Research on Sponge City Construction

Honggang Chen
Hangzhou Urban Land Development Co., Ltd, Hangzhou 310012, China
*Corresponding author’s e-mail address: 312727119@qq.com

Abstract. This research carried out the exploration of sponge city construction and proposed a model combining river water body restoration with low-impact development of "gray-green combination" so as to promote the coordinated development of new city construction and the ecological environment and bring certain benefits to society, ecology and economy.

1. Introduction
With the rapid progress of China’s social and economic development and urbanization, the development and construction model of “emphasizing society and ignoring ecology” has led to increasingly prominent environmental problems, such as lack of water resources, frequent floods and other water environment problems, which are directly related to the healthy development of the city. However, with the acceleration of urban construction and the significant expansion of urban scale, the discharge of sewage and wastewater has greatly exceeded the self-purification capacity of water bodies, resulting in an imbalance of the urban rivers, lakes and other ecosystems. Large-scale construction and over-engineering have changed part of the urban ground structure from pervious to impervious, causing changes in the circulation and distribution of natural water, rainfall forming runoff discharge, insufficient groundwater replenishment and are easy to form non-point source pollution as well. The problems such as frequent floods and disasters have become increasingly prominent. My country’s urban construction will inevitably transform from an extensive development model to a low-impact sponge city construction model, which will lay a good resource and environmental conditions for the healthy and sustainable development of the social economy.

Based on the practical experience of low-impact development and application at home and abroad[1,2], different parts of my country have studied sponge city construction models according to respective urban characteristics[3] and guided the comprehensive promotion and application of green ecological planning and construction methods. In the past three years, Zhejiang Province’s “five water governance” (i.e., sewage treatment, flood prevention, drainage, water supply, and water conservation) have achieved remarkable results. At present, urban water management has begun to shift from “engineering measures” to “ecological measures” and the construction of sponge cities are actively promoted in combination with the "five-water governance" in Zhejiang Province.

2. Common problems encountered in the process of urban construction
Before the development and construction, the direct discharge of domestic sewage and garbage dumping occurred from time to time, which resulted in the accumulation of silt, overgrown weeds, excessive ammonia nitrogen in rivers such as Danonggang. And blackness of river water and serious pollution of landscape water bodies also existed. Some real photos are shown in Fig. 1.
In some regions, rivers are crisscross and water systems are developed. However, in the initial stage of development and construction, water distribution in the entire water system was not in place, the ecological landscape was not perfect, the self-purification ability of water bodies was weak, the water quality of some rivers was poor, and the area was flooded frequently, which could not meet the residents' needs for water environment and ecological landscape.

Large-scale development and construction will inevitably change the natural shape of some rivers, causing certain damage to the water quality and the ecological environment of the river.

3. The solution to the problem

It is thought the problem should be solved adhering to the concept of green and ecology and combined with the “five-water governance” project to carry out the practice and exploration of sponge city construction. The principle is to take water as the main line, build a regional benign water cycle system according to local conditions, build a sponge-shaped area as a whole, effectively solve environmental and resource problems, enhance the water security capacity of the new city and the water environment carrying capacity, and promote the coordinated development of urban space expansion and ecological function improvement.

In response to the water quality purification needs of landscape water bodies, a series of river water body restoration and treatment technology application researches have been carried out. With biological/ecological technology as the core, the integrated system research and application of "ecological slope protection + ecological floating island + constructed wetland" has been carried out which aims to help repair damaged water bodies and enhance the landscape function of the water system.

(1) Ecological slope protection

On the basis of the previous school-enterprise cooperation, a series of functional ecological building blocks such as ecological fish nest type, easy-to-process heterogeneous combination type, interlaced embedded type, etc. have been developed, forming a practical ecological slope protection technology, which can help create an ecological environment suitable for the growth of aquatic organisms and improve the self-purification ability of the river.

(2) Ecological floating island

The root system of plants suspended in the water on the ecological floating island can absorb the organic matter in the water and transport sufficient oxygen, providing a suitable space for various organisms and microorganisms to inhabit, attach and multiply. Under the combined action of the absorption, feeding, adsorption, decomposition and other functions of aquatic plants, animals, and microorganisms, water pollution can be treated and a good natural ecological balance environment can be formed. Engineering application is shown in Fig. 2.
(3) Constructed wetland

Constructed wetland refers to the artificially constructed and controlled ground similar to the marshland, where sewage and sludge are distributed to the wetland under control. The wetland is filled with different media and different purification plants are planted [4] according to the need for the treatment of the pollutant. By putting aquatic animals in the waters around the wetland in a suitable quantity and a reasonable species ratio, the food chain of the ecosystem can be extended and the water purification effect can be enhanced.

Through the development of a low-impact system of "gray-green combination", that is, the combination of ordinary gray building facilities and green building facilities (such as grass ditch, stepped green space, green roof, etc.), it can minimize the impact of construction and development activities on the surrounding landscape ecological environment. In this way, the "seepage, retention, storage, purification, use, and drainage" of rainwater runoff can be finally realized, and a regional low-impact development system with ecological priority will be formed.

4. Application benefits

Social benefits, which focus on social, ecological and public welfare, adhere to the new concept of land development of supporting facilities and services first, paying equal attention to protection and development, people-oriented and people-first.

Ecological Benefits. In the process of urbanization, towns were planned and constructed with road networks and rivers as the context, and through the practice and innovation of landscape water system restoration, to make the surrounding residents gradually form a lifestyle of chatting in the riverside pavilions, walking on the riverside trails for fitness, and smelling the fragrance of flowers and enjoying the beautiful scenery in the riverside park.

Economic benefits. On the one hand, the improvement of the urban interface makes the value of land rise; on the other hand, related research results can provide technical support for water purification in other regions, promote the development of sponge city construction technology, and have certain economic driving benefits.

5. Conclusion

Aiming at the problem of incoordination between modern urban construction and the ecological environment, this paper proposes a model combining river water body restoration and low-impact development of "gray-green combination" according to local conditions. This model is used to solve environmental and resource problems and can further enhance the water safety guarantee capacity and the water environment carrying capacity, then promote the coordinated development of urban spatial expansion and ecological function enhancement, and bring certain benefits to society, ecology and economy.
References
[1] Pantip Kayee, Puntipar Sonthiphand, Chaiwat Rongsayamanont, et al. Retraction Note to: Archaeal amoA Genes Outnumber Bacterial amo A Genes in Municipal Wastewater Treatment Plants in Bangkok[J]. Microb Ecol, 2016: 72:262.
[2] Ayça N. Tekeli, Ayla Arslan. Characterization and assessment of Kullar Domestic Wastewater Treatment Plant wastewaters[J]. Environ Monit Assess, 2008, 138: 191–199.
[3] Chen Zhong. Constructing the Sponge City in the View of Landscape Ecology [J]. Chinese & Overseas Architecture, 2016(7):121-123.
[4] Nan Gao. Study on Pollutant in the water Removal efficiency of Several Trees Commonly Used in Urban [D]. Beijing: Beijing Forestry University, 2009.