COMBATING CLIMATE CHANGE SUSTAINABLY BLUE-GREEN INFRASTRUCTURE?

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Upon hearing the word "city," the imagery of a concrete jungle, high-rise buildings, urban housing blocks, roads, and grey-coloured hard surface structures springs to mind. Cities, however, can be more than just synonymous with the colour "grey."Globally, population in urban areas is expected to grow to 68% by 2050 and by then one in every two Indians is expected to live in cities (UN DESA,2018). Accounting for less than 2 % of Earth!s surface, cities consume 78% of the world!s energy and produce 60% of all greenhouse gas emissions (UN Habitat, 2011). These alarming facts highlight the increasing pressure put on land. Altering the natural landscapes to achieve urbanisation significantly impacts the hydrology and biodiversity of an area. Rapid urbanisation has made cities a major contributor to climate change, resulting in an increased occurrence of extreme weather events worldwide.Grey Infrastructure was adopted as an early approach to deal with climate change emergencies. It involves the use of concrete to construct manmade structures like dams, canals, seawalls, rainwater pump stations, etc.

The present-day demand is to build urban infrastructures that are climate resilient in multiple dimensions. Making headway for the transition from an isolated grey infrastructure approach to hybrid blue-green infrastructures as sustainable solutions to build climate-resilient urban spaces."Blue-Green Infrastructure" acronym "BGI! is a more suitable approach to address three critically interlinked aspects of sustainable development: economy, society, and environment.

BGI is a strategically planned network of hydrological (blue) and vegetation (green) components for countering urban and climatic challenges by building with nature.The goal of BGI is to emulate and create more natural hydrology for climate esilience while offering additional urban amenities such as recreation and quality of life. The early emphasis on simply the green component (land) of the green Infrastructure approach which got widespread attention from environmentalists during the 1990s "greenway movement" in the US excluded the hydrological (blue) component and was insufficient. But since land and water are inextricably linked, the term "blue-green infrastructure" comprehensively defines a wider range of these nature-based infrastructure solutions.

A CASE TO STUY

Singapore is an interesting case study for analysing blue-green infrastructure. Its Garden City moniker has earned it a worldwide reputation as a successful template for sustainable urban development.

Bishan-Ang Mo Kio Park, Singapore

In the early 1980s, a concrete canal (grey infrastructure) bisecting Bishan-Ang Mo Kio Park, was built for flood mitigation. Later, in 2009 in place of the canal, the landscape was designed to mimic a small, meandering stream, which provides natural cleansing of runoff through bio-retention and filtration. During periods of intense rainfall, the height of steam increases and floods up the banks of the adjacent green space, demonstrating the adaptability of BGI to extreme climate events.

BENEFITS OF BGI:

A typical blue-green infrastructure consists of elements like green roofs, blue roofs, bioswales, rain gardens, retention and detention reservoirs, infiltration systems etc.

BGI has a variety of benefits It increases the climate resilience of urban infrastructure by regulating rainfall variability, reducing the effects of urban heat islands, and increasing natural air ventilation. It helps mitigate the negative anthropogenic effects of land cover changes, such as the desiccation of urban soils and accompanying air pollution. Effective BGI design provides a variety of ecosystem services, including groundwater recharge, storm water runoff reduction, soil erosion and nutrient loss prevention etc. BGI management can provide secondary benefits by boosting biodiversity, allowing recreational activities that attract more people and thus contribute to the economy via tourism.

Image Source: -https://www.dreiseitlconsulting.com/bishan-ang-mo-kio-park

BLUE-GREEN INDIAN CITIES:

The concept of BGI, although new, is not entirely alien in the Indian context. India's smart cities mission aims to create urban spaces that can provide core infrastructure and a sustainable environment. To build these climate resilient cities blue-green components are being incorporated in the strategic master plans of Delhi and Bhopal (cities under the mission). Through a planned strategy, these "blue-green" initiatives seek to strengthen existing natural blue systems within the city and surrounding green spaces.

This includes measures to enhance the energy efficiency of buildings, waste management, recycling, and connecting land parcels to form a network of parks, bike paths, and green walkways. With six megacities of populations surpassing ten million predicted in India by 2030, it is vital to recognise that cities' socioeconomic stability is intrinsically related to the environment, and the only way ahead is to adopt BGI integrated development plans.

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BGI ELEMENTS

	ROOF ELEMENTS	SURFACE ELEMENTS	SUB-SURFACE ELEMENTS
LOCATION	Built above the ground	Built on the ground surface	Built under the ground
CLIMATE RESILIENCE	• Reduce runoff peak flows • Alleviate urban heat island effect	• Control storm-water runoff • Mitigate urban floods • Adjust rainfall variability	• Work as catchment • Mitigate urban floods
ECOSYSTEM SERVICES	• Enhance green areas in dense cities • Improve air quality • Improve natural air ventilation	• Infrastructural link between people, water and nature. • Beautify landscapes • Enhance biodiversity • Recreational activities	• Collect rainwater for reuse. • Groundwater recharge • Filter and distribute clean rainwater.
EXAMPLES	• Green roofs • Blue roofs • Green facades • Planter boxes	• Bioswales • Roadside bio-basins • Rain gardens • Bike-walk path • Cleansing biotopes	• Rainwater harvesters • Retention detention systems • Aquifers

WAY FORWARD:

Despite its tremendous potential, BGI faces profound challenges for its widespread adoption. It has been successfully implemented in Singapore, the USA, and Europe, but due to a general lack of awareness and a paucity of specialists and decision makers familiar with the technique, this concept has not been generally adopted elsewhere. Global agreement on its underlying principles is still elusive. Another concern is that BGI planning, and implementation are costly and time consuming. Although these monetary costs can be justified by the numerous socioeconomic and ecosystem service gains that accrue, priorities are frequently given to other, more familiar technological solutions and the maintenance of existing grey infrastructure, both of which have long-term negative environmental consequences.

Another difficulty is that many of the benefits of BGI are tricky to quantify and projects may lack the capacity to collect data where they are quantifiable. Connectivity is an important aspect of BGI. Many of its advantages are only attainable via an interconnected network of its constituent elements. Once these challenges are effectively addressed, BGI can be fully utilised in the creation of truly climate-resilient, sustainable citiesUrban areas are facing increasing climate risks and threats to human comfort and environmental justice. Of the four major global risks projected to have a negative decadal consequence on countries through temperature increases, three are primarily environmental—natural disaster, extreme weather and biodiversity loss, with climate action failure as the fourth. In attempts to address these challenges, growing attention.