ASSESSMENT AND ENHANCEMENT OF BLUE AND GREEN INFRASTRUCTURE IN AURANGABAD, MAHARASHTRA: A STUDY FOR SUSTAINABLE URBAN RESILIENCE

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ABSTRACT

Rapid urbanization in Aurangabad has resulted in the significant transformation of natural landscapes. With diminishing water bodies and declining green cover, the city faces challenges in managing stormwater, mitigating urban heat, and preserving biodiversity. This study employs remote sensing, GIS-based change detection, and literature synthesis to assess the current state of blue and green infrastructure (BGI) in Aurangabad. The paper proposes an integrated framework that combines traditional water management practices with modern urban design interventions to enhance urban resilience. Key outcomes include mapping the decline of natural spaces over the last decade, identifying priority areas for intervention, and recommending policy reforms for sustainable urban development.

1. INTRODUCTION

1.1 Background and Rationale

Aurangabad, a historic yet rapidly developing city in Maharashtra, is witnessing accelerated urban expansion. Such growth has often come at the expense of natural blue (water-centric) and green (vegetative) infrastructure. Declining green cover and diminishing water bodies have led to adverse effects such as reduced groundwater recharge, exacerbated urban heat island phenomena, and loss of urban biodiversity. In this context, a systematic study that assesses and enhances BGI is essential for sustainable urban planning.

1.2 Concept of Blue and Green Infrastructure

Blue infrastructure comprises natural and engineered water features (e.g., lakes, rivers, rainwater harvesting systems), whereas green infrastructure includes parks, urban forests, green roofs, and open spaces. Together, they contribute to climate regulation, ecological balance, and the overall quality of urban life. Recent research suggests that an integrated BGI approach can mitigate urban environmental challenges and improve resilience in cities like Aurangabad.

1.3 Objectives

The study aims to:

- Map and quantify the changes in blue and green infrastructure in Aurangabad over the last decade.
- Analyze the hydrological, environmental, and socio-economic impacts of diminishing natural spaces.
- Propose an integrated framework for BGI enhancement that combines modern design interventions with traditional water management practices.
- Provide policy recommendations and strategic guidelines for sustainable urban development.

2. LITERATURE REVIEW

2.1 Urban Change Detection Using GIS and Remote Sensing

Recent studies on Aurangabad have used GIS and remote sensing to quantify urban expansion and its impact on natural spaces. For example, the "Aurangabad City Blue and Green Infrastructure Change Identification Analysis" demonstrated a significant decrease in water bodies (approximately 18% over a decade) and highlighted the conversion of agricultural and open spaces to built-up areas.

2.2 Toolkit Approaches for Urban Resilience

Toolkits that integrate blue and green infrastructure elements are increasingly seen as effective means to enhance urban resilience. A toolkit described as "Blue Green Infrastructure: A Toolkit to Urban Resilience" provides strategies for mitigating urban heat, managing stormwater, and promoting biodiversity through green roofs, permeable pavements, and rain gardens.

2.3 Hybrid Approaches in the Maharashtra Context

A feasibility study titled "Hybrid Blue-Green Infrastructure: Feasibility Study for the State of Maharashtra; India" illustrates how traditional water conservation methods can be effectively integrated with modern BGI interventions. This hybrid approach is particularly relevant in regions with challenging geological conditions, such as those found in Aurangabad.

3. METHODOLOGY

3.1 Study Area and Data Collection

- **Study Area:** The urban and peri-urban zones of Aurangabad, Maharashtra.

- **Data Sources:**

o **Remote Sensing:** Satellite imagery (Landsat, Sentinel) and historical topographic maps.

o **GIS Analysis:** Digital mapping and change detection using ArcGIS 10.3.

o **Field Surveys:** On-site verification at key locations (e.g., Salim Ali Lake, Himayat Bagh, Tembhapuri Dam).

3.2 Data Analysis

- **Spatial Mapping:**

o Generation of thematic maps to delineate blue and green spaces.

o Quantitative analysis of land use changes over the past 10–15 years.

- **Hydrological Modeling:**

o Assessment of groundwater recharge potential and stormwater management efficacy.

- **Integrated Evaluation:**

o Combining spatial, hydrological, and socio-economic data to identify priority intervention areas.

3.3 Framework Development

Based on the analysis, the study develops an integrated framework that includes:

- **Retrofitting Interventions:** Restoration of degraded water bodies and establishment of green corridors.

- **Design Innovations:** Implementation of green roofs, permeable pavements, and rain gardens.

- **Policy Recommendations:** Urban zoning reforms and incentive programs to promote BGI.

- **Community Engagement:** Strategies for involving local stakeholders in BGI maintenance and planning.

4. RESULTS AND FINDINGS

4.1 Land Use and BGI Mapping

Preliminary GIS-based analyses indicate:

- A significant reduction in water bodies and green spaces, with built-up areas increasing notably over the past decade.

- Critical zones where natural resources have been severely impacted, including key urban nodes such as Salim Ali Lake and Himayat Bagh.

4.2 Hydrological and Environmental Impacts

- **Hydrological Impact:**

o Reduced natural infiltration areas have compromised groundwater recharge, increasing the risk of urban flooding.

- **Environmental Impact:**

o Loss of green cover has contributed to increased urban heat island effects and reduced biodiversity.

4.3 Socio-Economic Insights

Stakeholder interviews reveal:

- A strong need for integrating traditional water conservation practices with modern engineering solutions.

- Support among local authorities and communities for policy measures that protect and rehabilitate natural spaces.

5. DISCUSSION

5.1 Challenges Identified

- **Rapid Urban Expansion:**

o Uncontrolled development has led to the conversion of natural spaces into residential and commercial zones.

- **Policy Gaps:**

o Existing urban planning frameworks do not adequately protect blue and green infrastructure.

- **Technical Limitations:**
o Incomplete data on groundwater recharge and urban hydrology impedes accurate modeling.

5.2 Proposed Integrated Framework

The study recommends a multi-pronged strategy:

1. **Restoration Initiatives:**
o Revitalize key natural assets by reintroducing native vegetation and restoring historical water bodies.

2. **Smart Urban Design:**
o Incorporate green elements in new developments, including green roofs and bio-retention systems.

3. **Policy and Governance:**
o Formulate urban policies that incentivize BGI preservation, integrating GIS monitoring for enforcement.

4. **Community Participation:**
o Engage local communities in the planning and maintenance of green spaces through participatory design workshops.

6. CONCLUSION

The project underscores the urgent need to enhance blue and green infrastructure in Aurangabad to counteract the negative impacts of rapid urbanization. By employing a combination of remote sensing, GIS analysis, and field surveys, the study quantifies the loss of natural resources and proposes an integrated framework for BGI enhancement. The recommended strategies are expected to improve stormwater management, enhance urban biodiversity, and contribute to sustainable urban resilience. Further research and pilot projects are suggested to validate and refine these interventions.

7. REFERENCES

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