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INTEGRATED BLUE GREEN INFRASTRUCTURE APPROACH FOR STORM WATER MANAGEMENT

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ABSTRACT---
Due to urbanisation and climate change, stormwater management is an issue for cities throughout the world. Traditional techniques of stormwater management, such as grey infrastructure, are sometimes costly and offer little extra environmental advantages. This article presents an integrated blue-green infrastructure system for stormwater management, which mixes conventional grey infrastructure with natural green infrastructure. This strategy use a combination of manmade and natural systems to mitigate the environmental and health impacts of stormwater. The objective of the study article will be the success of this strategy in lowering stormwater runoff, boosting water quality, and enhancing urban green areas. The study will also address the economic and social benefits of this method, including lower infrastructure costs, greater property prices, and enhanced resident quality of life. The success of the integrated blue-green infrastructure concept will be demonstrated via case studies from cities that have implemented it. The study article finds that an integrated blue-green infrastructure strategy provides a more robust and sustainable solution for urban stormwater management.
KEYWORDS : *Stormwater management, Urbanization ,Climate change, Gray infrastructure ,Blue-green infrastructure, Urban green spaces*---

INTRODUCTION

Urban flooding is a major worldwide issue that the globe is currently confronting owing to the catastrophic climate change resulting from increased urbanisation. Climate extremes and land-use shifts will exacerbate the situation in the coming years. As a result, several worldwide cities are reconsidering and modifying their approach to flood risk management. This entails a shift from flood defence, in which towns are protected from rising rivers and sea levels by engineered structures, to flood resilience, in which surface water is promptly carried and removed via subsurface systems. This may be accomplished by utilising Blue-Green infrastructure (BGI) at the source facilities to retain, attenuate, store, and reuse surface water on-site.

NEED OF THE STUDY

This study is necessary owing to the rising difficulties urban regions confront in controlling stormwater as a result of urbanisation and climate change. Traditional grey infrastructure approaches for stormwater control are frequently costly and offer no extra environmental advantages. An integrated blue-green infrastructure concept provides a more robust and sustainable method for controlling urban stormwater. The objective of this project is to investigate the process of controlling stormwater by integrating blue-green infrastructure. This study will evaluate the efficacy of this strategy in decreasing the adverse effects of stormwater on the environment and human health. And to design a mechanism for merging BGI parameters with Storm Water Management to create an all-encompassing solution.

METHODOLOGY

This research paper's technique incorporates a two-step process. In the initial phase, we will concentrate on comprehending the idea of Blue Green Infrastructure (BGI) and identifying its aspects that directly impact or aid in stormwater management. To get a full grasp of BGI components and parameters, a thorough literature research will be conducted. In the second phase, we will analyse existing initiatives linked to urban stormwater management using BGI case studies in order to develop a framework for BGI stormwater management planning. The proposed framework would take the stated BGI characteristics and best practises for urban stormwater management into account.

SCOPE AND LIMITATION

The study article examines BGI features that improve stormwater capture and decrease runoff during a rain event. However, the scope of the study is confined to a single area, and the economic impact of BGI on stormwater management is not considered. Additionally, the study report focuses primarily on stormwater management with BGI and does not consider any other potential applications of BGI. In addition, the results of this study may not be applicable to other regions, and the advantages of widespread BGI adoption may differ by location. Despite these limitations, this study sheds light on the potential of BGI for stormwater management and shows the need for more research to understand the economic and location-specific elements that may impact the viability of BGI adoption for stormwater management.

THE MANAGEMENT OF BLUE-GREEN INFRASTRUCTURE : REVIEW

Blue-Green Infrastructure (BGI) has also been defined as a sustainable and cost-effective method for controlling urban stormwater (Urbanization and the Natural Drainage System, n.d.) by mixing green spaces with water management strategies. The incorporation of BGI features such as rain gardens, green roofs, and permeable pavements can minimise storm runoff and enhance water quality. It has also been demonstrated that BGI has various co-benefits, including as increasing biodiversity, lowering urban heat island impacts, and improved air quality.

Numerous research have investigated the efficacy of BGI in minimising the negative effects of urbanisation on water resources. For instance, a research done in Portland, Oregon revealed that the introduction of BGI methods reduced stormwater runoff volume by up to 87 percent (Atkins, 2015). Similarly, a London research discovered that the construction of green roofs lowered peak runoff rates by up to 65%. In addition, BGI has been acknowledged (Stormwater, 2014) as a crucial instrument for enhancing urban resilience to climate change by reducing the effects of extreme weather events. BGI can help lower the danger of floods and increase water availability during droughts by decreasing runoff and increasing infiltration.

Overall, the research demonstrates that BGI has the potential(Rosenzweig et al., 2019) to provide a sustainable, cost-effective, and multi-beneficial approach for controlling urban stormwater. Incorporating BGI principles into urban planning and development can aid in the construction of resilient and sustainable cities. (Barriendos & Rodrigo, 2006) Blue-Green Infrastructure (BGI) blends infrastructure, ecological restoration, and urban design to address urban and environmental concerns. Rain gardens, permeable pavements, and green roofs are BGI elements that assist regulate stormwater runoff and enhance water quality. BGI prioritises the building of sustainable, livable communities with green areas and walkable neighbourhoods. BGI has various benefits, including the reduction of flood danger, the improvement of air quality, and the promotion of human health and well-being. The incorporation of BGI into urban planning and development makes cities more resilient and sustainable, hence enhancing their capacity to adapt to urbanisation and climate change. BGI provides a nature-based approach to solve urban and climatic concerns (Barredo, 2009) such as pollution, increasing temperatures, and strained water supplies resulting from growing urbanisation. BGI components such as green roofs, rain gardens, and wetlands provide ecosystem services such as improvement of air quality and management of water. BGI also has significant economic effects, such as reducing the demand for cooling and energy and power. However, due to increased urbanisation, cities in India and other countries have suffered a drop in green and blue characteristics, resulting in environmental damages. By incorporating BGI into urban planning and development, cities may become more sustainable and resilient, minimising the negative effects of urbanisation and climate change.

i) Urban challenges faced due to climatic changes

Rising global temperatures caused by the greenhouse effect, which result in extreme weather events such as floods, droughts, and storms, are one of the difficulties posed by climate change to metropolitan areas. This can also facilitate the transmission of tropical illnesses. Urban areas are especially susceptible to disruptions in flora and ecosystems, which can worsen the effects of climate change (Depietri & McPhearson, 2018). Furthermore, pollution of air, water, and soil can have detrimental effects on human health and the ecosystem. The incorporation of blue-green infrastructure into urban areas can assist in mitigating some of these issues by offering nature-based solutions that control temperature, manage stormwater, enhance air and water quality, and sustain biodiversity.

1. Inadequate Basic Services: Inadequate basic services such as water supply, sanitation, waste management, and transportation pose difficulties for cities.
2. Infrastructure: Due to inadequate or badly maintained infrastructure, such as drainage systems and canals, urban flooding is a prevalent problem.
3. Quality of Life: Urbanization may result in pollution, congestion, noise, and overcrowding, all of which can negatively affect mental health and well-being.
4. Health: Urbanization can contribute to public health issues, such as air and water pollution and chemical exposure.
5. Urban Heat Island: Due to the absorption and retention of heat by urban surfaces, metropolitan regions can be much warmer than rural areas, resulting in greater energy consumption and heat-related health concerns.

ii) Ecological Restoration

Ecological restoration is the rehabilitation of degraded ecosystems. The benefits of healthy ecosystems include clean air and water, nutrient cycling, wildlife habitat, and recreation. Conventional stormwater (Winkler, 1988) management, often known as grey infrastructure, diminishes ecological services and pollutes stormwater. Restoring urban ecosystems can help mitigate the detrimental effects of grey infrastructure. Stormwater runoff offers ecosystem services such as soil moisture, interflow, baseflow, groundwater recharge, and environmental water filtering (Changnon & Westcott, 2002a). However, typical stormwater management approaches, often known as grey infrastructure, send runoff directly to surrounding bodies of water via storm drains, gutters, and subterranean systems (Chicago's Stormwater: Green Infrastructure Opportunities for Business, n.d.). This strategy lowers the ecosystem services provided by stormwater by limiting infiltration and groundwater recharge and by polluting stormwater with pollutants such as heavy metals, suspended particles, fertilisers, salts, oil, and hydrocarbons.

ANALYSIS ON BEST PRACTICES RELATED URBAN STORM WATER MANAGEMENT THROUGH BGI

i). Copenhagen, Denmark

In Copenhagen, wastewater from homes and businesses is treated in subterranean pipelines. The bulk of the city has a combined sewage system that discharges stormwater from roadways and residential wastewater for treatment at the city's central treatment plants (Changnon, 1980). Statistically, combined system overflows occur only once every ten years, whereas independent system overflows occur once every five years. Copenhagen's conventional stormwater infrastructure is threatened by climate change, growing urbanisation, and population increase. The Climate Adaptation Plan (CAP) of Copenhagen evaluates which climate change concerns are the most significant and where the city may get the biggest advantages by acting immediately.

- The Cloudburst Management Plan (CMP) is an offspring of the Climate Action Plan (CAP).
- The CMP describes the suggested strategies, goals, and actions for adapting to climate change, particularly excessive rainfall.
- Each water catchment and sub-catchment region is evaluated based on the four factors of risk, implementation, coherence, and synergy.

ii). Rotterdam, Netherland

Rotterdam's stormwater and sewage system includes 3,000 kilometres of sewers, 400 kilometres of canals, and 900 pumping stations. Rotterdam has difficulties to its traditional stormwater infrastructure as a result of climate change and extreme weather occurrences, such as heavy storm events, droughts, and rising temperatures (Changnon & Westcott, 2002b). The City of Rotterdam adopted the Rotterdam Climate Proof Programme in 2008. The objective is to make Rotterdam 100 percent climate-proof by 2025, while maximising economic advantages. The Rotterdam Climate Adaptation Strategy is based on four guiding ideas. The Climate Adaptation Strategy will be executed by the City of Rotterdam in collaboration with The Port Authority, Municipal Services, Other Government Departments And Utilities (For Example, Water Boards), and Private Organizations (Including Housing Corporations and project developers).

Identified Parameters of BGI which will help in management of Stormwater

- Ecological component
    - Ground water level
    - Water quality

    - Stormwater runoff
    - wetland/freshwater ecosystem
- Infrastructure
    - Drainage Infrastructure
    - Water infrastructure
    - Green infrastructure
- Urban design
    - Roof Elements
    - Landscape Surface elements
    - Landscape water system
    - Roadside Basin (Water retention)
    - Landuse
    - Soil type (pervious /impervious)
    - Identification of catchment

CONCLUSION

- A micro BGI element deployed in an urban area will not work well unless it is linked to other components and operates as a single entity: Distributed BGI concept: large-scale execution of minor projects
- It was discovered that BGI initiatives were connected with other active Urban development projects to increase the project's economic efficiency.
- Interdepartmental collaboration has a significant role in establishing the tasks to be included into various initiatives.
- Public-Private Cooperation: Cooperation among public entities is successful up to a certain extent due to the need for large-scale capital expenditures. Private collaboration can play a significant role in programme execution.
- Incentive-based development was implemented to stimulate the deployment of BGI projects on private property.
- Mandatory BGI for new construction: New commercial or governmental development projects that utilise a large quantity of land should be required to incorporate BGI.
- Guideline: For the creation and designing of a BGI element which may be used in any development an appropriate guideline should be developed .
- Professional acknowledgement:
- Compared to other BGI features, the Retention Pond (Catchment) and Infiltration trenches (managing runoff) have been utilised the most.
- If existing Green and Blue components in a region are recognised and partnered with a network of Distributed BGI elements, the entire municipality's storm water problem may be simply addressed.
- Meso projects clearly demonstrate a network of linked BGIs.

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