Published by :
http://www.ijert.org
International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

Creating A Sustainable Urban Oasis Integrating Water Management, Green Spaces, and Built Environments for Climate Resilience

Ar. Kalpana

Abstract. **Climate change poses significant challenges for urban planning and architecture, requiring innovative approaches to enhance resilience and sustainability in urban environments. This research explores the integration of climate-responsive strategies into urban planning, focusing on designing cities and urban spaces that can incorporate water management techniques.**
Urban development often faces challenges like fragmented urban blocks, lack of climate-responsive design, and increasing wastewater generation. Additionally, the conversion of fertile agricultural land for residential purposes raises concerns about resource exploitation. This design research proposes a novel approach integrating wastewater reuse with urban housing blocks to promote self-sustainable and environmentally conscious communities.
The conversion of agricultural land for urban expansion, while addressing housing needs, can have detrimental effects on soil fertility and food security. This scenario necessitates innovative solutions that address both urban development and environmental sustainability.
This proposal aims to create self-sustainable communities through the integration of wastewater reuse with urban housing blocks. Treated wastewater can be reused for non-potable purposes like irrigation, toilet flushing, and laundry, significantly reducing reliance on freshwater resources and promoting water conservation. Additionally, by integrating climate-responsive design elements like green roofs and rain gardens, this approach can mitigate the urban heat island effect, promote rainwater harvesting, and improve air quality.
The design strategy aims to create a unique amenity for residents by incorporating a constructed wetland park utilizing treated wastewater. The constructed wetland park would not only serve as a natural filtration system for the reused water, but also provide a recreational space for residents, developing a connection with nature and promoting community well-being. Moreover, by potentially reducing dependence on large, centralized wastewater treatment facilities, this strategy can optimize land use within urban blocks, freeing up valuable land for other purposes.
This approach enables the creation of sustainable communities, reduces environmental impact, and promotes efficient land use, paving the way for a more harmonious relationship between urban development and the environment.

Keywords: **Climate resilience, wastewater, constructed wetland, urban blocks, integrated water management**

1 INTRODUCTION

Climate change poses significant challenges for urban planning and architecture, requiring innovative approaches to enhance resilience and sustainability in urban environments. This research explores the integration of climate-responsive strategies into urban planning, focusing on designing cities and urban spaces that can incorporate water management techniques.
Urban development often faces challenges like fragmented urban blocks, lack of climate-responsive design, and increasing wastewater generation. Additionally, the conversion of fertile agricultural land for residential purposes raises concerns about resource exploitation. This design research proposes a novel approach integrating wastewater reuse with urban housing blocks to promote self-sustainable and environmentally conscious communities.
The conversion of agricultural land for urban expansion, while addressing housing needs, can have detrimental effects on soil fertility and food security. This scenario necessitates innovative solutions that address both urban development and environmental sustainability.
This proposal aims to create self-sustainable communities through the integration of wastewater reuse with urban housing blocks. Treated wastewater can be reused for non-potable purposes like irrigation, toilet flushing, and laundry, significantly reducing reliance on freshwater resources and promoting water conservation. Additionally, by integrating climate-responsive design elements like green roofs and rain gardens, this approach can mitigate the urban heat island effect, promote rainwater harvesting, and improve air quality.
The design strategy aims to create a unique amenity for residents by incorporating a constructed wetland park utilizing the treated wastewater. The constructed wetland park would not only serve as a natural filtration system for the reused water, but also provide a recreational space for residents, developing a connection with nature and promoting community well-being. Moreover, by potentially reducing dependence on large, centralized wastewater treatment facilities, this strategy can optimize land use within urban blocks, freeing up valuable land for other purposes.

This approach enables the creation of sustainable communities, reduces environmental impact, and promotes efficient land use, paving the way for a more harmonious relationship between ur-ban development and the environment.

1.1 Problem Statement

Jodhpur's peri-urban areas are experiencing water scarcity, and current centralized wastewater treatment plants are proving difficult to maintain effectively. This situation necessitates exploring alternative, sustainable solutions for wastewater management and water conservation.

1.2 Scope of the Study

This study focuses on developing a decentralized wastewater treatment approach for Jodhpur's peri-urban areas. It will explore two key aspects:

1.2.1 Greywater Segregation in New Buildings**:** The study will investigate the feasibility and design principles for implementing greywater segregation systems in newly constructed buildings. This includes identifying greywater sources (showers, sinks, washing machines) and designing a system for its collection and reuse for irrigation, gardening, and other non-potable uses.

1.2.2 Constructed Wetland Parks**:** The study will assess the suitability and design of constructed wetland parks for treating household wastewater in peri-urban areas. This involves researching the types of constructed wetlands suitable for the local climate and wastewater composition, determining the optimal size and capacity for these parks, and evaluating their effectiveness in purifying wastewater for potential reuse in park maintenance and potentially some household activities.

1.3 Relevance of the Study

1.3.1 Addressing Water Scarcity

By promoting water conservation through greywater use and wastewater reuse, the study directly addresses the water scarcity challenges faced by Jodhpur's peri-urban areas.

1.3.2 Sustainable Wastewater Management

The proposed decentralized approach using constructed wetlands offers a more sustainable solution compared to centralized plants. It requires less maintenance, reduces reliance on technical expertise, and minimizes pressure on existing infrastructure.

1.3.3 Environmental Benefits

Constructed wetland parks can function as green spaces, providing additional environmental benefits like improved air quality and habitat creation for local wildlife.

1.3.4 Cost-Effectiveness

The study will evaluate the cost-effectiveness of the proposed system compared to maintaining centralized treatment plants.

1.4 Research Questions

1.4.1 Greywater Segregation

- What are the most effective and cost-feasible methods for segregating greywater in newly constructed buildings in Jodhpur's peri-urban areas?
- What is the estimated volume of greywater that could be potentially reused for irrigation and other non-potable purposes?
- What are the potential challenges and limitations associated with greywater reuse in the local context?

1.4.2 Constructed Wetland Parks

- Which types of constructed wetland systems are most suitable for treating household wastewater in Jodhpur's peri-urban areas, considering factors like climate, wastewater composition, and maintenance requirements?
- What is the optimal design and size for constructed wetland parks to effectively treat wastewater for the intended reuse volume?
- What is the level of water purification achievable through the constructed wetland systems, and is the treated water suitable for specific reuse applications in parks and potentially even some household activities?

- 1.4.4 Integration and Sustainability:
- How can greywater segregation and constructed wetland systems be effectively integrated into existing and future infrastructure development in Jodhpur's peri-urban areas?
- What long-term monitoring and maintenance strategies are necessary to ensure the sustainability and effectiveness of the proposed decentralized water management approach?

1.4.3 Economic and Social Considerations:

- What are the initial and ongoing costs associated with implementing greywater segregation and constructed wetland systems compared to maintaining centralized wastewater treatment plants?
- What is the public perception and potential social acceptance of using treated wastewater from constructed wetlands for park maintenance and potentially some household activities?

1.5 Limitations of the Study

This study will address several aspects of decentralized wastewater management in Jodhpur's peri-urban areas, but there are some limitations to consider:

1.5.1 Focus on New Buildings

The study primarily focuses on greywater segregation in newly constructed buildings. Adapting existing buildings for greywater systems might require further investigation and may not be as readily achievable.

1.5.2 Pilot Scale Implementation
The initial implementation of constructed wetland parks may be on a pilot scale to assess effectiveness and refine the design before large-scale deployment.

1.5.3 Long-Term Performance Monitoring
While the study will assess the suitability of constructed wetland systems, long-term monitoring of their performance in treating wastewater and the quality of the treated water is crucial.

1.6 Expected Outcomes
Reduced Water Scarcity: Significant reduction in freshwater de-mand through greywater reuse.
Enhanced Green Spaces: Creation of green spaces that improve the urban environment and biodiversity.

1.5.4 Social Acceptance
Public perception and acceptance of using treated wastewater for park maintenance and potentially some household activities might require social awareness campaigns and further research.

1.5.5 Regulatory Framework
The study should acknowledge the existing regulatory framework for water reuse in the region and identify any potential gaps or need for adjustments to accommodate the proposed approach.

1.5.6 Cost-Benefit Analysis
The economic evaluation will consider initial and ongoing costs, but a comprehensive cost-benefit analysis should also factor in the long-term environmental benefits and potential water savings from reduced reliance on freshwater sources.
Cost Savings: Lower maintenance and operational costs compared to centralized systems.
Increased Resilience: Improved climate resilience through sustainable water management practices.

2 LITERATURE REVIEW

- Review existing literature on water scarcity and water conservation strategies in peri-urban areas.
- Discuss the concept of greywater reuse and its potential applications.
- Analyze the design, operation, and effectiveness of constructed wetland systems for wastewater treatment.
- Explore case studies of successful implementation of decentralized wastewater management in other regions with similar climatic conditions.

2.1 Scarcity of Water in Arid and semi-arid regions

Water scarcity in arid and semi-arid regions is a critical issue due to the inherent lack of moisture in these areas. Aridity is defined by the average climatic conditions, and these regions face significant challenges in water resource management. Urbanization exacerbates the problem as growing populations demand more water for various needs, including energy, raw materials, waste removal, and transportation. Many urban areas, particularly in developing countries, suffer from severe water shortages, and this situation is expected to worsen unless substantial measures are taken.
By 2025, many regions are projected to experience significant water scarcity. The Middle East and North Africa (MENA) is the driest and most water-scarce region, home to 6.3% of the world's population but only 1.4% of its renewable freshwater. Water scarcity in these regions is both a physical and economic issue, driven by factors such as aged infrastructure, lack of sewerage and wastewater treatment, poor solid waste management, and inadequate institutional frameworks.
Addressing water scarcity requires integrated planning, including the development of water demand management strategies, improved wastewater treatment and reuse, infrastructure renovation, and the promotion of water conservation practices. These steps are essential for sustainable water resource management in arid and semi-arid urban areas

2.2 Waste Water Issues in India and the World

Wastewater management in India is a complex and critical issue, with various challenges and developments in recent years. India produces an estimated 62,000 million liters of sewage daily, but the treatment capacity is only around 37% of this amount, leading to significant environmental and public health concerns. Urban areas are particularly affected, with inadequate sewage infrastructure resulting in untreated wastewater being discharged into rivers, lakes, and the sea.
Major cities like Delhi, Mumbai, and Bangalore face severe issues with sewage management due to rapid urbanization and population growth. Although the government has initiated various projects to improve wastewater treatment infrastructure, the progress is often slow. Key programs include the Namami Gange mission, which aims to clean the Ganges River by enhancing the treatment capacity and promoting community involvement in maintaining water quality.
Innovations such as decentralized wastewater treatment systems (DEWATS) (Mays, 2009)and the promotion of treated wastewater reuse for industrial and agricultural purposes are gaining traction. The implementation of these technologies can alleviate pressure on centralized treatment plants and reduce freshwater consumption.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

Despite the efforts, challenges like insufficient funding, lack of technical expertise, and public awareness hinder effective wastewater management. Addressing these issues requires a multi-faceted approach, including policy reforms, increased investment in infrastructure, and community participation in maintaining and monitoring wastewater systems.

2.3 Greywater reuse

Greywater use in arid and semi-arid regions is a vital aspect of integrated urban water management. Greywater, which is wastewater generated from household activities such as laundry, dishwashing, and bathing, can be treated and reused to address water scarcity issues. This practice offers a sustainable solution by reducing the demand on freshwater resources and alleviating pressure on wastewater treatment facilities.

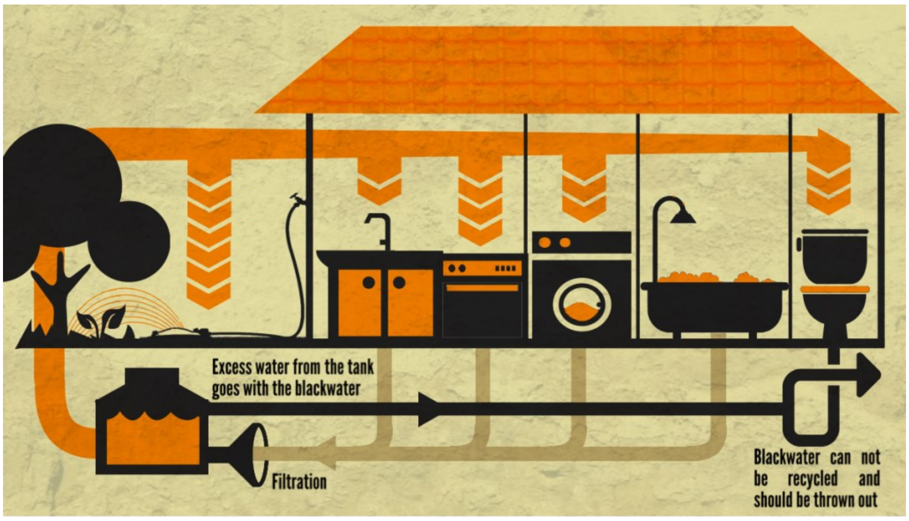


Figure 1: Greywater segregation

Reusing greywater for non-potable purposes, such as irrigation and toilet flushing, can significantly reduce the overall water consumption in urban areas. The treatment of greywater typically involves basic filtration and disinfection processes, making it suitable for reuse in landscape irrigation, where it can provide essential nutrients to plants, thus reducing the need for chemical fertilizers.

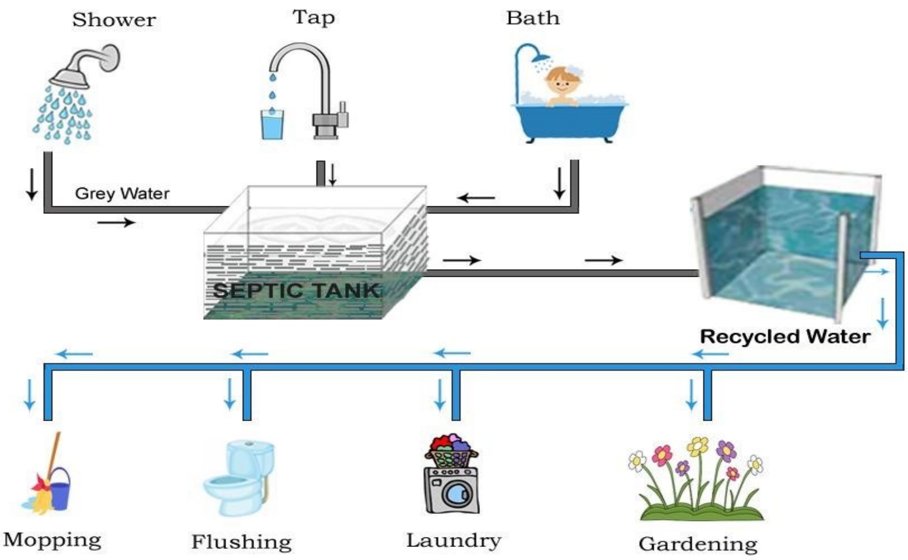


Figure 2: Greywater Recycling

Moreover, greywater reuse helps mitigate the environmental impact by decreasing the volume of wastewater discharged into the environment. This reduction in wastewater discharge can prevent pollution of natural water bodies and reduce the burden on existing sewage systems.

In regions with limited water availability, implementing greywater recycling systems can enhance water security and support sustainable urban development. By integrating greywater reuse into urban planning, cities can promote water conservation, reduce costs associated with water supply and wastewater treatment, and contribute to a more resilient and sustainable urban water management system.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

2.4 Decentralized Wastewater Treatment for Reuse

Decentralized wastewater treatment for reuse is a crucial component of integrated urban water management, especially in arid and semi-arid regions. This approach involves treating wastewater locally, at or near the point of generation, rather than relying on large, centralized treatment plants.

Decentralized systems offer several benefits, particularly in water-scarce areas. They reduce the need for extensive infrastructure to transport wastewater over long distances, which can be costly and resource-intensive. By treating water close to its source, these systems also minimize the risk of contamination during transport and allow for the immediate reuse of treated water. This is particularly valuable in regions where water scarcity is a significant concern.

The treated water from decentralized systems can be reused for various non-potable purposes, including agricultural irrigation, industrial processes, landscape irrigation, and toilet flushing. This not only conserves freshwater resources but also reduces the burden on existing water supply systems.

Implementing decentralized wastewater treatment systems requires careful planning and design to ensure they meet health and safety standards. Technologies such as membrane bioreactors, constructed wetlands, and aerobic treatment units are commonly used in these systems to achieve high levels of treatment efficiency.

Overall, decentralized wastewater treatment for reuse is a sustainable and efficient solution that supports water conservation, reduces environmental impact, and enhances resilience in water management practices (RK.GOYAL).

2.5 Constructed Wetlands

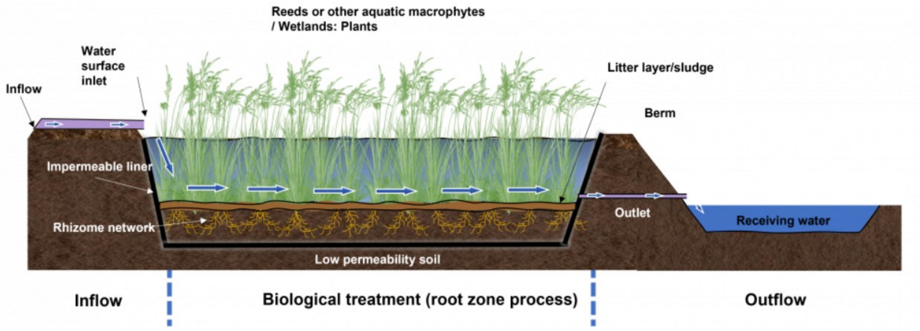


Figure 3: Labelled schematic of a constructed "Free-water surface flow wetland"

Constructed Wetlands: engineering systems for wastewater treatment that mimic natural habitats. Wetlands are used as sites to absorb sewage because of their ability to tolerate high organic loads.

Advantages: Inexpensive treatment, simple operation and maintenance, high treatment effectiveness.

2.5.1 Types of Constructed Wetlands

In general, there are three types of constructed wetlands:

- Surface Flow Constructed Wetlands
- Horizontal Subsurface Flow Constructed Wetlands
- Vertical Flow Constructed Wetlands

Surface Flow Constructed Wetlands

Figure 4: Surface flow constructed wetland

Surface flow constructed wetlands resemble natural swamps, where plants are rooted in a submerged layer of sand or gravel. The unique property of helophyte plants allows them to act as oxygen pumps, delivering dissolved oxygen through their roots to a variety of microorganisms.

These wetlands are typically used when flow rates are highly unpredictable, such as runoff from roads, and when anaerobic pretreatment in a septic tank or biodigester is not required, to avoid odor issues. The design of surface flow constructed wetlands depends on spatial limitations, ambient temperatures, matrix characteristics, and organic and hydraulic load.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

pre-treatment in a septic tank or biodigester is not required, to avoid odor issues. The design of surface flow constructed wetlands depends on spatial limitations, ambient temperatures, matrix characteristics, and organic and hydraulic load.

Horizontal Subsurface Flow Constructed Wetlands

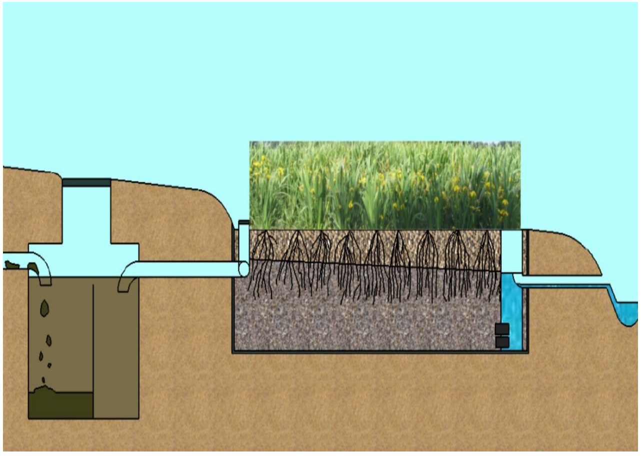


Figure 5: Subsurface flow constructed wetland

Horizontal subsurface flow constructed wetlands are most commonly used for aerobic post-treatment of domestic wastewater and can handle a higher hydraulic load than surface flow constructed wetlands. Anaerobic pre-treatment in a septic tank or biodigester is necessary to dissolve solid organic matter. A thick layer of gravel above the aquifer retains a layer of stagnant air, preventing odor issues.

Aeration occurs as in surface flow constructed wetlands, but in this system, wastewater is forced to pass through the matrix, ensuring intensive contact with bacteria in the rhizosphere (the root zone of the plants). This design ensures that all wastewater is thoroughly treated with no short-circuit flow possible. When accurately designed, horizontal subsurface flow constructed wetlands offer a reliable and low-cost aerobic post-treatment solution suitable for use worldwide.

Vertical Flow Constructed Wetlands

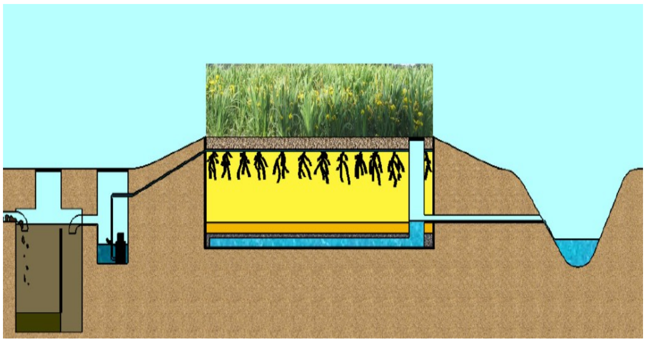


Figure 6: Vertical flow constructed wetland

The development of vertical flow constructed wetlands aimed to further reduce the size of constructed wetlands. Anaerobically pre-treated wastewater from a septic tank or biodigester is intermittently pumped onto the top of the constructed wetland. As the wastewater trickles down, it effectively draws air into the wetland whenever the pump stops, enhancing aeration in the rhizosphere.

This process increases the aeration capacity up to approximately twenty times compared to horizontal subsurface flow constructed wetlands. Additionally, no short-circuit flows occur, and nitrate is removed under anoxic conditions due to lower oxygen levels deeper in the matrix. The design parameters, such as the level of the aquifer and the depth of the matrix, can be adjusted accordingly.

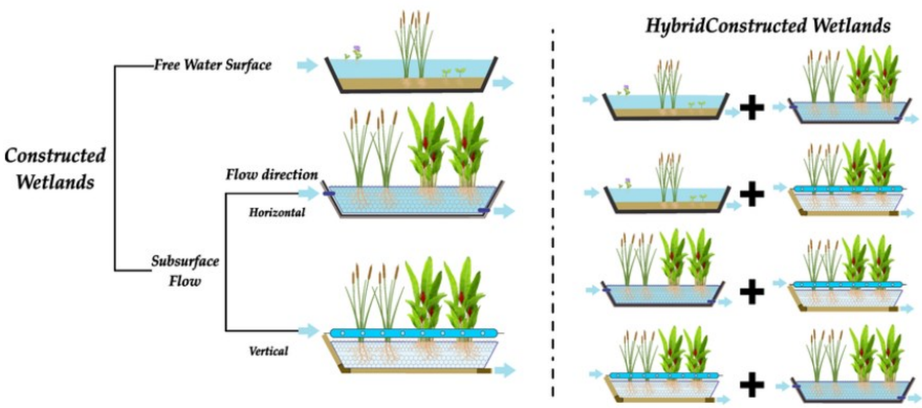


Figure 7: Scheme of constructed wetland types

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

2.6 Constructed Wetland Parks

Constructed wetland parks are innovative ecological solutions that combine wastewater treatment with recreational spaces, enhancing both environmental sustainability and community well-being. These parks utilize natural processes involving wetland vegetation, soils, and associated microbial life to treat wastewater. By mimicking natural wetlands, they efficiently remove pollutants from the water through physical, chemical, and biological processes.

The design of constructed wetland parks integrates aesthetics and functionality. They often feature a variety of plant species that not only contribute to the purification process but also create a habitat for wildlife, promoting biodiversity. Walking trails, educational signage, and recreational areas are commonly included, providing a space for community engagement and environmental education.

One of the significant advantages of constructed wetland parks is their ability to handle varying wastewater loads while maintaining their effectiveness. They are particularly beneficial in urban areas where they can mitigate the heat island effect, manage storm water runoff, and enhance the overall landscape. Additionally, these parks offer a cost-effective and low-maintenance alternative to conventional wastewater treatment plants.

Constructed wetland parks represent a harmonious blend of infrastructure and nature, offering a sustainable solution to water management while creating green spaces for communities to enjoy and learn from. They exemplify how environmental engineering can be both functional and beautiful, contributing to a healthier planet.

2.7 Integrated Water Management

- Discuss the principles of integrated water management (IWM) and its importance for sustainable water use in urban and peri-urban contexts.
- Analyze how decentralized wastewater treatment with constructed wetlands can contribute to a holistic approach to water management.

2.8 Waste water reuse in Peri urban areas

The reuse of wastewater in peri-urban areas offers a sustainable solution to water scarcity and environmental challenges. In these regions, treated wastewater is increasingly utilized for irrigation, particularly in agriculture. This practice helps to conserve freshwater resources and mitigates the over-extraction of groundwater. According to the strategy paper, peri-urban agriculture benefits from the proximity to urban wastewater treatment plants, reducing the costs and losses associated with long-distance water transportation.

Urban and peri-urban agriculture (UPA) plays a crucial role in food security, utilizing local resources for food production and other outputs. Reusing treated wastewater in UPA can significantly enhance the resilience of food supply systems in cities, especially as urban populations grow and climate change impacts water availability. Treated wastewater, when applied to irrigation, can be coupled with efficient methods like drip irrigation, which further optimizes water use and enhances crop yields.

Moreover, the economic feasibility of wastewater reuse is heightened in peri-urban settings due to the availability of infrastructure and the immediate demand for irrigation water. Policies and frameworks promoting the safe reuse of treated wastewater are essential for maximizing these benefits, ensuring environmental protection, and supporting sustainable agricultural practices.

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

3 METHODOLOGY

3.1 Quantitative Methods of Research

This study will utilize quantitative methods to gather and analyze data related to the technical and economic aspects of the proposed decentralized wastewater management system. Here are some specific examples:

Surveys: Surveys conducted among residents in peri-urban areas to gauge their water usage habits, assess their potential interest in greywater reuse, and understand their perceptions of using treated wastewater from constructed wetlands.

Water Flow Measurements: Measuring the volume of greywater generated from different sources in newly constructed buildings can help estimate the potential for reuse. Additionally, monitoring influent and effluent water flow rates in constructed wetland parks will be crucial to assess their treatment capacity and efficiency.

Water wastage/ person: 45 liters/ day
(As per National Sustainable Habitat Standards for the Urban Water Supply and Sewerage sector)
Greywater: Household waste water that excludes the flow originating from toilet flushing.
Reuse of greywater allows water to be used twice and in some cases water can be recovered for a third use.
Greywater: 75% of waste water
Grey water/ person: 34 liters/ day
1 family: 170 liters/ day
Total households in Jodhpur: 6.62 lacs
Total wastage/day in Jodhpur :11 crore liters
Total wastage / month/ household in Jodhpur: 5100 liters

Water Quality Analysis**:** Quantitative water quality testing of both greywater and wastewater treated by constructed wetlands is essential. This will involve analyzing parameters like turbidity, pH, coliform bacteria levels, and other relevant contaminants to ensure the treated water meets specific reuse standards for irrigation, park maintenance, or other intended applications.

Cost Analysis**:** A quantitative cost analysis will compare the initial investment and ongoing maintenance costs associated with implementing greywater segregation and constructed wetland systems against the current expenses of maintaining centralized wastewater treatment plants.

3.2 Qualitative Methods of Research

Qualitative methods will be employed to gain a deeper understanding of the social and behavioral aspects of water use and reuse in Jodhpur's peri-urban areas.

Focus Groups: Conducting focus groups with residents provide valuable insights into their attitudes and concerns regarding water conservation, greywater reuse, and the potential use of treated wastewater from constructed wetlands.

Interviews: Interviews with key stakeholders, such as water management officials, engineers involved in constructing wetland systems, and landscape maintenance personnel, provide valuable information on the feasibility, challenges, and potential integration of the proposed approach within existing infrastructure and practices.

Document Analysis: Reviewing existing policies, regulations, and guidelines related to water reuse in the region can help identify potential gaps or areas for modification to accommodate the proposed decentralized system.

By combining quantitative and qualitative research methods, this study will gain a comprehensive understanding of the technical, economic, and social aspects of implementing a decentralized wastewater management approach in Jodhpur's peri-urban areas
.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

4 SITE INTRODUCTION AND DESIGN PROPOSAL

4.1 Design Exploration and Iteration

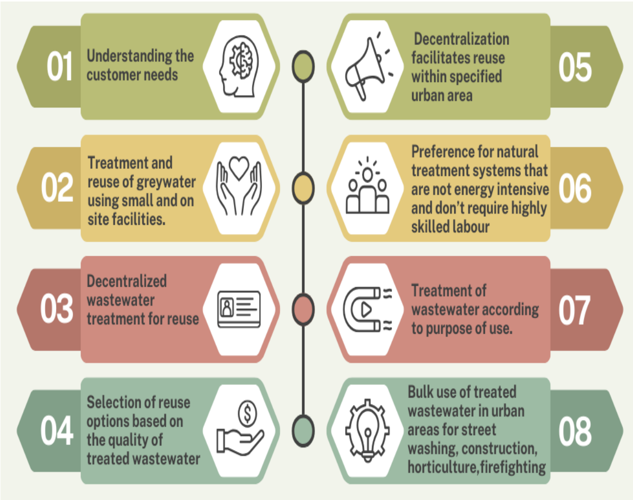


Figure 8: Design Approaches

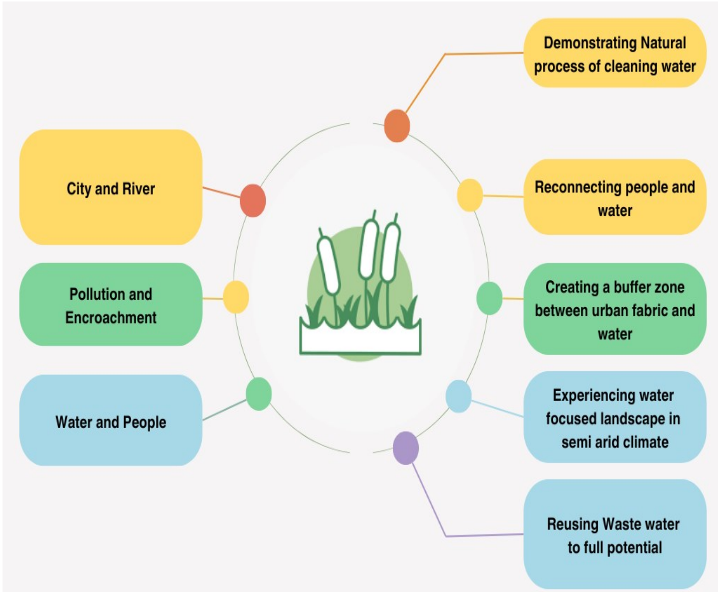


Figure 9: Stakeholder Concerns

- Define the design criteria for the proposed decentralized wastewater management system using constructed wetlands in Jodhpur's peri-urban areas. This should consider factors like:
- Treatment capacity required for the target population
- Suitability of different wetland types for local climate and wastewater composition
- Integration with existing infrastructure and development plans
- Social and cultural considerations for public acceptance
- Develop initial design concepts for constructed wetland parks, considering their functionality, aesthetics, and potential for community engagement.
- Utilize design thinking methods for rapid prototyping and iterative refinement of the proposed solution.
- Integrate user feedback through workshops, surveys, or focus groups to improve the design's usability and social acceptance.

4.2 Site Analysis and Integration with existing master plans

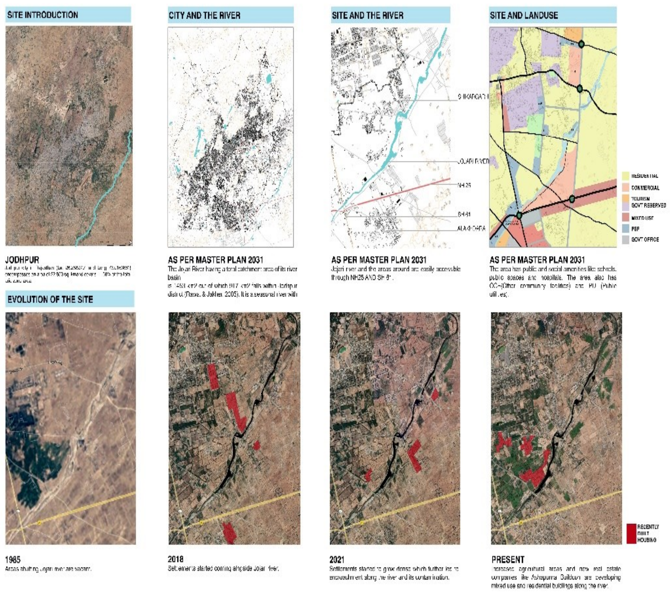


Figure 10: Master Plan 2031 Jodhpur and Evolution of the site over years

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

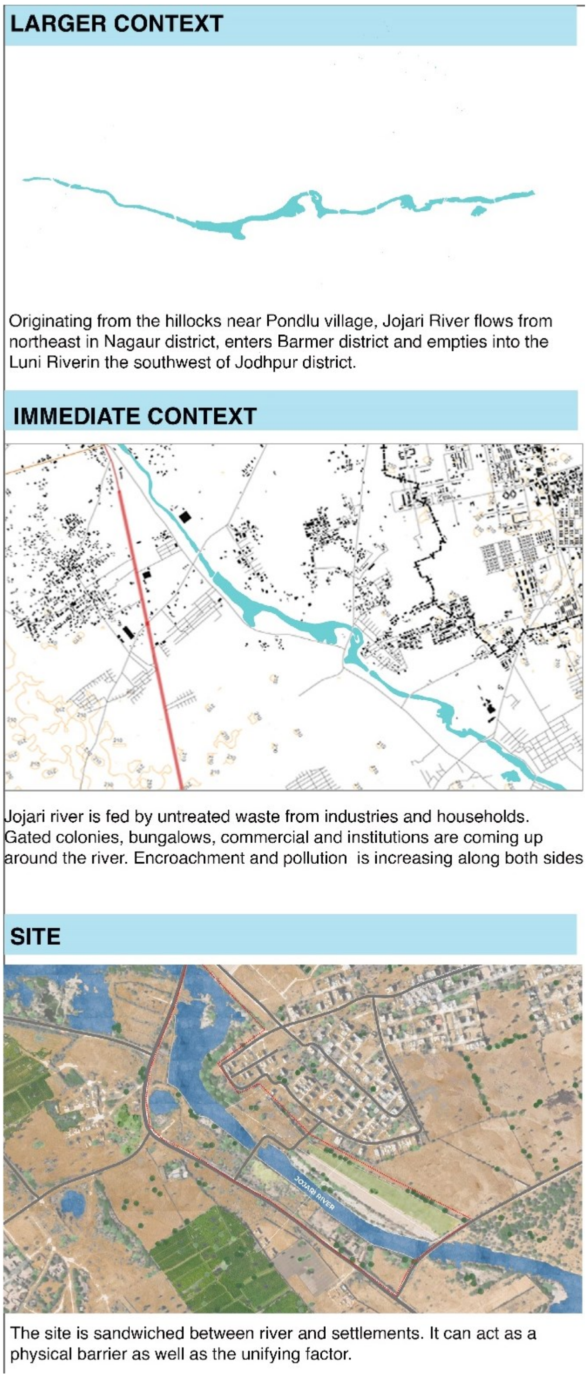


Figure 11: Site Context

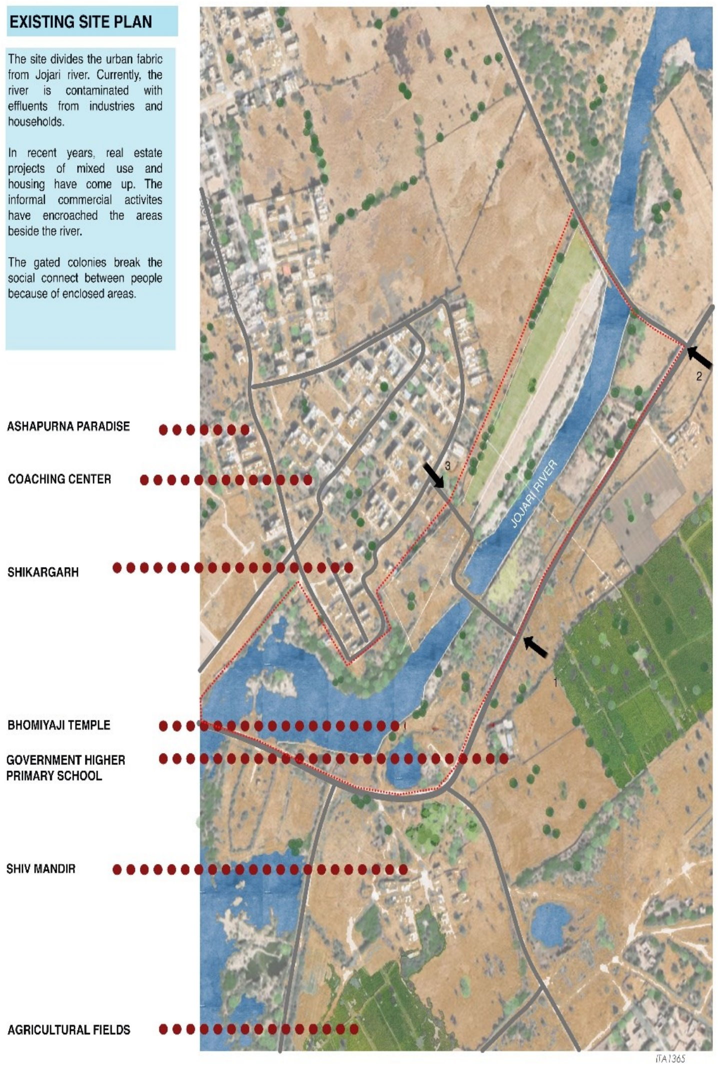


Figure 12: Existing Site Plan

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

Figure 13: Site Conditions

4.3 Design Evaluation and Implementation

The proposed constructed wetland park will span 40 acres and include a 1-kilometer stretch of the Jojari River. New settlements in the surrounding area are advised to implement water segregation at the household level. This segregation will separate greywater, which will then be directed to the wetland for purification. The purified water will be used to irrigate the park, and any surplus can be utilized by residents for non-potable purposes in their homes.

- Develop evaluation criteria for the proposed decentralized wastewater management system, focusing on:
- Effectiveness of wastewater treatment and water quality of treated effluent
- Functionality and maintainability of constructed wetland systems
- Social and economic feasibility of implementation
- Potential environmental benefits and contribution to IWM
- Conduct pilot-scale implementation of a constructed wetland park to test its performance and gather real-world data.
- Analyse the results of the pilot project and refine the design based on the evaluation findings.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

- Develop a comprehensive implementation plan for scaling up the decentralized wastewater management approach across Jodhpur's peri-urban areas.

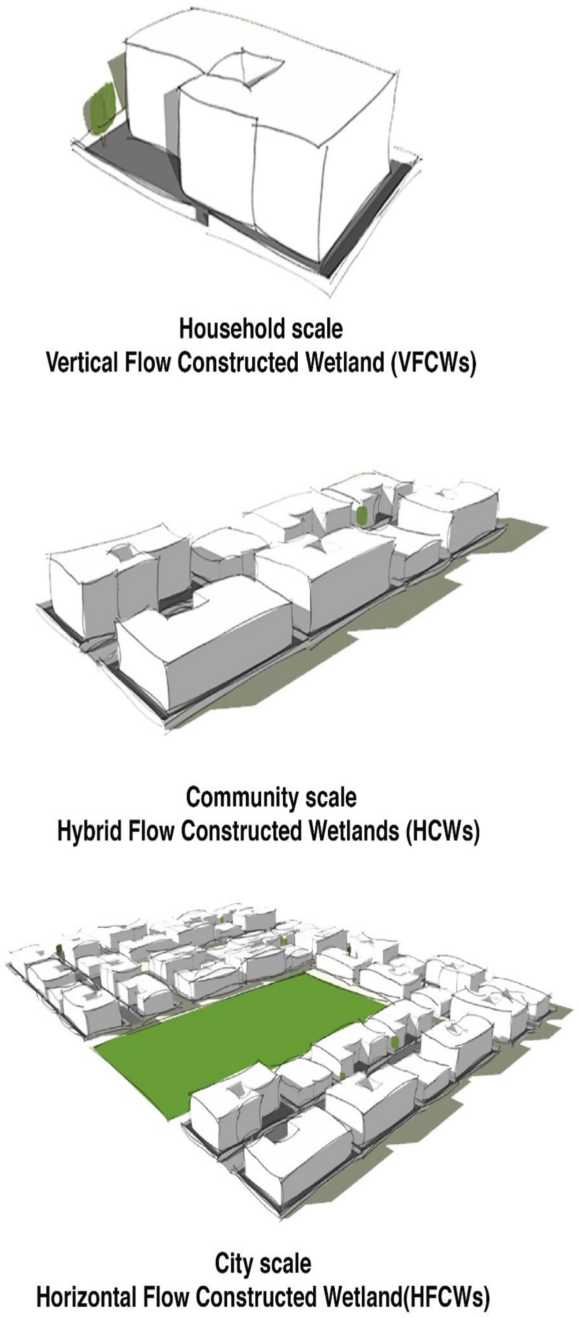


Figure 14: Scales of Network

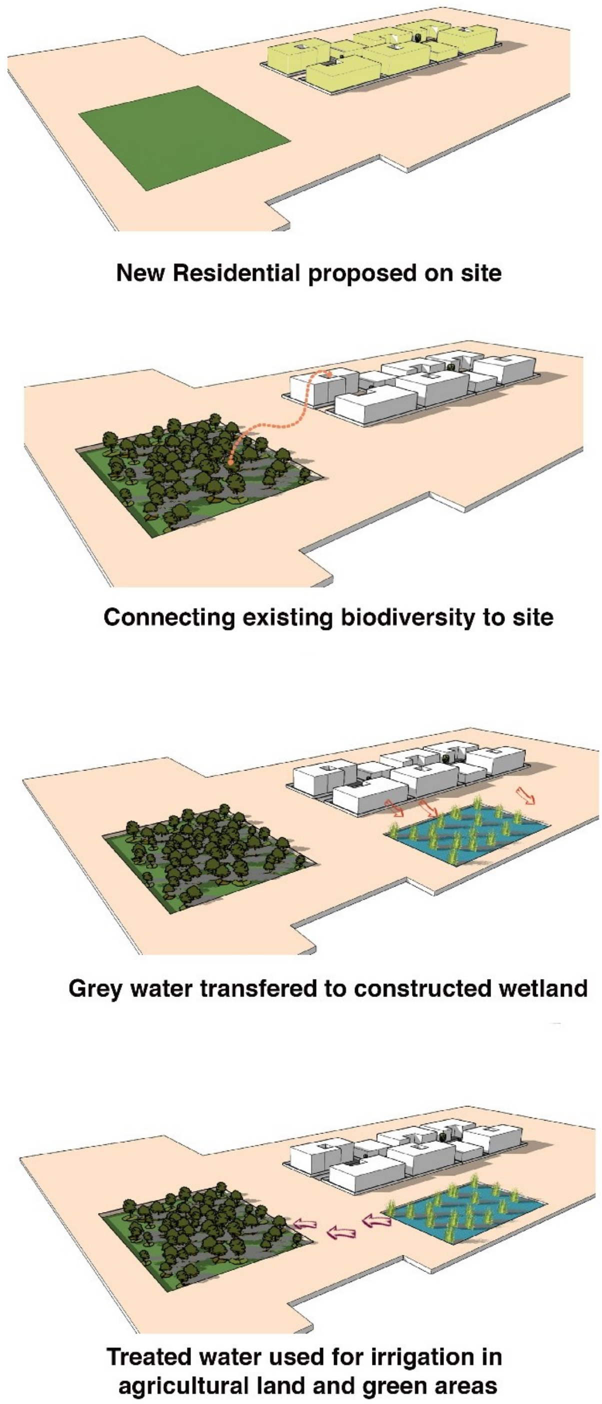


Figure 15: Integrating the green, blue and built

The design will prioritize features that encourage social interaction, entertainment, and leisure activities for residents.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

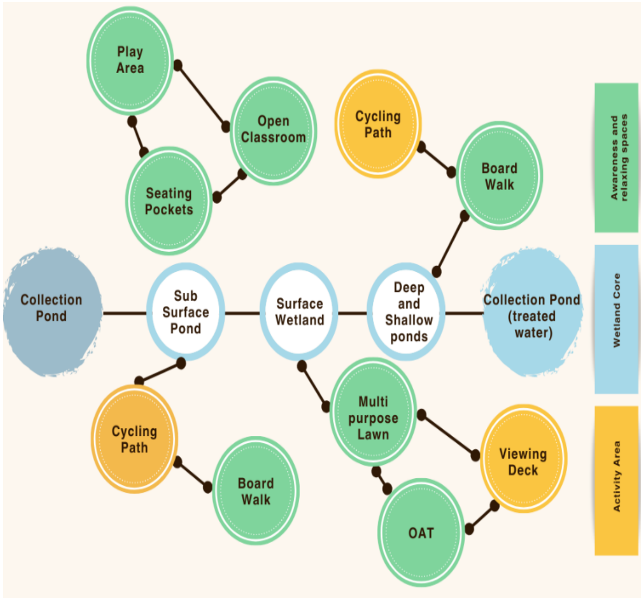
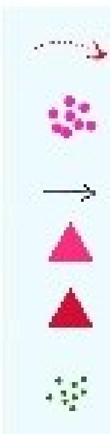


Figure 16: Space adjacency diagram for Constructed Wetland Park

Figure 17: Proposed Site Plan for Constructed Wetland Park

Open sitting spaces: These open spaces can host community events, outdoor markets, or movie nights, fostering a sense of togetherness and encouraging interaction among residents. Integrated walking and biking paths: Connecting the housing blocks with these paths not only promotes sustainable transportation but also encourages residents to connect while enjoying the outdoors.

Playgrounds and community gardens: These spaces provide opportunities for families, children, and individuals to engage in leisure activities and build social connections.
Open classrooms: These facilities can host workshops or classes offering residents opportunities to learn new skills, socialize, and increase awareness of water management.



Pedestrian Movement
User Intensity
Cycling Movement
Pedestrian Entry
Vehicular entry
Dense Vegetation Buffer

Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 13 Issue 07, July-2024

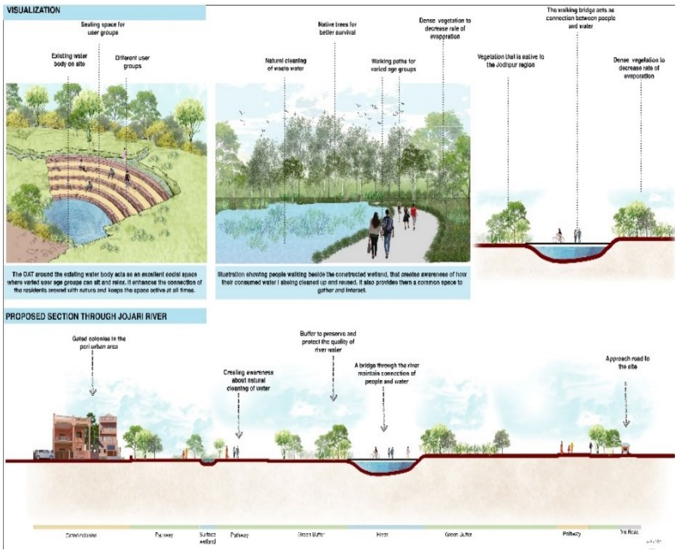


Figure 18: Visualizations and Sections of Constructed Wetland Park

5 CONCLUSIONS AND RECOMMENDATIONS

The integration of decentralized wastewater treatment systems, greywater segregation, and constructed wetlands presents a via-ble solution to address the water scarcity and sustainability chal-lenges faced by peri-urban areas in Jodhpur. This research high-lights the significant benefits of such an approach, including re-duced dependency on freshwater sources, cost-effective and low-maintenance treatment processes, and the creation of green spaces that contribute to the overall environmental health and resilience of urban areas

The proposed model not only addresses immediate water man-agement issues but also sets a foundation for long-term sustain-ability and climate resilience. By treating wastewater locally and reusing it for non-potable purposes, this approach reduces the burden on existing infrastructure and promotes a circular water economy. Furthermore, the constructed wetlands serve as multi-functional spaces, providing ecological, social, and recreational benefits to the community. Implementing these systems requires careful planning, commu-nity involvement, and continuous monitoring to ensure their ef-fectiveness and adaptability. The success of pilot projects will be crucial in demonstrating the viability of decentralized wastewater treatment and encouraging broader adoption. Collab-oration among urban planners, environmentalists, policymakers, and the community is essential to achieve these goals. In conclusion, the integration of water management, green spaces, and built environments through decentralized systems offers a sustainable pathway for urban areas to enhance their cli-mate resilience. This research provides a comprehensive frame-work that can be adapted and scaled to other regions facing sim-ilar challenges, contributing to global efforts towards sustainable urban development and climate adaptation.

6 REFERENCES

Avinash Mishra, A. K. (2023). Reuse of Treated Wastewater in Urban/Peri-Urban Agriculture in India. NITI Aayog, Govt. of India.

(2019). DECENTRALIZED WASTEWATER MANAGEMENT: COMPLEMENTING CENTRALIZED SOLUTIONS FOR. NATIONAL INSTITUTE OF URBAN AFFAIRS, NEW DELHI.

Lipkow, U. v. (2009). Constructed wetland for a peri-urban housing area Bayawan City, Philippines.

Mays, L. W. (2009). Integrated Urban Water Management: Arid and Semi-Arid Regions. UNESCO.

RK.GOYAL, V. I. (n.d.). Rainwater Harvesting Through Tanka in Hot Arid Zone of India.

Tripathy, S. D. (n.d.). On some avifauna from Jojari River – A Wastewater Wetland in Semi-Urban Area of Jodhpur City, Rajasthan. Kolkata : Malacology Division, Zoological Survey of India.

Vairagaya Joshi, H. S. (n.d.). A Project Report on Design of Rainwater Harvesting System for Jodhpur Institute of Engineering and Technology (JIET) Campus.