

Sustainable Development Goals and Green Libraries: Transforming India's Knowledge Spaces for a Greener Tomorrow

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Abstract

The United Nations Sustainable Development Goals (SDGS) offer an extensive framework for addressing environmental, social, and economic challenges. Libraries, as entities that advocate for democracy, are ideally situated to further these objectives by adopting sustainable practices. This study explores the notion of Green Libraries, emphasising their association with Sustainable Development Goals such as Quality Education (SDG 4), Sustainable Cities (SDG 11), Responsible Consumption (SDG 12), and Climate Action (SDG 13). Green Libraries can reduce their environmental impact by employing sustainable infrastructure, adopting digital transformation, and interacting with the community while promoting social fairness and ecological consciousness. In India, Green Library projects are emerging, however, they face issues including budget constraints, lack of awareness, and institutional hurdles. Nonetheless, prospects for expansion exist through governmental support, technical advancements, and community collaborations. Instances such as the Karnataka University Green Library and the Anna Centenary Library exemplify effective implementations. The study concludes with recommendations for transforming Indian libraries into sustainable knowledge centres, supporting the nation's climate goals and fostering an environmentally friendly future. By integrating with international sustainability programs, Green Libraries may substantially aid in attaining the SDGS and promote environmental stewardship.

Keywords: Green Libraries, Sustainable Development Goals (SDGS), Environmental Sustainability, Community Engagement, Eco-friendly Infrastructure

INTRODUCTION

The United Nations Sustainable Development Goals (SDGS) provide a thorough framework for tackling global sustainability issues, encompassing environmental protection, ethical consumption, and climate action. Libraries, as democratic entities, are distinctly equipped to advance these objectives by fostering education, enhancing sustainability knowledge, and guaranteeing digital inclusion (Hauke, Mocatta, & Pun, 2025). The Green Library Movement, initiated in the 1990s (Antonelli, 2020), corresponds with critical Sustainable Development Goals (SDGs) including Quality Education (SDG 4), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), and Climate Action (SDG 13). Through adopting eco-friendly infrastructure, resource conservation, and implementing sustainable practices, libraries are transforming into sustainability centers that mitigate environmental impact while fostering civic involvement and advancing social fairness.

The global climate problem is predominantly caused by human activity, especially the extensive dependence on fossil fuels, resulting in substantial rises in greenhouse gas emissions

and global temperatures (World Bank, 2021). International accords, like the Paris Climate Agreement, seek to restrict the increase in global temperatures to below 2°C, aspiring to maintain it at 1.5°C over pre-industrial levels. Countries like India have pledged to decrease greenhouse gas emissions by 33% by 2030 and attain net-zero emissions by 2070 (Rani & Chopra, 2024).

Libraries have historically been acknowledged as hubs of knowledge and continuous education (Antonelli, 2008; Ingole & Kumari, 2021). In response to global environmental concerns, they must take the initiative by implementing green and sustainable practices. However nascent, India's Green Library projects necessitate a systematic strategy to address challenges such as regulatory deficiencies, financial constraints, and insufficient awareness, in alignment with the Sustainable Development Goals to secure enduring ecological and educational advantages. Contemporary libraries are evolving beyond conventional functions to assume leadership in environmental initiatives. Libraries may motivate communities to embrace sustainable living practices by implementing energy-efficient structures, providing digital resources, initiating waste reduction initiatives, and participating in innovative projects. Their dedication to democracy, freedom of expression, and equal information access highlights their contribution to multiculturalism, linguistic variety, and social inclusion (Rahman & Nausheen, 2013). To effectively combat inequality and foster a sustainable future, libraries must save non-commercial literature and guarantee access for all individuals, irrespective of socioeconomic level (Omona, 2020).

This paper examines the notion of Green Libraries, emphasizing their worldwide importance and relevance in the Indian context. It analyzes the alignment of Green Library programs with the Sustainable Development Goals, offering a thorough mapping of their contributions to sustainability. This paper examines case studies of Green Libraries in India, identifying significant hurdles and providing strategic recommendations to promote the establishment of sustainable, environmentally conscious library facilities nationwide.

STUDY OBJECTIVES

The main objectives of this study are as follows:

- To explore the relationship between Green Libraries and the Sustainable Development Goals (SDGS).
- To analyse how initiatives in Green Libraries contribute to sustainable development in India.
- To provide a strategic roadmap for transforming Indian libraries into sustainable knowledge spaces.

LITERATURE REVIEW

The idea of Green Libraries has attracted great interest in recent years as environmental sustainability and compliance with the United Nations Sustainable Development Goals (SDGS) have become more urgent. Founded on the principles of reduction, reuse, and recycling, Green Libraries emphasize a few environmental issues: pollution, climate change, and deforestation

(Chandran and Haneefa K., 2020). Gupta (2020) went a step further by analysing frameworks like LEED and GRIHA and bringing attention to the role libraries play in green building designs, sustainable operations, and tech use. Sarkar (2020) underlined the need for Green Libraries to increase environmental awareness and promote community participation in keeping with the SDGS's goals to foster a sustainable future.

The empirical data from Singh and Dixit (2021) on the execution of sustainable practices in university libraries in India exposes a growing awareness among library staff. Academic libraries in Sri Lanka revealed a need; hence, Mashroofa (2022) looked at ways to include the SDGS in library initiatives. She underlined the need to map library activities to particular SDGS. Devi (2023) underlined the several roles Green Libraries play as environmental stewards and allies with the community in line with SDGS 12, 13, and 17. Hasan and Panda (2023) supported library energy efficiency, waste reduction, and green building in the Indian setting.

Emphasizing successful global projects including green building initiatives and climate literacy campaigns, Ajani, Tella, and Snarkier (2024) investigated the revolutionary function of libraries as advocates for climate action. Emphasizing their twofold role in operational sustainability and community education, Gajbhiye (2024) set libraries as leaders in the worldwide sustainability movement. As Sharma and Sarkar (2024) noted, Green Libraries are growingly crucial in India to promote environmental literacy and climate resilience. Shesha and Singh (2024) looked at how academic libraries may support SDGS and discovered challenges including insufficient funds and resources.

Emphasizing community involvement and sustainable construction practices, Singh (2024) offered a conceptual framework for Green Libraries in India. Sivaprasad, Thanuskodi, and Nagaiah (2024) examined the difficulties of becoming Green Libraries and highlighted the importance of rethinking the building's architecture, performing regular maintenance, and educating staff. Libraries may play a key role in reducing environmental impact and promoting a culture of sustainability by incorporating green technologies, as Ganesa Moorthy and Selvakamal (2025) pointed out.

Research Gap

Although current research has thoroughly covered the conceptual framework, advantages, and obstacles of Green Libraries, there is a clear lack of thorough studies linking Green Library projects to particular SDGS in the Indian setting. Though most research concentrated on particular features like green building design, community involvement, or operational sustainability, they lacked a comprehensive approach linking these factors with the more general SDG framework. There was microscopic study on how government funding and policy frameworks helped scale Green Library projects in India.

The present study filled this gap by thoroughly mapping Green Library projects to SDGS, examining Indian case studies, and suggesting a strategic road plan for changing libraries into sustainable knowledge spaces. This paper intends to close the gap between theory and practice by including local issues and possibilities into worldwide sustainability frameworks, providing practical ideas for library professionals, environmental campaigners, and legislators.

UNDERSTANDING GREEN LIBRARY

The Online Dictionary of Library and Information Science (ODLIS) defines a sustainable green library as one meant to maximise indoor environmental quality while minimising adverse effects on the natural environment. Careful site selection, using natural building materials and biodegradable goods, resource conservation (including water, energy, and paper), and appropriate waste disposal techniques like recycling help achieve this.

The International Federation of Library Associations and Institutions (IFLA) claims that a green library not only emphasises environmental sustainability but also considers economic and social sustainability in its operations and services. These libraries seek to lower their ecological impact through energy efficiency, trash reduction, ethical purchasing, and environmental literacy initiatives. Therefore, they are rather important in encouraging sustainability in their areas.

Features of a Green Library

- Green libraries prioritise energy efficiency by using sustainable building materials, efficient insulation, natural lighting, and energy-saving equipment.
- They investigate and include renewable energy sources—geothermal systems, wind turbines, or solar panels—to run library operations.
- Green libraries use waste management techniques include garbage segregation, recycling initiatives, and encouraging responsible consumption to reduce waste production.
- They educate workers and customers on water conservation techniques, install rainwater collecting systems, and employ water-efficient equipment.
- Green libraries emphasize purchasing ecologically friendly goods, including recycled or sustainable materials, and encourage the proper disposal of electronic trash.
- Through initiatives, seminars, and resource provision on sustainability subjects, they vigorously advocate environmental education and awareness.
- Green libraries work with local groups and include customers in sustainable activities, serving as community centres for environmental projects.

Roles and Goals of a Green Library: (Hauke *et al.*, 2021)

- Green libraries lead the way in sustainability by using energy-efficient structures, eco-friendly tools, and sustainable operational procedures, lowering their carbon footprint.
- They set SMART (Specific, Measurable, Achievable, Realistic, and Time-bound) environmental targets and report their success to motivate action in the larger society.
- These libraries offer access to pertinent and current knowledge by curating collections and resources on sustainability, climate change, and eco-friendly living.
- They increase environmental literacy and enable people to adopt sustainable practices by means of workshops, exhibits, and activities.
- Green libraries promote responsible resource use by conserving electricity, water, and materials.

- They make these practices available to their communities through circular economy techniques including resource sharing and recycling.
- Green libraries foster social inclusion, cross-cultural variety, and community involvement by providing shared spaces and programming that help to minimise inequality.
- They actively interact with their communities to promote education, literacy, and environmental consciousness.
- Green libraries promote sustainability and match their projects with worldwide frameworks such as the UN Sustainable Development Goals (SDGs), the Paris Climate Agreement, and UNESCO's Education for Sustainable Development.
- They motivate people and other organisations to embrace green practices and help to create a sustainable future.
- Green libraries offer innovative services like urban gardening, seed libraries, repair cafés, and citizen science projects, inspiring guests to adopt sustainable lives.
- They strive to ensure no one is left behind in the move to a greener tomorrow by guaranteeing fair access to knowledge and resources.

Green and Sustainable Library Principles

Green and Sustainable Libraries are built on principles integrating environmental, economic, and social sustainability into their operations and services. These principles guide libraries in becoming proactive change agents, contributing to a greener and more sustainable future. The key principles include (ENSULIB, 2023; Hauke, Mocatta, & Pun, 2025):



(Hauke, Mocatta, & Pun, 2025)

Fig. 1: Principles of a Green And Sustainable Library

Sustainable Library Equipment and Building

Green libraries seek to reduce their environmental effect by emphasising energy-efficient architecture and eco-friendly building materials. They use energy-efficient lighting and HVAC (heating, ventilation, and air conditioning) systems, including solar panels, among other renewable energy sources. The aim is to lower the carbon footprint of library buildings and equipment while fostering a sustainable and healthy environment for users.

Operations Environmental Sustainability

Libraries run sustainably in their daily activities, including cutting waste, recycling resources, and saving electricity and water. They apply green office ideas, including sustainable sourcing of materials and digital workflows, to reduce paper use. These policies guarantee that libraries run in an environmentally responsible way.

Keeping An Eye on Things and Maintaining Them

Long-term sustainability depends on regular monitoring and maintenance of library facilities and equipment. Using smart technologies, libraries track trash management, water use, and energy consumption. This data-driven strategy guarantees that sustainability targets are met and helps to highlight areas for development.

Ongoing Development and Assessment

Green libraries often review the success and influence of their sustainability projects. Based on input from the community and staff, they adjust their plans and establish reasonable environmental objectives. A fundamental value is constant development, guaranteeing that libraries keep leading the way in sustainability initiatives.

Staff Development and Training

Libraries invest in development and training initiatives to provide their personnel the information and tools required to carry out and support sustainable practices. Libraries guarantee that their staff members are dedicated to environmental stewardship and can properly interact with the community on sustainability concerns by encouraging a culture of sustainability among them.

Programs and Services for Sustainable Development

Green libraries provide several services and activities that encourage sustainable living and environmental awareness. These include internet resource access on sustainability, community gardening initiatives, and instructional seminars. Libraries also offer shared spaces and equipment, guaranteeing fair access to knowledge and technology for every community member.

MAPPING GREEN LIBRARY INITIATIVES WITH SDGS

Green Libraries play a vital role in promoting various SDGS by adopting environmentally friendly practices, embracing digital transformation, conserving energy, and engaging with the

community (Sharma & Sarkar, 2024). This approach encourages environmental responsibility and the sharing of sustainable knowledge.

Table 1: Green Library Initiatives And Aligned SDGS

Green Library Initiative	Example	Aligned SDGs	Impact on Sustainability
Sustainable Library Infrastructure	Eco-friendly design, solar energy, rainwater harvesting	SDG 9, SDG 11, SDG 13	Reduces carbon footprint, enhances resource efficiency
Digital Transformation	E-books, online resources, reducing paper use	SDG 4, SDG 12	Promotes education while reducing environmental impact
Energy Conservation	LED lighting, smart energy management	SDG 7, SDG 13	Lowers energy consumption and fosters climate action
Green Collection Development	Climate change literature, environmental studies	SDG 4, SDG 13	Educates and raises awareness about sustainability
Community Engagement & Awareness Programs	Workshops, eco-literacy campaigns	SDG 3, SDG 13, SDG 17	Strengthens public participation in sustainability efforts

The projects listed below show how libraries may support education, include the community, and lower their environmental impact, supporting several Sustainable Development Goals (SDGS).

Sustainable Library Infrastructure (SDG 9, SDG 11, SDG 13)

Libraries that employ eco-friendly architectural designs, utilise renewable energy sources like solar power, and install water conservation systems such as rainwater harvesting contribute to sustainable infrastructure (SDG 9) by enhancing resource efficiency. Encouraging green buildings and eco-conscious areas, these policies also help resilient urban development (SDG 11). They fit with climate action (SDG 13) by reducing carbon footprints and offsetting environmental deterioration.

Digital Transformation: SDG 4, SDG 12

The shift to e-books, online databases, and cloud-based repositories increases educational accessibility (SDG 4) by making knowledge more freely available. Moreover, by lowering reliance on physical books, printing, and paper-based activities, libraries help responsible consumption and production (SDG 12), reducing waste and encouraging sustainable resource use.

Energy Saving (SDG 7, SDG 13)

Libraries that use energy-efficient technologies like LED lighting, automated energy management systems, and eco-friendly heating, ventilation, and air conditioning (HVAC)

solutions help provide inexpensive and clean energy (SDG 7). These initiatives also promote climate action (SDG 13) by greatly lowering electrical use, hence enabling libraries to run with less environmental impact.

Green Collection Development (SDG 4, SDG 13)

By curating specialised collections concentrating on climate change, sustainability, environmental regulations, and eco-friendly technology, libraries play a vital role in fostering environmental consciousness and literacy. By arming students with the information required to grasp and address world environmental concerns, this directly promotes good education (SDG 4). Furthermore, by increasing knowledge and inspiring proactive efforts toward sustainability, these tools help to promote climate action (SDG 13).

Programs of Community Engagement & Awareness (SDG 3, SDG 13, SDG 17)

Libraries serve as community knowledge centres by organising eco-literacy workshops, sustainability awareness campaigns, and collaborations with environmental organisations. By informing people about sustainable living practices, these projects help to promote good health and well-being (SDG 3); by raising awareness, they help to advance climate education and action (SDG 13); and by working with local and worldwide organizations to strengthen sustainability efforts, they help to foster multi-stakeholder partnerships (SDG 17).

Cross-Connections Between SDGs Through Green Library Initiatives

Green Library initiatives often address multiple SDGs simultaneously, forming an interconnected sustainability network (see Figure 2).

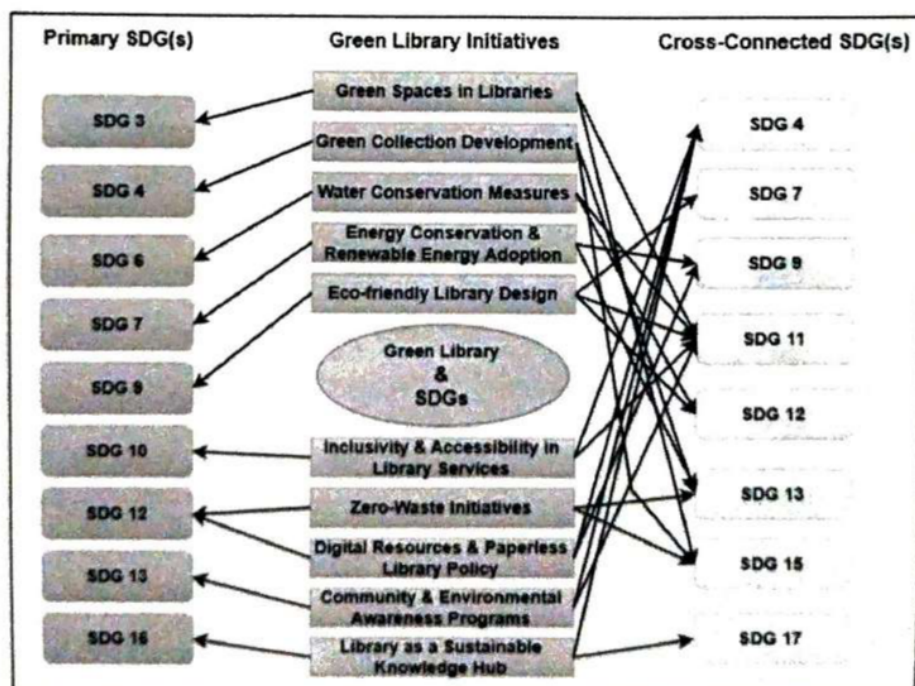


Fig. 2: Cross-Connections Between SDGs Through Green Library Initiatives

SDG 4 (Quality Education) → SDG 13 (Climate Action)

By offering venues for climate literacy, libraries significantly contribute to climate education. They provide seminars and materials that educate people on how climate change affects society. By equipping users with the knowledge and tools needed to make sustainable decisions, libraries promote informed actions that contribute to climate action (SDG 13) while supporting quality education (SDG 4) for all.

SDG 11 (Sustainable Cities) ↔ SDG 9 (Sustainable Infrastructure) ↔ SDG 7 (Affordable & Clean Energy)

Installing solar panels and energy-efficient technologies in libraries greatly reduces energy use, supporting SDG 7 (Affordable & Clean Energy). By building energy-efficient structures, which are vital to building sustainable cities (SDG 11), these projects also support sustainable infrastructure (SDG 9). In line with these linked Sustainable Development Goals (SDGs), green library designs reduce environmental footprints in urban areas and improve urban resilience.

SDG 6 (Clean Water) ↔ SDG 12 (Responsible Consumption) ↔ SDG 15 (Life on Land)

Water conservation initiatives, such as rainwater harvesting systems in libraries, are vital in promoting responsible resource consumption (SDG 12). Adopting such policies helps libraries preserve clean water (SDG 6) and encourage biodiversity conservation (SDG 15) by guaranteeing that natural water resources are used effectively, reducing environmental effects and supporting the preservation of life on land.

SDG 10 (Reduced Inequalities) → SDG 11 (Sustainable Cities) → SDG 16 (Strong Institutions)

By giving underprivileged people equal access to resources and sustainable knowledge, libraries are strong instruments for lowering disparities (SDG 10). By creating inclusive learning environments and sustainable spaces, libraries support the development of sustainable cities (SDG 11) and contribute to establishing strong institutions (SDG 16) that promote social justice, equity, and community resilience.

SDG 12 (Responsible Consumption) → SDG 13 (Climate Action) → SDG 17 (Partnerships for the Goals)

Libraries work with environmental groups to spread sustainable practices and educate people on responsible consumption. These partnerships (SDG 17) foster collective efforts to reduce carbon emissions and advance climate action (SDG 13), while also encouraging the community to adopt sustainable consumption habits (SDG 12). Through these collaborations, libraries play a pivotal role in disseminating eco-conscious practices at both local and global levels.

These interconnections enable Green Libraries to work towards specific SDGs and function as hubs of interdisciplinary sustainability. This reinforces the importance of integrated actions in achieving a greener and more equitable world.

CASE STUDIES OF GREEN LIBRARIES IN INDIA

Green Libraries in India: A Dedication to Environmental Preservation and Sustainability

Libraries in India have firmly adopted the idea of green libraries as sustainability and environmental preservation take front stage worldwide. A strong program called the Green Library Movement in India includes several tactics, techniques, and partnerships to foster sustainable behaviour in library services and operations (Gaffar *et al.*, 2021).

Green Library Standards and Prospects in India

Supported by consistent green rating systems like the Green Rating for Integrated Habitat Assessment (GRIHA) and the Indian Green Building Council (IGBC), the growth of Green Libraries in India is increasing steadily (Choudhury, 2019; Sivaprasad, Thanuskodi, & Nagaiah, 2024). By guaranteeing conformity with high environmental sustainability criteria, these systems offer necessary direction for designing, building, and operating eco-friendly buildings.

Green Rating for Integrated Habitat Assessment

By giving the minimisation of resource consumption, waste generation reduction, and ecological effect mitigation top priority, GRIHA, India's definitive national green building rating system, assesses the environmental performance of buildings. Officially accepted by the Government of India in 2007, GRIHA was created by the respected Energy and Resources Institute (TERI) and aggressively measures energy efficiency, renewable energy use, and waste management. Employing a thorough life-cycle approach addresses urgent environmental issues, including population expansion and resource depletion, and promotes sustainability. Designed to reduce greenhouse gas emissions and improve the use of renewable and recycled resources inside the building industry, the system provides qualitative and quantitative criteria (GRIHA Council, n.d.).

Engineered exceptionally to enable the design and assessment of new buildings during their early phases, the GRIHA framework carefully evaluates anticipated performance across the whole building life cycle from conception to operational phase. The assessment spans three important phases:

Factors evaluated in the pre-construction stage are site accessibility to public transportation, soil type, land characteristics, current flora and fauna, and the surrounding natural landscape.

The assessment under Building Planning and Construction Stages stresses resource conservation, resource demand reduction, resource recovery and reuse, efficient resource use, and occupant health and well-being considerations. The primary resources evaluated are land, water, energy, air, and green cover.

Under the Building Operation and Maintenance Stage, GRIHA tackles operational and maintenance concerns, monitors energy use, occupant health and well-being, and environmental effects at global and local levels.

Indian Green Building Council

Founded in 2001 under the Confederation of Indian Industry (CII), the Indian Green Building Council (IGBC) is determined to build a sustainable built environment, hoping to establish

India as a worldwide leader in this field by 2025. Based in Hyderabad, IGBC is leading the way in creating green building rating systems, providing certification services, and running training programs including its well-known yearly Green Building Congress.

India's top certifying authority, IGBC, works with many people, including architects, builders, governments, and foreign organisations such as the World Green Building Council. India currently has the second-largest green building footprint worldwide, behind only IGBC, which certifies more than 90% of the country's green buildings, with more than 14,510 projects spanning an astounding 12.3 billion square feet. IGBC-rated initiatives benefit from government incentives spread over 14 states, significantly strengthening their national and worldwide influence (IGBC, n.d.).

Ultimately, developing green libraries in India denotes a vital dedication to sustainability. These projects establish an excellent example of lowering the environmental effects of library services. Embracing these sustainable practices will shape how libraries run going forward; so, we must keep pushing these initiatives forward for the sake of our communities and the environment.

State of Green Libraries in India

In Gunawan's (2017) survey on green libraries in India, the author examined the implementation of green practices among UGC-approved libraries in the country. The study focused on specific indicators to assess the extent of sustainable initiatives. The research sample comprised a total of 178 libraries, and the significant findings of this study are summarized in Table 2.

Table 2: State of Green Libraries In India

Sr.No.	Parameters	Percentage of Libraries
1	Green building	22% (1% proper certification)
2	Natural ventilation	54%
3	Dual flush toilet with cistern	31%
4	Using natural daylight	60%
5	Using energy-saving bulbs (LED lights)	48%
6	Computerized monitoring of electrical systems	13%
7	Photocell occupancy sensors for automatic light control	7%
8	Solar panels	28%
9	Use of chemical-free products for cleaning	33%
10	Waste management of books	64%
11	Printing on both sides of paper	72%
12	Adopting measures for e-waste management	53%
13	Green programmes and activities	49%
14	Reducing, reusing, and recycling of the products	12%
15	Creating a 'Green Team' in the library	7%

Table 2 (Contd....)

...Contd. (Table 2)

16	Collection development	27%
17	Green initiatives in IT	21%
18	Rainwater harvesting	34%

(Gundawar, 2017)

Particularly in areas like cutting paper use during printing, efficiently managing book waste, using natural sunshine, and embracing green architectural techniques, the report shows significant progress Indian libraries have achieved in becoming green libraries. These elements show good progress toward sustainability objectives. There are, nevertheless, some regions calling for development. Indian libraries still have room for improvement in certain areas, such as the use of photocell occupancy sensors for automatic light control, the creation of a committed "Green Team" inside the library, and the efficient reduction, reuse, and recycling policies, if they are to be considered fully green libraries.

Examples of Some Green Libraries in India

The Green Library Movement in India has gained momentum in recent years, with numerous notable instances paving the way for sustainable practices and environmental consciousness in libraries (Hasan & Panda, 2023). Here are three significant examples of the Green Library Movement in India:

Karnataka University Green Library, Dharwad (Available at: <https://www.kud.ac.in/green-library.php>)

The Karnataka University Green Library in Dharwad is a unique and sustainable learning environment that combines nature, culture, and modern design. It gives pupils a green and tranquil setting to help them study more effectively.

The library's central campus position gives students quick access to important services, including comfortable seats, easily accessible water, and a WiFi connection. The library is a centre for cultural exploration via heritage tours and artistic expression and a big store of books, periodicals, and digital resources. Including eco-friendly elements like natural lighting, rainwater collection, and energy-efficient appliances shows the institution's dedication to academic achievement and environmental responsibility (Karnataka University Dharwad, n.d.).

The Anna Centenary Library (Available at: <http://www.annacentenarylibrary.org/>)

The Anna Centenary Library, situated in Kotturpuram, Chennai, Tamil Nadu, India, was founded in 2010 under a Tamil Nadu government project. Remarkable for its sophisticated infrastructure and environmentally sensitive design, this 8-acre library complex (ACL, n.d.). The Anna Centenary Library is a harmonic mix of contemporary and sustainability by combining creative technology with an emphasis on natural resources, including wood, light, and air. Constructed following environmentally friendly guidelines, the construction has earned a notable gold LEED (Leadership in Energy and Environmental Design) grade, a globally known certification for sustainable buildings (Srinivasan, 2011).



Fig. 3: Karnataka University Green Library



Fig. 4: The Anna Centenary Library

A meeting point for academics, researchers, and readers, the Anna Centenary Library is one of India's most remarkable green libraries. The library is a major cultural and educational monument in Chennai with its modern facilities, environmentally sensitive design, and emphasis on energy efficiency (Construction World, 2010).

The Perma Karpo Library

Situated at the Druk White Lotus School in Ladakh, the Perma Karpo Library embodies environmental and energy-efficient building ideas. Its design reduces environmental effects

by combining modern methods with locally obtained resources. While wool insulation helps control temperature, Trombe walls with ventilation catch solar heat during the day for passive heating. The mud roof provides excellent insulation, while timber panelling enhances beauty and provides extra insulation. By producing sustainable energy, rooftop solar panels help to lower the library's reliance on conventional energy sources.

By giving locally accessible materials priority and using community-driven information maintenance techniques, the Perma Karpo Library sets an example for environmentally responsible design, resource management, and energy efficiency (Sharma, 2016).

The Perma Karpo Library generally emphasises environmental preservation while offering necessary services; hence, it approaches sustainability holistically. Its design philosophy shows a dedication to responsible construction and resource use using a successful combination of sustainable building practices, locally produced materials, and energy-efficient technologies.

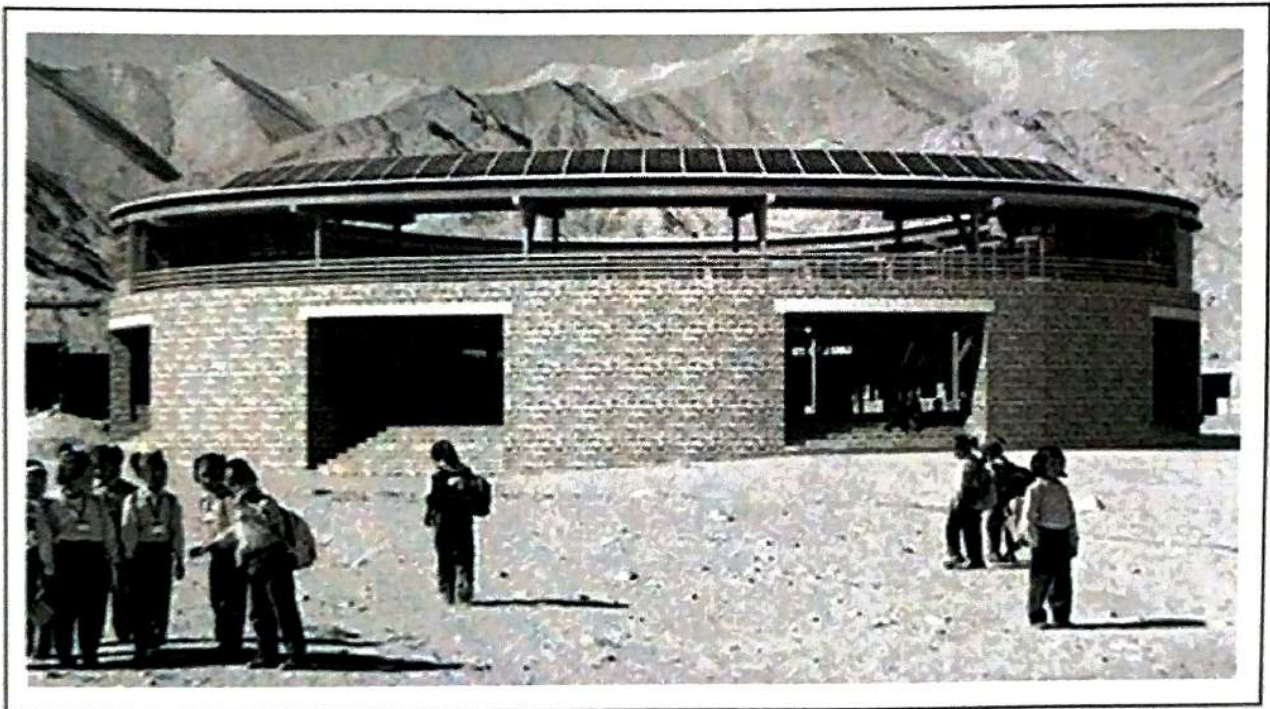


Fig. 5: The Perma Karpo Library

Some other notable examples and their areas of green movement are listed below:

GLOBAL GREEN LIBRARY INITIATIVES

To lower their environmental effect and support sustainability, libraries all throughout the world are progressively adopting green projects (Gajbhiye, 2024). These projects promote community involvement, resource conservation, and environmentally sustainable infrastructure by closely fitting with the Sustainable Development Goals (SDGS). Below are some case studies of worldwide library projects that show these green practices in line with the SDGS.

Table 3: Examples of Green Initiatives by Indian Libraries

Sr. No.	Name	Location	Green Initiatives
1	Knowledge Park	Bangalore	Knowledge Park, Bangalore, is a unique library promoting environmental awareness and sustainable practices. It emphasizes the importance of biodiversity, conservation, and eco-literacy. The library offers extensive books, periodicals, and resources related to ecology, climate change, sustainable development, and renewable energy. Knowledge Park organizes workshops, seminars, and educational programs on organic farming, waste management, and eco-friendly living. It acts as a hub for environmental enthusiasts, researchers, and students, fostering a culture of sustainability.
2	Nehru Memorial Library and Museum	New Delhi	The Nehru Memorial Library and Museum in New Delhi is renowned for its historical significance and commitment to sustainability. The library actively promotes green initiatives through various measures. It implements energy-efficient lighting, rainwater harvesting, and waste management practices. The library also encourages using digital resources to reduce paper consumption and offers e-library facilities. Furthermore, the institution hosts exhibitions, lectures, and events centered around environmental issues, providing a platform for sustainability and climate change discussions. (Indian Culture, n.d.)
3	The Energy and Resource Institute (TERI) Library	New Delhi	TERI is a renowned research institution focusing on sustainable development. Its library in New Delhi is committed to promoting green practices. The library features eco-friendly architecture with energy-efficient lighting, natural ventilation, and rainwater harvesting systems. It offers extensive books, journals, and research papers on environmental studies, renewable energy, and sustainable technologies. (TERI, n.d.)
4	Dnyaneshwari Library	Ahmednagar	The Dnyaneshwari Library in Ahmednagar, Maharashtra, is dedicated to promoting green practices and environmental education. The library incorporates sustainable features like solar power generation, rainwater harvesting, and eco-friendly building materials. It focuses on providing resources on ecology, climate change, and sustainable agriculture to educate and empower the local community.
5	Seshadripuram First Grade College Library	Bengaluru	This college library in Bengaluru is committed to sustainability and eco-consciousness. The library adopts digital technologies to reduce paper consumption and offers e-books and online resources to its users. It engages students and staff in environmental awareness campaigns, tree planting drives, and waste management initiatives.

(Hasan & Panda, 2023)

Leadership in Energy and Environmental Design (LEED) Certification

Developed by the U.S. Green Building Council (USGBC), LEED (Leadership in Energy and Environmental Design) is a well-known certification tool encouraging sustainable design, building, and operational practices. LEED, which was started in 2000, has set the bar for assessing the environmental performance of buildings, guaranteeing they satisfy high standards for energy efficiency, water conservation, material selection, and indoor environmental quality.

Buildings are evaluated in the certification process in six primary categories: sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and design innovation. Projects gain points depending on their adherence to these criteria, which match four certification levels: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points), and Platinum (80+ points). The rating system primarily relies on four credit categories: LEED BD+C: New Construction, LEED BD+C: Core and Shell, LEED ID+C: Commercial Interiors, and LEED O+M: Existing Buildings.

LEED certification's advantages go beyond environmental ones and include social and financial benefits. Certified buildings often have reduced running costs because of better energy and water efficiency and increased health and well-being for tenants, all while reducing their carbon footprint. LEED accreditation also highlights a project's dedication to sustainability, increasing its market attractiveness and compatibility with world environmental objectives.

To assist candidates throughout the certification process, the USGBC offers many resources, such as checklists, reference materials, and training courses. LEED has become a cornerstone of the worldwide green building movement by setting strict criteria and encouraging innovation, affecting sustainable practices in more than 188 nations and territories with 197,000 LEED projects worldwide. LEED v5, the most recent edition, marks a major turning point in matching the built environment with a low-carbon future. Its forward-looking framework is constantly changing to address new issues in the built environment, encouraging stakeholders to prioritise sustainability in both building and operations. It addresses important needs, including equity, health, ecosystems, and resilience.

Initiatives from International Libraries

Greening libraries involves adopting sustainable practices across their operations, infrastructure, and services. Below is a pointwise breakdown of methods to transform libraries into eco-friendly spaces:

Kocaeli and Istanbul, Turkey University Libraries

Among the many eco-friendly policies the University Libraries in Kocaeli and Istanbul have embraced are energy-efficient lighting, waste reduction initiatives, and using sustainable materials in their operations (Doğan & Gürpınar, 2023). These projects fit several Sustainable Development Goals (SDGs), including SDG 7 (Affordable and Clean Energy) through energy-efficient systems, SDG 12 (Responsible Consumption and Production) by encouraging waste reduction activities, and SDG 13 (Climate Action) by helping to mitigate climate change. This

paper emphasises the libraries' part in fostering environmental sustainability in academic institutions through their dedication to including green practices in their operations.

Yella Mundie Library, Sydney, Australia

Opened in December 2023, the Yella Mundie Library shows global efforts in sustainable library design through creative use of energy-efficient technologies and sustainable materials (Burke, 2024). The library shows advanced sustainable infrastructure in line with SDG 9 (Industry, Innovation, and Infrastructure). Its role as a public place also helps SDG 11 (Sustainable Cities and Communities) by promoting a sustainable local community. The Yella Mundie Library, a finalist for the International Federation of Library Associations and Institutions' Public Library of the Year award, is noted for its sustainable design and major community influence, hence establishing a standard for green libraries all around.

Dengzhou, Beijing, China

Spanning 75,000 square meters, the Beijing Library in Tongzhou illustrates sustainable architecture by combining climate control technologies and optimising natural illumination (Chung, 2024). Its modern architectural approach helps SDG 9 (Industry, Innovation, and Infrastructure), while its green public space that promotes community involvement helps SDG 11 (Sustainable Cities and Communities). Designed by Shweta and ECADI, the library draws influence from the nearby Tonghui River to foster a sustainable and culturally rich environment, seamlessly combining people, books, and nature.

Information on Green and Sustainable Libraries can also be found on <http://greenlibraries.org/>, a site devoted to documenting the environmental projects of North American libraries. This website also offers tools for creating sustainable and ecologically responsible libraries. The directory now shows 42 green libraries (Antonelli, n.d.).

METHODS FOR GREENING LIBRARIES

Figure 6 outlines various methods to transform libraries into green and sustainable spaces. It emphasises energy-efficient building design through renewable energy sources, smart lighting, and water conservation systems. Waste reduction and sustainable procurement are highlighted, alongside digital transformation to reduce paper usage and promote energy-efficient IT infrastructure. Community engagement is encouraged through sustainability programs, awareness campaigns, and green office practices. Libraries should adopt green certifications like GRIHA, LEED, or IGBC, develop sustainability policies, and form partnerships with governments and NGOS. Innovative initiatives such as seed libraries, repair cafés, and carbon offset programs further enhance their role as sustainability hubs.

CHALLENGES AND OPPORTUNITIES

Numerous unavoidable obstacles arise during the implementation of the Green Library project in India, which can impede the process; however, several appropriate opportunities must be taken advantage of to provide the best possible environment for implementing a sustainable library.

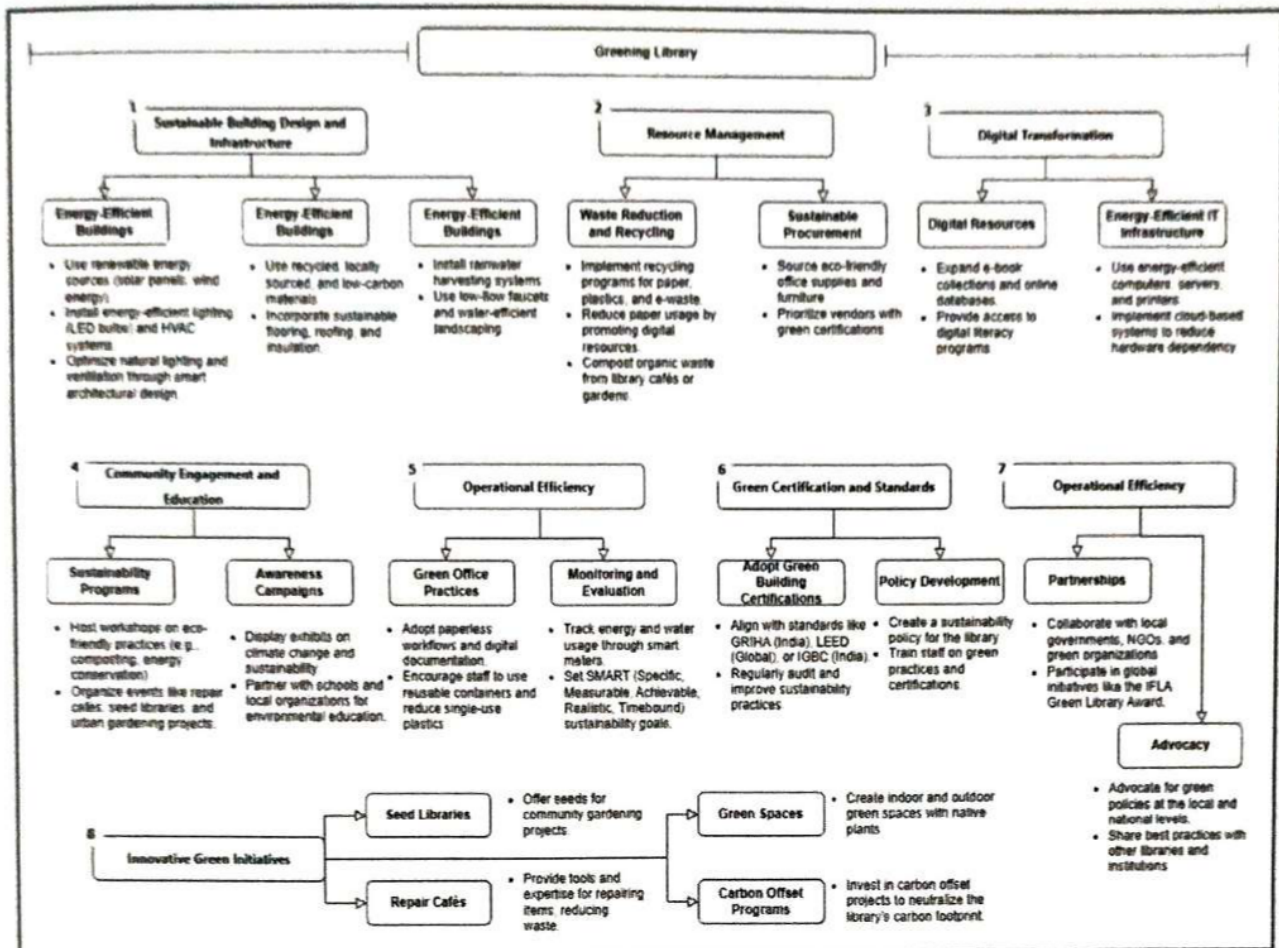


Fig. 6: Methods to Transform The Green Library

Table 4: Challenges and Opportunities Of Green Libraries

Challenges	Opportunities
1. Financial Constraints: High energy-efficient technologies and sustainable infrastructure costs limit implementation.	1. Government Support: Policies, incentives, and funding from the government can drive sustainability initiatives.
2. Lack of Awareness: Limited knowledge among library professionals about green practices and their benefits.	2. Collaboration and Knowledge Sharing: Partnerships with institutions and experts can enhance best practices and innovation.
3. Resistance to Change: Traditional workflows and mindsets hinder the adoption of sustainable practices.	3. Community Engagement: Libraries can educate and empower communities through workshops and environmental programs.
4. Access to Green Technologies: Limited availability and high eco-friendly materials and equipment costs.	4. Technological Advancements: Smart systems and digital resources can optimize energy use and resource management.
5. Institutional Barriers: Bureaucratic processes, unclear policies, and conflicting priorities impede progress.	5. Research and Development: Encouraging research on sustainable practices can unlock new solutions and foster growth.

CONCLUSION

The inclusion of Sustainable Development Goals (SDGs) into the structure of Green Libraries offers a notable chance for India's knowledge areas to support worldwide sustainability initiatives. Green Libraries can act as accelerators for environmental stewardship, social equity, and community empowerment by aligning with SDGs such as Quality Education (SDG 4), Sustainable Cities and Communities (SDG 11), Responsible Consumption and Production (SDG 12), and Climate Action (SDG 13). These libraries are becoming sustainability centres with eco-friendly infrastructure, digital transformation, and creative initiatives that reduce their environmental impact and motivate people to embrace greener living. Leading by example, pioneering green libraries in India like the Karnataka University Green Library and the Anna Centenary Library show the possibility for libraries to promote a culture of sustainability while tackling urgent environmental concerns.

However, the road to completely achieving Green Libraries' possibilities in India is not without obstacles. Financial limitations, lack of knowledge, and institutional hurdles hamper widespread adoption. These difficulties, however, also provide significant possibilities such as government backing, technological developments, and chances for community involvement. Indian libraries may overcome these obstacles and establish themselves as leaders in the worldwide Green Library Movement by using these possibilities and building alliances with different stakeholders. Green Libraries are important in promoting a sustainable future as India works to fulfill its climate goals and reach the Sustainable Development Goals, guaranteeing that knowledge spaces respect the past and save the world for next generations.

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