

Thriving in a Changing Climate by Celebrating Water as Runoff, Sewage, and Life: Dr. M.S. Swaminathan Eco-wetland Sponge Park in Chennai, India

Prospérer dans un climat changeant en valorisant l'eau sous toutes ses formes; du ruissellement aux eaux usées, en passant par la vie qu'elle soutient: le cas du parc "Sponge" éco-humide Dr. M.S. Swaminathan à Chennai en Inde

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RÉSUMÉ

Le parc écologique Dr. M.S. Swaminathan, situé dans la mégapole côtière de Chennai, est l'un des plus grands exemples indiens de parc éponge, une infrastructure bleue-verte (IBV) conçue pour atténuer les risques climatiques liés aux inondations, aux vagues de chaleur et à la pénurie d'eau.

Au cœur de ce projet de 6,7 hectares se trouve un plan d'eau restauré, alimenté par des eaux usées traitées. Grâce à sa restauration, ce plan d'eau est devenu une zone humide protégée et une zone tampon contre les inondations, avec une capacité de stockage de 30 000 m³. L'asphalte du parking a été retiré afin de créer un réseau de bassins pouvant stocker et recharger entre 845 et 2 400 m³ d'eaux pluviales. L'aménagement du parc a préservé tous les arbres matures, créant ainsi un espace de loisirs verdoyant et ombragé pour plus de 60 000 habitants des environs et 1 000 visiteurs quotidiens venus de la ville. En intégrant des équipements tels que des aires de jeux et des terrains de sport, le parc offre un espace public essentiel dans une ville hyper-dense où l'on ne dispose que de 0,65 m² d'espace vert par habitant.

Le parc permet aux étudiants, aux travailleurs et aux familles citadins de renouer avec les milieux humides, composés d'espèces aquatiques indigènes et de hautes herbes qui abritent plus de 85 espèces, dont des oiseaux migrateurs. Une promenade de 600 m, agrémentée de belvédères et de panneaux pédagogiques, offre aux visiteurs une immersion au cœur de la vie aquatique et les invite à considérer l'eau comme une ressource essentielle pour l'adaptation au changement climatique.

ABSTRACT

Dr. M.S. Swaminathan Eco Park in the coastal megacity of Chennai is one of India's largest demonstrations of a Sponge Park as blue-green infrastructure (BGI) for mitigating climate risks of flooding, heat, and water scarcity.

The heart of the 16.63 acres project is a restored waterbody receiving treated sewage water. With restoration, the waterbody has become a wetland habitat and flood buffer with 30,000 m³ of storage capacity. The asphalt in the parking lot was removed to create a network of ponds with the capacity to store and recharge between 845 - 2,400 m³ stormwater. The park design preserved all the mature trees to create a green and well-shaded recreational area for more than 60,000 people who live around the park and 1,000 daily visitors from the city. By integrating amenities like playgrounds and courts, the park provides critical public space in a hyper-dense city with only 0.65 m² of park space per capita.

The park reconnects urban students, workers, and families with wetland habitats consisting of native aquatic species and tall grass that support over 85 species including migratory birds. A 600 m boardwalk with viewing decks and educational signages offer visitors an immersive experience of living with water and celebrating it as a resource in climate adaptation.

General presentation of the operation/strategy

1 WHY CHENNAI NEEDS TO BE A SPONGE CITY

1.1 Metropolitan Climate and Development Context

The convergence of rapid urbanisation and intensifying climate hazards presents a defining challenge for metropolitan planning authorities worldwide. In rapidly growing urban regions like Chennai, the management of land is particularly challenging, yet essential. The Chennai metropolitan area (CMA) is home to over 12 million people and spans 1,189 km². The coastal megacity is almost entirely flat and receives more than 1,400 mm of annual rainfall, which is becoming increasingly intense due to climate change. In the past decade, Chennai has consistently experienced extreme flooding from cloudbursts and cyclones followed by periods of severe water scarcity. This dual risk of too much water and too little water is compounded by the metropolitan area's exposure to heat waves and saline intrusion. Climate change is projected to further increase the intensity of rain events, decrease monsoon predictability, and heighten the recurrence of strong cyclones, alongside a predicted temperature increase of 2.4°C to 2.5°C by 2041–2070.

At the same time, Chennai's pattern of urban development at the expense of the city's blue-green systems is increasing the city's vulnerability to multi-hazards. Urban expansion has resulted in encroached water bodies, reduced resilience to storm surges, increased contamination, and decreased aquifer recharge. Between 2006 and 2019, Chennai witnessed a 49.95% decline in water bodies/wetlands and a 29.27% decline in vegetation. The loss of green cover to concrete increases the runoff volume by more than 5 times and contributes to the heat island effect.

1.2 What is a Sponge City for Chennai?

As the volume of runoff from increasingly impermeable surfaces exceeds the designed capacities of stormwater drains and neighbourhoods expand into flood-prone areas with little to no stormwater coverage, the limitations of traditional, grey infrastructure for flood mitigation are becoming evident. Stormwater drains are only designed to convey water from streets and flush them to canals, lakes, or the ocean. Grey infrastructure only resolves the issues of flooding in specific storm events but does not help address water scarcity and extreme heat. In contrast, the Sponge City approach works with water and finds natural or constructed spaces to slow down, hold, and infiltrate rainwater. Sponge City is a form of urban Nature-Based Solution (NBS) where blue-green systems are protected and restored and multi-functional blue-green infrastructure is constructed to delay, store, filter stormwater and recharge groundwater. The Dr. M.S. Swaminathan Eco-Wetland Sponge Park is India's largest demonstration of the Sponge City approach. The project integrates stormwater and treated wastewater as a resource to create a thriving habitat and public open space that is resilient to the climate risks of flooding and extreme heat.

2 THE DR. M.S. SWAMINATHAN ECO-WETLAND SPONGE PARK

2.1 Project Site Context

The Dr. M.S. Swaminathan Wetland Eco-Wetland Sponge Park was designed by Sponge Collaborative and financed with the Chennai Metropolitan Development Authority (CMDA) on an open space reservation of 16.63-acres. The project was implemented between 2023 and 2025 with construction supervision by Sponge Collaborative. Before the intervention, the site contained a polluted waterbody with garbage dumping and overgrown with invasive weeds. The waterbody is not a recognised wetland but rather a pond receiving treated sewage water from the adjacent university campus. Part of the open space reservation land was taken over by an impervious parking lot built directly over a former water body area. Stormwater runoff from the campus was also brought into the site from concrete channels. The condition of the site is representative of ecological degradation at the metropolitan scale where CMA witnessed a 85% reduction in wetlands' storage capacity due to land use conversion. (Refer to Fig 1)

2.2 Sponge Park as blue-green infrastructure, habitat, and social amenity

The subsequent transformation of the park demonstrates the potential of Nature-Based Solutions to mitigate risks of flooding, heat, and pollution. The final design successfully functions as a multi-functional Sponge Park, integrating three key roles: blue-green infrastructure, ecological habitat, and socio-cultural amenity.

2.2.1 Blue-green Infrastructure Functionality of the Sponge Park

The park's design focuses on hydrological function and water quality enhancement. The former impervious parking lot was transformed into a sophisticated network of water treatment and storage features, including bioswales, sedimentation ponds, and phytoremediation ponds, all working to filter stormwater (Refer to Fig 2).

The park's capacity to manage extreme weather is significant. It is engineered to mitigate flooding from a 25-year return period storm, which typically brings around 70 mm of rainfall per hour. The park absorbs half of the stormwater runoff generated by the adjacent campus. The hydraulic system comprises a network of three primary ponds designed for water treatment and storage:

Sedimentation Pond: This is the first point of entry for stormwater, designed to settle out heavier solids.

Aeration Basin: Designed to enhance water quality, likely through oxygenation.

Phytoremediation Pond: This pond leverages wetland plants to naturally filter contaminants before the water reaches the main restored waterbody.

Collectively, this pond network filters and stores 845 m³ of water. Beyond the ponds, the broader design incorporates an expanded floodable area of 2,400 m³ and leverages the desilted wetland area for overflow storage, which can accommodate 19,000 m³. The total capacity of the wetland is approximately 30,000 m³. This structured water flow and storage capacity ensures that runoff volume is reduced and the hydrological lag time is increased, which is vital for flood management. Furthermore, treated water collected within the system is earmarked for industrial reuse, demonstrating the park's role in promoting water sufficiency (Refer to Fig 3).

2.2.2 Ecological and Socio-cultural Benefits of the Sponge Park

The success of the Sponge Park extends beyond technical flood mitigation to include ecological restoration and enhancement of public well-being. The wetland area was actively restored through processes like desilting, dewatering, and riparian planting of native species, successfully creating a richer habitat for urban wildlife, especially birds. This outcome directly counters the historical trend of wetland degradation in Chennai. The habitat attracts more than 80 migratory bird species (Refer to Fig 4).

Crucially, the Sponge Park directly addresses the issue of urban heat stress. Built-up areas contribute significantly to the urban heat island effect, increasing the risk of heat-related fatalities. The design incorporates features that provide cool respite for residents, particularly during the summer. Thermal measurements highlight the effectiveness of integrating water bodies and shading in heat mitigation: while unshaded basketball courts registered temperatures as high as 51.8°C and unshaded green areas reached 50.6°C, shaded areas near the waterbody measured 36.4°C, and shaded green areas registered 36.0°C. This significant reduction in temperature demonstrates the critical role of blue-green systems in creating more habitable and safer urban environments (Refer to Fig 5).

As a socio-cultural amenity, the park offers public recreation features such as badminton and basketball courts and playgrounds shaded by mature trees. This development fulfills the unmet public open space demand identified in the metropolitan gap analysis, transforming an ecologically stressed area into a vital community asset (Refer to Fig 6).

3 SCALING UP SPONGE PARKS TO BUILD CLIMATE RESILIENCE ACROSS CITIES AROUND THE WORLD

The success of Dr. M.S. Swaminathan Wetland Sponge Park has provided political and institutional momentum necessary to mainstream NBS in Chennai's land-use planning framework. Following the park's opening in 2025, the state government announced plans to build an additional seven Sponge Parks, backed by a budget of ₹9.1 million. This systemic change requires sustained effort beyond individual projects, focusing on capacity building and institutional integration. To empower further adoption, a detailed manual covering the entire life cycle of Sponge Parks—from planning and design to construction and maintenance—was developed. Furthermore, capacity building initiatives have trained over 200 municipal officials and engineers from six Indian states on the necessary skills to upgrade existing open spaces into functional Sponge Parks. This focus on empowering others is essential to ensuring that Sponge City projects are not isolated projects but integrated elements to build climate resilient metropolitan systems that understand, respect, and celebrate water.



Fig 1: Condition of site before interventions

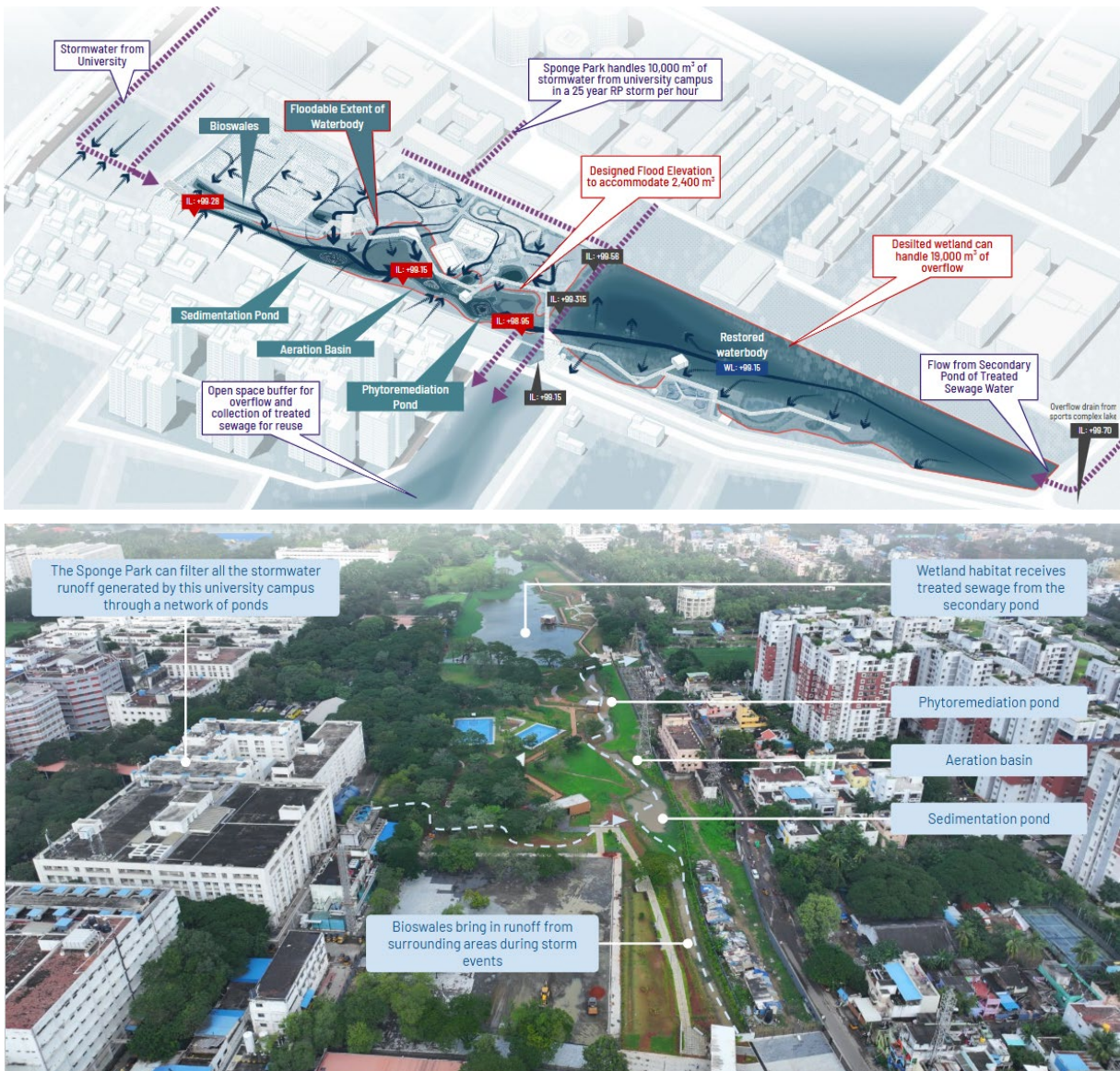


Fig 2: How the Sponge Park works: Network of bioswales, pond, and restored wetland as flood buffer

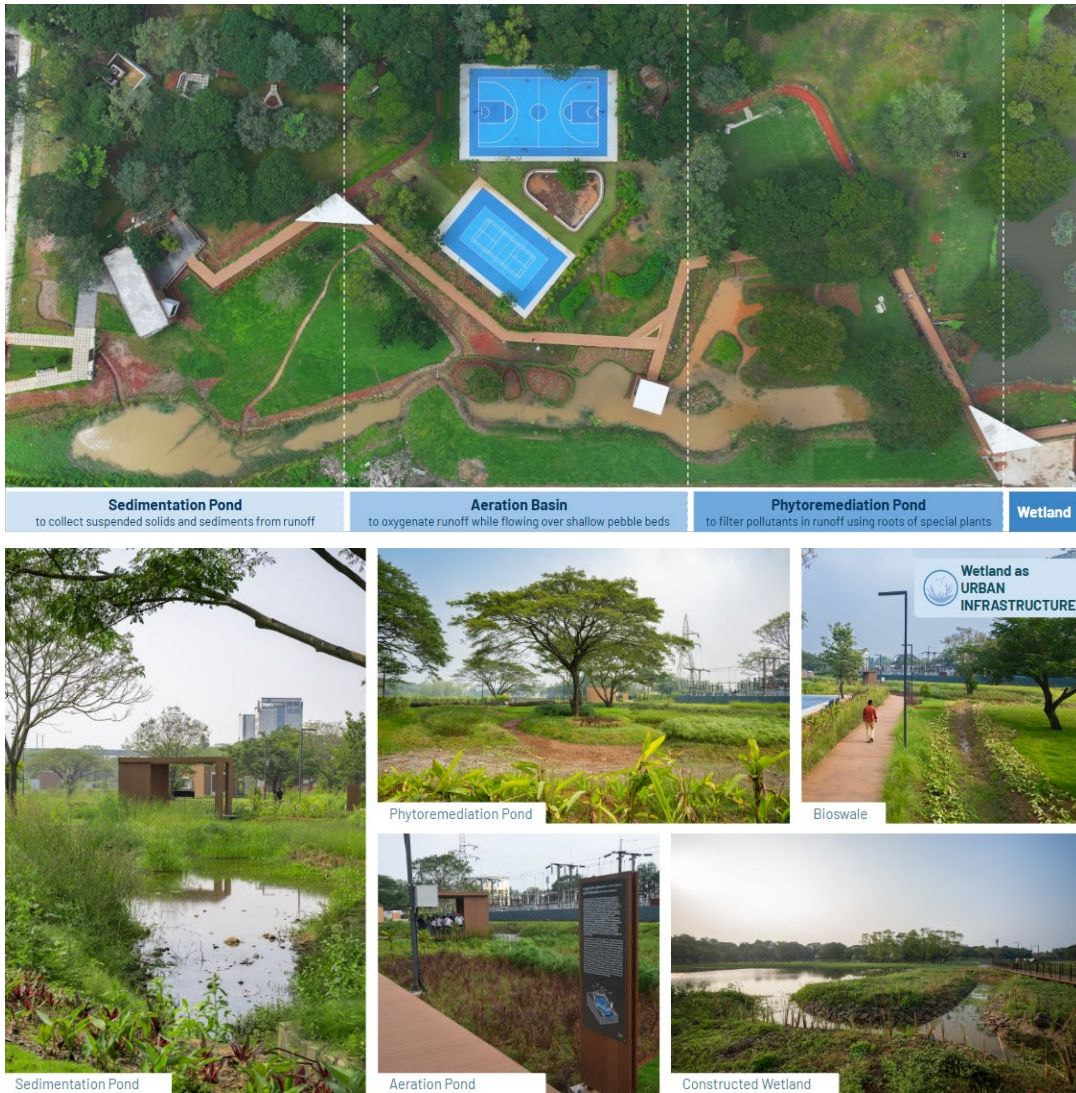


Fig 3: Living laboratory demonstrating India's first blue-green infrastructure system built at a large scale

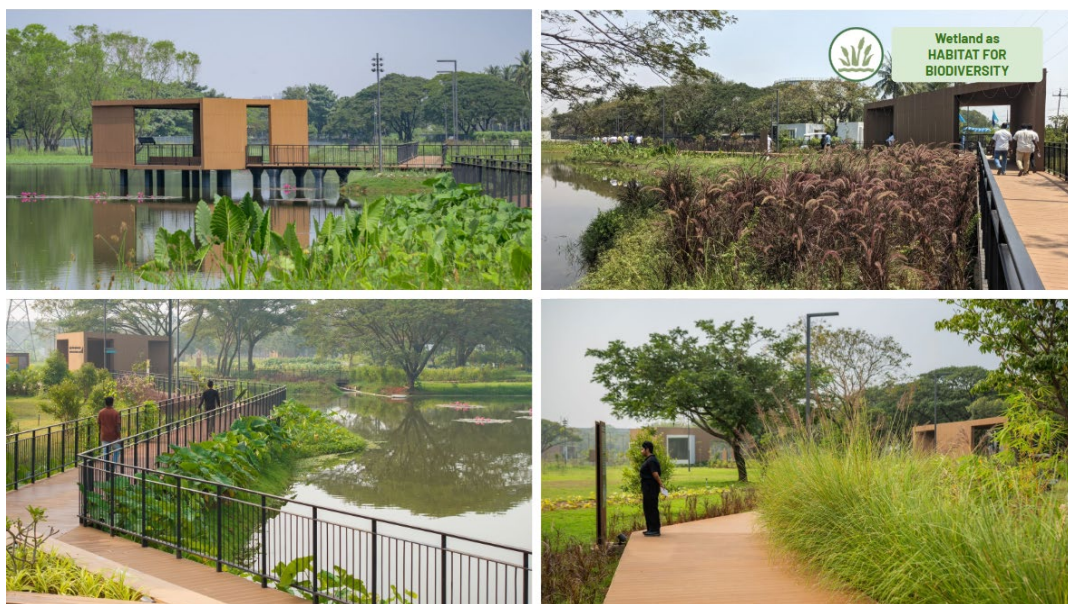


Fig 4: Layering of native trees, shrubs, tall grasses, and wetland species creates an urban wilderness experience and habitat



Fig 5: Land Surface Temperature readings show ambient cooling effects of more than 14C in shaded green areas of the Sponge Park

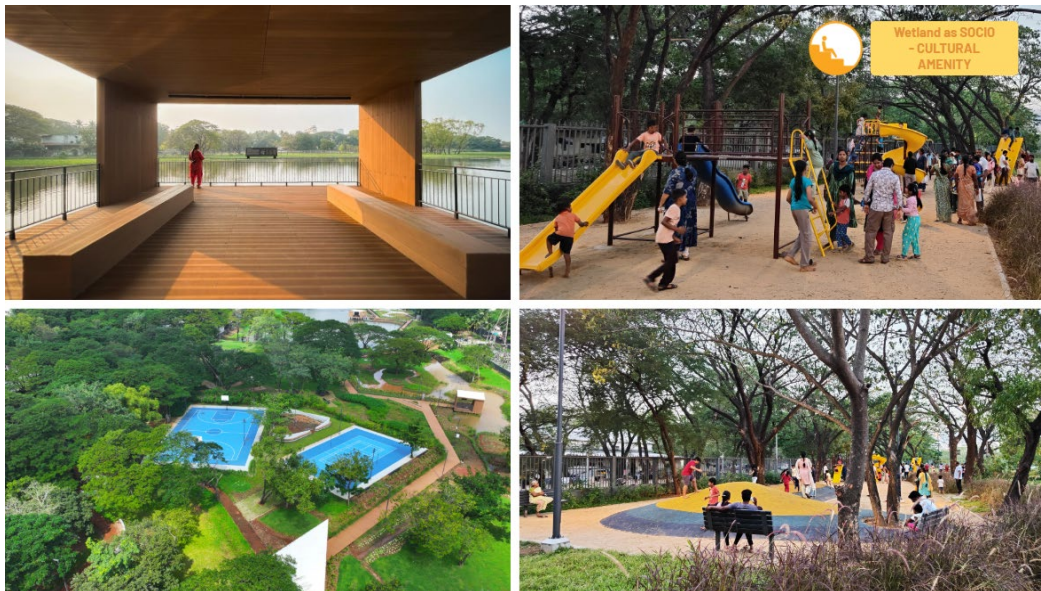


Fig 6: A 600m long boardwalk, shaded overlooks, plazas, playgrounds, and sport courts offer new experiences for all ages and genders