement, sunken lawn, collecting facilities of rainfall and etc. Ideally, building and community, roads and square, park and greenland and etc. gain certain ability to absorb, to detain, and to mollify the pressure when there is massive rainfall, effectively controlling over the rainwater runoff and achieving "small rain no accumulation, large rain no water-logging, water body does not turn black or smelly, and relief for heat-island".
The most famous and successful exemplar Sponge City construction is the one in Philadelphia. Before renovation, Philadelphia was similar to other old cities in the United States; in their city planning, there was only one set of functioning system of underground tube which has to deal with both sewage and rainfall. This caused the inability of the system to differentiate sewage and rainfall, causing immense amount of sewage going into river and streams. In 2011, the government established the plan Green Plan Philadelphia, aiming to improve the quality of river water, to upgrade and repair relating infrastructure, to protect and reconstruct the habitats of aquatic animals and plants and etc. Exact goals were also set, such as transforming one third of all ground with no permeability into "green land", building green-covered roof and rainfall garden, decreasing runoff by 80% to 90%, planting

trees along two sides of streets and so on. There are many thoughts and avant-garde designs that we are able to and ought to learn from and about.

3. The Common Characteristics for Selected Cities

Up to October of 2015, there is already more than 130 cities in china finished their construction plan of Sponge City. There are more than 600 cities in China, while 2/3 of them, approximately 400, are suffering from deficiency of water in different degrees. When Central Government determine the experimental 16 cities for Sponge City construction, those selected excelled because of their own idiosyncrasies. Here we briefly analyze the reason that they are chosen.

a. Precaution of Inundation and Flooding

Although the annual precipitation of some cities are comparatively low, yet they suffer from "no rain thus drought, rain thus water-log", such as one of the selected cities, Baichen. Despite its annual precipitation as 473mm, far lower than the average of China 628mm and the one of Asia 740mm, it was consecutively severely struck by flood in 2013 and 2014, following by disastrous damage upon the city. The reason why there is immense flooding in Baichen is the aging, inefficient technologically and insufficiency in quantity of underground tubing, drain-pipe, and etc. With Sponge City constructed, this problem will be majorly mitigated.

b. High Utilization Ratio of Precipitation

If the precipitation for one city is very strong, the construction of Sponge City will largely increase the utilization ratio of this city. According to the ideal of Sponge City, in common cities that uses"quick drain", there is approximately 80% rainfall that is directly led to rivers and sea, which means only less than 20%, in which about 5% is evaporated and naturally absorbed by vegetation, is being effectively recycled and used; however, in the mode of Sponge City, the ideal percent of tube draining is about 40% to 50%. Although there is also about 5% being evaporated and soaked by plants, the utilization percent is much higher than it was. Take Pingxiang, one of the selected, as an example. The average annual precipitation for Pingxiang is 1596.7mm, and the peak can even reach 2184.0mm. For this type of city with high base precipitation, the efficiency of constructing Sponge City is much higher than others with comparatively low precipitation. Pingxiang also suffers from environmental exploitation, low capacity for water conservation and etc.; Sponge City construction for Pingxiang is multifariously profitable and significant as a city.

c. Seek Innovation of Funding Mode

As the construction of Sponge itself being considered highly important, the consecutive management and maintenance is also the essence of the long-lasting vitality since each stage of Sponge City requires large financing; without proper overall planning or longterm fund guarantee, to realize the national construction is almost impossible. In order to inspire social capita to engage, new funding mode is highly advocated and supported during the accessing process and election of 16 selected cities. As stated, central government will increase the subsidies by 10% if PPP business mode has been practiced by certain percent.

Among 16 selected, River Nakao area in Nanning province has adopted the new business mode PPP. The river is approximately 6.6 km long with approximately 1,000,000,000 Chinese yuan investment(about $155 million)(including land requisition and levy fee). The construction include river improvement, sewage treatment, ecological remediation, sewage plants, coastal landscape, Sponge City, information management and etc. The construction idea of Basin Governance and Sponge city is also being introduced. After proper watershed management, sewage goes to relating plants according to proximity, while at the same time preliminary rainfall goes through the relating treatments such as natural condensation, natural permeation, purification and etc. This enables sewage and rainfall to be conducted into rivers with high quality after certain ministration and ensure the surrounding and aqueous balance, improving the upstream water-relating environment.

This project facilitates the 10-year cooperation between government and social investors with leading technology and plentiful experience in specific technical administration, in which deal the social capital stands more risk as the government pays according to effect. The government ensures the annual percent increase of general income to reimburse the service of social capital, which levitate governmental risk and short-term debt.

4. Potential Overall Investment

According to related deployment of Executive Meetings of the State Council in China, by establishing Sponge Cities, 70% of the rainfall is to be consumed and utilized locally. This goal is set to be achieved by 2020 by 20% of the area with finished construction. If in one city, the constructive area is 100 km square, at least 20 km square should reach this criteria. To 2030, 80% of all area should reach this standard. This is a general requirement; local government can set its own goal incorporating its situation, but the percentage being successfully achieved can only be higher, not lower.

Accordingly, we can roughly calculate the total amount for potential investment.

Based on the experience of 16 experimenting cities, 86,500,000,000 Chinese Yuan(approx. $13.4 billion) is to be invested for 450 km square, for each km square about 180 million. In China there is about 400 cities with shortage of water, each city with 100 km square as constructive area, then up to 2030(future 15 years), the investment on Sponge City can reach 400*100*180,000,000*0.8=57,600,000,000 Chinese yuan(approx. $8.9 billion), matching with the rough approximation of 60,000,000,000 Chinese yuan(approx. $9.3 billion) done by insiders and experts.

5. Social Capitals' Participation and Relating Method of Profiting

Because of the public-interest-oriented nature of Sponge City construction, the demand majorly comes from government and common people, while in such case, the investment are highly dependent on governmental revenue. In recent years, the city-wise economy has been reaching a comparatively low ebb; the increase of local revenue stagnates; the scale of governmental debt keeps expanding. It is safe to assume that the paying capacity of local governmental is highly limited.

Business mode PPP, constantly being renovated and improved, will conciliate the conflict between funding demand and supplement on Sponge City construction to a certain degree: by offering franchise, purchasing certain services, establishing equity cooperation and etc. in public domain, the government forms common pooling-of-interest and shared chance of risk with social capital and thus create longterm cooperation. A new, open, diverse, and sustainable mode of "joint venture" is thus created.

a. Bundle Up Non-operating Programs and Operating Programs

Currently, the common operating program is the sewage plants; it is easy to distinguish between the one who does pollution discharge and the one who pay for this service. This type of programs can be packed up with other non-operating programs such as channel cleaning, ecological management. The practice of this idea is business mode of River Nakao area in Nanning province.

b. Governmental Purchase of Certain Service

Because the profit gained through the programs is not covering the cost of establishment, the government therefore is required to pay for certain labor such as construction and management so that the Sponge City program is kept in operation. This type of purchasing will be the most significant and major financial solving factor during the construction of Sponge City.

c. Governmental Special Subsidies

In this time of experimenting of Sponge City construction, 16 cities were each offered 400 to 600 million yuan(approx. $61.8 to $92.7 million) according to their situations. In the future, this will also function as a major factor for Sponge City program.

d. Compensatory Investment Payback

I. Hire third-party evaluation corporation and evaluate the potential increase in value of local communities because of the environmental improvement such as the renovation of surrounding scenery, the quality of water, and other environment factor. Demand 5% to 10% of this increase from developers/property-holders as construction fee.

II. Sell the right of development of land with undeveloped stream-way, lake and etc. in its surrounding to companies with PPP program; use bundling programs to enhance relating companies' profiting level.

III. Transform ecologically-developed lakes and ponds into tourism projects. With increase in visitor flowrate, corresponding benefit can be gained by projecting advertisement. The Stormwater Garden in Portland, USA is globally well-known for its design and management; with this as an example, there is remarkable potential for such development in the cities with Sponge City program completed.

e. Lower Relating Taxes and Ease the Pressure for Participating Enterprises

With considerable marketing volume in sight, there is many sorts of relating firms being established all over China, completely or highly engaging during the planning and construction of Sponge City. To each participant, government can offer discounts or deduction in relating taxes and fees. For example, for the ones which produces materials with high permeability, to encourage production and sales, related taxed can be reduced or exempted; when transferring lands, certain types of firms can be offered certain allowances.

f. Learning from some of the European Countries, after the construction of Sponge City, small amounts of rainstorm treatment fee can be collected, equally distributed to each citizen. For participants of such construction and relating research team, different amount of governmental subsidies can be offered according to the situation

g. Offer Policy-wise Financial Support

Chinese Department of Housing has consecutively provided policy-wise financial support with China Development Bank, Agricultural Development Bank of China and etc. to the construction of Sponge City. For Sponge City construction programs, the longest loan term is prolonged to 30 years; the rates of interest can also be appropriately discounted. Under the circumstance with risk under control and business sustainable, the expected payoff of certain programs can function as guaranty for further loan. Support all companies with appropriate technological and funding capacity; do not discriminate due to corporation identity as foreign firms.

6. Epilogue

Sponge City construction is a commonwealth-concerning program; it is considerably hard to gain large amount of payback in a short amount of time. If the government promises too much during the incipient stage of Sponge City construction while fails to ensure continuous proper repay for participating social capitals, it can lead to disastrous social problems. Concerning the choice of firms and the scale of investment, government need to be highly conscientious throughout the process. It is already seen that some local governments promised 13% annual increase each year for Sponge City constructing firms; although it is not necessarily a high ratio, but considering Sponge City as a commonweal production, this mode may actually be quite unsustainable if ratio alike is constantly given.

For quite a long time, water-relating urban planning for discharge and recycling application has been a dependent program as an auxiliary and supplement to others, while effective connection between design and planning is not well established. Incorporating the idea of rainfall-resource-ize into city planning, water system planning, environmental planning and general natural disaster precaution is significant for the future healthy and sustainable development for one city. When this gap of investment suddenly soars with shift of governmental focus, we should keep ourselves collected and coolheaded, create new ways of utilizing water, perfect the relating laws, regulations and management policies, lead society to further investigation and research on the development as well as encourage them to put the ideology into practice. With protection that is legislative, economical, educational and etc., original and suitable technique and art of utilizing water will eventually be created.

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