


RESEARCH ARTICLE	 Green Libraries: Towards Sustainable Buildings for a Green Knowledge Environment
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Abstract This study aims to explore the methods and mechanisms that would enable current libraries to transition into environmentally friendly spaces capable of contributing to the creation of a green knowledge environment. Additionally, it seeks to highlight the essential components for implementing and achieving environmental sustainability concerning library buildings and their information services through the adoption of eco-friendly practices. The study also identifies the major challenges faced by libraries in achieving this transformation. The research employs a descriptive approach. One of the primary findings of the study is that the shift towards green building design and the provision of green services by libraries necessitates financial resources, a phased transition, as well as the readiness and commitment of library staff to embrace the importance of this step toward becoming green libraries. Furthermore, this shift requires a firm belief in the significant role of libraries in fostering and advancing environmental sustainability.	
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Introduction

Sustainable development and environmental sustainability have become shared responsibilities for all sectors. The field of library science, too, has become a significant player in this global phenomenon. Libraries, as social institutions, are key stakeholders in environmental protection and the promotion of sustainable development. This is particularly true in light of the increasing recognition of the benefits of green buildings, which has led many libraries to consider joining the green movement. They are integrating strategies to reduce the environmental impact of buildings on human health, the environment, and nature by creating green buildings and offering green services. These efforts are part of libraries' contribution to fostering a green knowledge environment.

The demands of the current environmental climate have reshaped libraries more profoundly than ever before, altering their identity and societal roles in order to ensure their survival and continuity. Libraries are evolving into green, environmentally friendly spaces, primarily aiming to activate the principles of environmental sustainability and sustainable development. A secondary goal is to promote environmental sustainability culture among

community members, all within the context of effectively contributing to the realization of a green knowledge environment.

Today's libraries have the capacity to play a leading role in environmental advocacy, especially given the alarming depletion of natural resources. Libraries play a crucial and foundational role in environmental preservation and the welfare of society. This is true both in terms of raising awareness about the importance of environmental sustainability through activities and seminars, and in terms of ensuring that their buildings are designed with environmental sustainability in mind, thus providing a safe space to serve their beneficiaries without compromising their well-being.

The spread of green libraries, along with the rise of green information services and sustainable library practices, is on the increase, furthering the realization of a green knowledge environment. A green library is an environmentally friendly facility designed to minimize negative impacts on the natural environment through the use of clean technologies, eco-friendly energy sources, and efficient management practices. Consequently, libraries must not only play a role in educating the public about sustainability but also serve as exemplars of sustainability in action, showcasing tangible, applied models of this culture.

Thus, green libraries, or sustainable libraries, have rightfully earned the title of ambassadors for the promotion and realization of a green knowledge environment. This concept has gained significant importance among library and information professionals. It is an essential direction that must be adopted through scientific standards, requirements, and steps, as well as efforts to implement and disseminate it within the professional community in support of environmental sustainability and sustainable development.

1. Study Background

1.1 Importance of the Study:

This study derives its significance from the importance of the topic it addresses, namely "Green Libraries: Towards Sustainable Buildings for a Green Knowledge Environment." This topic has emerged as one of the most recent issues in recent years, as there has been growing attention towards green resources across all sectors, with libraries being no exception. This is due to the idea and culture of environmental sustainability and green sustainability, which offer numerous advantages for preserving environmental resources for future generations, especially given the ongoing depletion of these resources. Additionally, the importance of this study lies in the significance of libraries as gateways to knowledge and the heart of any institution. Libraries are also key social partners in various community activities and events. Therefore, their role and contribution in building and advancing environmental sustainability, as well as sustainable development, are crucial. Libraries are more than just architectural structures; they are green, environmentally friendly buildings that work to enhance environmental awareness and sustainability among their users through programs, activities, and intellectual resources related to these topics. Their goal is to strike a balance between the need to provide high-quality library services and the necessity to be environmentally responsible and sustainable.

2.1 Study Objectives:

In addition to answering the research questions, the study aims to:

- Raise awareness, particularly in the Arab world, about the importance of transitioning to green libraries and their contribution to achieving a green knowledge environment, thereby protecting the environment and maintaining the ecological balance of the planet.
- Introduce Arab librarians to new trends in green libraries and guide them on how to transition to these libraries, while also raising awareness about the importance of their engagement and participation in making this transition successful.
- Identify the key requirements and components that current libraries must have to begin transitioning to green libraries, so they can benefit from their advantages and contribute effectively and efficiently to environmental sustainability, ultimately leading to the creation of a green knowledge environment.

- Educate Arab librarians about the key activities and library operations related to sustainable development and environmental sustainability, and promote green awareness, green practices, and green services to protect the environment through environmental engagement.

3.1 Study Problem and Questions:

This study seeks to discuss ways and requirements for enhancing the shift towards green library design and the key criteria involved, in order to support libraries' contribution to environmental sustainability and to promote this culture among their users. It will answer the following questions:

- What are green libraries and environmental sustainability?
- What are the reasons and justifications for transitioning to this contemporary model of libraries? What are the mechanisms for this transition? What are the requirements for achieving it?
- What are the features and characteristics of green libraries as buildings that support both environmental sustainability and a green knowledge environment?
- What are the key green services that can enhance the contribution and participation of green libraries in supporting environmental sustainability, thus achieving a green knowledge environment, particularly in the Arab world?

4.1 Reasons for Choosing the Topic:

- Interest in the developments and emerging topics in the field of library and information science.
- The many advantages and importance that green libraries bring to society.
- The growing global interest, across various sectors and institutions, including libraries, in embracing the idea of environmental sustainability and development, contributing to environmental protection and preservation.
- The global shift towards the idea of environmental sustainability and sustainable development, and the increasing necessity for libraries to participate actively and effectively in this process.

5.1 Study Areas:

- **Thematic Areas:** Green Libraries: Towards Sustainable Buildings for a Green Knowledge Environment.
- **Qualitative Areas:** The study is focused on the standards and requirements for the design of green libraries, as well as the green services they offer and their contributions to supporting environmental sustainability and achieving a green knowledge environment.

6.1 Study Methodology:

Given the nature and objectives of the study, the researcher used a descriptive approach as well as a theoretical review of intellectual contributions on the topic, relying on the documentary method by reviewing and analyzing numerous references and scientific studies—most of which are in English—that discuss various aspects of "Green Libraries: Towards Sustainable Buildings for a Green Environment." The aim is to identify the standards, requirements, and mechanisms for designing green buildings for modern libraries capable of supporting the culture of environmental sustainability and sustainable development in society.

7.1 Data Collection Tools:

We relied on documentary research by gathering sources related to the topic "Green Libraries: Towards Sustainable Buildings for a Green Knowledge Environment," published between 2017 and 2024, in both electronic and printed formats, primarily in English and Arabic. These sources were analyzed to extract relevant information related to the study.

8.1 Previous Studies:

As is the case with all emerging topics in the field of library and information science, the topic of "Green Libraries: Towards Sustainable Buildings for a Green Knowledge Environment" has been widely addressed in foreign intellectual production, particularly in English-language publications. Authors have made significant efforts to explore the possibility of transforming libraries into environmentally friendly, green spaces that support the philosophy of environmental sustainability, particularly concerning the standards, activities, and services of these libraries. The discussion on "green libraries" in the field of library and information science began in 1971 when Howard Armstrong published a report on the role of libraries in environmental education. Research and studies on this topic within the field of libraries remained limited until the early 1990s. In February 1991, *The Wilson Library Bulletin* published an article titled *Libraries and the Environment*, and in the same year, James and Suzanne LeRue published an article entitled *The Green Librarian*, in which they described how libraries can support the environment. The movement for writing on green libraries within the library field saw a resurgence in 2002 with the IFLA conference on the theme "Libraries and Sustainable Development," which explored providing beneficiaries with the right to a healthy environment and emphasized the global responsibility of libraries to support and consider quality of life, promote reading, and provide access to information in spaces that respect the environment by reducing electricity consumption and using eco-friendly energy sources (Ahmed, 2022: 2). In 2003, Bill Brown, in his article *The New Green Standard*, discussed the necessary requirements for green libraries and how they had become at the forefront of green designs. In 2008, Neale, J.C. provided a study on how libraries can be environmentally friendly, and that same year, Tseng, S. highlighted the design and development of green libraries. The U.S. Green Building Council also introduced the LEED (Leadership in Energy and Environmental Design) certification system in 2008. In 2010, Loder's study *Green Libraries* clarified that the subject was not only about energy efficiency but also about designing green spaces for users. Aulisio's study also discussed how green libraries go beyond just building design to encompass operations, procedures, activities, and tasks (Ahmed, 2022: 4). In 2013, Hauke, S. and Werner, K.U., along with Purohit, further discussed the green library movement as a new concept. Since 2016, and especially after 2017, foreign studies, particularly those in English, have focused more on the characteristics and specifications of green library buildings, also known as sustainable library buildings. For example, Sunil Rabidas's 2016 study on green library buildings outlined the process of making libraries sustainable.

Regarding the Arab contribution to the appreciation and promotion of the green library concept in support of environmental sustainability, a virtual international forum was held in Algeria on October 30-31, 2021, titled *The Contributions of Libraries and Information Institutions in the Shift Towards Green Investment and Sustainable Development: Institutions, Roles, and Innovative Services*. Its main objectives focused on raising awareness about the importance and necessity of adopting green practices and behaviors for sustainable development, highlighting the role of libraries and information institutions in shifting towards green investment and sustainable development, and identifying how libraries can contribute to promoting a green culture. Additionally, Lamia Ouahmed's 2022 article on *Green Libraries: A New Model for Library Design and Construction* and Ibtisam Abdel Salam Ali Sheta's 2022 study on public libraries in Egypt and sustainable development both sought to shed light on the criteria and specifications for designing green library buildings and the requirements for achieving such designs in a way that serves environmental sustainability and adheres to its regulations. These efforts ultimately aim to positively impact the library's role in society.

After reviewing the contents of these foreign and Arab studies, we have concluded that their findings converge on the following points:

- Identifying the standards and specifications for the design of green library buildings and the requirements for achieving them.
- Some studies focus on the specific standards and requirements for designing green library buildings.
- These studies agree that the transition of current libraries into green, environmentally friendly buildings is an essential move to support libraries as a social partner in spreading the culture of environmental sustainability and sustainable development to address the impacts of climate change. They also agree that this shift will transform library services into green services, with library activities and operations following suit.
- However, achieving this transformation and transitioning libraries to green, environmentally sustainable buildings will present a range of challenges, particularly those related to the financial resources needed to

equip libraries with the necessary green technologies and infrastructure, which are typically more expensive than their conventional counterparts. Despite these challenges, both foreign and Arab studies emphasize that libraries should not ignore the importance of becoming green, environmentally sustainable spaces, as the benefits of such a transformation will be realized over time, contributing to the preservation of the planet's resources for future generations, free from waste and depletion of non-renewable resources.

Based on the results of these previous studies, we are led to focus on the following questions, which we aim to answer in this research:

- In addition to the shift towards green architecture and building designs, including for library buildings, what are the key specifications and features agreed upon regarding the design of contemporary green libraries?
- What are the requirements and phases that will enable information institutions to implement the transformation of their buildings into green or sustainable buildings?
- Does the transition of libraries to green libraries introduce new and different roles for them? What are the transformations and developments that enhance and activate libraries' contribution to environmental sustainability and sustainable development?

9.1 Terminology of the Study:

Green Libraries:

The concept of "green libraries" is a relatively recent one that is still evolving. As a developing concept, it has gained significant popularity among researchers and library professionals worldwide. The terms "library" and "sustainability" are limited in scope but continue to grow and evolve. Topics related to green libraries and sustainability have garnered significant attention and extensive coverage in recent years through various publications aimed at library professionals (Kolkarni, 2018: 1). Several definitions of green libraries have emerged, including:

The concept of green libraries is not new. The movement was first introduced in 1971 by Howard Armstrong, who published a report titled "The Role of Libraries in Environmental Education." The green library movement saw a resurgence in the early 1990s, particularly in February 1991, when *The Wilson Library Bulletin* published an article titled *Library and Environment*. In the same year, James and Suzanne LeRue published an article titled *The Green Librarian*, in which they described how libraries could support environmental initiatives both in the home and within the library itself. That year also saw the establishment of a scholarly journal called *The Green Library Journal* by a group of environmentalists and green library advocates, aimed at promoting the value of green libraries and environmental literacy. The first issue of the journal, published in January 1992, featured several articles, including Nancy N. Pope's *The Greening of ALA Conferences* and Monte L. Steiger's *Oh, How Green is Your Library*, both focusing on green libraries and their characteristics.

In 1993, Atton C. published an article titled *Green Librarianship: A Revolt Against Change*, which described green library activities in the United States and warned librarians against adopting the consumerist commercial model for libraries.

After these early years, articles about green libraries remained scarce until 2003, when the movement gained significant momentum. Many articles were published, including Bill Brown's *The New Green Standard*, which outlined the essential requirements for green libraries. Louise Levy Schaper also published an article titled *Public Input Yields Greener Library Design*, explaining how Blair Public Library in the United States became the first LEED-certified sustainable library building. In 2008, Jane C. Neale's article *Go Green* discussed how libraries can become environmentally friendly, while Francine Fialkoff's article *Green Libraries are Local* explored how public libraries in California and San Francisco successfully transitioned into sustainable green libraries, offering a model for other libraries to follow (Antonelli, 2008, P-P 02-03).

In the following years, there was a surge in literature on green libraries, with an increasing number of articles and studies dedicated to the movement. Here are some key definitions of green libraries:

- Green libraries are defined as those that adopt the idea of sustainability and implement it across their operations, educational programs, awareness activities, and services offered (Aulisio, 2013, P.01).
- Green libraries are also defined as those that meet the standards set by the LEED (Leadership in Energy and Environmental Design) system, one of the most widely recognized international standards for assessing the sustainability of green buildings (Mohamed Louay Hatem, 2020).
- The Online Dictionary for Library and Information Science (ODLIS) defines green libraries using the term *Sustainable Library* as a synonym. It describes these libraries as designed to minimize negative impacts on the natural environment and enhance the quality of indoor environments through careful site selection, use of natural building materials, biodegradable products, resource conservation (e.g., water, energy, paper), and responsible waste disposal through recycling (Reitz, 2013).
- The International Federation of Library Associations and Institutions (IFLA, 2021) asserts that the concept of green libraries is not limited to the building itself. These libraries should also focus on services, activities, projects, events, and publications related to environmental issues, highlighting the social role and community responsibility of libraries as institutions that contribute to sustainable development.
- Furthermore, the concept of green libraries should extend beyond environmentally conscious practices to include the methods and strategies used in providing services to their beneficiaries, reflecting an overall commitment to sustainability (Mohamed Louay Hatem, 2020, p.145).

Sustainable Development:

Many researchers have focused on presenting a concept for sustainable development, despite its relative newness. They have tried to find foundations for the concept that help integrate social and economic principles into decision-making processes at both individual and public levels. However, there is no universally agreed-upon definition of the concept, primarily because sustainable development is a complex process characterized by constant change and is heavily dependent on individual, societal needs, and interests.

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It calls for collective efforts to build a future that is inclusive, sustainable, and resilient, benefiting everyone while ensuring the planet's health (United Nations, 2016).

The National Charter for the Environment and Sustainable Development defines it as development that, without it, leads to greater environmental degradation, disruption of natural balances, depletion of natural resources, worsening health issues, increased poverty, and a decline in the quality of life. It does not negate the need for economic development but requires improving living conditions for all people within the framework of equality and social justice without over-exploiting natural resources beyond the planet's capacity to sustain them, encouraging balanced patterns of production and consumption (Bousaha, Bhoulh, p.72).

Environmental Sustainability:

Environmental sustainability is one of the key pillars of sustainable development. Its goal is to preserve the environment and its resources while minimizing the negative impact on the environment to ensure its availability for current and future generations. This article will explore the importance of environmental sustainability, its definition, and the main challenges and solutions related to it.

Environmental sustainability focuses on achieving a balance between the environment, economy, and society. It aims to preserve natural ecosystems and their resources in ways that ensure the sustainability of both the economy and society. Environmental sustainability relies on the concept of green growth, which seeks to achieve economic development through methods that protect the environment while promoting social equity (Arab Network for Excellence and Sustainability, 2024).

2. Goals of Green Libraries:

- Raise awareness within the community about the importance of environmental conservation as a fundamental and essential condition for achieving sustainable development.
- Educate decision-makers about the importance of the environment and the methods and strategies to protect it through the information that libraries provide.
- Aim to be a social and cultural institution with environmental strategic dimensions in society, serving as an active and engaged entity.
- Instill a love for nature and environmental protection in young people, fostering a future generation committed to defending environmental causes and ensuring their preservation, with a goal of achieving sustainable development (Shabahi, Sabor, 2020, p. 05).
- Enhance the status of libraries within the community through sustainable green buildings and a range of green services and activities that meet modern environmental requirements.

3. Motivations for Transforming Libraries into Green Libraries:

The green transformation is a process occurring worldwide across various industries and fields, such as "green chemistry," "green energy chips," and "green vehicles." Therefore, it has become essential for libraries to also embrace the green transformation, particularly since this shift is a crucial step that requires immediate attention and action, especially in a time when pollution levels and natural disasters are rising and having a significant impact on both human beings and the environment. The reasons and motivations for libraries to become green are as follows:

- The cost of building green libraries has become lower compared to traditional libraries.
- Green libraries provide an environmentally friendly environment for both the community of users and staff.
- Pollution caused by construction materials such as cement, bricks, steel, and other harmful materials used in traditional library buildings.
- Green libraries help control pollution levels and reduce the emission of harmful gases into the environment.
- Green libraries promote the efficient use of energy and water through technologies such as solar panels and rainwater harvesting.
- Most natural resources have become limited, making it essential to use them responsibly and efficiently (Prasanth&Vasudevan, 2019, P.01).
- Kalda (2015, P.32) presents another perspective on the reasons for transitioning to green libraries, particularly regarding the community of library users. He emphasizes that green spaces have a very positive impact on the psychological well-being of library users. Linking the benefits of information sources with attractive and relaxing views helps users feel more at ease and promotes mental comfort.
- Green libraries have a significant positive effect on the performance of students and academic researchers by providing quiet green spaces, which encourages focused study and fosters creative thinking.
- With the changing environment, it has become essential for libraries to evolve as well, to ensure their survival while also contributing to environmental protection and supporting sustainable development.

4. Features and Specifications of Green Libraries Supporting Sustainable Development

The green initiatives of green libraries encompass all their components, starting from the building, through their green collections, and ending with the green services and activities they offer. This holistic approach ensures that they represent a true and practical model for social and cultural institutions that support sustainable development. The various features and specifications of green libraries that contribute to sustainable development can be summarized in the following aspects:

4.1 Architectural Aspect:

The *Leadership in Energy and Environmental Design (LEED)* system indicates that the design of a green library building does not rely on just one building element but rather integrates a set of elements within the structure to

make it a sustainable green building. Each element helps the others achieve the overall goal. These elements are the same ones used by the LEED system to measure the effectiveness of a green library building and include the following:

4.1.1 Site Selection:

This is one of the most important factors in ensuring the future development and sustainability of the building. It is not advisable to repurpose an old building as a library, as it is important that the chosen site has minimal negative impact on the surrounding ecosystem, including waterways, green landscapes, and the use of rainwater and stormwater storage systems. Additionally, the site must limit factors that contribute to environmental erosion, light pollution, thermal effects, and reduce the impact of construction processes (LEED, 2019). The site selection process should also include the following important criteria:

- The site should be in a populated area, ensuring easy access by public transportation.
- Nearby facilities should be available to prevent individuals from walking long distances to access different services.
- The library building should provide parking facilities, with priority given to energy-efficient vehicles (LEED, 2019).

4.1.2 Water Conservation:

Due to the rapid depletion of water resources, it is essential to use water optimally and efficiently in green buildings. Library buildings should be designed to help conserve water by incorporating systems for storing rainwater to irrigate green spaces around the building and for other necessary uses (LEED, 2019).

4.1.3 Energy Conservation:

This element is one of the most challenging aspects of designing green buildings. All negative strategies must be considered. The building's structure should be designed to rely on natural elements such as using natural sunlight during the day, installing solar panels on the building's roof to generate electricity, storing excess energy for summer use, and using motion sensors to automatically turn off lights in empty spaces (Aulisio, 2013, P.03).

4.1.4 Efficient Use of Construction Materials:

Construction materials should be carefully selected to minimize waste and ensure they are not harmful to the natural environment. For example, using wool bricks and paper insulation for walls, and using wax for flooring, bamboo, and cork for furniture. Generally, the construction materials should support the principles of the 3R Green Code: Reduce, Recycle, Reuse (LEED, 2019).

4.1.5 Indoor Air Quality:

Improving indoor air quality in library buildings requires a well-designed ventilation system. Windows and doors should be designed effectively to ensure that users do not feel trapped inside. Air conditioning should be used only when necessary, and plants should be placed around the building to provide fresh air (O₂). Additionally, CO₂ monitors can be used to ensure that levels remain safe, and air recycling systems can be implemented to avoid stagnant air, thus preventing harmful toxins from accumulating inside the library (Nikam, 2017, P.195).

4.1.6 Operating and Maintenance Practices:

These practices are aimed at improving the working environment, increasing productivity, reducing energy and resource costs, and ensuring optimal operation of library facilities. This includes rainwater management systems to reduce the building's environmental impact, eliminating the use of plastic bags, and using flexible padding under chairs to protect library floors from noise, as well as materials and systems that require less water, energy, and

chemicals (National Institute of Building Science, 2018).

4.2 Development of Green Collections:

There are several levels for developing green collections, starting with "Green Selection," followed by green collection sources and green programming materials. In New York, the *Metropolitan New York Library* established a special green library collection to support the goals and requirements of green libraries and to implement their practices. In 2007, the University of Wisconsin-Madison offered a program in Library Science titled *Eco Librarians: Changing Our Communities One Step at a Time*.

In December 2008, the *Southeastern Library Network* presented a seminar titled *The Greener Library*. Mechanisms for developing green collections include acquiring green information sources by following general guidelines for green subject headings, activities, and materials that align with this approach. Some ways that libraries can build green collections include:

- Selecting resources about organic gardening, fertilization, green computing, and energy conservation.
- Using green information resources to support information literacy frameworks, hosting awareness seminars, and reviewing publications related to green information sources.
- Recycling materials that are no longer part of the library collection by automatically sorting and evaluating materials, removing outdated and damaged works, and outdated journal subscriptions.
- Creating electronic links to environmental issues and how to preserve them.
- Offering alternative formats for green books, such as video clips and presentations (ALA, 2009).
- Avoiding the acquisition of information sources made from materials harmful to human health.

4.3 Services and Activities Aspect:

The transition to green services in libraries begins with educating library professionals on green practices that should be adopted within libraries. This ensures that green services are offered alongside green collections. Some methods libraries can adopt to offer green services include:

- Using automated cataloging systems such as OPAC to reduce reliance on paper catalogs.
- Providing online services using web 2.0 technologies and relying on electronic communication instead of paper-based communication.
- Supporting green projects by building relationships with environmental science groups.
- Implementing marketing programs to raise awareness about green library initiatives, which will increase awareness of the transition to a green environment (Prasanth&Vasudevan, 2019, P.03).
- Offering educational programs, scientific discussions, scholarships, and workshops focused on sustainable development.
- Raising awareness among educators about the concept of environmental sustainability, its importance, and requirements, and integrating these concepts into students' curricula and providing them with the necessary information sources.
- Creating opportunities for faculty and students to meet and support research projects in sustainability, providing access to related resources within the library (Squires, 2019, P.04).
- Organizing workshops for children to enjoy environmental science presentations and activities such as poster contests and silent poetry readings.
- Organizing open forums for green book clubs, with comfortable facilities. For instance, the Vallila Library in Helsinki organized several forums during spring, with experts and pioneers in the field. The topics included "Climate Change" (2010), "The Role of Water as an Environmental Factor" (2011), and "How to Live Sustainably" (2012) (Petra & Klaus, 2013, P.07).

5. Green Library Services and Activities Supporting the Spread of Environmental Sustainability Culture:

A green library cannot only be green in its buildings but must also contribute to spreading environmental culture and ecological awareness among the community, especially among its visitors. This is achieved through a range of activities referred to as environmental or green activism, defined as follows:

A. Environmental Activism:

Environmental activism refers to the set of organized activities and events conducted by green libraries aimed at imparting environmental culture to visitors and various segments of society. These activities raise awareness about environmental threats, ways to protect the environment, and encourage individuals to adopt practices that protect the environment in their daily lives (Shabahi, Sabor, 2020, p.13).

The goals of environmental activism in green libraries are:

- Environmental education and raising awareness about environmental issues, particularly among the youth.
- Contributing to environmental protection campaigns and promoting community-level action to preserve nature.
- Creating a generation of future leaders capable of making environmentally sound decisions and strategies.
- Fostering green citizens who contribute to the transition to a green society, aiming for a world free from environmental threats and natural disasters.
- Attracting a wide range of visitors, including those interested in environmental issues (Shabahi, Sabor, 2020, p.14).

B. Waste Management:

Before 2016, libraries did not consider the waste generated by their activities. However, with the implementation of the Green Library TLA standard, libraries began sorting and measuring waste before transferring it to designated waste collection points outside the library building.

C. Creation of Green Spaces:

Libraries have created green spaces around their buildings to filter dust and carbon monoxide (CO) and to introduce more fresh air, contributing to a "living" library atmosphere.

D. Environmental Management within Library Buildings:

For effective management of the library building, Rangist University Library follows a range of activities, including:

- Continuous measurement of light levels in reading spaces and staff offices.
- Air conditioning systems are switched on 15 minutes after opening and turned off 30 minutes before closing, with a temperature setting of 25°C.
- The smoking area is moved away from the library building, in collaboration with the Health Promotion Office, despite the law stating that smoking areas must be at least 50 meters from any library or university building.
- Printers are relocated from reading areas to protect the health of users and staff.

E. Raising Awareness Among Beneficiaries:

To raise awareness in the user community, libraries organize several activities, such as:

- Organizing green campaigns and activities.
- Promoting green campaigns and activities through social media and digital platforms.

- Organizing exhibitions about green libraries, the environment, and ways to preserve it.
- Conducting workshops on crafts like "DIY" using recyclable waste materials, including paper, plastics, and organic waste.

F. Providing Green Information Resources:

- Providing resources on sustainable development and green topics, as well as offering a range of databases, such as the *Green Digital Library*.
- Offering green information resources on the library's website through a dedicated *RSU Green Library* list.
- Creating a Green Corner in the library for users to access green resources.

G. Managing Greenhouse Gases:

This is done by reducing the emission of gases from the library's heating systems by following energy conservation guidelines and adopting green practices.

H. Managing Carbon Monoxide (CO):

This involves the design of an application that calculates and displays the amount of CO emitted each year by individuals. It uses data such as: the number of people in each household, the number of light bulbs, whether they own a car, and the distance between their home and work, among other factors.

This activity could enable the library to obtain a carbon-neutral certification from the Greenhouse Gas Management Organization in Thailand.

I. Cooperation and Partnership Agreements:

Libraries enter into multiple cooperation and partnership agreements with other libraries and organizations to achieve their goals, contribute to environmental conservation, and support the 2030 Sustainable Development Agenda. These agreements are made between libraries of similar types or across different sectors, as well as with loyal library patrons who are passionate about environmental work and actively involved in sustainable development and environmental sustainability. These agreements help enhance the role, participation, and contribution of libraries in environmental sustainability and sustainable development.

6. Results and Recommendations

6.1 Results: At the conclusion of this study, we have reached the following key results:

- As the negative impacts on the environment and the depletion of natural resources continue to rise, it is essential for everyone, including the library sector, to participate in revitalizing and restoring environmental sustainability practices and supporting sustainable development for the planet.
- The transition of current libraries into green, environmentally friendly libraries is becoming urgent due to the increasing spread of environmental pollution and its severe risks to the planet, including its creatures and natural resources.
- This transition should be phased and gradual, as it involves various requirements, especially the significant financial costs required to convert existing library buildings into green buildings that preserve the environment and support environmental sustainability. These libraries will also contribute to spreading environmental awareness and educating users about the importance of preserving nature's resources for the long term and future generations.
- The shift to green libraries is not limited to transforming the buildings alone. It also encompasses the transformation of information services provided to users, turning them into green services, as well as the green practices of library professionals.

- The implementation of sustainable development principles within green libraries can be achieved by applying sustainable environmental design standards and integrating environmental sustainability ethics into daily library operations.
- Green libraries contribute to achieving environmental sustainability and sustainable development through two main aspects. The first is through activating sustainable development principles in their internal and external environments, starting from the architectural design, service aspect, and extending to their green collections. The second aspect involves contributing to the spread of environmental sustainability culture within society through environmental activism.
- Transitioning current libraries to green libraries requires not only greater financial and material resources but also a gradual change in individuals' behaviors, elevating them to adopt green practices that support the environment and green sustainability. This process requires time and patience, depending on the degree of responsiveness from individuals, as well as the widespread dissemination of environmental sustainability and sustainable development culture across various segments of society.
- The transformation to green libraries also requires training library professionals on this new direction and educating them about the importance of their involvement in the success of this transformation. It is crucial to clarify the developments that will occur in their roles, the services, the collections, and other aspects of the library, and to train them on the green practices they will use to ensure effective application and utilization of these practices for developing their institutions and transforming them into "green, environmentally friendly libraries," which is the ultimate goal of this transition.
- In addition to training library staff, green libraries also need to focus on educating users to adopt green practices that will increase their active participation in supporting and promoting green sustainability culture and sustainable development.
- In the near future, people will undoubtedly notice the profound changes brought about by green libraries in environmental conservation and their contribution to spreading environmental sustainability and supporting sustainable development. These changes will be evident in the improved environment, the preservation of natural resources, reduced climate change impacts, and the availability of natural resources for future generations, particularly as users begin to imagine the healthy life they can enjoy by committing to simple daily practices with the guidance of green libraries and their green services and collections, helping to move Earth from the brink of environmental collapse to sustainability and healthy, eco-friendly living.
- Finally, libraries of all types must deeply believe in the importance of their role in changing individuals' irresponsible behaviors towards the environment into green practices. They must start the transition to green libraries with green buildings, services, and practices because natural resources are rapidly depleting. Even though the results of this participation will take time to be visible, this should not deter libraries from contributing to the creation of a healthier and greener planet.

6.2 Recommendations:

To enable libraries to transform into green libraries and make a better contribution to supporting and promoting environmental sustainability and sustainable development, this study recommends the following:

- Academic institutions in library and information science should enhance their curricula by including courses that cover all aspects of green libraries, such as green buildings, green services, green practices, environmental sustainability, and sustainable development, along with methods for implementing these principles in various types of libraries. These courses should combine theoretical content on green libraries' features and requirements with practical applications and concrete models to help students understand how the library profession can support and embody green libraries and environmental sustainability. This will also help them think about innovative new services and activities for green libraries.
- The study also recommends that libraries, especially those in the Arab world, that are hesitant about transitioning to green libraries start seriously considering how to adopt and implement green practices, even if partially, based on their financial, material, and human resources. It is not necessary for them to implement this transition all at once in every aspect, from buildings to services and equipment. What matters is taking the initiative and starting the transformation, as the future of humanity is facing significant environmental threats, and there is no room for hesitation or fear of beginning to contribute to creating a healthy, green world for Earth.

- Libraries should allow their information professionals to conduct exploratory studies on the readiness of their institutions for the transition to green libraries. These studies will help develop a clear and practical plan to guide the library in transforming into a green, environmentally friendly library, outlining how the transformation will be implemented and which areas will be involved.
- Encourage responsible officials in the Arab world's library and information sector, both morally and financially, to initiate the transition to green libraries, as seen in the United Arab Emirates and Saudi Arabia, which are considered pioneers in implementing this transformation in various types of libraries, both regionally and globally.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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