ASSESSING THE IMPACT OF RAPID URBANIZATION ON CLIMATE CHANGE IN GUWAHATI: EXPLORING GREEN INFRASTRUCTURE SOLUTIONS

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Journal	Samvakti Journal of Research in Business Management e-ISSN : 2582-8347 https://www.samvaktijournals.com/sjrbm Volume 5 Issue 2 Year of Volume 2024 Page No : 35 - 44
Discipline	Business Management
Conference	Sustainable Entrepreneurship: Perspectives of Industry and Academia
Conference Dates	Start Date: May 30, 2024 End Date : May 31, 2024
Institute Name	Royal School of Commerce

Date Received	: September 01, 2024	Publication Date	: To be updated later
ID	: sjrbm.2024.4	Paper Type	: Conference Paper
Dol No.	: 10.46402/sjrbm.2024.4	**Dol Url**	: https://dx.doi.org/10.46402/sjrbm.2024.4

ABSTRACT

Rapid urbanization in Guwahati, a major city in northeast India, has significantly contributed to climate change, manifesting through increased greenhouse gas emissions, urban heat islands, and exacerbated flood risks. The unplanned expansion has led to the loss of green spaces, deforestation, and higher energy consumption, further straining the city's ecological balance. This study assesses the adverse impacts of rapid urbanization on Guwahati's climate, focusing on rising temperatures and irregular rainfall patterns. It explores green infrastructure solutions such as green roofs, urban forests, and rain gardens, which can mitigate these effects by enhancing carbon sequestration, reducing surface runoff, and cooling urban areas. Implementing these solutions could not only improve air

quality and biodiversity but also foster sustainable urban development. The research involves analyzing existing environmental data, urban planning documents, and case studies from other cities to propose a tailored green infrastructure strategy for Guwahati. By adopting such measures, Guwahati can curb its environmental footprint, adapt to climate challenges, and set a precedent for other rapidly urbanizing regions in India. This strategy emphasizes the need to weave nature-conscious elements into city blueprints to cultivate hardy and lasting metropolitan biomes. The study utilizes a descriptive research methodology, analyzing secondary data to understand how urbanization affects climatic conditions in Guwahati and identifies opportunities for green infrastructure to enhance urban sustainability.

Keywords: Rapid Urbanization, Climate Change, Green Infrastructure, Guwahati, Sustainable Development.

INTRODUCTION

As our world experiences rapid growth and development, it's becoming increasingly evident that this progress often comes with a hefty price tag for nature. The relentless pursuit of economic prosperity frequently results in the degradation of our environment, manifesting in deforestation, pollution, habitat destruction, and climate change. While advancements in technology and infrastructure improve human lives, they often take a toll on the delicate balance of ecosystems worldwide[6]. In the framework of Guwahati, the second most tainted metropolis on the planet (IQAir, 2024), with an average annual PM 2.5 density of 105.4 micrograms per cubic meter (μg/m³)—a staggering 21 times the WHO standards—where brisk urban proliferation and industrial escalation likely play pivotal roles in exacerbating its contamination levels. Guwahati, the preeminent city in the Indian state of Assam, has witnessed a swift surge in populace and urban encroachment in recent years. This growth has spurred a burgeoning need for infrastructure, habitation, and services, as well as the inception of industries to sustain the urban economy. The concentration of industries in and around Guwahati, coupled with the influx of vehicles and other sources of pollution associated with urban living, has led to severe changes in the climatic conditions of Guwahati[3]. Manufacturing emissions, automotive vapors, building endeavors, and imprudent urban design methods—leading to an augmentation of the urban landscape at the cost of diminishing green zones—considerably amplify the urban heat island

phenomenon across the city[14], posing serious health risks to the city's residents. The current research endeavour aims to comprehend the impact of unfavourable climatic conditions within Guwahati city while also investigating the array of green infrastructure possibilities available in the region. As we continue to expand our footprint on the planet, it's imperative to recognize the inherent value of nature and prioritize conservation efforts alongside our pursuit of growth. Only by acknowledging and addressing the consequences of our actions can we hope to build a sustainable future where both human development and environmental health can thrive in harmony.

LITERATURE REVIEW

Kumar advocate for green infrastructure investment in India to foster sustainable development, stressing its crucial role in balancing development with ecosystem preservation and meeting decarbonization targets for sustainable economic growth[10]. Goswami delve into peri-urban expansion complexities in Guwahati, Assam, revealing adverse effects on agriculture and ecosystems. Their study highlights declining natural land cover, increased built-up areas, and agricultural land use, leading to agricultural degradation, deforestation, wetland deterioration, and habitat loss[5]. Andreucci explore urban open space design advancements for mental health sensitivity, emphasizing Urban Green Blue Infrastructure (UGBI)'s role in enhancing mental well-being, particularly among the elderly. They champion empirically grounded design and Nature-infused Solutions to combat crippling psychological ailments in metropolitan environments[2]. Alanbari highlight green infrastructure's pivotal role in urban planning, stressing its significance in promoting sustainability across social, economic, and environmental dimensions, thereby fostering a more sustainable urban landscape[1]. Dorninger examine the global human appropriation of net primary yield and its relationship to national land utilization intensity and international biomass commerce. They highlight a disconnect between domestic ecological productivity and global biomass demand, noting the complexity of resource footprints[4]. Idiata emphasizes Green Infrastructure (GI) as vital for climate change mitigation, benefiting humans and wildlife by preserving environmental integrity and providing clean water access. GI, promoting multifunctional green spaces, is essential for sustainable settings and achieving climate policy goals[7]. Janiszek and Krzysztofik stress integrating climate adaptation theory into spatial planning, especially in industrial areas like

Katowice, to enhance urban resilience through improved green infrastructure planning[8]. Jayasooriya conducted a SWOT analysis on Green Infrastructure (GI) practices in industrial zones, highlighting the need for systematic approaches to optimize GI for storm-water management and address research gaps[9].

OBJECTIVES OF THE STUDY

- To identify the environmental consequences of urban growth in Guwahati and its effect on climate change.
- To delve into the prospective function of green infrastructure in diminishing the detrimental effects of urban encroachment on Guwahati's climate.

RESEARCH METHODOLOGY

This study utilizes a descriptive research methodology, primarily relying on secondary data sourced from various outlets such as journals, research papers, online repositories, and published materials. By synthesizing existing knowledge, the study aims to analyse how urbanization impacts climatic conditions in Guwahati city and to identify green infrastructure opportunities that contribute to achieving sustainability in the urban environment.

DISCUSSION/ANALYSIS

Effects of rapid urbanisation in Guwahati

Several factors contribute to Guwahati's severe air pollution. Rapid urbanization and increased construction activities generate substantial dust, adding to the particulate matter in the air. Additionally, the surge in vehicular traffic exacerbates the situation, with emissions from a growing number of vehicles contributing heavily to air pollution.

Guwahati has recently ascended to the rank of the second most contaminated city globally, as reported in the 2024 World Air Quality Report by IQAir. The metropolis registered an average yearly PM2.5 concentration of 105.4 micrograms per cubic meter, greatly exceeding the guidelines set by the World Health Organization (WHO)[18].

The challenge of urban expansion in India has reached a pivotal juncture. In the past five decades, the population of India has almost doubled which resulted in an increased pace of urbanisation, needless to mention, in an utterly unplanned way.

Multiple studies in the previous time have found that crises like soil erosion, and landslides in parts of Guwahati are because of mass-scale deforestation and the conversion of hills into residential areas. While Guwahati has seen significant growth in terms of employment in recent years, the plan to deal with the increasing population has not been efficient enough. With the rising job opportunities in Guwahati people especially the youth of the northeast have started migrating to Guwahati. This has resulted in increased housing settlements in environmentally sensitive areas. This has triggered a heightened demand for subterranean water among the residents of Guwahati, leading to a depletion of potable water in the city (Nath B et al., 2020).

The recent development in terms of private and government structures has taken a major area of peri-urban areas as a part of its built environment (Mahtta et al., 2019). Apart from that, Guwahati is consistently facing the issue of a higher growth rate of built-up area compared to the growth in population (Pawe and Saikia 2020). As a participant in India's smart cities initiative, Guwahati must address and mitigate these challenges to effectively manage the burgeoning urban expansion within the city.

Alterations in land cover serve as a crucial engine of worldwide environmental shifts and are therefore at the heart of discussions on sustainable advancement in both urban and pastoral landscapes. Geographically, Guwahati's location in a valley surrounded by hills leads to poor dispersion of pollutants, particularly during winter months when temperature inversions trap pollutants close to the ground. This natural disadvantage is compounded by other pollution sources such as open burning of waste, emissions from small and medium-scale industries, and spontaneous fires at waste dumping sites.

The city's pollution problem is also influenced by the proximity of waste disposal sites like the one near the Deepor Beel wetland, which not only emits toxic gases when waste ignites but also impacts the surrounding ecological systems (IndiaSpend).

Addressing these issues requires comprehensive urban planning and stricter pollution control measures to mitigate the rising levels of air pollution and protect public health.

Green Infrastructure Opportunities in Guwahati

Guwahati, the largest city in Assam and a key urban center in Northeast India, is actively pursuing several green infrastructure initiatives to enhance environmental sustainability and resilience. Here are some key opportunities and projects:

a. Green Public Transportation: Guwahati is set to become the first city in India with a 100% green public transportation system by 2025. This includes the deployment of 200 new electric buses, supplementing the existing fleet of CNG buses. These initiatives aim to significantly reduce carbon emissions and pollution levels in the city (I Am Renew).
b. Solar Energy Initiatives: The Assam government has plans to generate 3000 MW of solar power to cater to the energy needs of Guwahati and the surrounding areas. This venture forms a vital thread in the grand tapestry of efforts aimed at embracing renewable energy sources and curtailing dependence on fossil fuels.
c. Urban Green Spaces: The Master Plan for Guwahati 2025 emphasizes conserving natural environments such as hills, water bodies, and the Brahmaputra River. The plan includes the development of parks, green belts, and other recreational areas to enhance the city's green cover, which is indispensable for cushioning the repercussions of climate transformation (Guwahati Development Department).
d. Integrated Waste Management: Guwahati is improving its waste management system to ensure efficient collection, segregation, and disposal of solid waste. This includes plans for comprehensive recycling programs and the development of facilities to process different types of waste, contributing to a cleaner urban environment (Guwahati Development Department).
e. Flood Mitigation: Addressing flooding is a significant concern for Guwahati. The city has implemented the "Mission Flood Free Guwahati," which includes the development of better drainage systems and the restoration of natural water bodies to manage and mitigate flood risks (Guwahati Development Department).
f. Sustainable Urban Evolution: The Guwahati Savvy City Initiative is a facet of the Smart Cities Endeavor, which underscores sustainable urban progression through superior infrastructure, optimal energy deployment, and enriched life quality for inhabitants. Key aspects include smart traffic

management systems, enhanced public transportation, and green building practices (Guwahati Development Department).

CONCLUSION

Rapid urbanization in Guwahati has led to significant environmental challenges, including increased pollution levels and land-cover changes, emphasizing the need for sustainable development strategies. Green infrastructure solutions, such as the implementation of a 100% green public transportation system, offer promising opportunities to mitigate the adverse effects of urban expansion on the city's climate and environment. The study underscores the importance of balancing urban development with ecosystem preservation and decarbonisation efforts to achieve sustainable economic growth. Guwahati's designation as the second most polluted city globally highlights the urgency of addressing environmental issues through green initiatives and sustainable urban planning. By recognizing the value of nature and prioritizing conservation efforts alongside urban growth, cities like Guwahati can strive towards a harmonious future where both human development and environmental health can coexist sustainably.

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