GREEN ROOFING: A POTENTIAL SOLUTION TO GLOBAL WARMING PROBLEMS IN SRI LANKA

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1. INTRODUCTION

One of the most pressing threats currently is the increasing urbanization in the main cities of Sri Lanka (United Nations-Habitat, 2018). Urbanization is expanding at a similar rate throughout the island, including the main cities of Sri Lanka. According to preliminary findings, the metropolitan region grew at a 9.57 % annual pace between 1995 and 2017, which is extraordinary even by global standards. Over 300 spatial case studies were reviewed across the country, and the average yearly rates of urban spatial expansion were found to be far lower in Europe, North America, Africa, India, and China between 1970 and 2000. As a result of rapid urbanization, big buildings and other new projects are being constructed at the cost of green space. This resulted in a lack of vegetation, which reduced canopy interception and transpiration inside the urban region, resulting in a rise in temperature and a reduction in air humidity (Berndtsson, 2009).

Sri Lanka was placed sixth in the Global Climate Risk Index 2020 for its vulnerability to climate change risks, based on the repercussions of severe weather occurrences and the socioeconomic losses they cause. In the future, the country may lose a sizable portion of its people as a result of future climate migration. Additionally, weather disasters in 2018 claimed 38 lives in Sri Lanka, caused over 3 billion US dollars in damages, and resulted in a 1.24 % decline in per capita GDP (Eckstein et al., 2020). Unplanned urbanization exacerbates environmental problems such as natural catastrophes and pollution. Urban populations' sensitivity to events like rising temperatures, sea-level rise, and declines in freshwater supply in large cities has become a regular occurrence in a number of area (De Zoysa, 2021). Local warming produced by urbanization's overall trend has contributed to a share of global warming during the previous century, making it a critical concern from a climate change viewpoint (Paranunzio et al., 2019).

Green buildings and policies for smart development are one method for mitigating global climate change, and they will be crucial in the future for reducing global greenhouse gas (GHG) emissions. Energy usage in buildings accounts for more than a third of all GHG emissions. Approximately 43% of carbon dioxide (CO_2) emissions are a result of energy services needed by residential, commercial, and industrial buildings (Brown and Southworth, 2008). Green roofing is a common concept in green buildings, since global warming concerns may be handled in part by modifying the properties of a building's roof (Oberndorfer et al., 2007). The addition of plants and soil to vacant rooftop areas is usually seen as an useful way to increase the sustainability of buildings. The goal of this research is to investigate the role of green

roofing in urban rising structures in terms of its components, advantages, and limits, as well as trends.

2. METHODS

Roofs with vegetation growing on top of a growth medium are referred to as "green roofs" (substrate) (Oberndorfer et al., 2007). One of the primary goals of this approach was promoting plants on building rooftops, which would in turn give both aesthetic and environmental benefits as well as economic ones. Green roofs typically include vegetation, substrate, filter cloth, drainage material, root barrier, and insulation. Each component of an architectural green roof system has a specific purpose, and the nature of each component is dictated by its placement (Vijayaraghavan and Joshi, 2015).

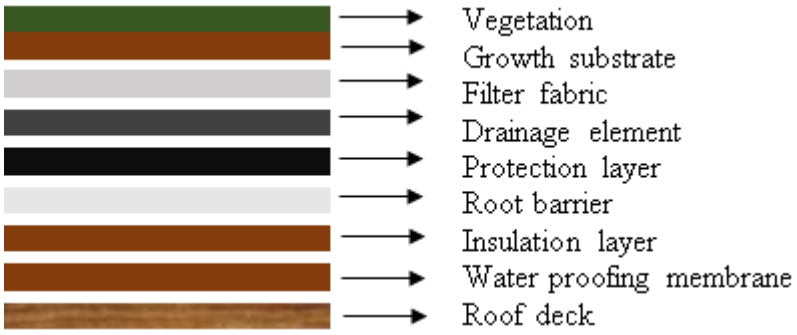

Figure 01: Schematic diagram of different green roof components

3. RESULTS AND DISCUSSION

Green roofs have been shown to minimize the danger of floods by retaining rainwater and delaying peak flow (Mentens et al., 2006). When it rains, the substrate and pores collect part of the rainfall that falls on green roofs. It may be taken by plants in a variety of ways and retained in their tissues or released into the atmosphere (Nagase and Dunnett, 2012). Rainwater runoff is decreased, energy consumption is reduced, environmental quality is enhanced (water and air quality), noise pollution is reduced, and roof life is extended. Additionally, green roofs help to mitigate the urban heat island effect and offer urban green space (Niu et al., 2010; Chen et al., 2015; Kader et al., 2021). The Babylonian Hanging Gardens, constructed about 500BC, are one of the best-known examples of ancient green roofs. Sod-covered roofs have grown in popularity in recent years as a method of sheltering dwellings from inclement weather. Although the notion of contemporary green roofs was inspired by ancient ways, technology improvements have made modern green roofs far more efficient, practical, and beneficial than their historical predecessors (Vijayaraghavan, 2016).

Constraints in green roof establishment and solutions

Green roofing is considered to have some constraints, especially in developing countries at least from the perspective of the public or policymakers (Vijayaraghavan, 2016). Without proper regulations and government support, the justification of the green roofing technology to the common public is difficult. Among the several hindrances that affect green roofing implementation, the cost is regarded to be the first and foremost. Green roof installation requires a significant long-term investment based on the type, labor, location, and equipment.

According to the cost of constructing a green roof in Chennai, India is around \$3-\$5/ft^2. Moreover, maintenance, operation, and disposals are some additional costs. However, a limited number of researches have been carried out related to the cost analysis of green roofing for the urban application so far. Furthermore, the potential profit is much higher than the expected losses. Proper maintenance of a green roof is another factor that confuses people. The green roof requires continuous watering, occasional fertilization, and regular weeding. The selection of plants is also limited to some succulent species making customers uncomfortable to adopt this technique. Nagase and Dunnett, (2010) suggested that by high plant diversity, using ground cover and removing older plants, weeds in green roofs can be controlled.

5. CONCLUSION

Green roofing is an efficient management practice to mitigate global warming issues due to urbanization. Numerous benefits of green roofing have been well-studied and established. Nevertheless, there is a significant knowledge gap that prevents green roofing to become popular. Considering the climatic conditions of Sri Lanka and the state of urbanization, studies are crucial for the successful implementation of green roofs. Furthermore, cost analysis should be done at different geographical locations to make policymakers understand the real scenario.

REFERENCES

Chen A., Lu J., Yuan J., Xu Y., and Yang Z, (2015). "Carbon sequestration potential of extensive green roofs," Zhongshan Daxue Xuebao/Acta Sci. Natralium Univ. Sunyatseni, vol. 54, no. 1, pp. 89–95, doi: 10.1347/j.cnki.acta.snus.2015.01.018.

United Nations-Habitat, (2018). "Is Sri Lanka one of the Least Urbanised Countries on Earth?," UN-Habitat - A Better Urban Future,. https://unhabitat.org/is-sri-lanka-one-of-the-least-urbanised-countries-on-earth.

Czemiel Berndtsson J., (2010). "Green roof performance towards management of runoff water quantity and quality: A review," Ecol. Eng., vol. 36, no. 4, pp. 351–360, doi: 10.1016/j.ecoleng.2009.12.014.

David Eckstein M. W., Vera Künzel, Laura Schäfer, (2020) "Global climate risk index 2020," 2020. doi: 978-3-943704-04-4.

De Zoysa M., (2021)."Urbanization, Climate Change and Environmental Resilience: Experiences in Sri Lanka," Urban Stud. Public Adm., vol. 4, no. 1, p. p46, doi: 10.22158/uspa.v4n1p46.

Paranunzio R., Ceola S., Laio F., and Montanari A., (2019). "Evaluating the effects of urbanization evolution on air temperature trends using nightlight satellite data," Atmosphere (Basel)., vol. 10, no. 3, pp. 1–20, doi: 10.3390/atmos10030117.

Brown M. A. and Southworth F., (2008). "Mitigating climate change through green buildings and smart growth," Environ. Plan., vol. 40, pp. 653–676, doi: 10.1068/a38419.

Oberndorfer E. (2007). “Green roofs as urban ecosystems: Ecological structures, functions, and services,” Univ. Calif. Press, vol. 57, no. 10, pp. 823–833, 2007, doi: 10.1641/B571005.

Vijayaraghavan K.and Joshi U. M., (2015). “Application of seaweed as substrate additive in green roofs: Enhancement of water retention and sorption capacity,” Landsc. Urban Plan., vol. 143, pp. 25–32, 2015, doi: 10.1016/j.landurbplan.2015.06.006.

Kader, S., Jaufer, L., Shiromi, K. and Asmath, A.M.M., (2021, November). Comparison of physical and chemical properties to find the alternative substrate material for the betterment of green roof technology. The international Academic Forum (IAFOR).

Mentens J., Raes D., and Hermy M., (2006). “Green roofs as a tool for solving the rainwater runoff problem in the urbanized 21st century?,” Landsc. Urban Plan., vol. 77, no. 3, pp. 217–226, 2006, doi: 10.1016/j.landurbplan.2005.02.010.

Nagase, A. and Dunnett, N, (2012). “Amount of water runoff from different vegetation types on extensive green roofs: Effects of plant species, diversity and plant structure,” Landsc. Urban Plan., vol. 104, no. 3–4, pp. 356–363, doi: 10.1016/j.landurbplan.2011.11.001.

Niu H., Clark C., Zhou J., and Adriaens P., (2010). “Scaling of economic benefits from green roof implementation in Washington, DC,” Environ. Sci. Technol., vol. 44, no. 11, pp. 4302–4308, doi: 10.1021/es902456x.

Vijayaraghavan K., (2016). “Green roofs: A critical review on the role of components, benefits, limitations and trends,” Renew. Sustain. Energy Rev., vol. 57, pp. 740–752, 2016, doi: 10.1016/j.rser.2015.12.119.

Nagase, A. and Dunnett, N., (2010). Drought tolerance in different vegetation types for extensive green roofs: Effects of watering and diversity. Landscape and urban planning, 97(4), pp.318-327.