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Green Library: A Strategic Approach to Environmental Sustainability

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Abstract

The world is facing the unprecedented consequences of climate change, where the terms pollution, e-waste, and depletion of natural resources has become a part of our daily lives. Libraries of the 21st century have the potential to play the leadership role and address the issue of environmental sustainability by developing green libraries. The aim of the paper is to provide a holistic approach and understanding to the concept of green libraries. The article has categorised four major measures and practices to help develop a green library: (1) by having a green design and interior, (2) by incorporating green practices in day-to-day operations of libraries, (3) green collection development and literacy programmes, and (4) adopting emerging innovative and smart technologies that can be integrated into the functioning of libraries. Significant findings of previous literature on the status of green libraries in India and the impact of green libraries in energy reduction are also discussed. The paper analyses the LEED and GRIHA green-building rating system, green library initiatives undertaken in India, and the objectives of the IFLA Green Library Award. The article gives an insight into the strategic green library practices adopted by Rangsit University, winner of the IFLA Green Library Award 2020, and the contribution of a green library in achieving the UN Sustainable Development Goals 2030. The article concludes with major insights that the author has observed, after evaluating green library literature, giving suggestions for promoting and implementing green libraries.

Keywords: Green Libraries, Sustainable Libraries, Green Building, LEED, GRIHA, Green Practices

Introduction

India ranked 168 out of 180 countries in the 2020 Environment Performance Index (National Herald, 2020). This year, the EPI ranked 180 countries on 32 performances across 11 issues, with categories covering environmental health and ecosystem vitality. According to researchers, India needs to accelerate its decarbonisation plan, as the country is facing several environment related health risks, including low air quality. This trend shows that it has become imperative to tackle the issue of environmental sustainability in which modern or green libraries can also play a significant role.

In the early 1990s, the Green Library Movement began, and it became a trending topic of research among Library and Information Science professionals (Gupta, Natarajan, Gulati & Batcha, 2018). The aim of a green library is to make the library sustainable by adopting those practices that reduce dependence on non-renewable energy sources and use environment-friendly resources efficiently, by adopting innovative technologies, and creating awareness through green literacy.

According to the Online Dictionary of Library and Information Science (ODLIS), "Green library or sustainable library is defined as a library designed to minimise negative impact on the natural environment and maximise indoor environmental quality by means of careful site selection, use of natural construction materials and biodegradable products, conservation of sources like water, energy, paper and responsible waste disposal recycling etc."

Green library also includes the use of green technologies, strategic planning, and adopting green practices, which contribute to sustainability, in libraries. Communities need libraries that can act as a role model for sustainability, by educating people on green topics and ideas, environment-friendly building practices, and help them switch to renewable energy options. It is the right time for librarians to support the Green Library Movement (Antonelli, 2008).

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Objectives of the Study

- To discover the different measures and practices to develop a green library.
- To explore the green library initiatives adopted in India.
- To analyse LEED 2011 and GRIHA v2019 green-building rating system.
- To discuss the objectives of the IFLA Green Library Award and the contribution of a green library in achieving the UN Sustainable Development Goals.

Literature Review

Author	*Year*	*Purpose*
Tsengand the post-occupancy evaluation (POE	2008	Explored the planning and architecture of Taipei Public Library in designing the diamond-class green library and raised concerns about the issues of environment protection.
Chowdhury	2012	Investigated the positive impact of digital library services over printed materials in reducing their impact on the environment.
Barnes	2012	Explored green building technologies and activities, and demonstrated ways public libraries use it as a tool to educate the community about sustainability.
J. Aulisio	2013	Highlighted various initiatives and recommendations for building green libraries and defined a green library that promotes sustainability through education and awareness.
Binks et al.	2014	Discussed recommendations and frameworks for designing new buildings, refurbishing library buildings, and community awareness programmes.
Jones & Wong	2016	Discussed the green library strategies adopted and implemented by the Chinese University of Hong Kong (CUHK) Library and its impact on reshaping library services.
Meher & Parabhoi	2017	Provided an overview of the concept of a green library, Indian green libraries initiatives, and discussed the three green-building rating system (UNDP, IGBC, & LEED).
Gupta et al.	2018	Investigated the area of implementation of a green Chhatrapati Shahu Ji Maharaj (C.S.J.M.) University Library, and proposed models and suggestions for a green library.
Manna et al.	2019	Identified the status of green libraries in the Seven-Sister States of North-East India.

Measures and Practices to Build a Green Library

The paper has categorised the green initiatives into four major steps that can be integrated in the library landscape to develop an effective green library.

- Green Library Building Design
- Green Library Practices and Operations
- Green Collection Development and Literacy Programme
- Smart and Innovative Technologies for Green Libraries

Each one is explained in detail to understand the ways they can contribute to a sustainable and eco-friendly library.

Green Library Building and Design

LEED (Leadership in Energy and Environment Design) is the most prominent rating system to assess green buildings. LEED has defined the protocols and standards for green buildings, in terms of the site selection, energy conservation, reduction of water consumption, adequate disposal of waste material, and providing green information literacy.

With the proper design and architecture, it is possible to develop a green library building and its premises by deploying various initiatives that are mentioned in Table 1 (Binks, Braithwaite, Hogarth, Logan & Wilson, 2014) (Bhagat & Bhagat, 2019) (Binks et al., 2014) (Jennifer King & Christopher Perry, 2017) (Vasishta, Navjyoti & Dhanda, 2019).

Table 1: Green Building Design Initiatives

Green Building Design Initiatives	*Benefits*
Properly designed ventilation systems	Ensures air regulation, controls impurities, reduces room temperature, controls humidity levels, and reduces energy usage.
Window shading	Keeps the room warm and cold according to the season and reduces heat gain.
Low- and Zero-VOC paints	Reduces sources of pollutants, has less odour compared to high-VOC paints which cause health issues and negatively impacts the environment.
Airtight construction	Restricts dust, pollutants, smoke, and other pollutants, and provides fresh air.
Rooftop gardens	Reduces the heat of the building, keeps the building cool, and removes CO2
Use of sensor taps and dual-flush toilets	Decreases water usage in bathrooms.
Solar power produces power by converting sunlight into electricity and wind turbines to convert wind into energy	Libraries can use renewable energy to meet their electricity requirements and act as a role model for others.
Tree plantation around the library	Tree plantation prevents pollution and increases the aesthetic appeal of the library.
Building materials made from recycled materials (e.g. flooring made from recycled rubber) are particularly useful alternatives	Saves natural resources and reduces pollution.
Use of LED lights	LED lights are more efficient and utilise less energy than conventional lighting; low heat radiation, high brightness, and longer life.
Use of soft pads in chairs	With the use of acoustic controls, soft pads are being used over the feet of the chairs to reduce noise pollution.

Green Library Practices and Operations

By bringing changes in the day-to-day activities of libraries, it is possible to integrate green practices in the libraries. These initiatives play a significant role in making people use resources carefully (Gupta et al., 2018; Kurbanoglu & Boustany, 2014) (Sornasundari & Sara, 2016) (Yoopuang, Kaewmanee & Jomsri, 2015) (Pangail, 2015).

- Proper policies and guidelines for recycling damaged and unused books and documents.
- Digitisation of printed material to reduce the use of paper.
- Automate and digitise library operations and activities using library software, which makes updating and retrieval of information easier.
- Cleaning of floors and shelves using old clothes and biodegradable clothes.
- Recycled ink cartridges must be used for printers, which cause less harm to the environment.
- Double-sided printing facilitates reduction in paper wastage; this should be encouraged.
- Reuse and donate old and discarded library items.
- Ensure proper segregation of dry and wet waste.
- Eliminate the use of plastics and use eco-friendly utensils and products.
- Use chlorine-free and FSC-certified paper.
- Use the duplex setting of copier/printer.
- Use of stairs rather than elevators when possible.
- Running multiple servers on one server box to save energy.
- Libraries should focus on procuring e-books and e-journals over printed materials as it encourages students to reduce the use of paper; students also prefer digital resources.
- The setting up of a water-harvesting system, which can be used for watering plants and other purposes, reducing the wastage of water and water bills.
- Use of IT applications in libraries due to digitisation, library automation, e-repositories, and e-resources have also increased energy consumption. With the application of newly emerging technology such as

cloud computing, green IT can be an alternative to save energy consumption (Warnasooriya, 2019).

- Switching from old library technologies to new technologies and harnessing the application of ICT for the implementation of digital libraries also leads to reducing dependency over printed materials.

Green Collection Development and Literacy Programme

The library professionals can also support and promote green libraries by engaging in and creating awareness among people through green literacy, proper collection development, foster behavioural change, and educate people on how to adapt green practices in their lives.

There are various ways to promote a green library through education, awareness, and literacy programmes (Aulisio, 2013) (Datta & Research Scholar, 2015).

- To promote the concept of sustainability, libraries need to maintain a useful collection of green resources and online materials, and ensure better reach to those resources.
- To create awareness among students by conducting programmes, campaigns, and events, such as organising talks, competitions, video-making, painting, poetry, and photography on the 'green' concept, which will educate the users and also nurture creativity among them.
- Libraries can play the leadership role by indulging in and making connections with like-minded people with the intention to promote sustainability by educating the students and faculty.
- To become aware of what other libraries are doing and train the library professionals, so that the new-generation librarians will adapt this idea.

Smart and Innovative Technologies for Green Libraries

The new-age innovative and cutting-edge technologies have the potential to reduce energy consumption and contribute to the mission of a green and sustainable world (Ferreira, 2016). These technologies can be leveraged by libraries to improve the energy performance of the library.

- *Solar Panels:* Installation of solar panels on the roof of the library building helps reduce the dependence on non-renewable sources of energy. It also promotes the use of renewable sources of energy and creates awareness among people.
- *Motion Sensor Devices*: Cases of wastage of electricity are prominent in libraries where users leave the place without switching off the devices. With the help of a motion sensor device, which can automatically detect your absence and switch off the electrical appliances, will help conserve energy. For example, at the National Library, Singapore, sensors are used to dim or brighten the lights.
- *Automatic Lighting Controls:* It is an effective strategy that contributes to energy-saving significantly by operating the lighting as per the requirement. The amount of available light adjusts according to the space occupied.
- *Smart Automatic Energy Saving System:* Detects the entry of a person with PIR sensor, monitoring the room temperature and brightness, and adjusting the speed of the fan accordingly; also shuts down the complete system in the absence of any individual, which helps in reducing wastage of energy.
- *Indoor Air Quality Monitoring:* With the application of the Internet of Things and ambient-assisted living technologies, it is possible to monitor and assess the air quality of the building (Marques, Saini, Dutta, Singh & Hong, 2020). The IAQ monitoring systems helps maintain energy efficiency in buildings and provides excellent ventilation to ensure healthy air quality in the library and the well-being of the users.

Major Findings of Previous Literature

Gundawar (2017) in the thesis 'A survey of green libraries in India' investigated the green practices exercised by UGC-approved libraries in India, based on certain indicators. The sample total of 178 libraries were evaluated; Table 2 lists the major findings of the research.

Table 2: Status of Green Libraries in India

Indicators	*Percentage of Libraries*
Green building	22% (1% proper certification)
Natural ventilation	54%
Dual flush toilet with cistern	31%
Using natural daylight	60%
Using energy-saving bulbs (LED lights)	48%
Computerised monitoring of electrical systems	13%
Photocell occupancy sensors for automatic light control	7%
Solar panels	28%
Use of chemical-free products for cleaning	33%
Waste management of books	64%
Printing on both sides of paper	72%
Adopting measures for e-waste management	53%
Green programmes and activities	49%
Reducing, reusing, and recycling of the products	12%
Creating a 'Green Team' in the library	7%
Collection development	27%
Green initiatives in IT	21%
Rainwater harvesting	34%

Table 2 demonstrates the percentage of libraries that adopted green library practices and initiatives based on certain indicators. It shows that only 22%, with only 1% of properly certified, green library buildings exist. Natural ventilation, using natural daylight, waste management of books, printing on both sides of paper, and adopting measures for e-waste management practices are more prominent initiatives, which have been undertaken by more than 50% of libraries, whereas computerised monitoring of electrical systems, sensors for automatic light control, reducing, reusing, and recycling of products, and creating a 'Green Team' in the library are measures that are used by less than 20% of the libraries.

Table 3: Impact of Green Libraries on Conservation of Resources

Green Libraries	*Impact*
Fayetteville Public Library, Minneapolis	• Reduced air temperature by 20 degrees Celsius; saved $2,40,000/- (per annum) energy cost, by 'green' roofing. • Roof water saves energy cost by 75%.
Seattle Central Library	• Located in a dense area; cost of transportation of water was reduced by installing a 40,000-gallon-tank for roof water harvesting.
Minneapolis Public Library	• With green roofs, and a glass-and-concrete building, saves 42% water and 50% energy.
Council Tree Library, Fort Collins, Co	• LEED platinum holder. • Saves 55% water, 92% construction waste recycled, and 97% energy-saving equipment.
Eden Prairie Library, Eden Prairie, Mn	• Annual saving of $82,000 with the use of natural gas fuel cell to produce power and heat onsite.
Harper Woods Public Library, Harper Woods, Mi	• 87% of the building structures was reused. • Reduced water consumption by 50% and a saving of 100,000 gallons per year.

Table 3 shows that libraries that have implemented green practices are not only contributing towards saving library expenses, but have also made a considerable impact on the conservation of natural resources.

Analysis of LEED 2011 and GRIHA 2019 Green Rating System

Table 4: LEED and GRIHA Green Rating System

LEED 2011	*GRIHA v2019*
U.S. Green Building Council developed the Leadership in Energy and Environmental Design (LEED) Green Building Rating System to make a comprehensive standard to promote eco-friendly buildings and evaluate them. Indian Green Building Council embraced LEED – India 2011 with the intent to make a LEED rating system in the Indian context. LEED gives guidelines and specifications regarding the construction of buildings to achieve sustainability.	Green Rating for Integrated Habitat-Assessment (GRIHA) was set up by TERI (The Energy and Resources Institute, New Delhi) under the aegis of the MNRE (Ministry of New and Renewable Energy). It is an assessment tool that measures the performance of the buildings based on the various nationally accepted indicators. GRIHA Council has recently launched the new version of the GRIHA rating – Version 2019 in December 2019, in order to address emerging advancements in the highly dynamic construction sector (GRIHA v2019 abridged manual).
Main Categories of Assessment: • Sustainable Sites • Water Efficiency • Energy & Atmosphere • Materials & Resources • Indoor Environmental Quality • Innovation & Design Process • Regional Priority	• Major Categories of Evaluation: • Sustainable Site Planning • Construction Management • Energy Efficiency • Occupant Comfort • Water Management • Solid Waste Management • Sustainable Building Materials • Life Cycle Costing • Socio-Economic Strategies • Performance Metering and Monitoring • Innovation
Credit point for different levels of certification: 40-49: Certified 50-59: Silver 60-79: Gold 80+: Platinum	Percentile point for achieving stars: 25-40: 1 star 41-55: 2 stars 56-70: 3 stars 71-85: 4 stars 86 and more: 5 stars
The CII-Godrej GBC, Hyderabad (2003), the *Anna Centenary Library, Chennai (2010),* Biodiversity Conservation India, Ltd. (BCIL), Bengaluru, are some LEED-certified buildings.	The Centre for Environmental Sciences and Engineering, IIT Kanpur (2009) and Suzlon 'One Earth' Office Complex (2010), Pune, are some GRIHA 5-stars certified buildings.

LEED rating system has made some mandatory requirements along with options, whereas GRIHA is a more flexible option in its approach, where all criteria are available, which sometimes makes LEED a more integrated system.

Various other green-rating systems across the world are NABERS (National Australian Built Environment Rating System) in Australia, BREEAM (Building Research Establishment Environmental Assessment Method) in the UK, China Green Building Label, Japan Comprehensive Assessment System for Built Environment Efficiency (CASBEE), the European Union's Energy Performance of Buildings Directive (EPBD), Canada's Building Environmental Performance Assessment Criteria (BEPAC) (Shenoda & Wang, 2015)

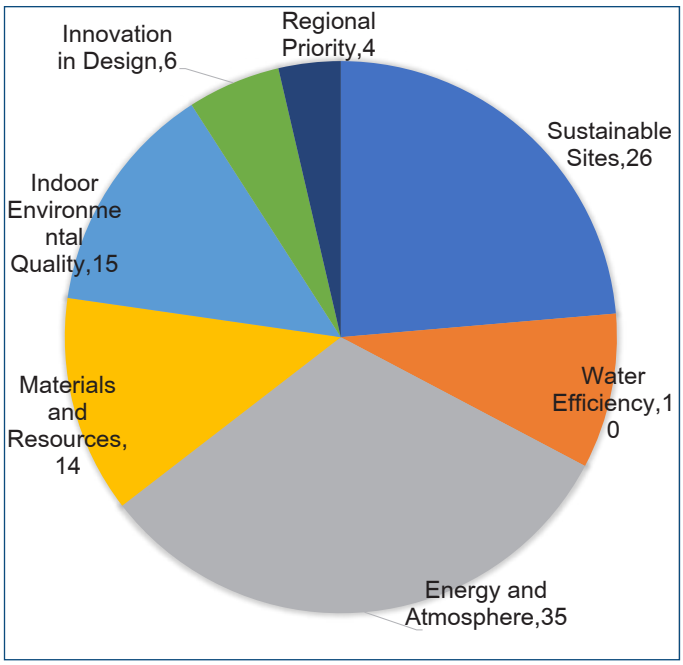

Fig. 1: LEED 2011 – Distribution of Credit Points to Major Categories

Fig. 1 shows that there are total of 100 possible points in five main categories – SS, WE, EA, MR, and IEQ; six points under 'Innovation and design', and four points under 'Regional priority'. The total number of points that can be achieved is 110.

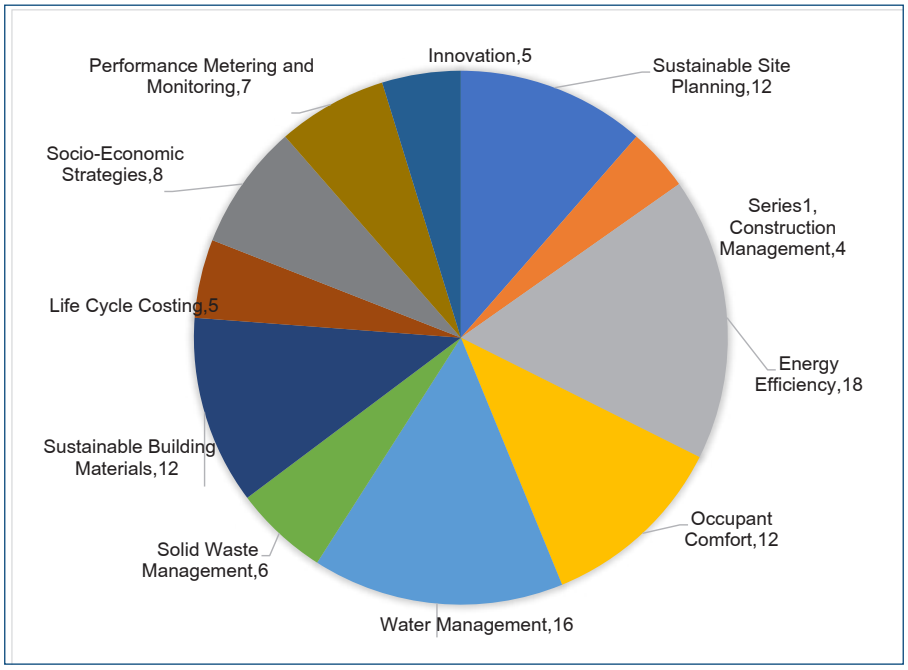

Fig. 2: GRIHA v2019 – Distribution of Credit Points to Major Categories

Fig. 2 shows that here are total of 100 possible points in ten main categories and five points under 'Innovation'. The total number of points that can be achieved is 105.

Green Library Initiatives in India

India placed third on the list of top ten countries in Leadership in Energy and Environmental Design outside America, as per the latest US Green Building Council report. Various green library initiatives have been undertaken in different parts of the country, a few of which are mentioned below (Meher & Parabhoi, 2017) (USGBC, 2019).

Anna Centenary Library, Chennai: The library was established in 2010. It is equipped with modern technology and proper use of light, air, and wood has been made. Gold rating by LEED.

Karnataka University Library, Dharwad: The library was started in 1950. The green library initiative started with the need to facilitate the system of Gurukul and to provide open spaces for group discussions.

Mumbai University Library: The Mumbai University Library was established in 1880. The library was developed using environment-friendly products and ensures proper lighting, providing open spaces for the readers.

Madras University Library: It was built in the year 1907 in the Indo-British style. The windows are designed in a manner that ensures proper lighting of the reading area and the circulation of fresh air.

Perma Karpo Library, Ladakh, in the Indian Himalayas: The library makes use of solar panels, and is surrounded by the white lotus garden, and innovative technologies.

IFLA Green Library Award

The IFLA Green Library Award was started in 2015 by ENSULIB, IFLA's Environment, Sustainability, and Libraries Special Interest Group, and generously sponsored by the German publishing house, de Gruyter Saur, to foster the role of libraries in environmental sustainability (Hauke, 2019).

Objectives of the IFLA Green Library Award

- To award the library that shows its commitment towards sustainability of the environment with the Best Green Award.
- Libraries are motivated to demonstrate leadership qualities and ensure social responsibility towards green education.
- To promote and strengthen green library movement through green buildings, information literacy and resources, and conservation of energy and resources.
- To encourage the development of green libraries, locally and worldwide.
- To motivate green libraries to showcase their activities and initiatives in an international arena.

Winner of IFLA Green Library Award 2020 – Rangsit University, Thailand

Rangsit University was awarded the IFLA Green Library Award in 2020. The university is situated in Lak-Hok sub-district, on Paholyothin Road, Pathumthani Province, Thailand, and received the Carbon Neutral Certification from the Thailand Greenhouse Gas Management Organization in September 2019 (Rangsit University Library, Pathumthani, 2020).

Rangsit University planned and implemented various green ideas, initiatives, and programmes, which are mentioned below.

- Energy conservation and reduction guidelines for air conditioners, computers, elevators, fuel, electricity, water, paper, and printing ink were introduced.
- Recycled paper was purchased from the UHT box to conserve natural resources.
- The library ensured segregation of waste into general, recycle, and hazardous waste.
- Recycled waste such as plastic bottles and biological waste were used to make crafts and multipurpose cleaner liquids.
- The library organised DIY workshops and other creative activities from the waste materials, to increase awareness.
- To maintain the suitable temperature, the library expanded its green area, filtering the dust and carbon monoxide, adding more purified air, and providing a sense of a 'living' library.
- LED light bulbs have replaced standard lights.

- Green campaigning was initiated with the help of posters, to educate users; digital and social media were used to communicate the message of green practices.
- Fashion design ideas from waste materials were presented in the New Year 2020 Academic Affairs.
- The library has maintained a good collection of materials on green and sustainable environment.
- Green knowledge training was imparted to the library staff.
- Only products labelled 'green' were procured.
- By reducing greenhouse gas emissions and carbon monoxide through managing the waste, energy consumption, and resource usage, the library became a carbon-neutral zone.

Rangsit University demonstrated the remarkable example of a 'green library' by introducing proper green library guidelines, recycling and reusing of products, using environment-friendly products, creating awareness among people through innovative ideas, and implemented strategies for the effective use of resources.

Role of Green Library in SDGs

The implementation of the UN Sustainable Development Goals (SDGs) in 2015 led to the launch of the IFLA International Advocacy Programme. The aim of IAP is to support and promote the role of libraries in the planning and implementation of SDGs. Later, other initiatives have been undertaken by libraries to fulfil the objectives of the SDGs and broaden their scope of action ('Sustainable Development Goals and Libraries First European Report', 2020) as an initial set of indicators may need further development and refining. This chapter mentions several frameworks that have been proposed to measure the progress of societies. The point is simply that there are potentially useful frameworks that seek to capture the definition and scope of national wellbeing. They provide potential starting points. However, the framework that is most suitable for a given locality, country or group of countries should be determined through a process of deciding and meeting user requirements, which is explored in the chapter. For the wellbeing conceptual framework that the Organisation for Economic Co-operation and Development (OECD. Fig. 3 shows the four SDGs that can be achieved and promoted through green libraries.

Fig. 3: Role of Green Library in Achieving Sustainable Development Goals

Fig. 3 shows the role of a green library in accomplishing sustainable development goals – libraries can ensure affordable and clean energy by switching to renewable energy; they can promote responsible consumption and production by promoting recycling and reusing of products; they can combat against climate change by educating and creating awareness among people; and they can support life on land by encouraging gardening and tree-planting activities.

Findings

After investigating the literature on green libraries, it was found that initially the concept of a green library was confined to green buildings only, but now it has broadened its nature and scope. There are different measures and practices that can contribute to building green libraries, such as green building designs, green practices in the day-to-day functioning of libraries, green library literacy

and knowledge programmes, and green technologies. Some libraries have been remarkably successful in the implementation of green practices, which helped them to reduce their library expenditure and contribute to the conservation of resources. Green rating system has become a crucial tool to assess library buildings; however, there are no specific guidelines which are used for evaluating the other green efforts yet.

LEED and GRIHA are two prominent rating systems used in India. A maximum of 110 credit points can be achieved in LEED and 105 in GRIHA. IFLA is a well-known international organisation in the library community; it promotes the concept of green libraries through the IFLA Green Library Award, where libraries get the opportunity to showcase their work and motivate other libraries to go green. Green libraries also contribute to four sustainable goals: affordable and clean energy, responsible consumption and production, climate action, and life on land.

Suggestions

- Proper guidelines and policies are required to assess the impact of libraries on environmental sustainability.
- Library Science professionals should be trained and educated, by incorporating green library concepts as part of their curriculum.
- Effective strategies and proper financial aid by the government and concerned authorities to support and promote the concept of green libraries must be ensured.
- Innovative ideas such as introducing a green library award, rewards, and monetary grants by the government must be adopted, as these help motivate libraries to go green.
- Libraries should leverage the benefit of green technology to create a green library.

Conclusion

Librarians are emerging as leaders of social responsibility; they should broaden their roles and functions in the upcoming era. The role of librarians is shifting from that of a 'traditional' librarian to a 'digital' and 'social' librarian, where environmental concerns and green libraries are emerging as a new field of research in library and information sciences. Libraries can achieve sustainability by embracing green building designs, green practices, literacy programmes, and the use of green technologies. IFLA Green Library initiative is a great effort to promote green libraries and get inspiration, ideas, and innovative techniques implemented by libraries worldwide. In the near future, libraries should be the focal point of driving the green movement; they should act as a critical agent of environmental stewardship. Hence, libraries are continuously expanding their horizons and act as role models for an eco-friendly, sustainable environment.

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