Indian J. Applied & Pure Bio. Special Vol. 2(1): 230-235 (2021). **ISSN: 0970-2091**
National e-Conference on Biodiversity Building and Natural Resource Management (NC BBNRM) Date: 22nd-23rd, December, 2021 **A web of Science Journal**

Reviving Urban Forestry for sustainable Cityscapes; An insight to the Refuge of existing Natural Resources

Sajitha Siril*[1], Firosh Raja*[2] and Ajin Reji*[3]

*All authors carry equal weightage

[1]Department of Forestry, Uttar Banga Krishi Viswavidyalaya (UBKV), Cooch Behar, West Bengal (India)
sajithasirildas@gmail.com, +919496201259
[2*]Department of Seed Science and Technology, Kerala Agricultural University, Thrissur-680656 (India)
firoshraja007@gmail.com, +917012044799
[3]Master of Environmental Science, UWA School of Agriculture and Environment, The University of Western Australia (UWA), Perth, (Australia)
ajinreji03@gmail.com, +918606611682

Abstract

More than half of the world's population lives in urban areas. The dense population in cities is leading to unsustainable exploitation of natural resources like air, soil, water, and wildlife. Even though there are numerous scattered papers regarding urban forestry, their contribution to the sustainability of natural resources is less explored. This paper aims to coordinate various research fields in urban forestry through a literature review. The study indicates that the trend in publication on urban forestry shows a sharp increase in recent years. It further reveals that urban forestry is an innovative way to conserve urban natural resources for future generations, and they provide various direct and indirect benefits and ecosystem services.

The world's 56.15% population shares space and resources in urban areas since it attracts people for better opportunities and improved living standards. Consequently, an overflowing population combined with changing land-use patterns causes depletion of natural resources in cities. The excess pressure on these resources is reflected in the quality of living of the inhabitants. According to the World Air Quality report[18], "Air pollution contributesto about 7 million early deaths annually", and urban areas lead the $PM_{2.5}$ pollution rankings. Cities are heating up at twice the global average rate; the UNEP report[39]

[2*]Research Assistant

shows that by 2100, many cities worldwide could warm as much as 4°C if greenhouse gas emissions continue at current levels. Also, natural resources in cities confront various problems like urban flooding[40], heavy surface soil runoff, and water quality deterioration[31]. In this context, urban forestry emerges as a long term strategy to protect natural resources from different threats in urbanised locations.

Urban forests can be defined as woodlands and other tree components in urban areas, which are dedicated to enhance the sociological, physiological and economic well-being of urban society. FAO[13] describes urban forests as the backbone of the green infrastructure that bridges urban and rural areas and ameliorates the environmental footprint of cities.

Several studies highlight the benefits rendered from urban forests and green spaces. The vegetation components in urban areas regulate soil, water and air quality. Moreover, they play a crucial role in microclimate amelioration, temperature maintenance, and runoff reduction[35]. The urban vegetation provides cooling effects and simultaneously mitigate air pollution by intercepting gaseous pollutants and particulate matter[4,19,38]. Their role in noise pollution abatement is significant[30]. Urban forests improve the resilience of cities by enhancing socio-economic, ecological and physiological values[6,17]. Urban greens provide several cultural ecosystem services like recreation, aesthetic aspiration, social relation and spiritual experience[34].

The carbon sequestration potential of urban forests plays a role in alleviating the global climate crisis and global warming[16,23]. Urban Greens act as a 'Noah's ark' for the existing biodiversity and remaining resources in patches as it provides habitats for numerous animals, birds, and microbes, which enrich the biodiversity status of the city. Urban forestry contributes towards sustainable development goals (SDG) 3 (human health and wellbeing), SDG 6 (clean water and sanitation), SDG 8 (decent work and economic growth), SDG 11 (improving living standards of cities sustainably), SDG 13 (climate action) and SDG 15 (life on land)[4]. The current study tries to review the role of urban forestry in the sustainable development of cities with a special emphasis on natural resources: soil, water, air, vegetation and wildlife.

For this study, we conducted a quick literature search to explore the research patterns using databases such as Google Scholar, ScienceDirect and ResearchGate. The keywords included were 'Urban Forestry', 'Urban Greening', 'Natural Resource' and 'Sustainability'. Only peer-reviewed research articles in English were selected, excluding thesis and dissertations. About 155 documents were available following the search. After careful screening at the title and abstract levels, 52 relevant papers were selected for the full-text read. Potential articles were classified according to the specific research focuses. Further data extraction and meta-analysis were carried out using Microsoft Office packages. Trends in research in areas of interest were noted and analysed systematically.

Meta-analysis showed astonishing results on how urban forestry is understudied, even though it has a remarkable effect on

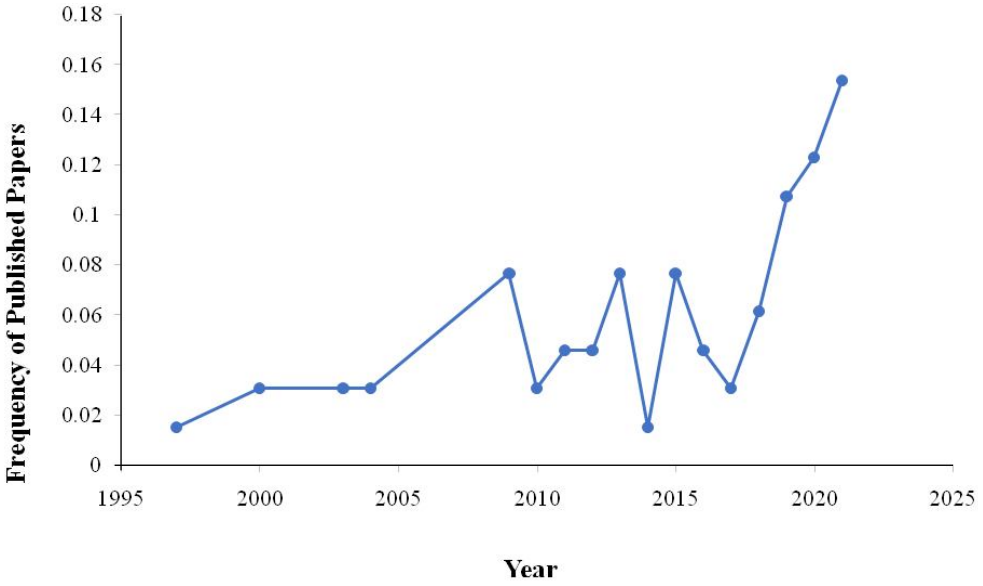

Fig. 1. Year-wise publication frequency of literature on urban forestry.

sustainable natural resource management in cities. It was found that the research frequency has increased over the last few years, attributed to the concerns on the global climate crisis, enhanced interest in sustainability, and increasing popularity of urban forestry (Figure 1). The latest papers regarding urban forestry interpret qualitative benefits through quantitative data analysis, which indicate the advancement of research and technology.

A classified table of specific and related spheres of research in urban forestry is shown in Table-1. The data shows that most of the articles deal with the benefits and ecosystem services of urban forestry. The provisional, regulating, supporting, and cultural services of urban forestry exhibit its importance and necessity in the cities (Figure 2). Concerning natural resource management, air and water are studied more compared to the soil, possibly due to the impact of air and water on the quality of urban life.

Table-1. Percentage frequency of publication on various urban forestry related topics

Discussed Aspect of Urban Forestry	Article Number (Percentage frequency)
1. Benefits	33.85
2. Ecosystem services	16.92
3. Natural Resource Conservation	
• Air	15.38
• Water	12.31
• Soil	3.08
4. Biodiversity enrichment	15.38
5. Challenges	7.69
6. Sustainability and resilience	7.69

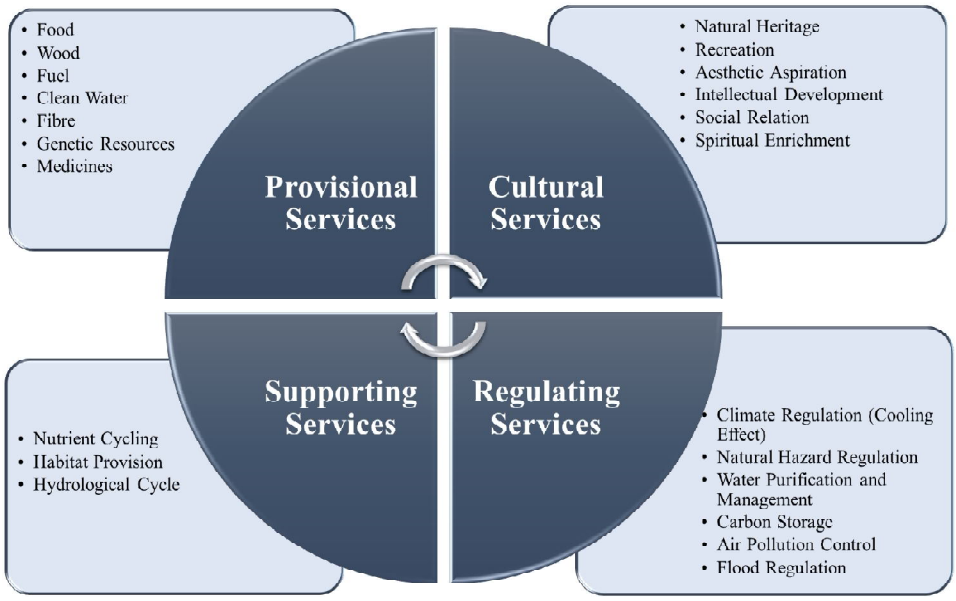

Fig 2. Ecosystem services of urban forestry.

There were ten articles on the role of urban forests in ameliorating air quality. Some studies reveal the ability of urban forests to mitigate air pollution by lowering the gaseous[10,27] as well as the particulate pollutant concentration in the atmosphere[2,3,5]. Urban forests also act as a carbon sink by sequestrating large quantities of carbon[11,36] which in turn reduces the major greenhouse gases and minimises global warming[1].

Urban forests help regulate the air temperature by producing a cooling effect through evapotranspiration and providing shade[7,14,26,29]. Additionally, it helps control noise pollution[12,20,32] and checks the wind speed in the cities[22,37].

The urban forest performs an integral part in regulating the city's hydrology by canopy interception of precipitation, delaying the runoff, providing rainwater storage, enhancing the infiltration efficiency and transpiration of captured stormwater[8,25,26]. In addition, they function as biofilters by removing various potential pollutants from the water[9].

Wildlife resources and biodiversity status of urban forest ecosystems are detailed in about ten paper which mostly studied on floral[15] and avifaunal diversity[21,33]. Trees in urban forests provide habitat, food and shelter to diverse organisms, enhancing ecological balance and preservation. Urban forestry is introduced as an innovative way to conserve genetic, species and structural levels of biodiversity[21,33]. In addition, biodiverse ecosystems can promote positive physical, mental, social health and well-being[27].

There are several studies regarding the function of urban forestry in enhancing the sustainability of the cities. The benefits include the improvement of air, water, and soil quality. The urban vegetation also plays a significant role in regulating the wind speed, air temperature, and hydrology of the locality. A general trend followed by the researchers exhibits a change in focus from broad benefits of urban forests to more complex quantitative studies.Even though the concept of urban forestry is relevant in this modern context, it is not widely popular and is still ignored in urban planning activities. Thus, new policy intervention and awareness must go in tandem to extend the research outcomes to benefit the immediate community. Reviving urban forestry by conserving old green patches and introducing designed green spaces would benefit the civic society altogether.

References :

1. Afuubi NA, L Fanglin and E Owusu (2020) *International Journal of Management Sciences and Business Research, 9*(11): 179-187.
2. Baumgardner D, S Varela, FJ Escobedo, A Chacalo, and C Ochoa (2012) *Environmental Pollution, 163:* 174–183.
3. Beckett KP, PH Freer-Smith and G Taylor (2000) *Global Change Biology, 6*(8): 995–1003.
4. Borelli S, M Conigliaro, and F Pineda (2018) *Unasylva, 69*(1): 3-10.
5. Chaturvedi A, R Kamble, N G Patil, and A Chaturvedi (2013) *Urban Forestry & Urban Greening, 12*(1): 79–87.
6. Chaudhry P, K Bagra, and B Singh (2011) *International Journal of Environmental Science and Development, 2*(2): 98-101.
7. Chen A, XA Yao, R Sun, and L. Chen (2014) *Urban Forestry & Urban Greening, 13*(4): 646–654.
8. Coville R, T Endreny, and DJ Nowak (2020) In *Ecological Studies* (pp. 459–487) Springer International Publishing.
9. Denman EC, PB May, and GM Moore (2016) *Journal of Environmental Quality, 45*(1): 207–214.
10. Douglas ANJ, PJ Irga, and FR Torpy (2019) *Environmental Pollution, 247:* 474-481.
11. Dwivedi P, CS Rathore, and Y Dubey (2009) *Applied Geography, 29:* 194–200.
12. Fang CF, and DL Ling (2003) *Landscape and Urban Planning, 63*(4): 187–195.
13. FAO (2016) *Guidelines on urban and peri-urban forestry*, *178:* 2-7.
14. Farrugia S, MD Hudson, and L Mcculloch (2013) *International Journal of Biodiversity Science,* Ecosystem Services & Management, *9*(2): 136–145.
15. Ghosh K, S Bardhan, and S Roy (2018) *Indian Forester, 144*(4): 354-362.
16. Haase D (2021) *Urban Forestry & Urban Greening, 64:* 127304.
17. Huff ES, ML Johnson, LA Roman, NF Sonti, C C Pregitzer, L K Campbell, and H McMillen (2020) *Arboriculture & Urban Forestry*, *46*(3): 185–196.
18. IQAir (2020) *World Air Quality report,* pp. 4-15.
19. Jaganmohan M, LS Vailshery, S Mundoli, and H Nagendra (2018) *Urban Forestry & Urban Greening, 32:* 64–70.
20. Kalansuriya CM, AS Pannila, and DUJ Sonnadara (2009) *Proceedings of the Technical Sessions, 25:* 1–6.
21. Khera N, V Mehta, and BC Sabata (2009) *Urban Forestry & Urban Greening, 8:*

187–196.
22. Khodayari N, A Hami, and N Farrokhi (2021) *Journal of Architectural Engineering Technology.*
23. Konijnendijk CC, S Sadio, TB Randrup, and J. Schipperijn (2004) *Journal of Arboriculture, 30*(5): 269-276.
24. Kuchelmeister G (2000) *Unasylva*, *51:* 49-55.
25. Kuehler E, J Hathaway, and A Tirpak (2017) *Ecohydrology*, *10*(3): e1813.
26. Livesley SJ, EG Mcpherson and C Calfapietra (2016) *Journal of Environmental Quality, 45*(1): 119–124.
27. Marselle MR, SJ Lindley, PA Cook, A Bonn (2021) *Current Environmental Health Reports, 8:* 146–156.
28. Mcpherson EG, D Nowak, G Heisler, S Grimmond, C Souch, R Grant, and R Rowntree (1997) *Urban Ecosystems, 1*(1): 49–61.
29. Moss JL, KJ Doick, S Smith, and M Shahrestani (2019) *Urban Forestry & Urban Greening, 37:* 65–73.
30. Mukherjee A (2015) *IOSR Journal of Humanities and Social Science*, *20*(8): 89-94.
31. Muller A, H Osterlund, J Marsalek, and M Viklander (2020) *Science of the Total Environment, 709:* 136125.
32. Önder S, and A Akay (2015) *Journal of Engineering and Economic Development, 2*(2): 23–35.
33. Panda B P, B Mahapatra, AA Sahoo, SS Ray, S P Parida, and A Pradhan (2020) *Asian Journal of Conservation Biology, 9* (2): 290-297.
34. Sen S, and SK Guchhait (2021) *Ecological Indicators, 123:* 107338.
35. Sharma P, and P Ghimire (2019) *Grassroots Journal of Natural Resources*, *2*(1-2): 53-62.
36. Stoffberg GH, MW Van Rooyen, MJ Van Der Linde, and H T Groeneveld (2010) U*rban Forestry & Urban Greening, 9*(1): 9–14.
37. Tahir HMM, and TA Yousif (2013) *Journal of natural resources and Environmental studies, 1*(2): 1-3.
38. Tallis M, G Taylor, D Sinnett, and P Freer-Smith (2011) *Landscape and Urban Planning, 103*(2): 129–138.
39. UNEP Report (2021) *Beating the heat: a sustainable cooling handbook for cities,* Pp. 3-9.
40. University of Maryland and Texas A&M University (2018) *The Growing Threat of Urban Flooding: A National Challenge,* pp.1-10.