

Integration of Water and Green Infrastructure in Urban Lake Landscape Design

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Abstract

Urban lakes are important for maintaining environmental balance and providing public spaces. However, many lakes in cities are polluted and neglected. This paper explains how water and green infrastructure can be used together to improve lake environments. It focuses on Hari Nagar Lake and suggests simple, natural, and sustainable solutions like wetlands, green buffers, and public spaces. The goal is to improve water quality, increase greenery, and make the lake usable for people again.

Keywords: Urban lakes; Green infrastructure; Water-sensitive design; Constructed wetlands; Urban ecology; Hari Nagar Lake

1. Introduction

Lakes have always played an important role in cities. They act as water storage systems, help recharge groundwater, reduce temperature, and support biodiversity. In addition, they provide open spaces where people can relax and connect with nature.

In modern cities, however, lakes are under stress due to pollution, sewage discharge, encroachment, and lack of proper planning. Many lakes have lost their natural character and are no longer usable.

Hari Nagar Lake is one such urban lake located in West Delhi. It is surrounded by residential areas and has high potential to become a community space. But currently, the lake is polluted and poorly maintained.

This research focuses on improving the lake using water-sensitive design and green infrastructure, which are sustainable and nature-based approaches.

Aim

The main aim of this study is to revitalize Hari Nagar Lake using water and green infrastructure to create a clean, sustainable, and people-friendly environment.

Objectives

- To improve water quality using natural treatment methods
- To develop green areas around the lake for ecological balance
- To create safe and attractive public spaces
- To increase biodiversity by introducing native plants

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Limitations

- Limited availability of accurate site data
- Dependence on government approval for implementation
- Maintenance challenges after development
- Possible resistance from nearby residents
- Continuous pollution from surrounding areas if not controlled

2. Understanding Water Infrastructure

Water infrastructure includes systems that manage water flow, treatment, and storage. In lake design, it helps in controlling pollution and maintaining water levels.

At Hari Nagar Lake, untreated sewage is a major issue. This can be improved using simple systems like:

- Constructed wetlands
- Sedimentation tanks
- Rainwater harvesting

These systems are cost-effective and environmentally friendly.

3. Green Infrastructure

Green infrastructure involves the use of plants and natural systems to improve environmental quality.

3.1. Key Elements

- Trees and plants around the lake
- Grass areas to absorb water
- Natural habitats for birds and animals

Green infrastructure helps in reducing pollution, improving air quality, and making the area visually attractive.

3.2. Study Area: Hari Nagar Lake



Figure 1 Location map of Hari Nagar Lake, West Delhi



Figure 2 Existing site conditions



Figure 3 Surrounding Area

Hari Nagar Lake is located in West Delhi near Tihar Jail. It is surrounded by dense residential areas.

3.3. Current Issues

- Polluted water due to sewage
- Garbage dumping
- Poor edge design
- Lack of public spaces
- Limited greenery

Despite these issues, the lake has strong potential for redevelopment.

4. Design Strategies

4.1. Natural Wastewater Treatment

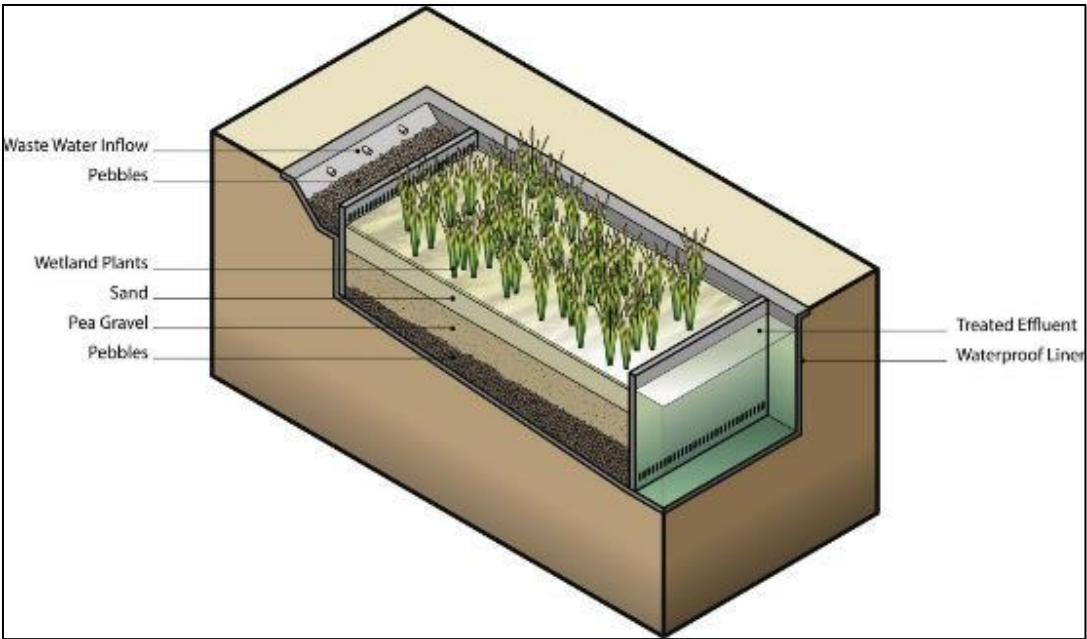


Figure 5 Diagram of constructed wetland system

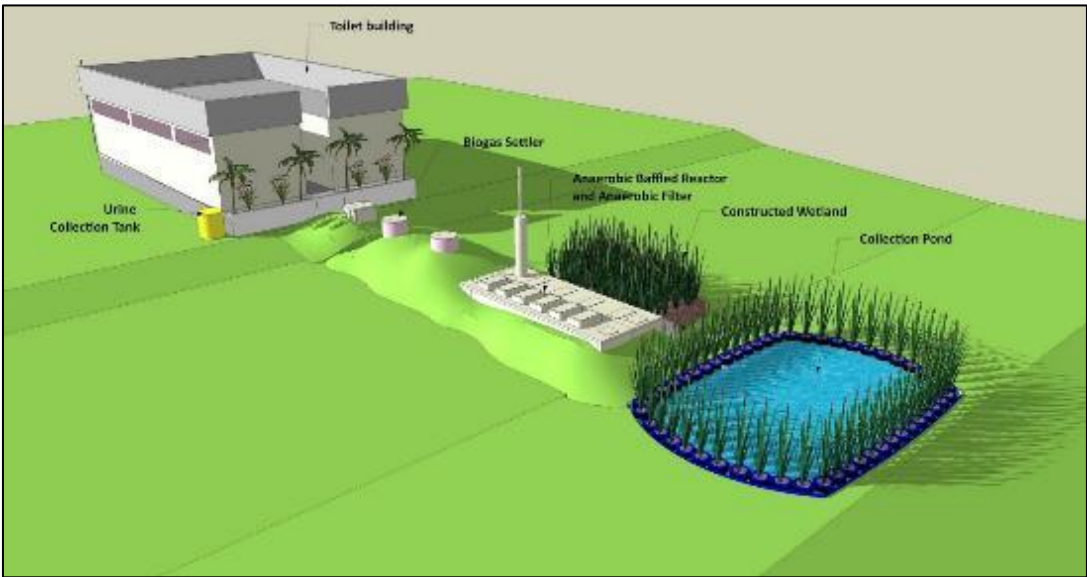


Figure 6 Wastewater treatment process using vegetation



Figure 7 Proposed natural edge with vegetation

Constructed wetlands can clean wastewater naturally.

- Water passes through plants
- Plants absorb harmful substances
- Clean water enters the lake

4.2. Lake Edge Improvement

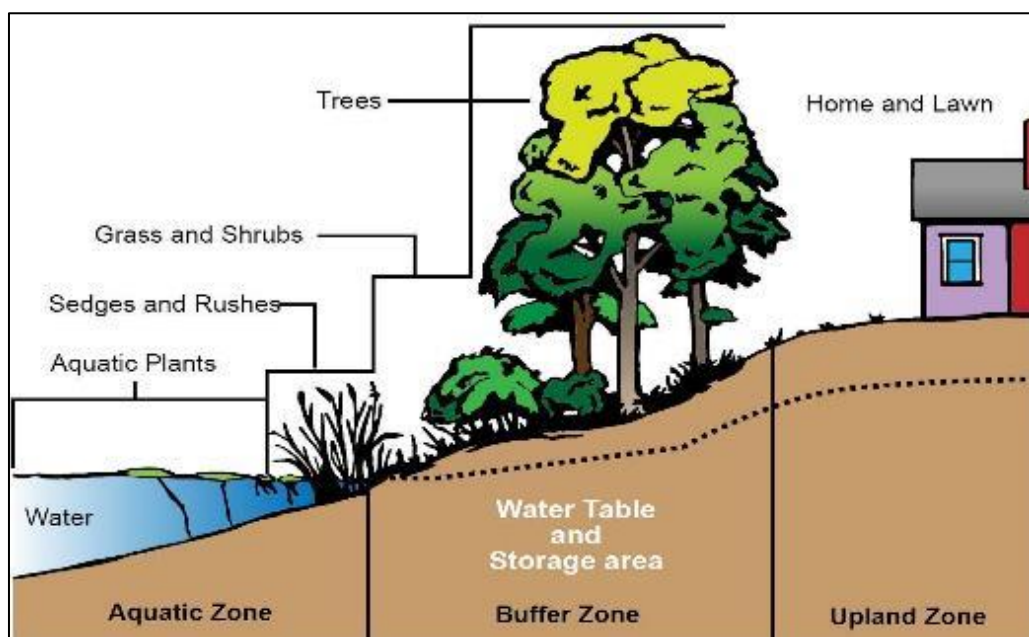


Figure 8 Section showing buffer zone design



Figure 9 Proposed pedestrian pathway along lake edge



Figure10 Seating and recreational space design

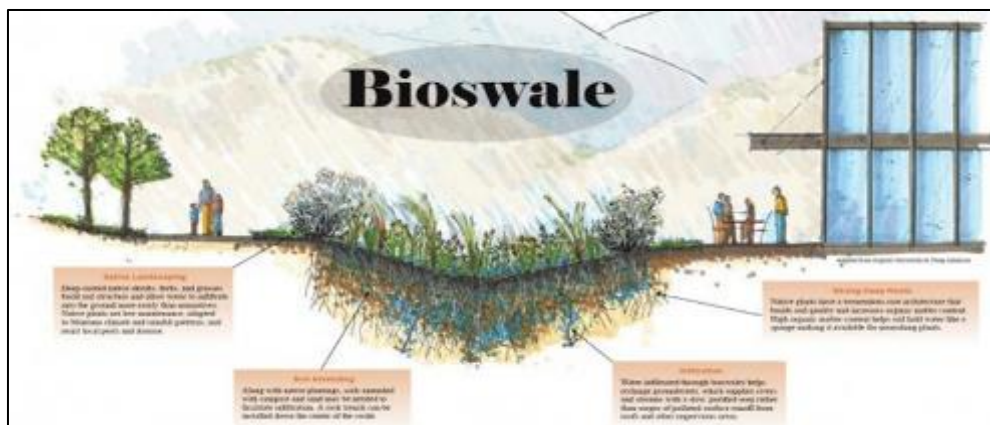


Figure 11 Bioswale

- Replace concrete edges with natural slopes
- Use native plants and grasses
- Create buffer zones to filter pollutants

4.3. Stormwater Management

- Bioswales to absorb rainwater
- Permeable surfaces
- Rain gardens

These help in reducing water pollution and improving groundwater recharge.

Public Space Development



Figure 11 Seating and recreational space design



Figure 12 Integrated blue-green infrastructure strategy

- Walking and jogging tracks
- Seating areas
- Shaded spaces
- Lighting for safety
-

4.4. Blue-Green Integration



Figure 13 Permeable pathway within urban green landscape

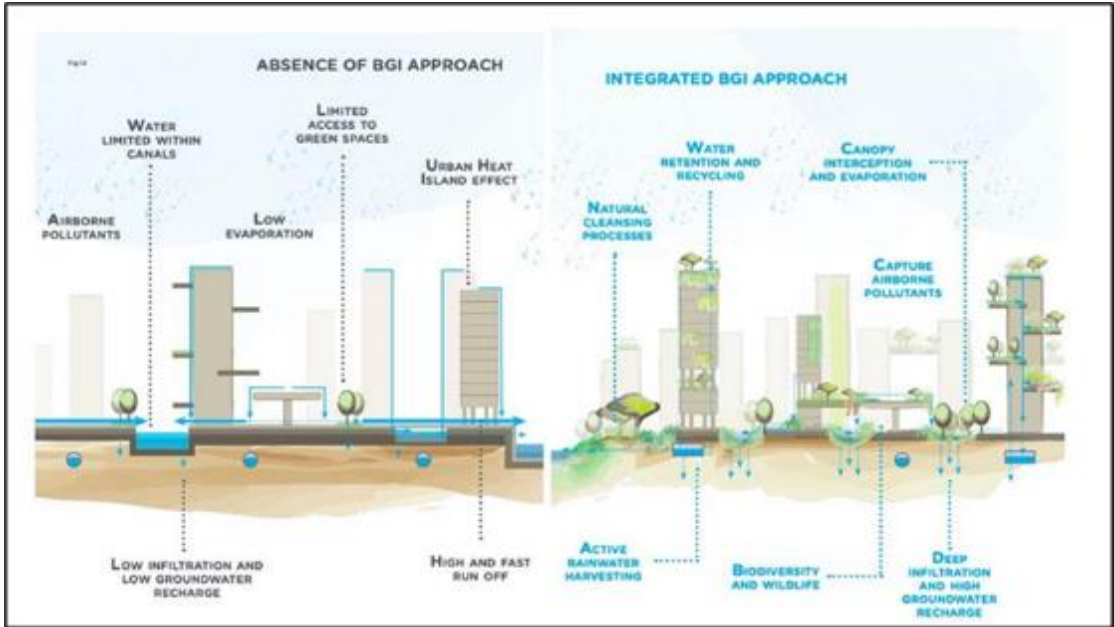


Figure14 Comparison of conventional and integrated blue-green infrastructure approach

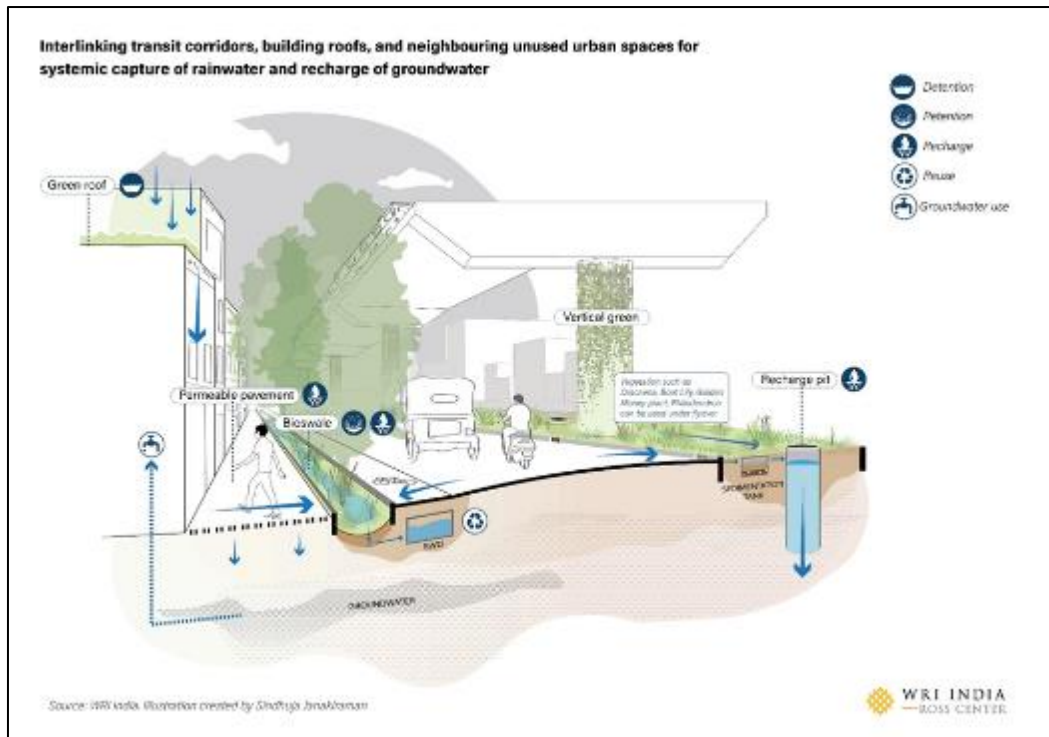


Figure 15 Integrated urban rainwater management system with green infrastructure



Figure 16 Bioswale for natural stormwater management



Figure 17 Wetland ecosystem functions and benefits

- Combine water systems with greenery
- Create ecological corridors
- Develop a self-sustaining system

5. Benefits of the Design

5.1. Environmental

- Clean water
- Better biodiversity
- Improved climate

5.2. Social

- Better public spaces
- Health benefits
- Community engagement

5.3. Economic

- Increased land value
- Low maintenance cost
- Tourism opportunities

5.4. Challenges

- Encroachment around the lake
- Lack of awareness
- Maintenance issues
- Continuous pollution

Proper management and community participation are important to solve these problems.

6. Conclusion

The improvement of Hari Nagar Lake through water and green infrastructure is a sustainable and practical solution. Instead of using heavy construction, natural systems like wetlands, plants, and green spaces can effectively solve environmental problems.

This approach not only restores the ecological balance of the lake but also creates a lively and usable public space. It can serve as a model for restoring other urban lakes in Delhi and across India.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

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