

## Adapting Sponge City Concept for Dhaka City

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**Abstract:** Dhaka, the capital city of Bangladesh, is one of the populous Mega Cities in the world. As the growth of urban population taking place at an exceptionally rapid rate, the city is unable to cope with changing situations due to their internal resource constraints and management limitations. In recent years Dhaka City is facing extensive water logging during the monsoon (May to October) as a common and regular problem of the city which corresponds water pollution, traffic congestion, air and noise pollution, solid waste disposal etc. Another main water related problem is the water scarcity during summer as continuous depletion rate of ground water table. This paper focuses on how the sponge city concept can help the city to overcome from this situation for better aspect.

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### I. Introduction

A **sponge city** is a city that is designed to passively absorb, clean and use rainfall in an ecologically friendly way that reduces dangerous and polluted runoff. Associated techniques include permeable roads, rooftop gardens, rainwater harvesting, rain gardens, green space and blue space such as ponds and lakes. Properly implemented a sponge city can reduce the frequency and severity of floods, improve water quality and allow cities to use less water per person. Associated strategies such as green space can also improve quality of life, improve air quality and reduce urban heat islands. Overall, A “sponge city” will not only be able to deal with “too much water”, but also reuse rain water in order to deal with “water shortages”.

### II. Background

Dhaka is facing number of water issues which causes great difficulties for inhabitants of this city. Firstly, Heavy downpour occurs in Dhaka City during monsoon, as it is located on the extensive floodplains of Ganges and Brahmaputra. But the unplanned spatial development activities and growth of habitation due to rapid population growth are causing encroachment on retention areas and natural drainage paths with little or no care of natural drainage system that creating obstacles to properly drained out the urban runoff. Therefore water logging is tracking place as different parts of the city remains inundated for several days sometimes for months. Inadequate drainage sections, conventional drainage system with low capacity and gravity, natural siltation, absence of inlets and outlets, indefinite drainage outlets, lack of proper maintenance of existing drainage system, and over and above disposal of solid waste into the drains and drainage paths are accounted for the prime causes of blockage in drainage system and water logging. In addition, seasonal tidal effect and the topography of the city area also causing water logging.

Secondly, water supply of Dhaka city is heavily dependent on groundwater extraction where more than 87 percent of the supplied water is being extracted from this source. Such extensive dependency enhances a very high depletion rate of groundwater table. Dhaka city has been experiencing a sharp declination in groundwater table with more than 20 meters lower down during the last seven years at a rate of 2.81 meter per year (m/y). Considering the existing depletion rate, the study predicts that the groundwater table will go down to 120 meters by 2050. The study shows that the potential groundwater recharge of Dhaka city is only 1.33 m/y in contrast to 2.81 m/y of groundwater depletion rate. Such finding implies that despite sufficient amount of rainfall, Dhaka city is experiencing 1.48 m/y groundwater recharge deficit every year. Moreover, increased rate of urbanization, illegal occupation, and encroachment reduce the amount and volume of surface water bodies around the city that deteriorate the present situation.

To solve these issues government has taken a lot of initiatives but all of them are goes in vain because of unplanned activities. A new concept rather than that conventional concept should be considered for Dhaka city to overcome huge water problem is Sponge city. In 2014, the People’s Republic of China established the concept of the ‘Sponge City’, which was used to tackle urban surface-water flooding and related urban water management issues, such as purification of urban runoff, attenuation of peak run-off and water conservation. The concept is being developed to make use of ‘blue’ and ‘green’ spaces in the urban environment for storm

water management and control. It is envisaged that related practices will enhance natural ecosystems and provide more aesthetically pleasing space for the people that live and work in urban environments, in addition enabling nature-based solutions to improve urban habitats for birds and other organisms. The Sponge City concept and related guidelines and practices will provide multiple opportunities to integrate ideas from eco-hydrology, climate change impact assessment and planning, and consideration of long-term social and environmental well-being, within the urban land-use planning process.

**Progression of Sponge city concept:**

The protection of sponge bodies such as natural rivers, lakes or wetlands has the advantages of no manpower and material consumption, simple and convenient compared to construction of artificial sponge. From the point of view of city development, city construction and development of the early in rivers, gathered in the river basin near the river basin land has a relatively long history of development and utilization, in the land development process in the long time, farming and land use structure of the disorder are all human the activities of the obvious effect on the river water environment, rivers are fragile ecological environment. The vulnerability of the ecological environment of the river will be directly reflected in the artificial lake area of terrestrial plants and aquatic organism damage, aquatic organisms, particularly fish resources of the natural proliferation was severely affected, balanced development will ultimately be a serious threat to the ecological environment. The water environment protection of urban rivers and artificial lakes should begin with ecological greening. We consider the seasonal and ornamental nature of green vegetation to achieve the unity of ecological protection and urban beautification. Relevant government departments and staff need to implement the construction of widening the river and increasing the depth of the river as soon as possible, contributing to the development of the city's cavernous body.

Under the traditional extensive urban construction mode, the urban green space, water body and wetland have been destroyed, which can be restored and repaired gradually by means of physical, biological and ecological techniques. Polluted water bodies and land not only disable to save and regulate rainwater, but also they have a negative impact on the lives and health of the people around them. Therefore, it is urgent to repair and restore the damaged cavernous body. There are many methods for the repair of sponge body. The most common methods are physical sieve filtration, sewage interception, dredging and biological ecological restoration. The physical filtration control pollutants from the source, improve the sewage pipe network system and city garbage removal system, and through the combination of mechanical and hydraulic erosion of two kinds of means, in the drought period and flood period of pollutants in rivers of silt cleaning, removal of point and non-point source pollution. Biological and ecological restoration technology is a new type of environmental biological technology developed in recent years, mainly the use of microorganisms, plants and other biological life activities, transfer, transformation and degradation of pollutants in water. We need to rely on the city river and the formation of the artificial lake as the municipal engineering construction projects in the development of "sponge" the most effective water conservancy construction project. However, the serious deterioration of the water environment in the industrialization and modernization of this artificial lake has become increasingly prominent, and seriously affected the ecological water system of the whole city, so it is urgent for the relevant staff to deal with and improve it. We should also set up a corresponding water cut and drainage network between the lake and the river to avoid the lake surface erosion and pollute the water body.

In the process of urban development and construction, we should rationally control the development intensity and reduce the damage to the original urban water ecological environment. Keep the ecological land, rivers and lakes proper excavation ditch, increase water area. From the beginning of architectural design, roof greening, permeable pavement, constructed wetlands and so on are adopted to promote rainwater storage and purification. This will be from the planning point of view, increase the green land area, and truly from the amount of water to ensure that sponge water, spit water smoothly, not just rely on the effect of limited technology. The main ways to increase the urban greening are to construct the country park, the small green space and the small park, and build a complete urban green water permeable network. In the low impact development and the construction of the grey infrastructure, we pay attention to the excavation and supply of the cavernous body, and the green infrastructure itself is another form of expression of "sponge". Through the planning and reconstruction of the used land resources, a simple, low-cost and efficient facility can be built to save land and solve the problem of rainwater circulation and utilization. The low impact development and green infrastructure work, not only can effectively solve the city waterlogging, the rain quickly away from the road surface, but also can complement the conservation of groundwater resources, groundwater is rich in content, to solve the problem of insufficient groundwater dry winter period, is a very effective city "sponge" reserve resources development and construction method. Through the rain garden, grass ditch and sunken lawn, and the green roof, improve green rainwater retention and infiltration capacity. Vigorously promote permeable pavement, as far as possible more buildings, outdoor ground, roads, squares and parking spaces can be converted to permeable surface, so that rainwater infiltration, recharge groundwater. Rainwater passes through

these "sponge", infiltration, stagnant storage, purification, reuse, and finally the remaining part of the platoon. The construction of such cities is to flexibly control the rainwater, address waterlogging in cities, thus achieving a city development mode during which the rainwater can be naturally stored, permeated and purified, according to the statement issued by the government.

To meet the goals, governments at all levels will carry out the construction of sponge cities in new city districts, industrial parks and development zones, while the construction of old city areas will be coordinated with renovation of shantytowns, dilapidated buildings and old communities to address the waterlogging issue. The government will oversee the construction of sponge cities and let the market play a decisive role in allocating resources. Various fund-raising methods, including public private partnership and franchising, should be promoted, according to the guideline. All related authorities should consider sponge city construction as key livelihood projects, and encourage financial institutions to step up credit support for such projects. Banks will also be given incentives to provide mid- and long-term loans, according to the guideline.

### **III. Conclusion**

However, investment in sponge city initiatives is still difficult, with only tepid interest from domestic investors. The government should explore supply-side vehicles for stimulating investment, including tax credits, deductions, and time-or performance-based privileges.

Dhaka has the opportunity to showcase how prudent planning and regulatory discipline can transform urban flood management and improve water quality. The government has acknowledged this growing challenge and provides resources and guidance, while enterprising localities compete to fund innovative proposals with ambitious targets.

To complement sponge city investment, the central government should now take additional measures to improve groundwater quality, adopt a whole-of-system approach for pollution control and incentivize private investment.

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