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TRANSFORMING AHMEDABAD: BLUE-GREEN INFRASTRUCTURE INTEGRATION IN THE WATER SECTOR FOR SUSTAINABLE URBAN DEVELOPMENT AND RESILIENT LIVING

Ms. Disha Patel, Dr. Satyajeet Deshpande, Dr. Sanjay Pardeshi

Ph.D. Scholar
Department of Economics
Gujarat University

Associate Professor
Central University of Gujarat
Gandhinagar.

Associate Professor
Gujarat University
Ahmedabad.

Abstract

The research aims to explore the effectiveness of Blue-Green Infrastructure (BGI) as a tool to assess and enhance the livability of Indian cities with a specific focus on Ahmedabad. This case study delves into the water sector as a pivotal element of Blue-Green Infrastructure (BGI) in Ahmedabad to assess key indicators focusing on water quality assessment, surface runoff dynamics, and the cultural and recreational facets of water bodies, the study employs a comprehensive literature review and meticulously examines city initiatives, policies, and interventions in water management.

INTRODUCTION

Cities are significant contributors to climate change, responsible for around 75% of global greenhouse gas emissions. Urban activities, including rapid economic growth and urbanization, amplify climate change impacts, making cities key players in the issue .Addressing climate change in cities is crucial for sustainable development and global climate action. Blue Green Infrastructure provides solutions by combining green (natural areas) and blue (water bodies) elements to enhance urban resilience and resource efficiency.

Blue-Green Infrastructure (BGI) is an innovative approach to urban planning that integrates natural and built elements to create sustainable, resilient, and ecologically friendly environments. It involves strategically incorporating green spaces, water bodies, and ecological corridors alongside engineered systems to manage water, mitigate flood risks, and enhance biodiversity in urban areas. The term "blue" represents water-related features, while "green" denotes natural elements, working together to address urban and climatic challenges in a holistic and environmentally conscious manner.

LITERATURE REVIEW

The "Urban Blue-Green Conundrum: A 10-City Study on the Impacts of Urbanization on Natural Infrastructure in India" is a working paper that explores the effects of urbanization on natural landscapes in India's 10 most populated cities. It discusses changes in built footprints, impacts on surface water, and alterations in green cover due to urban development. The study highlights the disconnection between urbanization and natural infrastructure, emphasizing the need for sustainable urban planning to mitigate adverse impacts on the environment and enhance resilience.

Many cities globally are in different stages of implementing Blue-Green Infrastructure (BGI) to mitigate storm water runoff and enhance environmental sustainability. Case studies, such as those presented in the book "Blue and Green Cities" by RC Brears, offer insights into successful BGI implementation. These studies discuss uncertainties, barriers, and solutions, drawing examples from Portland, Oregon, and exploring urban policy innovations promoting the application of blue-green infrastructure in water resource management

Existing Blue-Green Infrastructure Projects Across the Globe

There are several blue-green infrastructure projects around the world that uses Nature Based Solutions (NBS) to mitigate pollution improve thermal comfort in the cities, reduce the effect of urban heat islands, manage storm

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water runoff, among many other benefits to the environment, and to the physical and mental health of urban dwellers.

Project Name	Location	Launch Year	Objectives
Active, Beautiful, Clean Waters Programme	Singapore	2006	Improve water quality and enhance livability by transforming canals, rivers, and reservoirs into recreational spaces.
Grey to Green Initiative	Portland, Oregon, United States	2008	Enhance green spaces, restore watershed connectivity, create ecoroofs and bioswales, and plant trees for water cleaning.
Rain City Strategy	Vancouver, Canada	-	Implement sustainable rainwater management to improve water quality, resilience, and livability, treating rainwater as a resource.
Sponge City Programme	China	-	Emphasizes green infrastructure for flood management, addressing issues like flooding, water pollution, and water scarcity in urban areas.

Ahmedabad and Blue Green Infrastructure.

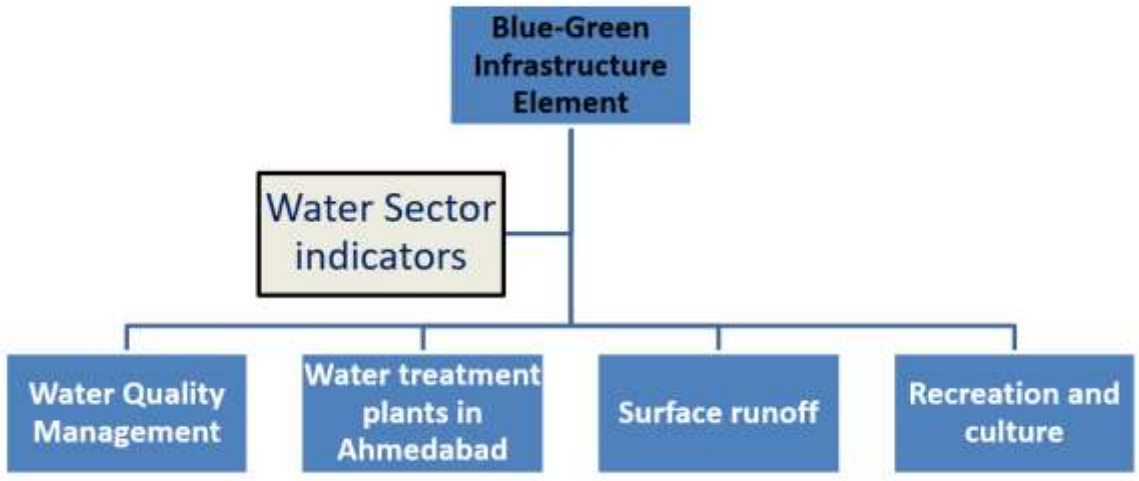
Ahmedabad, situated in the western Indian state of Gujarat, is the largest city and former capital of the state. Located along the Sabarmati River, Ahmedabad has been a prominent economic and industrial hub.

The city of Ahmedabad is facing challenges related to urban sprawl, impacting its water balance and necessitating sustainable stormwater management. The expansion of urban areas reduces natural recharge potential zones, leading to imbalances in water availability.

To address these issues, there is a need for the integration of Blue-Green Infrastructure (BGI) in Ahmedabad. BGI can play a crucial role in sustainable storm water management, enhancing water quality, and promoting resilience in the face of climate change.

METHODOLOGY

In the context of a case study, the research methodology is structured to holistically examine the water sector within Ahmedabad's Blue-Green Infrastructure (BGI). The study begins with an extensive literature review to understand global BGI practices, narrowing the focus to water quality assessment, surface runoff, and the cultural and recreational aspects of water bodies. The positive and negative facets of each indicator will be systematically analyzed. The study aims to offer a current status of Ahmedabad's water sector in the BGI framework. The conclusions drawn from this case study aim to contribute valuable insights for urban policymakers, offering a holistic perspective on the successes, challenges, and potential future directions for the city's water-related endeavors.



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Water Assessment in Ahmedabad.

Ahmedabad's comprehensive water quality assessment structure serves as a key indicator of Blue-Green Infrastructure (BGI). Regular monitoring programs ensure that water sources align with stringent quality standards, reflecting BGI's commitment to environmental sustainability and human health.
Ahmedabad Municipal Corporation is responsible for catering to the domestic and commercial water demand of the city. Sabarmati river and Narmada canal are the two main sources of water for the city.

1. Water Quality Management-

Date	Zone	Distribution System			Municipality Source		
		Total Sample (Residential Tape)	Beyond Microbial Presence Limits	Available Residual Chlorine	Total Sample	Beyond Microbial Presence Limits	Available Residual Chlorine
01/12/23 To 15/12/23	East	208	3	206	201	201	201
	West	200	1	199			
	North West	192	0	192			
	South West	189	0	189			
	North	238	0	238			
	South	364	10	335			
	Middle	384	4	379			
	Total	1775	18	1738	201	201	201

Source- https://ahmedabadcity.gov.in/

- The majority of zones report no samples beyond microbial presence limits.
- The South zone stands out with a higher number of samples beyond microbial presence limits, suggesting a potential concern in water quality in that area.
- The consistent value of 201 ppm for available residual chlorine indicates effective disinfection measures.

2. Water treatment plants in Ahmedabad

Sewage and industrial effluents are the two major sources of urban used water. The AMC has 16 operational STP (Sewage Treatment Plant) as of 2020 to treat 993 MLD of sewage and two more are under trial. The treated sewage from STPs now has to meet stricter standards prescribed by the National Green Tribunal (NGT) in 2019.

S. No	Water treatment plants in Ahmedabad	Capacity(MLD)	Utilised Capacity(MLD)
1	Kotarpur (river Narmada water)	830	810
2	Jaspur (Dholka branch canal of Narmada)	400	345
3	Raska (river Mahi water)	200	200
4	Borewells	100	130
5	French wells	170	0(currently not used)
	Total	1900	1485

Source- https://ahmedabadcity.gov.in/

The implementation of robust water treatment plans further underscores the city's dedication to BGI. These plans incorporate advanced technologies, contributing to the sustainable management of water resources. By

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addressing pollutants and enhancing water quality, Ahmedabad's treatment initiatives align with the principles of BGI.

3. Surface runoff-

Ward	Catchment area (Ha)	Watershed runoff (cubic metres/sec)
Navrangpura South	1,382.68	116.6
Gandhigram South	487.98	41.9
Naranpura	240.55	18.22
New Wadaj	494.12	41.25
Sabarmati	181	15.04
Paldi	172.47	15.34
Stadium	36.89	2.45
Vasna	56.52	4.85
Gandhigram North	179.73	14.2

Source- The Times of India- Ahmedabad.

Current Status:
Approximately 40% of the average annual rainfall in Ahmedabad results in surface runoff, highlighting the need for ecological solutions to enhance water absorption.
The data reveals that Ahmedabad faces a significant challenge in managing surface runoff, indicating a gap in the implementation of Blue-Green Infrastructure (BGI) principles. High levels of surface runoff can lead to increased flood risks and pose threats to water resources. In Ahmedabad's context, the current status emphasizes the need for immediate attention and targeted interventions to align with BGI objectives.

4. Recreation and culture.

Under the recreation and culture elements of BGI we discuss the example of Sabarmati and kankaria lakefront development as recreational activities are likely integrated as part of the broader urban planning and environmental improvement efforts.

Sabarmati Lakefront Development.

Environmental Improvement	Flood protection, bank protection, and river training strategies Optimal waterway width of 263 meters selected
Sewage Diversion	Integrated stormwater and sewage system with interceptor sewers Interceptor lines capturing 38 sewage discharge points which is routed to treatment plants
River Cleaning	Adoption of Floating Trash Skimmer Machine for cleaning. Successful river cleaning and improved biodiversity. Monitoring water quality and oxygen levels.
Social Upliftment	Resettlement of over 10,000 households from riverbank slums. Slum dwellers provided with 'pucca' housing. Integration of informal activities.

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	Transformation of riverfront.
Sustainable Development	Project planned to be self-financing without government funding. Sale of reclaimed land for commercial development.
Water Retention and Recharge	Planning for treated sewage water use. Water retention enables recreational activities and an 11.5 km pedestrian walkway.

Kankaria Lakefront Development

Aspect	Details
Project Initiator	Ahmedabad Municipal Corporation
Objective	Create a comprehensive lakefront precinct for recreational urban space, fostering new activities.
Activities	Boating, Museum, Aquarium, Water walk, Butterfly park, Exhibition, Safari, Balloon safari, Food courts, Kids play zone, Zoo park, Toy train Desert
Attractions at Kankaria Lake	Zoo park, Balvatika, Amusement park, Kids city, Toy train, Balloon safari, Nagina wadi, Stone mural park, Aquarium, Ambubhai Purani Vyamshala
Festivals and Events	September: Ras Garba December: Kankaria Carnival January: Dog Show by Ahmedabad Police
Cultures Enhanced/Controlled	Culture of celebration (e.g., Dushhehra, Eid, Kankaria Carnival, Navratri) Culture of food (enjoying food at the lake)
New Cultures Added	Culture of walkability (pedestrian-friendly public space) Culture of public art (wall paintings, stone murals) Culture of recreation and games (outdoor activities for kids, interaction with murals)
Context and Opportunity	Socio-economic context: Kankaria Lakefront as a site for the annual Kankaria Carnival, source of income for vendors and hawkers Architectural/Environmental context: Historical buildings, green areas, census of planted trees

CONCLUSION

Ahmedabad, confronted with the consequences of rapid urbanization, emerges as a crucial arena for the implementation of BGI. The research has systematically analyzed the city's water sector, highlighting successes in water treatment and quality management, while also identifying challenges in surface runoff management that demand immediate attention.

The Sabarmati and Kankaria Lakefront Development projects serve as shining examples of successful BGI integration, contributing not only to environmental improvement but also social upliftment and sustainable development. These initiatives showcase the transformative power of BGI in creating recreational spaces that enhance livability while fostering a harmonious connection between communities and their natural surroundings. The findings from this research provide valuable insights for urban policymakers. The strategic incorporation of BGI principles into Ahmedabad's urban planning frameworks contributes to a vision of urban development.

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