Bengaluru Urban Flood

Knight Frank

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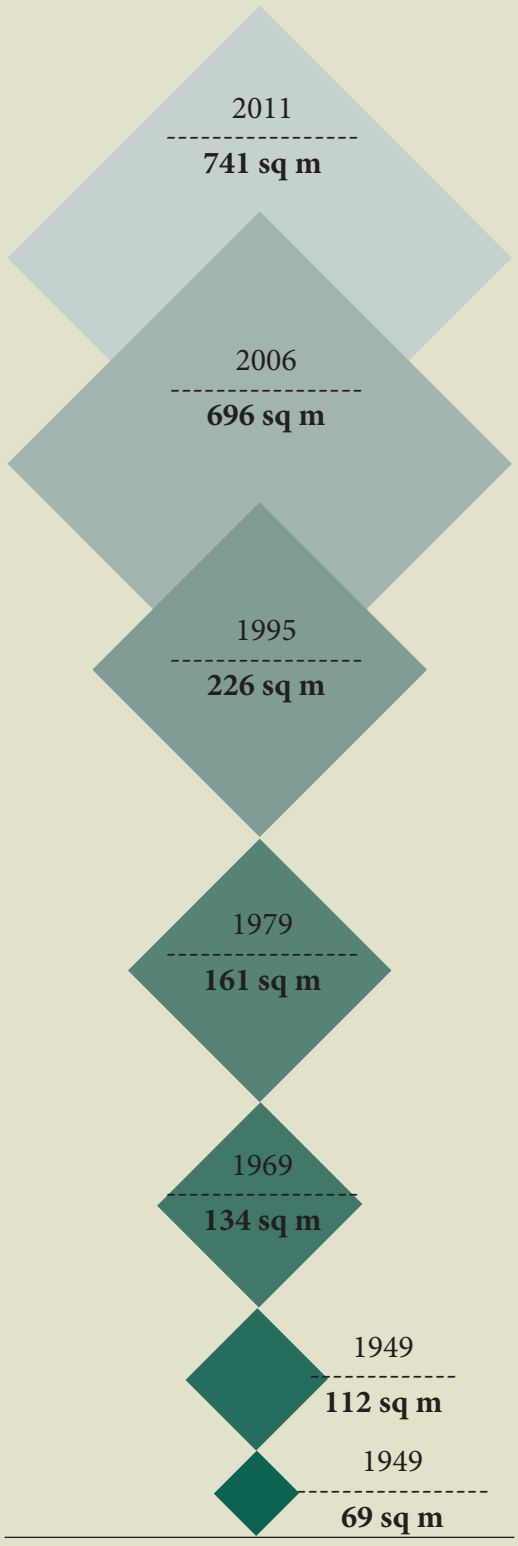
Bengaluru Stormwater Infrastructure: Desperate Need For A Masterplan And The Way- Forward

Bengaluru, the capital of Karnataka is the third largest city and the fifth largest metropolitan area in India with an estimated population of 13 mn[1]. The city has witnessed massive growth in the last two decades led by development and expansion of the Information Technology (IT) corridors, Biotechnology, education and research institutes and industrial developments. These sectors have been generating vast employment opportunities; Bengaluru comprises 18% of all the jobs created in India. Owing to its robust employment generation and its multiplier effect on the economy, Bengaluru contributes over 36% to the Karnataka states' Gross Domestic Product (GDP), in addition to driving the state's per capita income higher than the national average[2]. To accommodate the population influx and the economic growth, the local planning area (LPA) of Bengaluru Development Authority (BDA) is spread over an area of 1219.5 sq km[3].

[1]Bangalore Water Supply and Sewerage Board, Government of Karnataka
[2]Economic Survey of Karnataka, 2022-23
[3]Bengaluru Development Authority (BDA)

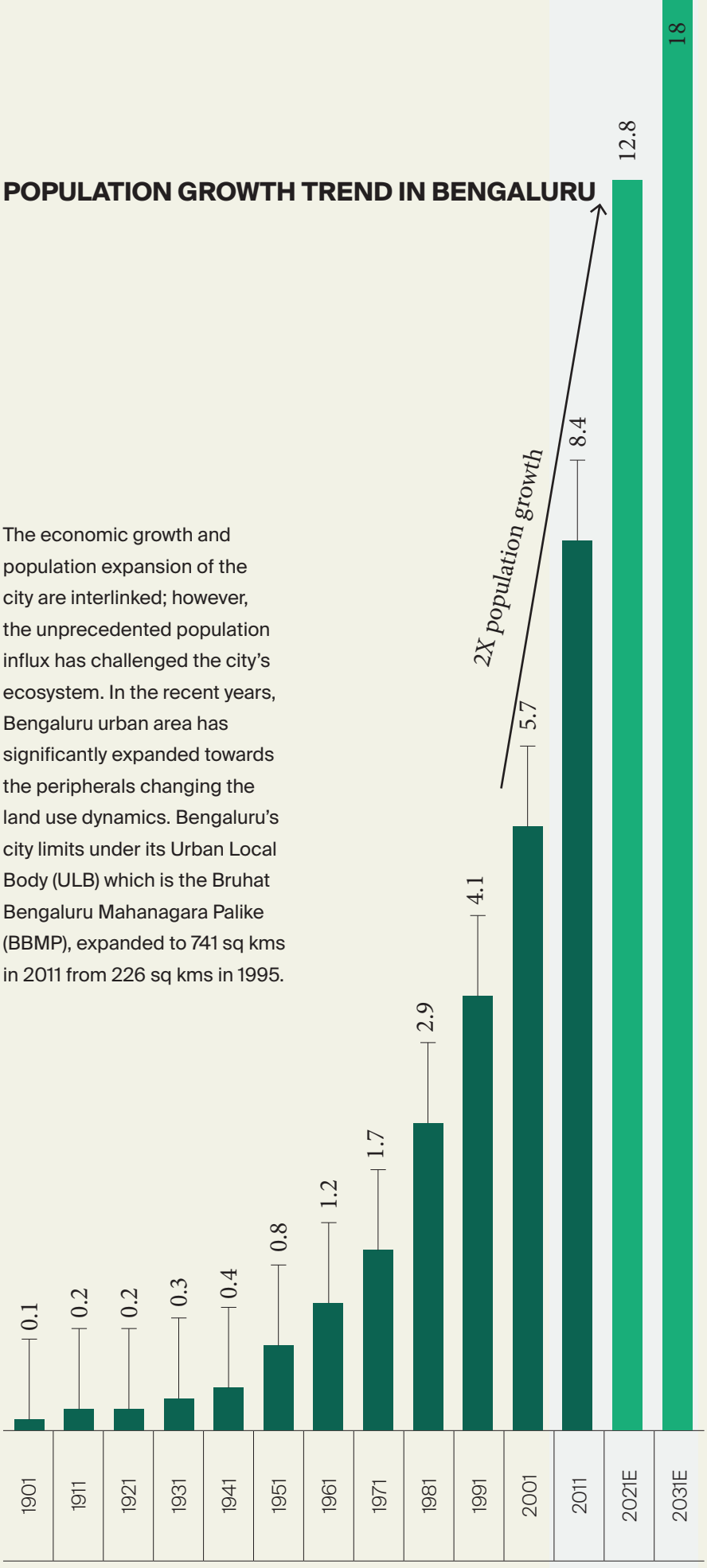
SPATIAL INCREASE OF BENGALURU CITY UNDER BBMP



Source: BBMP

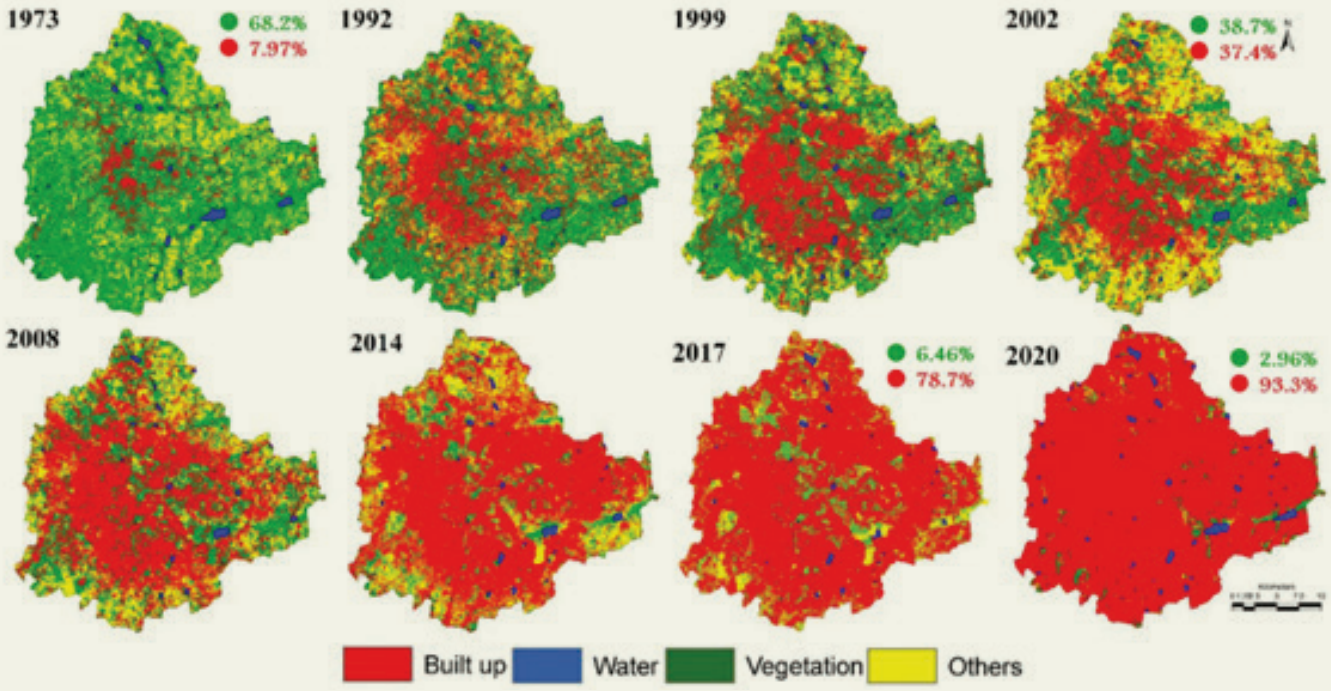
POPULATION GROWTH TREND IN BENGALURU

The economic growth and population expansion of the city are interlinked; however, the unprecedented population influx has challenged the city's ecosystem. In the recent years, Bengaluru urban area has significantly expanded towards the peripherals changing the land use dynamics. Bengaluru's city limits under its Urban Local Body (ULB) which is the Bruhat Bengaluru Mahanagara Palike (BBMP), expanded to 741 sq kms in 2011 from 226 sq kms in 1995.



Due to population influx and the real estate and infrastructure development to accommodate the same, the share of built-up area of the city has increased from 37.4% in 2002 to 93.3% in 2020[4] As a result of rapid and unplanned development, the infrastructure supporting the natural eco-system of Bengaluru, especially the stormwater drainage system, has come under severe stress. Primarily, the interconnection between the waterbodies such as lakes and stormwater drains are severely affected causing recurrent floods in the event of heavy rainfall.

CHANGING LAND USE DYNAMICS IN BENGALURU



Source: Indian Institute of Science, Knight Frank Research

Topography and Drain System of Bengaluru

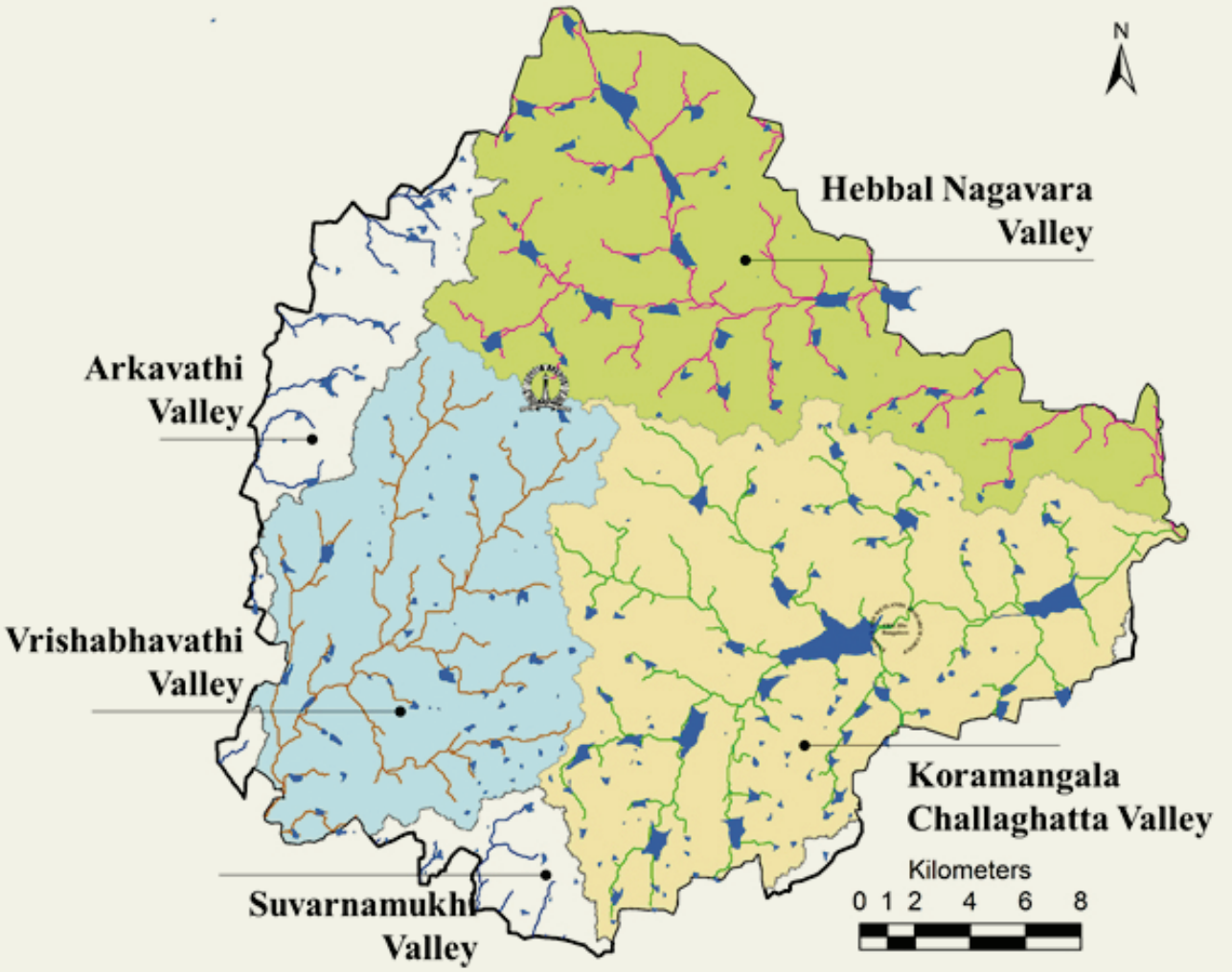
Geographically, Bengaluru is located on the Deccan Plateau at an altitude of 920 m above the mean sea level, highest amongst the major cities of India. In any given year, Bengaluru receives an average rainfall of 880 mm with approximately 60 days of rain[5]. Bengaluru is located on the watershed of two principal river basins - Arkavathi to the West and South Pennar to the East. The city is located on the ridge along three valleys, namely Koramangala-Challaghatta Valley (225 sq km), Hebbal Valley (207 sq km) and the Vrishabhavathi Valley (165 sq km). The configuration of these valleys has provided Bengaluru with a natural system of drainage without recourse to pumping.

Bengaluru was once famously known as the 'City of Lakes' due to the presence of around 285 lakes in an area of 161 sq km until the 1980s. These lakes were interconnected through a cascading

[4]Insights to Urban Dynamics through Landscape Spatial Pattern Analysis
[5]"Frequent Floods in Bengaluru: Causes and Remedial Measures", IISC, December 2017

drainage system wherein the primary drains or Rajakaluves connected one lake to another. Further, the secondary and tertiary drains (roadside drains) channelised rainwater runoff into the primary drains. Uninterrupted waterflow into these drains and the lakes ensured that the excess rainfall did not flood the city and catered to the maintenance and recharging of ground water, providing drinking water to the surrounding areas. However, due to unplanned urbanisation, nearly 50% of Bengaluru's stormwater drainage infrastructure has now deteriorated in terms of length. Currently, there are 633 stormwater drains within the BBMP limits with a total length of 842 kms.[6]

RIVER AND LAKE NETWORK ALONG BENGALURU VALLEYS



Source: IISC, Knight Frank Research

RECEDING STORMWATER DRAIN LENGTH IN TWO MAIN VALLEYS

Valley	Drain Length in 1900s	Drain Length in 2016-17
Koramangala	113.2 km	62.8 km
Vrishabhavathi	226.3 km	111.7 km

[6]Performance audit of management of stormwater in Bengaluru urban area, CAG, 2021

Increase in Flood Risk with Changing Climate and Deteriorating Infrastructure

The surge in infrastructure and real estate development to accommodate the population growth and the associated increase in land surface properties has interrupted the natural valley system of Bengaluru and damaged the interconnectivity of the lakes within the city. Additionally, at a few places the primary stormwater drains connecting the lakes are old and decayed due to non-maintenance and have lost the capacity to withstand water runoff in case of heavy rainfall. Also, due to climate change, there has also been a short duration, high intensity precipitation further accentuating risks of flooding in the city amidst limited infrastructure to contain the same. For instance, in September 2022, Bengaluru received 131.6 mm of rainfall, which was the highest daily recorded rainfall during the month since 2014. Such excess rainfall, combined with ill equipped infrastructure to deal with it and a topography that is prone to flooding, have caused incidences of flooding in different parts of the city in the last few years.

Real Estate: The Key Driver of Bengaluru's Economic Growth

Bengaluru being the key engine of Karnataka's as well as the country's economic growth, will continue to be one of the fastest growing cities. The population of the city is expected to reach 18 mn by 2031. To complement the population growth and to accommodate the same, the real estate and infrastructure in the city will also continue to develop.

The real estate sector has had a significant multiplier effect on Bengaluru's economy. Bengaluru's real estate development comprises about 213 mn sq ft of Grade A office space which has generated nearly 1.7 mn white-collar jobs predominantly by the IT/ITES sector since 2008. Each of these jobs has a capacity to generate nearly eight indirect jobs in the economy. The multiplier impact of the city's employment boosts consumption demand, which in turn creates the demand for real estate, social infrastructure, and transport infrastructure. Thus, real estate and infrastructure development in Bengaluru is inevitable for Bengaluru's economic growth. Bengaluru's Gross District Domestic Product (GDDP) increased from USD 16 bn in FY 2005 to USD 97 bn in FY 2023[7]. On par with national average, real sector contributes an estimated 7% to the city economic growth.

Additionally, taxes collected from real estate development such as property tax is one of the key revenue sources for the Urban Local Body. During FY 2022-23, BBMP is estimated to have collected Rs 31,070 mn (USD 388 mn) as a revenue from property tax collection. Thus, real estate is one of the key contributors to the city improving economic profile. India's real estate sector is poised to grow significantly and is expected to reach USD 1 tn by 2030[8]. Bengaluru being one of the fastest growing cities, its real estate sector would also grow in tandem. However, for long term sustenance, a focus on sustainable growth of the city is of prime importance. There needs to be a greater emphasis on cohesive development of real estate and strengthening of the support infrastructure without causing further damage to the ecosystem of Bengaluru.

[7] Karnataka Economic Survey, 2021-22
[8] India Real Estate Industry Overview, IBEF

Necessity for Remodelling of Stormwater Infrastructure in Bengaluru

Unplanned real estate development unfortunately damages the city's stormwater infrastructure which in turn leads to flooding of the area during instances of heavy rainfall. Such instances are very prominent in growing cities. With the support of Urban Local Bodies (ULBs) some Indian cities have initiated active measures to build and strengthen stormwater infrastructure to support their respective real estate and economic growth and withstand events of excessive rainfall.

For instance, following the severe flooding in Mumbai in 1985, the Municipal Corporation of Greater Mumbai (MCGM) had carried out an extensive study of the stormwater drainage system and prepared a master plan to ensure efficient stormwater drainage to address the recurrent flooding issue: the Brihanmumbai Storm Water Drain (BRIMSTOWAD) project. The key objective of this project was to rehabilitate Mumbai's stormwater drainage system which involved rejuvenation of drains, setting up of pumping stations in flood prone areas such as Worli and Haji Ali, construction of five-metre-wide roads alongside major drains for desilting, removal of obstructions from the drains and rehabilitation of slum-dwellers. However, due to lack of financial resources, the project was not acted upon until the occurring of another catastrophic flood in 2005. The project was then immediately implemented by the municipal corporation at an estimated cost of INR 1200 cr (USD 300 mn) . The cost of the project, however, increased multi-fold since inception. From 2005 until FY 2022, the MCGM has been provided a grant of INR 4000 cr (USD 500 mn) for the BRIMSTOWAD project . Apart from this, MCGM also incurs an annual capital expenditure of approximately INR 1000 cr (USD 125 mn) each year for stormwater drainage maintenance of the city . Thus, maintaining a stormwater infrastructure of a city requires significant capital expenditure. Much of such capital expenditure is funded by the state and the central government grants. Bengaluru, similarly, requires a stormwater drainage master plan for the efficient management of infrastructure and sufficient revenue stream to fund the required capital expenditure. Broadly, the objective of such masterplan would be to ensure free flow of stormwater and minimise flooding in the prone areas of the city. Alike Mumbai, management of stormwater infrastructure in Bengaluru requires a significant capital expenditure

Currently, Bengaluru has a drain length of 842 kms which includes primary and secondary drains . Owing to the spatial expansion, the city broadly requires an addition of approximately 658 kms of major drains adding up to a total length of 1500 kms. As per our analysis at an estimated cost of 2.2 Cr/Km (USD 0.28 mn/km) the capital expenditure to build new primary drains is approximately Rs 1448 Cr (USD 181 bn) in addition to Rs 556 Cr (USD 70 mn) required for rehabilitation of existing drains. Thus, the total cost of construction of new primary drains along with rehabilitating the existing drains sums up to an estimated Rs 2003 Cr (USD 250 mn). In addition to construction and maintenance of primary drains, the tertiary drains and the lakes needs interventions in the form of cleaning, dredging etc. This involves a capital expenditure of approximately Rs 800 Cr (USD 100 mn). Thus, capital expenditure to construct, rejuvenate and rehabilitate Bengaluru's stormwater drain infrastructure is estimated to be Rs 2800 Cr (USD 350 mn). Besides, there would also be an annual operation cost for maintenance of the infrastructure. Currently, as per the BBMP's budget, about ~1% of the total capital expenditure is incurred for maintenance of the stormwater infrastructure of the city in addition to the grants provided by the state government.

In line with our estimates, the Karnataka government in its FY2023-24 budget announced an allocation of Rs 3000 Cr (USD 375 mn) for developing stormwater infrastructure in the city, with assistance from the world bank.

Thus, the provision of financial assistance is not an hinderance, however, there is a compelling need to remodel Bengaluru's stormwater infrastructure.

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[9] BRIMSTOWAD PROJECT REPORT, MCGM
[10] MCGM budget report
[11] MCGM budget report 2021-2022
[12] Performance audit of management of stormwater in Bengaluru urban area, CAG, 2021

Stormwater infrastructure supported by nature-based solutions: A Case of Sponge City Development in China

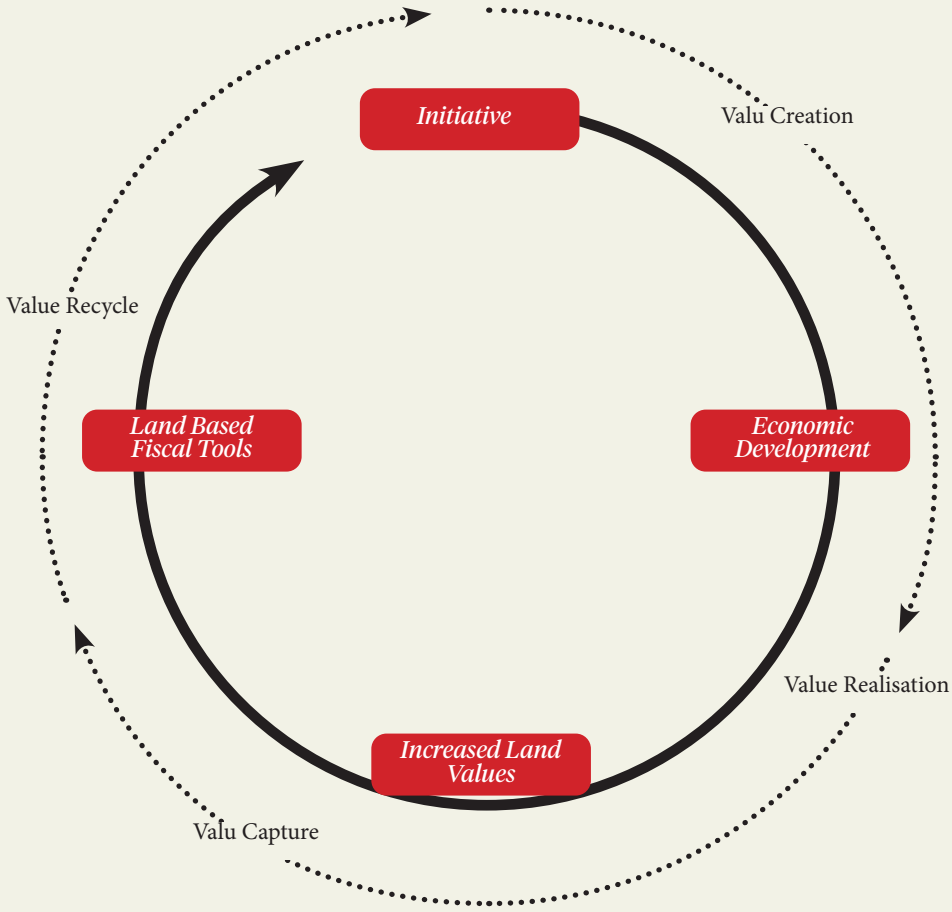
To rejuvenate and remodel Bengaluru's existing stormwater infrastructure for sustainable development, the city can also adopt nature-based solutions such as 'sponge city' developments as a resolution measure to urban flooding.
Sponge city is a new urban construction model for flood management developed in China aimed at strengthening ecological infrastructure and drainage systems . Surface water flooding is viewed as the most serious water-related issue in many of China's large cities due to rapid urbanization and land-use change in the process of rapid socio-economic development. In 2014, the People's Republic of China established the concept of a 'Sponge City', which lays emphasis on tackling urban surface-water flooding and related urban water management issues such as purification of urban runoff, attenuation of peak run-off and water conservation. This approach integrates green spaces and 'blue' systems like wetlands into conventional 'gray' infrastructure such as concrete embankments, contributing to the 2030 UN Sustainable Development Goal (SDG) to "make cities and human settlements inclusive, safe, resilient and sustainable". Various studies show that sponge city development has controlled urban flooding in China in addition to resolving water resource shortages and the urban heat island effect and improved the ecological environment by absorbing and capturing rain water. In the case of Chuan province, which was the demo project in the sponge city program in China, the economic benefit was very significant. The Chuan project effectively reduced the occurrence of flooding and prevented economic loss which could have occurred. It benefitted the environment by diminishing water pollution in the nearby Chuan Zi River which further improved the water quality in the region. Investments to develop China's sponge cities have come primarily from public funding. In 2014, each pilot received a central budget allocation estimated between USD 57 mn and USD 86 mn per year for three consecutive years. By 2030, China aims to turn 80 percent of its urban areas 'sponge-like', addressing surface-water flooding, attenuating peak run-off, improving purification of urban runoff, and enhancing water conservation while improving environmental quality, community health and economic prosperity. As per World Bank, the investment needed to scale up the program is an estimated USD 1 tn by 2030, with the financing gap expected to be covered by provincial and local governments and financial institutions together with the private sector and local communities .
The need for sponge cities development tin Bengaluru as well as in India is more relevant now than ever before as cities are repeatedly experiencing flooding due to unprecedented rainfall and the lack of drainage capacity to withstand the same. The sponge city mission can be delivered through AMRUT (Atal Mission for Rejuvenation and Urban Transformation).

Financing Stormwater Infrastructure through Real Estate

The traditional paradigm of financing urban infrastructure consists of internal accruals of the ULB and loans and grants from the state government. For instance, in 2021, the Greater Chennai Corporation (GCC) proposed an integrated urban flood management project which involved construction and rejuvenation of stormwater drain network in the area around Kosasthalaiyar River basin of Chennai. The project involved the construction of 588 kms of new stormwater drains and rehabilitation of 175 kms of stormwater drains. It is expected to benefit 4.7 mn people anticipated to be living in the project area of 127.78 sq km by 2028. The cost of the project was estimated to be USD 470.5 mn and the proposal for financing the project was made to Asian Development Bank (ADB).
In case of Bengaluru, restoration and construction of Bengaluru's stormwater infrastructure is of prime importance to avoid the economic and social loss which could arise due to recurring events of urban flooding. However, in the long term financing of such sustainable infrastructure could be challenging as it involves enormous capital expenditure in the form of initial cost along with long term operation and maintenance cost. In case of excessive fund requirement, innovative and more diversified financing options are necessary for filling the financing gap. Efficient stormwater management mechanisms have a potential to increase the value of surrounding land and real estate development. Therefore, the government authorities can tap into financing through real estate using mechanisms such as Value Capture Financing (VCF).

Value Capture Financing (VCF) is based on the principle that private land and buildings benefit from public investments in infrastructure and policy decisions of governments. VCF tools can be deployed to capture a part of the increment in value of land and buildings. In turn, these can be used to fund new infrastructure projects of the Central/State Governments and Urban Local Bodies (ULBs). This generates a virtuous cycle in which value is created, realized, and captured, and used again for project investment. It gives governments the opportunity to launch new projects, even with a small resource base. Some of the VCF tools include Land Value Tax, fees for changing land use (agricultural to non-agricultural), betterment levy, development charges (impact fees), Transfer of Development Rights (TDRs) etc.

In recent years, various local governments in India have used VCF to capture the value of land and harness it to develop major infrastructure. For instance, the Sabarmati Riverfront Development project in Gujarat implemented by SRFDCL in 2008, is one of the most innovative and revenue sustainable projects. Apart from the socio-economic benefits of Sabarmati River redevelopment, the project also generated revenue for the Amdavad Municipal Corporation (AMC).
Similarly, in 2019, the Maharashtra Government levied a metro cess of 1% in additional to the stamp duty on property purchases across Mumbai, Thane, Pune, Navi Mumbai and Nagpur, as a transport surcharge to support the state's transport infrastructure.



Through metro cess the Maharashtra government was able to generate Rs 500 Cr in Mumbai alone during FY2019-20. The revenue collected from metro cess is to be used to fund transport infrastructure projects in the state. A similar financing/ revenue generating mechanism can be implemented by the Karnataka Government as well for sustainable development of stormwater infrastructure.

Sabarmati Riverfront Development – Gujarat

The Sabarmati Riverfront Project is an environment improvement, social upliftment and urban rejuvenation project for Ahmedabad. The project encompasses both banks of the Sabarmati River of 10.5 km stretch, creating approximately 185 ha of reclaimed land. The aim of the project was to reclaim the private river bank as a public asset and restore the city's relationship with the river. The Riverfront Project presented an opportunity to create a public front to the river on the eastern and the western sides of Ahmedabad with claims of providing solution to flood management, protection of the river from sewer pollution, as well as creating value on land that was earlier unutilised or wasted.

Outcome

The project was estimated to contribute significantly to the financial resources of the municipality. 14.5% of the total area was intended for multi-use land sale. 2,94,082 sq m of total area and 8,40,000 sq m of total saleable floor area was expected to be sold (amounting to INR 1,700 cr) which was estimated to allow the Amdavad Municipal Corporation (AMC) to sufficiently cover their CAPEX expenditure and contribute towards the corpus for O&M. INR 1,200 cr was estimated to be returned by SRFDCL to AMC. Additionally, an increase of INR 50 cr was estimated to be realized from property taxes.

Source: Value Capture Finance Policy Framework, Ministry of Urban Development

Conclusion

The frequency of urban flooding in major cities in India has considerably increased causing enormous socio-environmental hazards, economic loss and in some instances the loss of lives. Over the last few years, instances of urban flooding were witnessed in cities such as Bengaluru, Hyderabad, Gurgaon and Pune. In case of Bengaluru, due to the economic development of the city, population growth and expansion, the city picked up at a faster pace leading to a surge in real estate and infrastructure development. However, such a rapid pace of development has stressed the stormwater infrastructure of the city. Moreover, the existing stormwater infrastructure can no longer withstand high intensity rainfall. Bengaluru being one of the key engines of the country's economic growth, the real estate development will continue to expand to accommodate the city's growth. Hence, for long term sustenance, there needs to be a greater emphasis on the cohesive development of real estate and strengthening of supporting infrastructure without causing further damage to the ecosystem of Bengaluru. To avoid recurring instances of urban flooding, the governing bodies need to rejuvenate and remodel the city's stormwater infrastructure. Efficient stormwater management infrastructure has the potential to increase the value of surrounding land and real estate development. The governing bodies in turn can use mechanisms such as Value Capture Financing (VCF) to capture a part of the increment in land value and real estate development for financing the investment and maintenance cost of the infrastructure.

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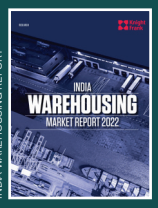

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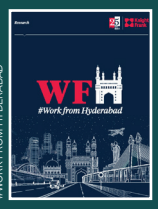

#WORK FROM HYDERABAD

We like questions, if you've got one about our research, or would like some property advice, we would love to hear from you.

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