International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Encapsulating Green Infrastructure in Modern Urban Landscape

Dr. Ankita Jasmine Lall[1], Prof. Sabina R. Bodra[2], Anant Saxena[3]

[1,3]Assistant Professor, Dept. of Economics, Christ Church College, Kanpur (U.P.)
[2]Professor and Head; Dept. of Economics, Christ Church College, Kanpur (U.P.)
[1,3]Student, B. Com; Dept. of Commerce, Christ Church College, Kanpur (U.P.)

Abstract:
The growing urbanisation has casted various challenges in building a resilient infrastructure supporting sustainable landscape. The present urbanisation challenges faced around the globe is related to the waste management and mindful consumption of renewable and non-renewable resources. The traditional urban landscape had used the grey infrastructure that in the present scenario is aging and showing incapability of handing disasters. The modern landscapes require advanced technological involvement in a planned manner to have a sustainable future. This review paper considered various studies of economies of rebuilding their landscapes with modern green infrastructural approach with the use of solid waste management, waster management, Government Interventions and the use of AI for a better tomorrow.

Keywords: Green Infrastructure, Modern Technologies, Urban Landscape

INTRODUCTION

By 2030, nearly 60% of world's population will live in urban areas (Aulakh, 2014). The problem of urbanization is mostly in developing countries and by large influx of people in urban areas carbon footprints and other issues like pollution, heat waves, waste management, exhaustion of non-renewable sources of energy, water-supply sanitation problems and other hazards have further augmented and hence making it very challenging for developing countries to tackle these problems. Burgeoning carbon footprints are detrimental for our environment especially for urban landscape making them a major point of greenhouse gases (GHGs). Studies have revealed that the temperature increase forecasted for 2090–2099 may range from 1.1 to 6.4 degree Celsius as relatively compared to the previous century (1990-1999) that actually showcases a big concern at a global stance (Aulakh, 2014). The other major issue is not having a robust system to treat wastes. The per capita waste generation rate in India has increased from 0.44 kg/day in 2001 to 0.5 kg/day in 2011. Big cities collect about 70 - 90% of Municipal Solid Waste (MSW) generated. With continuous growth of developing nations, the expectations on quality of life have raised but in India proper disposal systems are absent resulting in 91% of MSW amassed on open lands. Open burning of these MSW releases many pollutants in the atmosphere which includes carbon monoxide (CO), nitrogen oxides (NO_x), etc (Annepu, 2012). Urbanization leading to migration has escalated the need for construction of buildings which are major creators of pollution and wastes. Carbon dioxide released from embodied energy that comes from construction materials like tiles, concrete account for 40%–50% of energy use, water consumption and contributes to approximately 40%–50% of water pollution and air pollution, greenhouse gas and chlorofluorocarbons (CFCs) to the environment. Demand

for green buildings is escalating due to issues like population growth and urbanization. Green building is only the energy-efficient measure towards achieving sustainable development (Dod, 2015). In addition to them, India has many disaster-prone areas. Early warning systems and with use of other technologies like GIS, remote sensing, etc can alert the public regarding natural hazards but need for new technology is vital to assess and monitor these hazards (Siddharatha, 2017). All the above issues are pushing urban landscape towards peril. Hence, a sustainable urban landscape needs to be designed where the solutions of these issues can be formulated.

Green Infrastructure: Green Infrastructure (GI) is an approach that encompasses a wide array of green and ecological practices that delivers many environmental benefits for commoners of both urban and rural areas and solves various environmental challenges. Examples at the urban scale includes planting more trees, developing green parks and open spaces and restoring wetlands. Other critical components of Green Infrastructure include providing clean water, conserving ecosystems, proper waste management system. Green Infrastructure system also provides cleaner air and water and beautiful green spaces when installed in the urban landscape while tackling the environmental issues plaguing the globe. Exposure to green spaces also provides associate benefits to human population by improving people's mental & physical health, lowering risk of number of chronic diseases, enhancing cognitive functions in adults (Nieuwenhuijsen, 2020) which is an important parameter of healthy living.

Difference between Traditional & Modern Landscape: Historically cities have used Grey Infrastructure which refers to systems of gutters, pipes, water treatment plans, tunnels, etc to tackle environmental issues. Grey Infrastructure is aging and it is not designed to handle escalating floods and droughts. Moreover, it's capacity to manage large volumes of water is also decreasing in many urban cities across the globe. Hence, a modern approach was the need of the hour to protect wildlife, tackle environmental issues and enhance public health and life which they found in Green Infrastructure systems. The Modern landscapes adheres not only to these issues but also takes care of having a sustainable future.

Importance of Green Infrastructure: There was no security and flexibility in the grey infrastructure system whereas green infrastructure provides security and flexibility which urban cities need in their present dynamic environment. Secondly, green assets provide important air filtering functions by removing air pollutants and thereby improving air quality. Thirdly, trees and other green assets regulate water flow and storm-water runoff through intercepting and reducing storm-water runoff over impervious surfaces. In addition to it, Green Infrastructure also reconnects the humans and the nature and provides psychological benefits (Swilling, 2013) that actually fosters physical and mental wellbeing.

Current Scenario: There are many problems which are been faced by current infrastructure of countries like India, Bangladesh, China and South Africa such as small evidence base of research focussing on socio-ecological connectivity, lack of engagement of public to ensure a long-term connectivity. These countries are reticent in exploration of evidence base. Moreover, there is still a scope to embed GI within government policies of the developing economies. Not illustrating the value of GI to politicians, partners make sure that GI does not form a part of discussion of planning mechanisms. (Mell, 2017) Current infrastructure is also more energy consuming and upsurges the material resources due to lack of efficiency improvements in the production process.

Inbuilding Green Infrastructure in Indian Urban Landscape: Urban areas of India are facing many environmental issues such as climate change, extreme weather and biodiversity loss, etc. Climate proofing the economy and building resilient development sectors is the priority of India. In order to avert these issues, potential steps are been taken by giving suffice attention to green assets (trees, parks, gardens, etc) and blue assets (wetlands, seas, etc). Due to greenhouse gas emissions, the average temperature increased by 0.7 degree Celsius between 1901 and 2018. (Driver, 2021). Cities are a key contributor to climate change consuming a large percentage of world's energy and also producing a huge percentage of greenhouse gas emissions. One in two Indians is expected to live in cities by 2050. India has a population base of more than 1.22 billion, whereas urban housing deficit is touching nearly 23 million. (Mukherjee, 2013). Many of India's urban planning statutes are outdated and follow rigid development control regulations. With the aim of enhancing existing blue systems in the cities, many prominent Indian cities such as Delhi, Bhopal, Bengaluru are including blue-green components in their action plans. Delhi has included a blue-green policy focus in its 2041 masterplan to ensure that green features are planned to mitigate pollution and adapt to climate challenges. Bhopal is among the 100 cities selected for Smart Cities Mission, is creating a formulating a 'Blue and Green Masterplan' to maintain and grow the green cover, create an environmentally sustainable city, and improve health. Green Infrastructure system is now accepted by Indian cities and they are considering including green and blue infrastructure in their sustainability transition (Driver, 2021) which is the basic requirement for modern urban landscape.

Objective of the Study

This review paper is based on identifying the modern technologies adopted by developing economies related to sustainable urban landscapes that can be suggested for Indian Economy.

Methodology

This review paper considers the blend of modern technology and green infrastructure for assessing the latest trends in Sustainable Urban landscapes. For which various studies around the globe has been considered through an intensive literature review and different techniques adopted by them has been identified and incorporated in this paper.

Various Technologies Adoption: Various technologies are been adopted by various countries to tackle the environmental issues that have been plaguing the urban landscape of countries. The countries are trying to tackle these issues from the grassroot level by their formulated policies and environment friendly steps. Many progressive and efficient steps have been taken by various countries to tackle issues such as solid waste management, water management, climate change, etc.

1) **Solid Waste Management**:

The management of solid wastes have been a problem for many developing countries for a prolonged period of time. Due to rapid industrialization, the ecosystem's capacity to assimilate and transform the wastes naturally has been depleting, therefore one of the pivotal sectors of green economy is waste recycling, i.e. waste management. With the use of new technologies by various countries to manage the wastes, this problem is been tackled at the grass root level in most developing countries but an integrated approach which covers all aspects such as social, technical, legal, has not been considered. In Japan, UNEP-IETC has been most active worldwide on developing guidance for technology assessments. Development of Environment Technology Assessment (EnTA) developed further into Sustainability

Assessment of Technologies (SAT), that comprised improvements from initial method to put focus on informed decision making and the outcomes. SAT mentions its potential use for- "end-of-pipe or waste management" technologies where it evaluates technology through a three phased process with detail in its ambit of applications. Some options are eliminated through logical yes/no operators in the first screening phase while the second phase comprises of scoping which evaluates the option using quantitative information. Assessment of remaining options in detail with quantitative information is done in the final phase. A very little attention is given to human factor to operate the technology in a correct way by the SAT while considering many dimensions of sustainability criteria (Christian Zurbrügg, 2014) especially focussing on economic, social and environmental aspects.

In Indonesia, economic assessments compared the options available for traditional market waste disposal, composting in a centralized plant, a centralized biogas production facility and a landfill for electricity production (Christian Zurbrügg, 2014). Cost-benefit with a ratio of three times higher after conversions, as compared to before was also applied options for market waste use, showing how converting organic waste into biogas is advantageous both financially or environmentally in Thailand (Christian Zurbrügg, 2014) which serves the sustainability aspect well.

If we look at the larger picture towards sustainable solid waste management, technology is a small part of it. We need an integrated approach which covers social, economic, legal, technical and environmental issues under its ambit and must try to maintain a balance these to obtain practical ways to manage waste. In developing countries, existing technologies should be revamped for better management of solid waste.

2) **Renewable Energy:**

Renewable energy has always been a better alternative to fossil fuels as it is clean and can be used in most parts of the world. Over the last decade, developing countries have tried to increase the capacity of installed renewable energy. For the production of clean electricity, green energy infrastructure combines energy from renewable sources like wind, hydroelectricity. With the adoption of green energy infrastructure, we can ensure better quality of the water and air and a reduction in greenhouse gas emissions. China uses hydropower energy more than other types of renewable energy. There are various renewable energy sources such as wind energy, hydropower energy, etc. Developing countries have not made any significant investments in renewable energy development. The main reasons could be complexities of renewable energy system and its implementation costs.

China is one of the most important countries which are investing in renewable energy development. China increased the hydropower installed capacity to 300000 MW in 2015 and comparing it to 2010, there was increase of 100000 MW. China has also built more than capacity of each hydropower system is greater than 1000 MW indicating high potential of these hydropower plants in generating electricity. The provinces of Fujian, Hubei, Yunnan consume more than 30% of their electricity from hydropower energy (P. Balakrishnan, 2019). Also, it has the world's largest wind energy installed capacity in the world and is considered as the leading country in wind power generation. The total wind energy capacity of China is nearly 4350 GW and out of it 200 GW is allocated to offshore wind farms. China's attempts to constant increase in wind power energy prevents the emissions of 140 million tons of CO_2 and 150 million tons of coal consumption every year (P. Balakrishnan, 2019) that indicates its potential to optimise the use of renewable energy.

3) **Water Management:**

Urban cities play a significant role in management of freshwater resources. They have an impact on both water quality and quantity through contamination, land-use change, overexploitation. Through an integration of the urban design process with other disciplines responsible for provision of water services, cities need to give water due prominence in urban development. Future urban landscapes need to capture opportunities and technologies to maintain the cities' resilience towards the impacts of climate change, which have already created uncertainties regarding urban water supplies and weather extremes. Planning should address the need to provide ecosystem services that protect downstream aquatic environments and other ecological habitats from these impacts. Thus, urban landscapes beyond providing spatial amenities, have ecological functions that facilitate hydrological processes such as evaporation, infiltration and detention (Bergen, 2017). Improved urban drainage, reduced water footprint, improved quality of discharge, increased conservation of ecosystem should be the key improvements in building sustainable and green urban cities.

Global cities such as Berlin in Germany, City of Melbourne in Australia, City of Philadelphia in the US and Sino-Singapore Tianjin Eco-city in China are well known around the globe for their water management practices. Represent a broad geographical distribution, these cities are renowned for their commitment to Sustainable Urban Water Management (SUWM). Singapore and Berlin are internationally renowned for their water supply system. For its Water Sensitive Urban Design strategy, Melbourne is praised worldwide. Philadelphia was recommended by experts from Portland as the forerunner city in USA. Sino-Singapore Tianjin Eco-city was selected because of its all-round ambition on striving for sustainability, including Urban Water Management (UWM) (Bergen, 2017) which sets a specimen for all to follow.

4) **AI:**

Artificial Intelligence (AI) is another important aspect which will play and is playing a critical role in developing countries for tackling environmental issues. Use of AI can be used to monitor air quality, better treatment of wastes and energy collection in the urban landscape. Its impact will elevate the lives of the commoners living in the urban cities.

AI can work in various domains of the urban landscape such as public health, wellbeing and education areas. After the culmination of COVID-19 pandemic, we have noticed that use of AI is by leaps and bounds in the health sector by using sensors and analytical tools embedded in homes or workplaces to monitor health and enhancing the health of the commoners through medical imaging analytics. In addition, AI is also enhancing the quality of the students' academic career by expanding the ambit of students' curriculum through personalized learning options and also teaching grammar and other subjects to adults (Cugurullo, 2020) so it is the next future for us.

Another domain of AI where it can play a pivotal role for a prolonged period of time for urban landscape is Environment. Climate change mitigation, clean air, biodiversity conservation, forecasting disasters, etc can be effectively done with the use of AI. Various application areas for climate change mitigation include urban planning, energy production and consumption, use of land. Application areas of AI for clean air consists of pollution filtering and monitoring, clean energy and real time adaptive urban management. AI also have application areas for biodiversity and conservation such as habitat protection, sustainable trade. Application areas for clean water security includes sanitation, drought planning, water supply quality whereas predicting and forecasting disasters, early warning systems, resilient infrastructure are various

application areas of AI for weather and disaster resilience (Cugurullo, 2020) all this gives you a better monitoring and conservational benefits of resources in the modern landscape.

5) **Government Interventions:**

Laws play a pivotal role in tackling various environmental issues. There are various laws abiding which many countries have seen a progressive change in their urban landscape. Japan was one of the most polluted nations in the world in the late 1960s, but with famous 'Pollution Diet' of 1970 passed a list of 14 comprehensive environmental protection measures began a big turn-around. Sustainable concepts were also featured in Japan government's Basic Environment Plan of 1994 (Stepan Wood, 2006).

Through Foundational Resource Management Act 1991, New Zealand was the first country to make sustainable management as the beacon for its decision makers. National Strategy for Ecologically Sustainable Development was formulated in 1992 and sustainability principles were laid down as the statutory objects for environmental agencies in Australia. Advisory on President's Council on Sustainable Development (PCSD) which published towards a Sustainable America was established in 1993 in US. A European Strategy on Sustainable Development was issued by European Commission in May 2001 (Stepan Wood, 2006). But the real problems can be understood as the cogent laws which are formulated by governments of countries worldwide and their promptness to create new layer of institutions does not have much impact in their urban landscape and also progress in transforming their economies have lagged.

Suggestions/Conclusions:

Several attempts are been made in cities across the globe to introduce green infrastructure aspects for climate adaptation and mitigation. Global cities need an all-encompassing plan that acknowledges that its cities' economic and social stability is dependent on the environment. Urban cities in developing countries must move towards dynamic and not rigid urban planning that considers changes taking place. Green Infrastructure interventions must have a substantial level of community participation as well to make it successful. It is also paramount to keep up with innovations in urban planning ranging, such as environmental real-time GIS mapping or using artificial intelligence for sustainable urbanisation. Green Infrastructure is a multi-sectoral work and should move beyond jurisdiction and hence urban local bodies, recognised by the Constitution must be given the autonomy to take decisions pertaining to green infrastructure and should be provided with adequate access to funds and resources for its successful execution. Climate change cannot be mitigated only through greening. This will have to be coupled with sustainable land management strategies. The green infrastructure approach is crucial for sustainable land management and should be considered for wastewater treatment, reuse of wastes, etc.

References:

1. Annepu, R. K. (2012). Sustainable Solid.
2. Ashutosh Kumar Singh, H. S. (2020, October). Green infrastructure of cities: an overview. 1-15. doi: 10.16943/ptinsa/2020/154988
3. Aulakh, S. S. (2014). Planning for Low Carbon Cities in India. *Environment and Urbanization AsIA*, 17-34. doi: 10.1177/0975425314521535
4. Bergen, L. L. (2017). Green infrastructure for sustainable urban water management: Practices of five forerunner cities. *Cities*, 1-3.

5. Christian Zurbrügg, M. C. (2014, January 27). How Assessment Methods Can Support Solid Waste Management in Developing Countries—A Critical Review. *Sustainability*, 545-570. doi:10.3390/su6020545
6. Cugurullo, T. Y. (2020, October 15). The Sustainability of Artificial Intelligence: An Urbanistic Viewpoint from the Lens of Smart and Sustainable Cities. *Sustainability*, 1-24. doi:10.3390/su12208548
7. Dod, D. T. (2015). Role of Green Buildings in Sustainable Construction- Need, Challenges and Scope in the Indian Scenario. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) 015), 12*(2), 1-9. doi: 10.9790/1684-12220109
8. Driver, S. U.-M. (2021, May). Blue-Green Infrastructure: An Opportunity for Indian Cities. *Observer Research Foundation*, 1-37.
9. Mell, I. C. (2017, January 12). Green infrastructure: reflections on past, present and future praxis. *Landscape Research Group*, 135-145.
10. Mukherjee, M. (2013). Urban India: Challenges for Green Infrastructure. 1-4.
11. Nieuwenhuijsen, M. J. (2020, December 14). Green Infrastructure and Health . *Public Health*, 317-328.
12. P. Balakrishnan, M. S. (2019, June). Current status and future prospects of renewable energy: A case study. *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, 1-6. doi:10.1080/15567036.2019.1618983
13. Siddharatha, V. (2017, January). Forecasting and Early Warning Systems & Communication and Information Technology for Various Types of Disasters. *International Journal of Engineering Research & Technology (IJERT), Vol. 6* (Issue 01), 143-146.
14. Stepan Wood, B. J. (2006). Environmental Law for Sustainability. *Osgoode Digital Commons* , 1-18.
15. Swilling, A. S. (2013, February). Valuing green infrastructure in an urban environment under pressure — The Johannesburg case. *Ecological Economics*, 1-12. doi:10.1016/j.ecolecon.2012.05.008