

Green Infrastructure development for sustainable and efficient urban areas in India

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Abstract—one of the most dynamic changes over the century has been urbanization. Today, 54 per cent of the world's population lives in urban areas, a proportion that is expected to increase to 66 per cent by 2050 (United Nations report). According to *World Urbanization Prospects (2014)*, by 2050, India is projected to add 404 million urban dwellers. Due to the high rates of Urbanization, major cities of India, have seen the depletion of water level and green spaces to cater the needs of its increasing population demand. Managing the urban development has become the most challenging in 21st century. Conventional approaches have been proven to be unsustainable practices. Need of the hour to reorient the traditional urban planning and management tools to meet the fundamental for managing urban growth and development. For this development to be sustainable and efficient must be guided by an approach that aims at a positive social environment, physical and overall economic impact, "Green Infrastructure"

Index Terms— Urbanization, Unsustainable practice, Water level depletion, Green Spaces, Urban growth, Sustainable, Green Infrastructure.

1 INTRODUCTION

AFTER Independence, urbanization in India began to accelerate due to the development of the private sector.

According to the 1901 census, only 10.8 per cent population was residing in Urban areas and about 90 per cent population lived in the village^[1] which increased to 27.81% per cent by the (2001, census) and 31.16% per cent (2011, census)^[2]. According to *World Urbanization Prospects (2014)*, by 2050, India is projected to add 404 million urban dwellers^[3]. Due to this significant growth in population development which is outpacing infrastructure and utility capabilities, municipal governments faces significant difficulty in meeting resident basic needs. These many aspects have created many physical, social and environmental problems in the urban areas. In order to meet the needs of the ever-growing population, most of the cities have faced the challenge of declining the water level and open areas. As a result the environmental resources have been declining. India adopted a **National Action Plan** on Climate Change (NAPCC) in 2008 which was an attempt to balance the Environment protection^[4]. Although several acts and laws in relation to environment has been inducted from time to time but overall impact of environmental legislation is not very encouraging. The standard community planning and management must re-orient to meet the fundamental of handling urban growth and development. For this growth to be effective and successful, it must be driven by a new strategy that strives for a positive social, physical, economical and environmental effect, "Green Infrastructure".

2 GREEN INFRASTRUCTURE AS A STRATEGY

Green infrastructure (Global context) is a low impact Development (LID), for example planting trees and restoring wetlands rather than constructing an expensive new water treatment plant^[5]. It attracted popularity after the Greenway movement in 1990. Europe commission, 2013 describe, Green infrastructure, "strategic network of natural and semi natural areas with the other environmental features built and managed to provide a wide range of ecological services^[6]". According to US environmental protection agencies, "Green infrastructure is a cost-effective, resilient approach to address wet weather impact that of a multiple neighbourhood benefits intended to transfer urban storm water away from the developed environment, reduces and manage strong water at its source while providing natural social and economic will benefits^[5]."



Figure 1: A bio retention system on the University of Virginia Grounds intercepts storm water through screened inlets, thereby reducing, slowing and improving water quality. Most of the intercepted runoff is consumed by vegetation, percolates into groundwater, or is temporarily stored and then slowly released^[7].

Figure 1 A bio retention drainage swale in Melbourne Australia is designed to intercept curb flow, treat the water in a set of connected

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vegetated cells, and slowly return lower volumes of flow to another curb cut down the street. Vegetation design fits the context of the garden and has been adopted by residents. (Source: B. Larry ,2018 *Green Infrastructure: Ecosystems in the City and the City as Ecosystem*) [7].

Green infrastructure (Indian context), according to the Centre for science and environment in New Delhi define green infrastructure as, "Green Infrastructure refers to natural or semi-natural ecosystems that provide water resource management by introducing the natural water cycle into urban environments. It provides effective measures to manage urban flooding, water supply and quantity regulation, at the same time generating multiple environmental benefits [8]." The development of green infrastructure in India began in prehistoric period civilisation floodplain dating back to 3000 BC with the city of *Mohenjo-Daro* serving as the first example of planned water management scheme. Till date number of guidelines on sustainable habitat was published and guidelines on water responsive urban architecture and planning as well as green infrastructure are published in 2017 [8].

When we compare the concept of green infrastructure in the India to the rest of the world, we see that in Indian context green infrastructure is management of water resources in the urban areas which include water supply management and introduction of natural or semi natural water cycle into the urban climate. In the global sense green infrastructure are low - impact development, in variety of fields which not only include the water resource management but also mitigation of urban heat islands and is a measure to improve biodiversity and ecology in the city.

3 CASE STUDY APPLICATIONS

3.1 Case Study one: The City Of Trees Manchester

The benefits of the tree are many, which include preventing runoff, land cooling, and introduce city biodiversity [9]. [10]. In this following case study, The City Of Trees has used tree as an infrastucture. This project aimed to bring green infrastructure solutions to the greater Manchester. This is accomplished by development and diversion of water courses, and management of natural forest and tree planting [11]. The project aims to develop a new environmental service and improve people's interaction with nature. The City of trees project aim to grow 3 million trees one for every citizen in Manchester. Improve people access to natural environment and water land. Restored 2000 hectares of unmanaged lands forest area. The city of tree project is divided into two schemes [12]:

a- *Cleavleys wet Woodland*: The scheme goal was to boost water quality decrease water volume increase biodiversity and provide local resident with more leisure opportunities . It provides the complete system for the diversion of highway drainage and capture the pollutant before they enter worsley brook downstream.

b- *Pretwick High Street* : Special, tree pits have been used to channel rainwater across the greater Manchester, irrigating the plants providing water infiltration, and draining waste water

to mitigate the need to come and handle surface flooding.



Figure 3 Cleavleys Wet Woodland [12].

Figure 4 Prestwich High Street [12].

3.1.1 Insights from case study one : The City Of Tree

It provide a mixed use recreational areas for community while also reducing highway run-off in which the contaminants were captured beforehand and infiltrated by the aquatic plants. Urban flood control and urban cooling while also providing shelter for priority species. Access to clean water and effective wastewater treatment as well as improve air quality by lowering emission and CO² was reduced by 9% and PM 10 was reduced by 21%. Raising the visual appearance of street and 15% increase in the sales of business.

3.2 Case Study two: Wild West end, London UK

Green infrastructure development is not a massive scale project , it can be performed at varius scales. Like London's west introduce green infrastructure to enhance there neighbourhood [13]. Green roof, green wall, planters, street trees, flower boxes and pop-up spaces are being used to accomplish these goals. The top prerorrrity is to re-introduce the habited that were once evident in London such as the black redstart and the house sparrow [12]. [14].



Figure 5, 6 Wild West end, London UK

3.2.1 Insights from case study two: Wild West end, London UK

Enhanced micro climatic conditions through localised area quality enhancement and enhanced temperature regulation. Increase the bra biodiversity through ecosystem supply and biological connectivity. Climate resilience through rainwater management, renewable energy . Increase climate resilience through rainwater management sustainable energy. Better social stability through improved opportunity for social participation and interaction. Better fitness through development

of sensor sensory and active green spaces [12],[13], [14]

4 CONCLUSION

Today major challenges in urban areas of India is; urban flooding, pollution, inadequate infrastructure, urban heating and reduction in environmental resources. Great lessons wait for India in the implementation of the green infrastructure. Green infrastructure case study highlights how the multiple challenges of urban area can be sustainably overcome. Thus, can generate multi-benefits of for business, environment and society. Green Infrastructure development can reduce the impact of future climatic change including the risk of urban flood flooding and overheating. GI provides long -term value in terms of improves well-being, health and better environmental outcome. Thus, can help in regulate micro climatic conditions through rainwater management, renewable energy. Opportunity for better social engagement through social participation. Better city ecosystem through active green spaces.

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REFERENCES

- [1] J.S. Bridle, H.H. Risley and E.A. Gait , (1903), "Report On The Census Of India, 1901" , Calcutta , Superintendent of Government Printing , p. 1
- [2] Ministry of Housing and Urban Affairs, Govt., " Urban Scenario, <http://mohua.gov.in/cms/urban-growth.php.2021>
- [3] United Nations Department of Economic and Social Affairs (DESA), ' "2014 revision of the World Urbanization Prospects, <https://www.un.org/en/development/desa/publications/2014-revision-world-urbanization-prospects.html>
- [4] R. Garg, "National Action Plan on Climate Change, 2008 (NAPCC), <https://blog.ipleaders.in/national-action-plan-on-climate-change-2008-napcc/>
- [5] U.S. Environmental Protection Agency, "Urban Runoff: Low Impact Development, <https://www.epa.gov/nps/urban-runoff-low-impact-development>
- [6] Europe commission 2013, "The forms and functions of green infrastructure, https://ec.europa.eu/environment/nature/ecosystems/benefits/index_en.htm
- [7] Miles, B. and L. Band, 2015, Green infrastructure stormwater management at the watershed scale: urban variable source area and watershed capacitance, *Hydrological Processes*, 29, 2268-2274. J. Duncan, C. Welty, J. Kemper, P. Groffman, and L. Band, 2017, Dynamics of nitrate-concentration discharge patterns in an urban watershed, *Water Resources Research*, 7349-7365.

- [8] Ministry of Housing and Urban Affairs, Centre for Science and Environment, "Green Infrastructure A Practitioner's Guide, pp. 19-22, , 201 .
- [9] JB. Turner-Skoff, "The benefits of trees for livable and sustainable communities <https://doi.org/10.1002/ppp3.39>
- [10] R. Ennos , D. Armson and M. Asrafur Rahman," How Useful are Urban Trees? The Lessons of the Manchester Research Project, Trees, people and the built environment II
- [11] Manchester The city of trees, "The case for more trees in Greater Manchester, <https://www.cityoftrees.org.uk/>
- [12] Winch, Robert & Clough, Julia & Mant, Alistair & Hamilton-Russell, Elfrida & Barker, Adam & Payne, Sarah & Gilchrist, Anna & Tantanasi, Ioanna & Clay, Gareth & Rothwell, James. (2019). Making the Case for Green Infrastructure: Lessons from Best Practice. 10.13140/RG.2.2.27410.81607.
- [13] Green cities Europe,"Wild West End, https://uk.thegreencities.eu/best_practices/wild-west-end/
- [14] The Wild West End,"What is Wild West End, <http://www.wildwestend.london/vision>