



Fostering Sustainable Development through Green Libraries: Cultivating Reading Habits among Readers

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HOW TO CITE

Khatun, S., Jaman, F., & Khatun, M. A. (2026). Fostering sustainable development through green libraries: Cultivating reading habits among readers. *Development Compilation*, 19(1), 9–28. <https://bips.bd/journal>

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ARTICLE HISTORY

Received: 20 June 2026

Revised: 10 July 2026

Accepted: 13 July 2026

Available online: 20 July 2026

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Abstract

This paper examines the role of green libraries in promoting sustainable development and fostering reading habits within diverse communities. It explores how eco-friendly design, energy-efficient technologies, and inclusive programs contribute to environmental sustainability and community well-being. The study was adopted on a comprehensive literature review approach of global green library initiatives. It explores sustainable practices, including renewable energy integration, digital service expansion, and eco-literacy programs in library settings. Green libraries make significant contributions to multiple Sustainable Development Goals (SDGs), particularly in areas related to education, the environment, and social inclusion. These libraries act as community hubs that promote literacy, environmental awareness, mental well-being, and civic engagement. Despite their advantages, green libraries encounter notable challenges, including high implementation costs and ongoing digital divides. The study provides actionable recommendations for policymakers, librarians, and stakeholders. Emphasis is placed on integrating sustainability into library policies, encouraging collaborative initiatives, and leveraging technology to enhance green library infrastructures. This paper underscores the transformative potential of green libraries in bridging ecological responsibility with intellectual and social development. It positions green libraries as key drivers in cultivating a culture of sustainability and lifelong learning.

Keywords: GreenLibrary, Sustainable Development, Reading Habits, Library Design Standards, Social Inclusion, Digital Service

1. Introduction

In the last decade, the world has been moving in respect to the green. Libraries are not distant from the green movement. The library is the store house of knowledge, individuals representing themselves as aware citizen in society by gathering knowledge about sustainable development through a green library. Recently, environmental pollution has reached alarming levels. Libraries must endeavor to fulfill their roles and adopt sustainable practices to contribute positively to society and the environment, raise awareness about environmental issues, and promote eco-friendly etiquette in the community. Green libraries are also known as sustainable libraries. Green libraries are eco-friendly libraries that are planned, constructed, recovered, and executed in a resource-efficient manner (Chandran & K, 2020; Vellaichamy & Jey shankar, 2014). The term “green” is defined as concerning or supporting environmentalism, and “sustainable” relates to “forms of human economic activity and culture that do not lead to environmental erosion, esp. excluding the long-term depletion of natural resources (Oxford English Dictionary, 1989, p. 811).

The term 'Sustainability' is defined in Online Dictionary of Library and Information Science (ODLIS) as, "the capacity to meet the needs of the present without compromising the ability of future generations to meet their own needs. Green or sustainable libraries are the formation that is schematic, manufactured, regenerated, operated, or recycled in an ecological and resource-effective manner. The green library movement emerged in the early 1990s and is achieving popularity in the field of library and information science. Library professionals are also operating to progress a library that minimizes electricity expense, is energy efficient, and environmentally friendly (Meher & Parabhoi, 2017). Where as the Green Library Movement focused on an environmental understanding of sustainability by “greening” library buildings, practices, and services (Antonelli, 2008).

Today, libraries and librarians are progressively desired to act promptly in relation to the global sustainability agenda. Worldwide, libraries and librarians have built task forces, networks, and partnerships to execute proactively for sustainable advancement and change (Kraljević & Lukačić, 2015; Tanner et al., 2019). IFLA's adaptation of the United Nations 2030 Agenda of “Transforming our world” and the UN Sustainable Development Goals (SDGs) exemplifies a thriving focus on libraries and librarians working with or subscribing to sustainability and sustainable development (Mathiasson & Jochumsen, 2022; Hauke, 2017, p. 1). A green library, also called a sustainable library, that's several motives because libraries should integrate green features into their structures. It's vital for the health of library users and the earth on which we humankind live; green libraries are a part of the green structure movement. Green libraries are being demonstrated all over the world with multiple high-profile systems bringing the concept into the mainstream (Ingole & Kumari, 2021). Libraries are a vehicle for the advancement of society. The construction of a green library is cost-effective. Construction ingredients and energy resources are readily available. It doesn't require any extreme budget allocation. It is very crucial for the health of our Earth. We can eliminate carbon emissions by administering the green library (Chandran & K, 2020).

The economy and ecology are the two most important elements for creating healthy and flourishing sustainable libraries. One aspect of libraries is the use of resources, saving money, time, and keeping the relationship between living things and their environment eco-friendly. Green library management focuses on a new mindset of taking accountability for the stability of the atmosphere, health of library patrons and staff, and catering to the needs and interests of future generations of users (Kumar & KD, 2014). In its 2015 resolution on sustainable libraries, the American Library Association states “libraries that exhibit leadership in making sustainable decisions that positively determine climate change, respect and use natural resources, and create healthy indoor and outdoor environments will stabilize and reduce their long-term energy costs, aid build more sustainable

communities, and thereby enhance community support for the library” (American Library Association, 2015; Mwanzu et al., 2023).

The Green Library acts as a community center, promoting social inclusion and tackling SDG 10 (Reduced Inequalities) by providing equitable access to environmental and educational resources. On the other hand, green libraries include digital technology such as virtual reading rooms and digital lending to cut down on paper use and carbon emissions in order to achieve SDG 12 (Responsible Consumption and Production) (Sharma & Sarkar, 2024). To reduce the carbon footprint of the green library system, it decreases the CO₂, which can help users' health. Green Libraries present as examples for other institutions to adopt sustainable practices amidst offering resources and programs that provide continuous education on sustainability. Green Library fosters reading habit among providing LEED lighting, which reduces eyestrain. Reading is a vital habit and one kind of tonic to mind and soul. Reading is also an occupational leisure and pleasure; it will make our hours pleasant, as long as we live. Reading is a basic human skill, including the reader's eyes, his brain, and the matter being read (Vellaichamy & Jeyshankar, 2014). Green Library has significant features, including ecofriendly site location, Community Engagement and Educational Programs, Improved Indoor Air Quality, Water and Energy Preservation Enhancements, which are the hubs to increase the readers' reading habit. By providing green materials and technology user can get prompt access to their requirements, such as Online encyclopedias, novels, children's books, and geographical guides, which are easily accessible via user-friendly OPAC systems. To select the accurate site in densely populated areas, it ensures convenient access via public transportation, walking, or biking, more individuals are likely to visit regularly in a diverse group of people. Further water preservation strategies like rainwater harvesting and landscape irrigation add natural beauty to the library's atmosphere, creating attentive outdoor spaces conducive to reading.

Features of Energy efficiency by Passive solar designs and energy-efficient lighting provide natural, glare-free illumination, making reading enjoyable for extended periods. Fostering recycled and eco-friendly materials in the library's interiors creates an aesthetically pleasing and environmentally conscious atmosphere, which play the vehicle to read more and more to the reader. Proper ventilation and the use of plants to improve air quality help create a relaxing ambiance, encouraging readers to spend more time in the library. Although existing literature includes narrative reviews, conceptual analyses, and case studies on green libraries, there remains a lack of systematic and comprehensive knowledge synthesis, particularly because many studies focus on green building design, energy efficiency, sustainable practices, AI, and the green library movement while providing insufficient methodological details such as database selection, search strategies, and inclusion and exclusion criteria. Consequently, the present study addresses these methodological and conceptual gaps by employing a comprehensive literature review approach that systematically integrates scholarship on environmental sustainability, libraries, reading culture, and the SDGs through structured database searches, clearly defined keywords, and rigorous screening procedures. This study aims to explore the role of green libraries in promoting sustainable development, examine their influence on reading habits among different user groups, identify sustainable library practices that enhance environmental awareness and learning engagement, highlight major international green library initiatives, explain techniques and methods for greening libraries, and identify relevant green library standards.

2. Methodology

This study employs a comprehensive literature review methodology to synthesize existing scholarly work on green libraries, sustainable development, and the cultivation of reading habits. Though there has conceptual

discussion, case studies, and narrative reviews on green libraries, prior studies has lack of integration of educational and environmental dimensions of green libraries and reading habits. To address these limitations, a comprehensive literature review approach was employed through a structured and multistage procedure. Firstly, the most relevant study was recognized across multiple academic databases, including Google Scholar, ResearchGate, and selected library and information science journals via certain keywords such as green library, sustainable library, eco-friendly library, reading habits, and sustainable development to ensure exhaustive coverage of the topic. Secondly, we rejected irrelevant papers and selected relevant articles that were double-checked for references, strengthening the scientific value of this study. Besides, we accessed the Library Journal Article. Thirdly, the included literatures were reviewed, coded, and synthesized meticulously to identify frequent themes, patterns, and research gaps. Moreover, this review approach provides a holistic synthesis of existing knowledge and exhibits a stronger empirical foundation for denoting trends, gaps, and future research instructions associated to green libraries and their role in fostering sustainable development and reading habits.

3. Literature Review

In the field of library and information science, the green library movement is currently gaining steam. According to the Online Dictionary of Library and Information Science (ODLIS): “Green library or sustainable library is defined as a library designed to reduce negative effect on the natural environment and increase indoor environmental quality using careful site selection, utilize of natural structure materials and biodegradable products, preservation of sources like water, energy, paper, and responsible waste disposal reusing etc.” (Sivaprasad et al., 2024). Further, according to New World Encyclopedia green library, also known as a sustainable library, is, “a library inaugurated with environmental concerns in mind.” Green Libraries are conventionally defined via building aspects viz. eliminating “negative impact on the natural environment” and enhancing “indoor environmental quality using careful site selection, use of natural construction materials and biodegradable products, preservation of resources (water, energy, paper), and responsible waste disposal (Hauke, 2015). Public awareness of green libraries increased as the literature on the topic began to develop (Demirtas Dogan & Gulpinar, 2023).

The idea of “green libraries” has become more well-known recently as a creative answer to the global demand for sustainability (Afacan, 2017). Digital trash has an adverse effect on the environment, solibraries must adopt sustainable methods. Green library projects are salient to sustainable development and environmental conservation by delivering eco-friendly design, green libraries seek to foster sustainable development and diminish their negative impacts on the climate (Singh & Mishra, 2019). They demonstrate to the larger framework of sustainable development goals (SDGs) by applying eco-friendly procedures in libraries, the Green Library Movement, which was founded in the 1990s, seeks to lessen the hostile effects on the environment. This encompasses conforming to sustainable practices inside the library, providing green services, and greening the current buildings.

The movement places a strong emphasis on the value of a welcoming environment for students as well as the instructive potential of sustainable building. Furthermore, Green Library acts as a role model for environmental supervision and is essential in encouraging people to read (Fedorowicz, 2020; Armstrong, 1971; Barnes, 2012; Binks et al., 2014; Miller, 2010; Antonelli, 2008). Research investigates architectural design methods to lower energy usage through eco-conscious techniques using sustainable materials in construction and state of the art technology, water management, and renewable energy to ensure sustainability, affordability, and environmental efficiency, which improve the health of the library environment. Green libraries promote

sustainable practices, aligning with SDGs 13 and 11 by constructing and recycling buildings in an environmentally friendly manner (Meher&Parabhoi,2017;Mwanzu^{et al.},2023; Afacan, 2017; Antonelli, 2008).

Furthermore, green libraries are experimental in raising environmental awareness by reducing the environmental impact of library operations, maintaining sustainability for future generations, and natural light enriches psychological health for both patrons and users to create a learning and working experience in library facilities. In this context, green information literacy focuses on critical thinking, sustainable behaviors, and the effects of human behavior on the environment. It aims to promote behavioral change at the individual and institutional levels to harmonize library operations with environmental oversight (Bincy & Vasudevan, 2023; Datta, 2015; Kurbanog& Boustany, 2014; Mwanzu et al., 2023; Genovese & Albanese, 2011). Another significant role of green libraries is their capacity to cultivate reading habits by providing natural lighting, resource conservation, and multipurpose areas that promote cultural and educational activities are given top priority in sustainable design such as blend innovative architecture, green technologies, and community-focused strategies, gardens and open air reading areas, create tranquil settings which delivers accessibility, community involvement, encourage prolonged engagement with books and the creation of welcoming areas for study, leisure, and social interaction (Flannery & Smith, 2013; Samuel, 2022;Ahmad^{et al.},2023;Wordu&Nwaizugbu,2021).

In the worldwide push for sustainability, green libraries contribute to a wide range of methods to the advancement of the Sustainable Development Goals (SDGs) by demonstrating a dedication to social responsibility, environmental care, and economic sustainability. In line with SDG 13 (Climate Action), the idea of a “green library” absorbs sustainable resource management techniques, energy generated from renewable sources, and environmentally friendly architectural designs. By insulating energy-efficient technologies such as solar panels, Energy Management System (EMS), LEED lighting and motion sensors, rainwater harvesting system, smart HVAC system, etc., that eliminate carbon footprint and promote environmental sustainability in a green library. Additionally, green libraries reinforce SDG 4 (Quality Education) by providing environmental literacy and promoting access to knowledge. Green libraries contribute to SDG 11 (Sustainable Cities and Communities) by making cities more inhabitable, to encourage community people to interact with and clasp sustainable lifestyle, and social cohesiveness.

Besides, the green library organizes educational events, a library outreach program about going green, which fosters a sustainable community and functions as a center for lifelong learning. Green libraries represent SDG 12(Responsible Consumption and Production) by incorporating the rainwater harvesting system, efficient resource use, viz., digital collections providing e-book, online journal, reducing paper consumption, purchasing eco-friendly products, recycled paper, FSC-certified furniture and materials, non-toxic cleaning supplies, etc. Furthermore, the green library converts biodegradable waste by reusing the waste from the library café, which promotes consumption and production. Incorporating eco-practices in a library, it mitigates climate change.

Green libraries teach the public the value of reducing, reusing, and recycling through workshops, seminars, and cantered around communities’ projects (Sharma & Sarkar, 2024). Despite their benefits, the implementation of green libraries faces increasingly complex challenges, including high initial costs, restricted awareness, cybersecurity threats, misinformation, and digital divides, which can hinder progress towards achieving the SDGs. Green libraries need partnership from international organizations, government agencies, civil society, and the commercial sector to advance sustainable development goals, protect resources, and promote environmental inclusiveness. Policymakers should invest in digital infrastructure for libraries and promote digital literacy programs, particularly in underserved areas, to support green library initiatives that

reduce environmental impacts through digital services aligned with sustainable development (Oyedokun, 2022).

Green libraries have emerged as transformative spaces that not only promote sustainability but also influence literacy, life-long learning, and equitable education, all of which are critical for sustainable development by providing broad access to a variety of information and services. These libraries offer an inclusive environment, catering to humankind from varied age groups, socioeconomic backgrounds, and sustainable community development while acting as catalysts for economic, cultural, and educational advancement (Bortolotto & Skounti, 2023; Okechukwu et al., 2024). For children and young readers, green libraries supply a nurturing space that fits education with environmental awareness. The Central Public Library launched My Tree House, the first green library for kids, which consists of energy-efficient LED lighting, eco- friendly tapestries, and refurbished bookshelves are all part of its design to stimulate inquiry and environmental consciousness, engaging features such as the "knowledge tree" shadow play wall teach kids about energy saving and environmental issues. in 2013. The library conducts storytelling sessions, workshops, and theme-based activities which foster environmental education, also provoke early literacy, and provide awareness about love for books and nature concurrently (Bodh, 2021).

On the other hand, the green library accommodates digital advances, viz., augmented reality (AR) and virtual reality (VR) to offer hypnotic educational experiences that tackle environmental concerns, through which Teenagers and young adults explored the innovative ideas from these technological current features. Besides, Digital platforms ensure to enlarge access to materials and services, connect a wider audience, and provide online materials. Furthermore, young adults can engage in peer learning and creative projects by creating maker spaces that deal with accessing a variety of information sources, such as online resources, databases, eBooks, and audiobooks (Wordu&Nwaizugbu, 2021; Okechukwu et al., 2024). Respectively, this apparatus enhances reading skills as well as fosters critical thinking, problem-solving skills, and self-improvement. Green libraries provide the opportunity for individuals to exchange their own cultural thoughts, to explore a wide range of topics, and stay informed about global issues due to hosting cultural events, book clubs, skill-building workshops, and dialogues among community members (Abdullah et al., 2015). The Green library serves as the vehicle to make smart citizens by capturing the technological and sustainable practices among individuals.

Green libraries enhance motivation, making them ideal spaces for uninterrupted reading and intellectual pursuits. Senior citizens, often overlooked in traditional library settings, find green libraries particularly provide natural light, site location, and zone design, which play a vital role in fostering reading habits. Natural light enhances alertness, cognitive performance, and mood, establishing a calming and attentive reading atmosphere. A well-planned site location maximizes daylight hazard and integrates serene surroundings, reducing distractions. Thoughtful zone design, such as dedicated adult areas with cozy seating and nature-engaged spots, a calm and peaceful ambience, reading books, and access to outdoor spaces where visitors can relax and enjoy the surroundings, further supports focused and enjoyable reading experiences. Beyond just lending out books, green libraries are community centers that provide engaging activities that fosters a love of reading and exploration while reducing feelings of loneliness and isolation, promote social interaction social interaction and reducing feelings of isolation.

Green libraries often organize community events and reading programs specifically for seniors, which encourage reading habits because they provide connected, inclusive, and encouraging environments by fostering trust, participation, and a sense of belonging through cooperative projects, cultural events, and common objectives as they promote mental well-being and active aging through regular meetings with books (PERMAISURI & XUAN, 2023). Furthermore, marginalized and underserved communities benefit immensely

from green libraries, which act as hubs for information sharing, literacy, environmental awareness, collaboration, and skill development, promoting inclusivity across socioeconomic groups, knowledge dissemination, and empowerment. These libraries promote self-expression, creativity, and interaction through their inviting environments, craft programs, and collaborative workspaces. Green libraries foster connections, learning, and personal development by bridging the gap between different socioeconomic groups (Aabø & Audunson, 2012; PERMAISURI & XUAN, 2023).

In summary, green libraries influence reading habits across diverse user groups by offering Energy-efficient lighting, renewable energy sources, and passive solar design. These sustainable library features that produce cozy, environmentally friendly areas, from nurturing early literacy in children to promoting lifelong learning among adults, exemplify how sustainability and education can coexist harmoniously. By embracing the principles of green library design and operation via enhancing lighting, temperature, and air quality, these design features lessen distractions and encourage concentration. Communities worldwide can cultivate a culture of reading and sustainability, contributing to a more informed and equitable society (PERMAISURI & XUAN, 2023). The Green Library is categorized as an environmentally friendly library or a sustainable library. Based on your literature review, the main literature gap is that most studies discuss green libraries from the perspective of sustainability, architecture, environmental awareness, SDGs, and library services, but there is limited focused research on how green library features directly influence users' reading habits across different groups. Your review mentions children, young adults, senior citizens, and marginalized communities, but the relationship between green library design and actual reading behavior is still not deeply examined.

4. Results

Standards or Norms for Green Libraries



Figure 1: Green Library Standards

Figure 1. shown that green library standards demonstrate core green building evaluation frameworks and organizations, including COSTFORD, HTG, BREEAM, GRIHA, AND LEED (adapted from Ingole & Kumari, 2021).

Centre of Science and Science and Technology for Rural Development (COSTFORD)

It's a non-profit voluntary Association established in 1984 with technological aid in green structure technology. It focuses on the use of energy-efficient methods and accouterments, viz., padding arbor roofing, exposed brickwork, bamboo, slip-up, etc., and reduces the use of accouterments similar to cement, bricks, sword, etc. (Ingole & Kumari, 2021).

Habitat Technology Group (HTG): HTG productively designs structures with nominal cost and the least effect on the eco-friendly terrain. It's also a non-profit government association established in 1987 in Kerala. Till now, HTG has formed over 1 lakh green structures around the world (Ingole & Kumari, 2021).

Building Research Establishment Environmental Assessment Method (BREEAM): It's the world's longest-established system for evaluating, standing, and certifying the sustainability and environmental aspects of the structure. It has been working in over 50 countries around the globe and has handed further than structures the BREEAM certified structure marks (Ingole & Kumari, 2021).

Herbage Standing for Integrated Habitat Assessment (GRIHA): TERI (The Energy and Coffers Institute, New Delhi) is another association that's at the forefront of the green structure movement in India. It was TERI who forecasted the need for the development of an indigenous tool for a standing green structure in India, which led to the foundation of 'GRIHA'. The Energy and Resource Institute (TERI) was established in 1974 with the vision of working in the direction of clean energy, water conservation, waste management, pollution control, air quality control, eco-friendly environment, etc. TERI developed a standard system named GRIHA. In the time 2007 Government of India espoused GRIHA as the public standing system for green structures (Ingole & Kumari, 2021).

Leadership in Energy and Environment Design (LEED): In the time 2000, the LEED (Leadership in Energy and Environment Design) was established under the association of USGBC (United States Green Building Council). The LEED is the internationally honored body that produces the framework for the Eco-friendly, cost-effective, well-constructed green structures. The green structure can qualify for four situations of an instrument, such as Pukka 40-49 points, tableware 50-59 points, gold 60-79 points, and platinum 80 points (Ingole & Kumari, 2021).



Figure 2: Green Library Element

Figure 2 discovered the major green library elements: resource conservation, plastic-free library, waste reduction and recycling, energy consumption, green infrastructure, sustainable building materials, and indoor air quality (Tanzin & Hoq, 2024; Ingole & Kumari, 2021; Meher & Parabhoi, 2017; Kumar & KD, 2014).

Key Components of a Green Library

A Green Library is designed to minimize environmental impact and promote sustainability through various features. Below are some essential components that contribute to making a library eco-friendly:

Resource Conservation: A green library emphasizes effective use of natural resources, viz. water, energy, and paper, and conserves through water-saving installation, rainwater harvesting, utilizing digital resources instead of printed materials, notebooks made from recycled paper, etc. (Tanzin, &Hoq, 2024).

Plastic-Free Library: A library can establish an environmentally friendly environment by reducing the use of plastic-based stationery and promoting refillable pens, biodegradable packaging, and reusable water bottles among visitors. Additionally, a plastic-free library motivates the use of sustainable alternatives such as cloth or jute bags instead of plastic ones (Ingole & Kumari, 2021).

Waste Reduction and Recycling: A green library is created by reusing old books, reshaping furniture, and donating outdated materials instead of discarding them also subscribe to waste reduction. Furthermore, libraries can digitize their resources to cut down on paper waste.

Energy Consumption: Energy consumption can be fixed by diverse methods such as motion-sensor lights, and energy- saving HVAC systems, energy-efficient lighting (such as LED bulbs), Renewable energy sources,

Rooftop photovoltaic (PV) systems (such as solar panels), etc. Moreover, enhancing natural light through well-placed windows and skylights can diminish dependence on artificial lighting (Kumar & KD, 2014; Meher & Parabhoi, 2017).

Green Infrastructure: The physical structure of a green library is designed to be environmentally responsible. Features such as green roofs, rooftop gardens, and vertical greenery improve insulation and contribute to temperature regulation. The inclusion of outdoor reading spaces, gardens, and tree plantations also enhances the environmental value of the library (Tanzin, &Hoq, 2024).

Sustainable Building Materials: Eco-friendly libraries capture sustainable building materials via using Bamboo, recycled wood, and non-toxic paints are preferred over conventional materials that may damage the environment (Tanzin, &Hoq, 2024).

Indoor Air Quality: Green libraries incorporate clean and healthy indoor air by maintaining proper ventilation systems, air-purifying plants, non-toxic cleaning supplies, and avoiding the use of chemicals and low-emission materials, which is crucial for both library patrons and staff (Kumar & KD, 2014; Tanzin, &Hoq, 2024).

Table 1. encompasses the major green library green libraries international initiatives, such as name of the libraries, country belong and features etc. (Kumar, & KD, 2014).

Table 1: Green Libraries International Initiatives

Sr.	Name of the Libraries	Country Belong	Features
01.	Any think Brighton, Brighton	USA	First carbon-positive library in USA (Kumar, & KD, 2014).
02.	Ballard Branch Seattle Public Library, Seattle	USA	Green roof , conserve rain water, adds solar panels, skylight s to use daylight and recycled carpet USA (Kumar, & KD, 2014).
03.	Blair Library, Fayetteville Public Library	USA	First building in the state of Arkansas to register for LEED certification and features rainwater catch for irrigation, white membrane roof, cork flooring, recycled content furnishings, low VOC finishers and fabrics(Kumar, & KD, 2014).
04.	Bozeman Public Library, Bozeman	USA	Utilizes daylight, green materials that have been recycled, Photovoltaic system, received LEED silver certification (Kumar, & KD, 2014).
05.	Crowfoot branch, Calgary Public Library, Calgary	Canada	Incorporates energy and daylight harvesting, reduce the use of water and use recycled materials (Kumar, & KD, 2014).
06.	Spanish Peaks Library, Walsenburg	UK	Geothermal system for heating and cooling. Flooring made of recycled rubber and recipient of Stephen H Richard award in 2010(Kumar, & KD, 2014).
07.	Helsinki	Germany	A green roofed and solar powered library (Kumar, & KD, 2014).
08.	Kanazawa	Japan	A spacious and natural light filled environment supported by 6,000 small circular windows (Kumar, & KD, 2014).

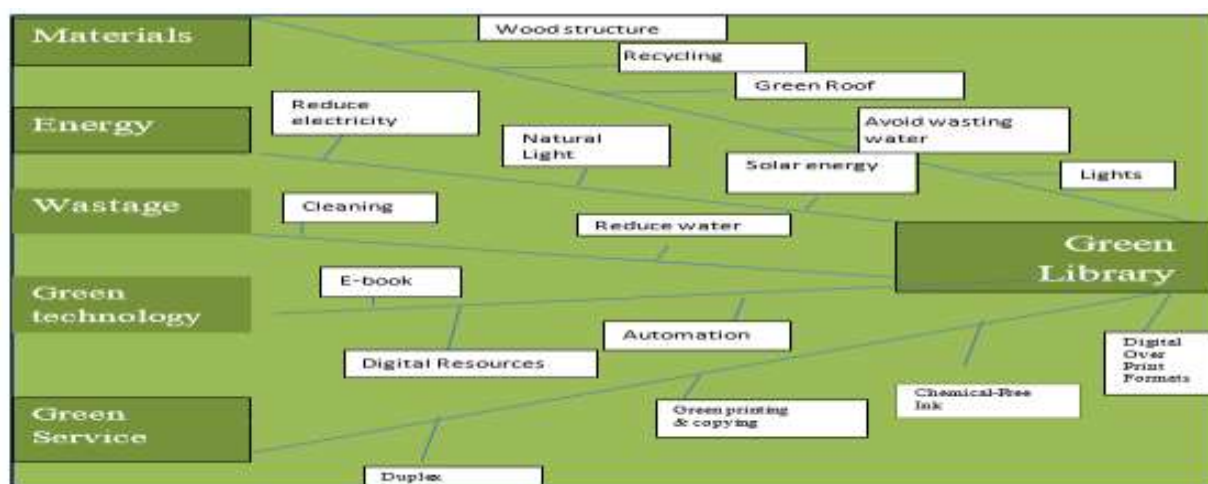


Figure 3: Greening methods for the library (Kumar & KD, 2014).

Figure 3 explores the greening methods for the library materials, wastage, green technology, and green services (Kumar & KD, 2014; Mallo et al., 2024; Singh & Mishra, 2019).

To create the Green Library, we must adapt some techniques. It is enlisted below-

Materials: For going green library fixes strategically placed windows, eco-friendly light bulbs, geothermal heater and solar tubes, put soft pads, purchase eco-friendly computers etc. which saves costs, reduce electricity, to protect the floor, to diminish noise to meet the sustainable environment (Kumar & KD, 2014).

Wastage: A Library is established an eco-friendly by maintaining cleanliness through wastage materials, accountable disposals of materials like paper, plastics, e-wastage and promoting usages of organic waste such as coffee grounds, food scraps to create compost for library gardens (Kumar & KD, 2014).

Green Technology: Creating green technology in a green library involves integrating energy-efficient systems such as digital resources, cloud-based services, and automated book management enhances sustainability (Mallo et al., 2024).

Green Services: Greener services are printing and copying. This method involves the use of low-VCO (Volatile Organic Chemical) inks, recycled paper, energy-efficient computers and equipment, remanufactured laser toner cartridges and ink cartridges for printers, paperless or electronic information dissemination. YSoftSafeQ delivers comprehensive management and administrative control of all printing, copying and scanning operations. It provides high levels of security for all documents, cost savings, conservation of environmental resources, and greater convenience for users (Singh & Mishra, 2019).

Successful Green Library Example

Tu Delft Library

The TU Delft library is more than just a collection of books. The University campus is encompassing by lawns, flowers, and trees, offering an informal setting for students and professors to meet. The library's construction with a green roof and cone house that has four levels of typical study space linked by a helical stair. It provides daylight to the internal reading room via the glazed roof. The library creates use of underwater storage, which assists in cooling. The building consists of three critical green elements such as a green roof, cold storage, and environment facades (Bodh, 2021).



Rangsit University Library

Environmental preservation has been main concern of Rangsit University Library since 2004 when

Figure 4: Source: (In habitat - Green Design, Innovation, Architecture, Green Building, 2010)

there was energy crisis in Thailand. In that movement university has announced energy conservation policy. As per green library standard library has also separate the litters as general waste, recycle waste and hazardous waste. Not only this library has enhanced more green areas around the library building to filter the dust and carbon monoxide. The library has also created green corner for the user. University supports the good and healthy university environment policy and reduces the expenditure especially on energy electricity water fuel (Bodh, 2021).



Figure 5: Sources: (<https://www.ifla.org/node/92963>)

Green libraries are vital in fostering sustainable development and cultivating reading habits. Their eco-friendly infrastructure, educational initiatives, and inclusive programs align closely with the UN SDGs. By inspiring environmentally conscious behavior and enhancing access to knowledge, green libraries demonstrate how innovative spaces can drive both environmental and social sustainability. Further research and investment are needed to overcome existing barriers and expand the reach and impact of green libraries globally.

Considering the mentioned circumstances, this study aimed to analyze the fostering sustainable development through green libraries. First, we provide an overview of the green libraries. Secondly, we answer the main research question, how do green libraries contribute to sustainable development? What environmental practices do libraries adopt to promote sustainability?

How do green libraries encourage reading habits? What challenges and opportunities exist in managing green libraries? by the comprehensive literature review we determine based on Sustainable Development Goals (SDGs), Impact of eco-friendly environments on human behavior and learning, examining factors that encourage reading behavior, definitions, principles, and global standards (LEED and ISO 14001: Working Together, n.d.) renewable energy use, green building design, and waste reduction, Role of library environment in encouraging reading and literacy programs. Finally, we describe how to make a green or sustainable library and why? Core findings of this assessment should provide helpful guidelines to library users, Library professionals, researchers, and LIS students, for further intervention and targeting this vulnerable social group to take effective long-term measures.

5. Discussion

Environmental Contribution :Use of sustainable materials, energy-efficient designs, and green technologies

Green libraries stand as a beacon of environmental innovation, integrating sustainable materials, energy-efficient designs, and green technologies into their core infrastructure. Green libraries stand as a beacon of environmental innovation, integrating sustainable materials, energy-efficient designs, and green technologies into their core infrastructure which not only reduce the carbon footprint but also supports the protest of sustainability of their community (Morriello& Sardo, 2024). The sustainable materials play the pivotal role to a green library. Recycled wood (certified by Forest Stewardship Council), recycled steel and aluminum, recycled glass, bamboo, cork, Low-VOC (Volatile Organic Compounds) Paints and Finishes, Natural Fiber Carpets ordinary stuff used in establishing and developing green libraries (Honrao, n.d). Green library not only reduce the ecological emissions associated with traditional building techniques but also minimize the maintenance costs, making them economically viable via using energy consumption, water recycling, waste management system. Patrons educate in sustainable practices and make those applicable in everyday life through showcasing practical use of green materials in a sustainable library. As, the library represents vital center for knowledge, cultural preservation, community development in a society, the green library serves as the milestone to increase awareness about environment to the society (Makul et al., 2021). Energy efficient methods are one of the crucial features to create a green library which deals with contributing to the economy in a nation. By incorporating natural lighting for windows, insulated walls, automated climate control system, Heating Ventilation and Air Conditioning (HVAC) system reduce energy consumption while administering a comfortable reading environment. Green libraries can produce renewable energy by installing solar panels and geothermal energy systems. For instance, libraries in Scandinavia have founded net-zero energy models, where their energy consumption is counteracted by renewable sources (Ulpiani et al., 2023; Amaral et al., 2020). Green library inspires communities to clasp sustainable practices in their homes and workplaces. By incorporating green roof and vertical gardens enhance biodiversity and improve air quality through ensuing oxygen. Besides rainwater harvesting system reduce water usage by recycling rainwater (Mishra, 2023). The term ecological preservation exists in a green library via smart systems for implementing energy, lighting and heating which operate efficiently and sustainably. Additionally, through arranging programs, Interactive exhibits and guided tours of the eco-friendly features which highlights the benefits of sustainable materials, energy efficiency, practical lessons in environmental stewardship (Altassan, 2023). In conclusion, green library plays a key revealing role in fostering ecological awareness using sustainable materials, energy-efficient designs and innovative green technologies and bridging the gap between knowledge and action for a greener future (Kang, 2020).

Social Impact: Libraries as community learning hubs promoting environmental awareness and literacy

Green libraries are environmentally friendly buildings that are thriving community learning centers for patrons to improve literacy. Besides, libraries significantly support to the advancement of an informed and ecologically responsible community through establishing focused programming and

environment (Partap & Bala, 2024). However, one of the notable characteristics of a green library is to unite its community via promoting expressive conversations about environmental issues among people from a wide range of backdrops and it occurs by holding sustainability-related workshops, seminars, and discussion forums (Panda, 2023). For example, libraries conduct eco-literacy programs to qualify individuals with the necessary skills like energy saving, composting, and recycling, which ensure sustainable practices in their daily life. Additionally, marginalized communities can take concrete actions that foster sustainability and social solidarity (Quiroz-Niño & Murga-Menoyo, 2017). Green libraries provide programs among underserved populations, including children, the elderly, disabilities. They are receiving equitable access to educational and environmental resources. For instance, programs for children's storytelling sessions cultivate a love of nature among them. By providing accessibility improvement programs, such as ramps and braille books, libraries can connect with lifelong learning to create a green library (Roberts & Smith, 2010). Furthermore, green libraries collaborate with environmental organizations that impact the social community. For example, collaborative projects including clean-up campaigns, sustainability fairs, workshops, and tree planting drives, which are made possible by partnerships with NGOs and similar associations (Riedman, 2024). Firstly, it increases the connection between the library and users by providing better sustainable quality services, skill development and knowledge sharing through green libraries programs. Secondly, green libraries offer volunteer work and community projects which attach with a sense of accountability, environmental justice and social equity. Finally, green libraries act as dynamic centers that promote literacy, environmental consciousness, the intellectual and social fabric of communities while authorizing them to cradle sustainable living through promising inclusivity.

Educational Impact: Improved learning outcomes due to eco-friendly, stress-free reading environments

The green library provides eco-friendly, stress-free environments that significantly improve educational outcomes and are conducive to learning (Chukwujindu et al., 2024). Green libraries are designed to deal with reader-centered approaches, creating an environment that makes readers more attentive, creative, and increases better academic performance (Minor, 2023). Sustainable reading environment features of green libraries are natural lighting, proper ventilation, tranquil, inspiring settings, green spaces like indoor plants or outdoor gardens, which contribute to the peaceful atmosphere, reducing stress and enhancing focus for readers (Naqvi, 2023). A study demonstrates that natural elements of green libraries reduce stress, develop cognitive function, which connects students and readers to excellent focus, retention in their studies, and leisure reading (Russell et al., 2013). Additionally, green libraries actively promote learning experiences through promoting wellbeing, eco-friendly design, such as sound absorbing elements that reduce noise pollution, creating quiet zones, ideal for studying, and temperature regulation, which ensures comfort, allowing patrons to concentrate for extended periods without distraction (Sharma & Deshpande, n.d). These features connect with sustainable development goals SDGs especially as SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education), which encompass the environment and educational benefits (Kioupi & Voulvoulis, 2019). Green libraries also inspire curiosity in their users through innovative programs, offering, viz. workshops, seminars, and lectures on sustainability. Furthermore, green libraries often collaborate with schools and universities to incorporate their resources into educational frameworks and bridge the gap in traditional classroom settings (Krolak, 2006). Technology integration is another salient feature to create green libraries, which also promotes learning outcomes. Green libraries use digital resources such as e-books, virtual workshops, and online journals, which exclude the use of physical materials (Ajani et al., 2024). By this feature, modern readers enhance their technology adaption, flexible access to diverse learning options that truly ensure the inclusivity and equity in education (Adetayo et al., 2023). Moreover, green libraries promote academic achievements by cultivating an understanding of eco-conscious accountability (Ali et al., 2024).

In conclusion, green libraries provide significant learning outcomes by cultivating a stress-free space, sustainable educational programs, and materials.

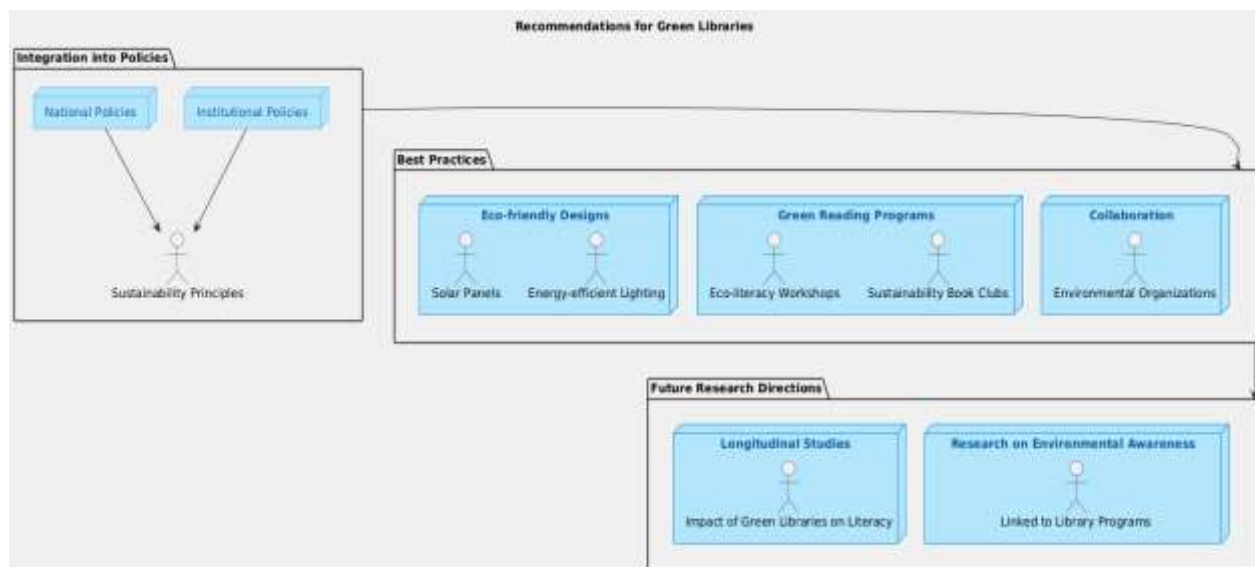


Figure 6: Conceptual framework for Recommendations in green libraries.

Figure 6 demonstrates the conceptual framework of recommendations for green libraries, focusing on policy integration, implementation of best practices, and future research directions.

Policy Integration: The library should embody national and institutional policies into library planning and operations. This includes green library standards such as LEED or GRIHA, which are developing green structures with the concept of sustainability around the world. It determines the rules and norms to be followed for Green Building Certificate Systems.

Eco-friendly Infrastructure: The library should incorporate eco-friendly design by installing energy-efficient lighting, solar panels, rainwater harvesting systems, green roofs, natural ventilation, and sustainable construction materials, which ensure a green environment.

Green Programs: To create a green library, it needs to introduce green reading programs such as eco-literacy workshops, sustainability-themed book clubs, motivating programs for the use of reusable bags and containers, Composting programs for organic waste, Book donation, and recycling drives, etc.

Collaboration: The library should cooperate with environmental organizations, NGOs, and local government bodies to establish a green library. The library needs to guarantee sustainability, set up sessions for strategic planning, and thought for catching government grants and financial support.

Future Research Directions: Finally, there is a need for longitudinal studies to examine the long-term impact of green libraries on advancing literacy. Further research can also explore how environmental awareness aligns with library programs and user perceptions of specific green library initiatives.

6. Conclusion

This review analyses the previous literatures how impact of green libraries on sustainable education through sustainable environmental infrastructure, energy efficient technologies, and green practices library. This study found that eco-friendly libraries not only reduce their carbon footprint and cultivate healthier, more inclusive environments but also fosters reading habits by offering comfortable, stress-free spaces to readers of all ages which promotes reading habits and lifelong learning. Additionally, this review explored the crucial role of libraries in supporting environmental awareness, offering an eco-friendly educational atmosphere, and associating library services with sustainability goals. Notwithstanding, rising research interest, gaps remain in empirical investigation and longitudinal studies, which denotes the future research direction to analyze measurable outcomes of green libraries.

7. Acknowledgement

I am remarkably grateful to my professor, Dr. Armanul Haque of the Department of Information Science and Library Management at Rajshahi University and Zihadur Rahman, Library Circulation Officer at East-West University, Bangladesh, for supervising me in writing this paper. Additionally, I would like to thank the editorial team and peer reviewers at the International Conference on Business Innovation and Sustainable Development, Varendra University, Rajshahi, Bangladesh. Besides, all of my coauthors who assisted me in writing this paper.

Conflict-of-Interest Statement

The author declares that there are no conflicts of interest.

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