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Research Paper

Assessment of Biophilic Design Strategies on Users of Nigeria Southwest University Libraries Toward the Design for LAUTECH College of Agriculture, Iseyin

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ABSTRACT: *Biophilic design is an architectural approach that incorporates nature into built spaces to promote user well-being. This study assessed the presence and effects of biophilic design strategies in selected university libraries across Southwest Nigeria to guide the proposed design of LAUTECH College of Agriculture Library, Iseyin. Using a mixed-methods approach, data were collected from 280 respondents selected via Slovin's formula from a total population of 5,600. The study covered FUTA, LAUTECH, UNILAG, and FUNAAB libraries. Results showed the most common biophilic elements included natural lighting (58.6%), indoor plants (49.3%), and outdoor study areas (46.3%). Key benefits identified were improved mood (29.5%), enhanced productivity (26.3%), and increased comfort (24.8%). Thematic analysis revealed structural limitations, low awareness, and budget constraints as major challenges. Mean weighted analysis showed natural element comfort (3.38) ranked highest in user impact. The study recommends integration of natural light, green spaces, and ventilation to improve user experience and serve as a model for sustainable library design at LAUTECH College of Agriculture, Iseyin.*

KEYWORDS: *Biophilic Design, University Libraries, Natural Elements, User Well-being, Sustainable Architecture, LAUTECH Iseyin, Natural Lighting, Indoor Plants, Environmental Psychology*

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I. INTRODUCTION

Libraries are critical components of educational institutions, particularly universities, where they serve as academic hubs for study, research, collaboration, and knowledge dissemination. However, the quality of user experience in university libraries often depends not only on the resources available but also on the spatial and environmental qualities of the library itself. In Southwest Nigeria, many university libraries are designed with a utilitarian focus—prioritizing storage and functionality over user comfort and environmental quality **[16]**. As academic pressure increases, the need for learning environments that promote well-being, reduce stress, and enhance productivity becomes increasingly relevant. This underscores the importance of biophilic design as a strategy for creating more engaging and restorative learning spaces.

Biophilic design, a term stemming from E.O. Wilson's concept of "biophilia"—defined as the innate human tendency to seek connections with nature and other forms of life **[25]**—has gained traction globally as an architectural and planning approach that integrates natural elements into built environments. The concept is rooted in the idea that humans thrive in environments that reflect nature, even when situated in urban or institutional settings where natural features are often limited or inaccessible. Research has shown that incorporating elements such as daylight, vegetation, natural ventilation, water features, and views of nature can improve concentration, reduce mental fatigue, and increase overall cognitive function **[4], [10]**.

In the context of educational facilities, biophilic design has been found to significantly enhance the learning experience. According to Kellert **[12]**, environments designed with biophilic principles foster improved focus, emotional well-being, and academic performance. This is especially relevant for library spaces, where users often spend extended periods engaged in reading, research, and study-related activities. A study by Gillis and Gatersleben **[7]** further confirmed that exposure to nature-based features within educational environments not only improves mood and mental clarity but also encourages prolonged study sessions, better retention of information, and higher levels of user satisfaction.

Despite these demonstrated benefits, the implementation of biophilic design in Nigerian university libraries remains limited. Many libraries across Southwest Nigeria, even in newer institutions, reflect traditional architectural models that emphasize rigidity, standardization, and cost-saving, often at the expense of environmental responsiveness **[16], [15]**. The resulting spaces, though functional, are often uninspiring and do not fully support students' emotional and psychological needs. As Ogunlana **[16]** notes, students report feelings of fatigue, discomfort, and reduced focus in poorly ventilated, artificially lit library environments. Given the demanding academic schedules and mental stress associated with university life, there is an urgent need to rethink how library spaces can be improved to better support students' well-being.

In addition to its psychological and academic benefits, biophilic design supports broader environmental and sustainability goals. It promotes the use of local, natural, and renewable materials, enhances indoor air quality, and contributes to energy efficiency through passive ventilation and lighting strategies **[9]**. As climate change intensifies and resource efficiency becomes a global priority, universities are increasingly expected to model environmentally responsible design practices. The integration of biophilic strategies into institutional infrastructure aligns with global green building standards such as LEED (Leadership in Energy and Environmental Design) and SDG Goal 11, which advocates for inclusive, safe, resilient, and sustainable cities and human settlements **[21]**.

In Nigeria, where urban sprawl, environmental degradation, and cultural disconnection from nature are pressing concerns, biophilic design offers a socio-ecologically relevant architectural solution **[11]**. By reconnecting students and academic communities with nature—through access to green spaces, use of daylight, natural textures, and organic forms—universities can foster a culture of environmental consciousness while improving students' quality of life. The Ladoke Akintola University of Technology (LAUTECH) College of Agriculture, Iseyin, presents a unique opportunity for the application of biophilic design. The region's rich agricultural and ecological context supports a site-specific, culturally grounded approach to sustainable learning environment design.

Furthermore, recent studies conducted in sub-Saharan Africa have affirmed the relevance and adaptability of biophilic design to local climates and cultural settings **[6]**. For instance, Oyeleye and Obembe **[17]** found that students studying in libraries with biophilic features reported higher satisfaction, greater academic engagement, and improved mental health outcomes compared to those in traditional library spaces. This aligns with findings by Salama and Remali **[19]**, who emphasized that biophilic design not only improves user well-being but also contributes to climate-responsive architecture by promoting resilience, energy efficiency, and environmental stewardship.

Given the increasing importance of student-centered learning environments and the global shift toward sustainable infrastructure, there is a need to explore the integration of biophilic principles in the design and renovation of university libraries in Nigeria. This study, therefore, investigates the extent to which biophilic design elements are currently applied in university libraries across Southwest Nigeria and evaluates their impact on users' well-being and academic performance. The research further seeks to propose a biophilic library design for LAUTECH College of Agriculture, Iseyin, as a model for future sustainable academic infrastructure in the region.

II. LITERATURE REVIEW

2.1 Overview of Biophilic

Biophilic design has emerged as a transformative architectural philosophy that seeks to bridge the gap between humans and nature by integrating natural elements into the built environment. This section reviews existing literature on the theoretical and practical dimensions of biophilic design, particularly in educational contexts such as schools and university libraries. The impetus behind this approach is rooted in increasing recognition of the role of nature in promoting psychological well-being, cognitive performance, and overall health. Scholars such as E.O. Wilson (1984), who coined the term *biophilia*, argues that humans possess an innate tendency to seek connections with nature and other forms of life **[25]**. Building on this foundation, researchers have explored how incorporating biophilic elements like daylight, vegetation, water features, and organic materials into architectural design enhances user comfort and engagement.

In university libraries—environments that demand extended concentration and foster academic pursuits—the integration of biophilic design is especially relevant. Traditional libraries often prioritize functionality and capacity over user experience. However, current studies suggest that user-centric, biophilic-inspired spaces contribute to reduced stress, improved learning outcomes, and heightened satisfaction **[7]**. This literature review provides a comprehensive understanding of the key concepts, historical evolution, pioneers, and biophilic strategies relevant to academic libraries. The section also examines implementation challenges, particularly within the Nigerian context, and highlights gaps that this study aims to address.

2.2 Conceptual Framework

The conceptual framework provides a structured lens for understanding the key theories and constructs that underpin biophilic design in educational architecture. In the context of this study, it establishes the theoretical grounding for assessing biophilic design in university libraries and connects the concepts of environmental psychology, sustainability, and human-centered design with academic performance and user well-being.

2.2.1 Definition of Key Concepts

1. **Biophilic Design:** A nature-centered architectural approach aimed at integrating natural elements—such as daylight, vegetation, natural ventilation, and views of nature—into the built environment. It is premised on the biophilia hypothesis by E.O. Wilson (1984), which posits that humans are biologically predisposed to connect with nature **[25]**, **[14]**.
2. **User Well-being:** Refers to the holistic physical, mental, and emotional wellness of individuals using a space. In university libraries, well-being is influenced by variables such as light quality, acoustics, access to greenery, indoor air quality, and spatial aesthetics **[7]**.

2.2.2 Relevance of Biophilic Design in Educational Spaces

Educational environments that incorporate biophilic design principles offer cognitive, emotional, and physiological benefits. Exposure to natural elements has been associated with enhanced memory retention, reduced mental fatigue, and better academic outcomes **[20]**. Additionally, biophilic features can align academic infrastructure with broader sustainability goals by leveraging local ecosystems and cultural elements in design.

In the context of Southwestern Nigeria, biophilic design represents a unique opportunity to address the disconnection from nature caused by urbanization and environmental degradation. The College of Agriculture in Iseyin, LAUTECH, situated in an agriculturally rich landscape, provides an ideal case for applying culturally relevant and environmentally responsive biophilic principles.

2.3 Historical Background of Biophilic Design

2.3.1 Evolution of Biophilic Design

The conceptual roots of biophilic design can be traced back to the biophilia hypothesis formulated by E.O. Wilson in 1984 **[27]**. His assertion that humans have an innate affinity for nature catalyzed a new wave of research in environmental psychology and architecture. During the 1990s, the movement evolved with growing concerns over energy efficiency, health, and sustainability in building practices **[8]**.

The publication of *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life* **[9]** marked a milestone in the field. The book articulated a structured framework for implementing biophilic strategies in architecture and urban planning. Since then, biophilic design has expanded to sectors including healthcare, corporate offices, and education, becoming a staple in sustainable and wellness-focused design philosophies.

2.3.2 Key Pioneers and Theoretical Contributions

E.O. Wilson remains a seminal figure in biophilic theory, whose foundational work laid the intellectual basis for modern biophilic design **[27]**. Stephen Kellert, a Yale University professor, operationalized these ideas into architectural strategies. His typology of biophilic experiences—direct, indirect, and place-based—continues to guide architectural applications **[8]**.

Judith Heerwagen contributed significantly through her psychological insights, emphasizing restorative environments that mitigate stress and support mental well-being **[10]**. Roger Ulrich's Stress Reduction Theory (1984) provided empirical backing, showing that patients with views of natural landscapes recovered more quickly **[26]**. Together, these pioneers created a multidisciplinary foundation that supports the implementation of biophilic design across various sectors.

2.4 Biophilic Design Strategies

2.4.1 Integration of Natural Light

Daylighting is one of the most effective strategies in biophilic design. Exposure to natural light regulates circadian rhythms, enhances mood, and boosts productivity. Edwards and Torcellini found that students exposed to natural light performed better academically **[5]**. Furthermore, Heschong reported that students in well-lit classrooms scored 20% higher on standardized tests compared to peers in poorly lit environments **[11]**.

2.4.2 Use of Vegetation

Indoor plants and green walls introduce tactile and visual connections to nature. Vegetation reduces air pollutants, regulates indoor humidity, and has calming psychological effects. Studies show that greenery in study spaces

reduces mental fatigue and fosters a sense of tranquility, contributing to increased time spent studying and improved academic outcomes **[27]**.

2.4.3 Water Elements

Water features, such as fountains and ponds, provide multisensory stimulation. The auditory qualities of flowing water are known to reduce stress and enhance focus. Water also plays a thermoregulatory role, especially in warm climates like Nigeria's. Incorporating water elements in libraries can create ambient environments conducive to deep learning and reflection **[24]**.

2.4.4 Natural Materials and Textures

Materials like bamboo, wood, clay, and stone connect occupants to nature through texture and scent. These materials contribute to biophilic authenticity, reinforcing local culture and promoting sustainability. The use of indigenous materials in design not only reduces carbon footprint but fosters a sense of place and identity **[9]**.

2.4.5 Views and Visual Connections to Nature

Access to outdoor views enhances occupants' spatial experience. Strategic placement of windows, skylights, and courtyards enables users to connect visually with the natural world. Visual access to green spaces has been shown to reduce anxiety, increase satisfaction, and enhance cognitive clarity **[22]**.

2.5 Challenges of Biophilic Design Implementation in Nigeria

Despite its benefits, the adoption of biophilic design in Nigerian academic institutions faces several challenges. These include budget constraints, lack of technical expertise, inadequate policy frameworks, and maintenance difficulties. Furthermore, urban planning in many Nigerian cities prioritizes functionality over sustainability, creating resistance to innovation in building design **[1]**.

Climate considerations also present a hurdle. While biophilic design thrives in temperate zones, its adaptation in tropical climates requires innovation in passive cooling, water management, and material selection. There is a pressing need to localize biophilic principles to align with Nigeria's cultural and ecological realities.

2.6 Identified Gaps in Literature

While global research on biophilic design is extensive, there is a noticeable dearth of literature focused on its application in Nigerian university libraries. Most studies have concentrated on corporate and healthcare settings, leaving a gap in educational infrastructure. Moreover, few investigations have examined the cultural dimensions of biophilic design in African contexts, particularly the integration of indigenous materials and motifs **[8]**.

This study seeks to fill these gaps by assessing existing library designs in Southwestern Nigeria, proposing a context-sensitive, biophilic library model for LAUTECH College of Agriculture, Iseyin. In doing so, it contributes to localized architectural innovation that supports sustainability, cultural identity, and academic excellence.

III. RESEARCH METHOD

3.0 Introduction

This study adopts a mixed-methods approach, integrating both quantitative and qualitative techniques to provide a comprehensive analysis of biophilic design practices, user perceptions, implementation challenges, and design strategies for university libraries in Southwest Nigeria. The research was conducted across four purposively selected institutions: Federal University of Technology, Akure (FUTA); Ladoke Akintola University of Technology, Ogbomoso (LAUTECH); University of Lagos (UNILAG); and Federal University of Agriculture, Abeokuta (FUNAAB). The methodology is structured to address the research objectives methodically using questionnaires, interviews, observations, and architectural sketches. Analytical techniques employed include descriptive statistics and integrative analysis, with data processed using SPSS and Excel.

3.1 Research Design

A combination of **descriptive** and **design-based research** approaches was employed in multiple phases:

1. **Phase One – Descriptive Research:** Structured questionnaires were administered to library administrators, staff, and users to assess the presence and perception of biophilic elements such as natural light, vegetation, natural materials, and views of nature.
2. **Phase Two – User-Centered Research:** Aimed at measuring perceived benefits such as well-being, productivity, and satisfaction among students and staff using descriptive statistics (mean, median, frequencies, standard deviation).
3. **Phase Three – Qualitative Interviews:** Conducted with facility managers, architects, and university administrators to explore implementation challenges, including funding limitations, maintenance issues, and institutional constraints. Thematic analysis was used to extract dominant themes from responses.
4. **Phase Four – Design-Based Research:** Using insights gathered from prior phases, a biophilic-responsive design framework was developed for LAUTECH's College of Agriculture Library, integrating cultural, environmental, and spatial needs with biophilic principles.

3.2 Data Collection Methods

3.2.1 Primary Data

Primary data was collected directly from respondents and field observations. Instruments used include:

1. Structured questionnaires for library users and administrators
2. Interviews with professionals and stakeholders
3. Observational checklists and case studies
4. Preliminary design sketches for the proposed library framework

3.2.2 Secondary Data

Secondary data sources included academic journals, books, published articles, architectural case studies, government documents, policy reports, and online databases. These were used to support primary findings and align the study with existing literature on biophilic and sustainable architecture.

3.3 Research Population

3.3.1 Sampling Frame

The sampling frame comprised all recognized universities in Southwest Nigeria, categorized into Federal, State, and Private institutions. A total of 53 universities were identified from six states (Oyo, Ondo, Ogun, Osun, Ekiti, and Lagos). These included:

- 6 Federal Universities
- 9 State Universities
- 38 Private Universities

Table 3.1: Universities with Libraries in Southwest Nigeria

S/N	Selected States	Federal universities	State universities	Private Universities
1	Oyo state	University of Ibadan, Oyo State. (UI)	Ladoke Akintola University of Technology, Ogbomoso (LAUTECH). The Technical University, Ibadan. .	Kola Daisi University, Ibadan. Dominican University, Dominion University, Ibadan, Ibadan. Lead City University, Ibadan. Ajayi Crowther University, Oyo. Atiba University, Oyo. Precious Cornerstone university, Ibadan.
2	Ondo State	Federal University of Technology, Akure (FUTA)	Adekunle Ajasin University Akugba Akoko (AAUA). Akungba Akoko. University of Medical Science (UNIMED). Ondo State University of Science and Technology (OSUSTECH).	Achievers University, Owo, Ondo State. Wesley University of Science and Technology, Ondo State. Elizade University Ilara-Mokin. Hezekiah University, Achiever University.
3	Ogun State	Federal University of Agriculture, Abeokuta (FUNAAB)	Olabisi Onabanjo University, Ago Iwoye (OOU)	Babcock University, Ilishan-Remo, Bells University of Technology, Ota, Covenant University. Ota, Chrisland University, Abeokuta. Mountain Top University, Crescent University, McPherson University, Hallmark University, Southwestern University.
4	Osun State	Obafemi Awolowo University, Ile-ife (OAU)	Osun State University (UNIOSUN)	Bowen University, Iwo Adeleke University, Ede. Fountain University, Osogbo. Joseph Ayo Babalola University Ikeji-Arakeji. Kings University, Ode-Omu. Oduduwa University, Ipetumodu. Redeemer's University, Ede. Westland University, Iwo.
5	Ekiti State	Federal University Oye, Ekiti (FUOYE)	Ekiti State University (EKSU)	Afe Babalola University, Ado Ekiti (ABUAD). Bamidele Olumilua University of Education, Science and Technology, Ikere Ekiti.
6	Lagos State	University of Lagos (UNILAG).	Lagos State University (LASU)	Pan-Atlantic University, Ibeju-Lekki. National Open University of Nigeria (NOUN). Augustine University. Anchor University Ayobo, Lagos State. Wellspring University, Trinity University, Eko University of Medical and Health Sciences Ijanikin, Lagos.

Source: National University commission. (2023)

3.3.2 Sample Size

A **multistage purposive sampling technique** was used:

1. **Stage 1:** Selection of universities offering agricultural sciences.
2. **Stage 2:** Further selection of universities with libraries dedicated to agricultural research.
3. **Stage 3:** Final selection of libraries with biophilic design elements (e.g., natural light, green spaces, water features, local materials).

From this process, four university libraries were selected. The total capacity of these libraries was 5,600, from which a **sample size of 280 respondents** was derived using **Slovin's formula** (e = 0.05). This exceeded the minimum acceptable sample size and ensured representative coverage.

Table 3.2: Universities with Biophilic Libraries Strategies in Southwest Nigeria.

S/N	Universities Libraries Design for Agriculture Studies and Research	Universities Libraries Names	Universities Libraries Purposively built with Biophilic Strategies	Sample Frame (Libraries Capacity)	Sample size 5%
1	University of Ibadan	Kenneth Dike Library	___	___	___
2	Ladoke Akintola University of Technology	Olusegun Oke Library	Olusegun Oke Library	1500	75
3	University of Lagos (UNILAG)	University of Lagos Library	University of Lagos Library	2000	100
4	Federal University of Technology Akure (FUTA)	Albert Ilemobade Library (AIL)	Albert Ilemobade Library (AIL)	1500	75
5	Obafemi Awolowo University	Obafemi Awolowo State University Library	___	___	___
6	Osun State University (UNIOSUN)	Osun State University Library	___	___	___
7	Federal University of Agriculture, Abeokuta (FUNAAB)	Nimbe Adedipe Library	Nimbe Adedipe Library	600	30
8	Ekiti State University (EKSU)	Ekiti State University Library	___	___	___
	TOTAL			**5600**	**280**

Author's field survey and compilation (2024)

3.3.3 Sampling Technique

Purposive sampling was adopted to identify universities most relevant to the study objectives. The Slovin formula was used as follows:

n=N1+Ne2

Where:

- n=280 (Sample size)
- N=5600 (Population of users in selected libraries)
- e=0.05 (Margin of error)

A total of 280 questionnaires were distributed proportionately across the libraries based on their user capacity.

3.4 Research Log Frame

To ensure systematic alignment of research objectives, data types, instruments, and analysis techniques, a research log frame was developed.

Refer to *Table 3.3: Research Log Frame*, which outlines:

1. Research objectives
2. Data types and sources
3. Data collection tools
4. Analysis methods (descriptive statistics, cross-tabulations, thematic content analysis, integrative synthesis)

3.5 Data Analysis

3.5.1 Descriptive Statistics

Descriptive statistical techniques were used to summarize the dataset, including:

1. **Mean & Median:** To determine central tendencies of user responses
2. **Standard Deviation:** To measure variability and spread in perceptions
3. **Frequency Distributions & Percentages:** To quantify responses and highlight patterns across institutions

These measures helped identify trends in user satisfaction, perceived benefits of biophilic design, and frequency of specific design elements.

3.5.2 Analytical Tools

SPSS and Microsoft Excel were employed for:

1. Organizing and cleaning raw data
2. Performing statistical analysis (e.g., frequency tables, means, charts)
3. Presenting results using tables, bar graphs, and pie charts for easy interpretation

3.5.3 Integrative Analysis

Findings from all research objectives were integrated to:

1. Correlate biophilic design practices with user-reported benefits
2. Analyze which design strategies faced greater implementation barriers
3. Guide the design framework for LAUTECH's College of Agriculture Library, using design-thinking informed by empirical data

IV. RESULT AND DISCUSSION

4.1 Socioeconomic Characteristics of Respondents

This section analyzes the socioeconomic characteristics of respondents across four Nigerian universities—FUNAAB, FUTA, LAUTECH, and UNILAG—based on a total of 280 survey participants. The gender distribution revealed a slight male dominance (53.9% male, 46.1% female), with LAUTECH showing the highest male proportion (60.3%). The sample size was evenly spread, ensuring representativeness across institutions.

The findings suggest underlying demographic and cultural factors influencing gender representation in academic settings. Notably, LAUTECH may benefit from targeted efforts to encourage female participation through inclusive library design and gender-sensitive programs. This demographic analysis offers crucial context for designing equitable and user-focused biophilic library spaces. Further research on age and academic level distributions is recommended to deepen understanding of user needs in Southwest Nigeria's university libraries.

University	Male	Female	Total
FUNAAB	39 (53.4%)	34 (36.6%)	73 (100%)
FUTA	29 (46.8%)	33 (53.2%)	62 (100%)
LAUTECH	44 (60.3%)	29 (39.7%)	73 (100%)
UNILAG	39 (54.2%)	33 (45.8%)	72 (100%)
Total	151	129	280

Table 4.1 Gender & Number of Respondents

Source: Author's Computation, 2024

4.2 User Perceptions of Biophilic Features in University Libraries

This study assessed users' awareness and experiences of biophilic features in four university libraries—FUNAAB, FUTA, LAUTECH, and UNILAG. Results revealed varied levels of biophilic integration and user perception across institutions. Over half of respondents (52.5%) identified natural features like plants, lighting, and ventilation as key to stress reduction, with FUNAAB and LAUTECH reporting the highest awareness. Similarly, nearly 48% acknowledged improved focus through outdoor views and large windows, particularly in LAUTECH and UNILAG.

Comfort through natural airflow was noted by 55.7% of respondents, with FUTA scoring highest. However, designated relaxation areas such as gardens or courtyards were largely absent, with only 21.1% confirming their

presence. Sustainability awareness remained low overall (27.9%), pointing to a need for increased visibility and advocacy of eco-friendly practices in library design. Lastly, outdoor study spaces were associated with longer study durations, especially at UNILAG and LAUTECH.

University	Natural Features	Natural Design Spots	Natural Flow Design	Big Windows/View
FUNAAB	42 (28.57% Yes)	37 (26.24% Yes)	39 (25.0% Yes)	31 (23.13% Yes)
FUTA	30 (20.41% Yes)	26 (18.44% Yes)	44 (28.21% Yes)	27 (20.15% Yes)
LAUTECH	40 (27.21% Yes)	41 (29.08% Yes)	39 (25.0% Yes)	40 (29.85% Yes)
UNILAG	35 (23.81% Yes)	37 (26.24% Yes)	34 (21.79% Yes)	36 (26.87% Yes)
Total	147 (100.0% Yes)	141 (100.0% Yes)	156 (100.0% Yes)	134 (100.0% Yes)

Table 4.3 Simplified Awareness and Presence of Biophilic Features

Source: Author's Computation, 2024

4.4 Impact of Biophilic Design in University Libraries

Biophilic design significantly enhances library user experience by reducing stress, improving focus and comfort, and extending study duration. Across the surveyed universities (FUNAAB, FUTA, LAUTECH, UNILAG), over 100% of respondents recognized the positive effects of natural elements such as daylight, airflow, greenery, and outdoor views. LAUTECH and FUNAAB led in stress reduction, while LAUTECH also ranked highest in focus improvement through large windows. FUTA recorded the highest comfort levels from natural airflow, and UNILAG had the most recognition for outdoor relaxation and sustainability awareness. However, green spaces and outdoor study areas remained limited across institutions.

Findings emphasize the need to integrate more natural lighting, ventilation, and greenery in libraries, especially at LAUTECH College of Agriculture. Enhanced outdoor study zones and sustainability efforts would further improve academic engagement and user well-being.

University	Stress Reduction (Natural Features)	Focus Improvement (Windows)	Comfort (Natural Flow)	Relaxation (Gardens)	Sustainability Awareness	Study Duration (Outdoor Areas)
FUNAAB	42 (15.0%)	31 (11.1%)	39 (13.9%)	17 (6.1%)	21 (7.5%)	18 (6.4%)
FUTA	30 (10.7%)	27 (9.6%)	44 (15.7%)	12 (4.3%)	15 (5.4%)	19 (6.8%)
LAUTECH	40 (14.3%)	40 (14.3%)	39 (13.9%)	12 (4.3%)	20 (7.1%)	24 (8.6%)
UNILAG	35 (12.5%)	36 (12.9%)	34 (12.1%)	18 (6.4%)	22 (7.9%)	27 (9.6%)
Total	147 (52.5%)	134 (47.9%)	156 (55.7%)	59 (21.1%)	78 (27.9%)	88 (31.4%)

Table 4.4 Biophilic Features impact Summary

Source: Author's Computation, 2024

4.5 Sustainability and Eco-Friendly Practices in University Libraries

Sustainable and eco-friendly practices in library design contribute significantly to user experience and environmental responsibility. Across the four surveyed universities (FUNAAB, FUTA, LAUTECH, UNILAG), awareness of sustainable materials and green design elements varied.

UNILAG and FUNAAB recorded the highest awareness of eco-friendly materials, while FUTA trailed, indicating a need for increased visibility and education. Support for green roofs and walls was moderate, with LAUTECH leading in user recommendations. FUNAAB showed the strongest presence of local plant usage, enhancing the natural ambiance of its library environment. However, the general recognition of green spaces and relaxation gardens remained low across all institutions.

Awareness of climate-adaptive features like natural ventilation and shading was highest at FUNAAB and UNILAG but notably lower at FUTA. These findings emphasize the opportunity for LAUTECH's College of Agriculture and other institutions to enhance their libraries with local greenery, green walls, eco-friendly materials, and climate-responsive design. Promoting sustainability through design interventions and awareness campaigns can foster environmentally conscious behaviors and improve the overall academic atmosphere.

University	Eco-Friendly Materials Awareness	Green Roofs/Walls Recommendation	Local Plants Usage	Relaxation Benefits (Gardens)	Climate Consideration Awareness
FUNAAB	21 (26.9%)	19 (22.1%)	27 (32.5%)	17 (28.8%)	23 (31.1%)
FUTA	15 (19.2%)	20 (23.3%)	18 (21.7%)	12 (20.3%)	12 (16.2%)
LAUTECH	20 (25.6%)	25 (29.1%)	21 (25.3%)	12 (20.3%)	17 (23.0%)
UNILAG	22 (28.2%)	22 (25.6%)	17 (20.5%)	18 (30.5%)	22 (29.7%)
Total	78 (100.0%)	86 (100.0%)	83 (100.0%)	59 (100.0%)	74 (100.0%)

Table 4.5 Sustainability and Eco-Friendly Practices

Source: Author's Computation, 2024

4.6 Perceived Benefits of Biophilic Design in Selected University Libraries

The survey reveals that biophilic design elements significantly enhance the library experience by improving mood, focus, productivity, and user comfort across the four studied universities (FUNAAB, FUTA, LAUTECH, UNILAG). LAUTECH consistently ranked highest in user acknowledgment of biophilic benefits, followed by FUNAAB and UNILAG, while FUTA scored lowest across most metrics.

Mood and well-being improvements were recognized by 118 respondents, with LAUTECH leading (29.7%), suggesting that access to greenery and natural light enhances emotional wellness. Focus and productivity were affirmed by 105 respondents, again with LAUTECH (30.5%) at the forefront, implying that biophilic features support sustained concentration and academic performance.

Study effectiveness, comfort, and a deeper connection to nature also received strong endorsements—particularly from LAUTECH—indicating that well-integrated natural elements foster both academic and emotional benefits. However, FUTA's lower scores in all categories suggest a need for improved incorporation of nature-based features.

These findings support the recommendation that LAUTECH's College of Agriculture should prioritize green infrastructure—such as natural lighting, plant installations, and open-air study zones—to improve user satisfaction and academic outcomes. Promoting biophilic awareness through campaigns can further encourage nature-oriented library use and design improvements.

Table 4.6 Perceived Benefits of Biophilic Design Summary

University	Mood & Well-being Improvement	Focus & Productivity Enhancement	Study Effectiveness	Environmental Connection	Comfort & Relaxation
FUNAAB	30 (25.4%)	27 (25.7%)	25 (25.8%)	22 (25.9%)	26 (26.3%)
FUTA	25 (21.2%)	20 (19.0%)	18 (18.6%)	15 (17.6%)	19 (19.2%)
LAUTECH	35 (29.7%)	32 (30.5%)	30 (30.9%)	28 (32.9%)	31 (31.3%)
UNILAG	28 (23.7%)	26 (24.8%)	24 (24.7%)	20 (23.5%)	23 (23.2%)
Total	118 (100.0%)	105 (100.0%)	97 (100.0%)	85 (100.0%)	99 (100.0%)

Source: Author's Computation, 2024

4.7 Impacts of Biophilic Elements on Library User Experience

Using a 5-point Likert scale, this study assessed how biophilic elements influence user experiences across selected university libraries. The findings, summarized in Table 4.9, reveal that **Natural** Element Comfort received the highest mean score (M = 3.38), indicating that users strongly associate features such as plants, natural light, and materials with enhanced physical and emotional comfort.

Moderate ratings were recorded for Sunlight and Focus (M = 3.06), Nature-Friendliness of the Environment (M = 3.04), and Design Influence on Study Mood (M = 3.02), suggesting general acknowledgment of the role of biophilic design in promoting a visually stimulating and mentally engaging study space.

However, lower mean values were noted for Stress Reduction (M = 2.96), Study Duration (M = 2.95), and Nature-Inspired Aesthetics (M = 2.92), pointing to inconsistencies in the quality or visibility of these features across the libraries. These results suggest that while users appreciate existing biophilic features, implementation remains uneven and could be enhanced.

Overall, the data affirms the value of biophilic design in supporting comfort and cognitive engagement, but calls for improved integration—particularly in areas like stress relief, aesthetics, and prolonged study support—to optimize user experience in academic library environments.

Questions	Very High (5)	Moderate (3)	Low (1)	IBUL
Nature-Friendliness Rating	59.0	108.0	113.0	3.04
Design Impact on Study Mood	99.0	85.0	96.0	3.02
Features Impact on Focus	95.0	90.0	95.0	3.0
Greenery Stress Reduction	94.0	86.0	100.0	2.96
Sunlight and Focus	91.0	106.0	83.0	3.06
Nature-Inspired Design Mood	85.0	99.0	96.0	2.92
Extended Study Duration	87.0	99.0	94.0	2.95
Natural Element Comfort	59.0	138.0	83.0	3.38
Overall Design Experience	55.0	107.0	118.0	2.93

Mean 27.26/9 = 3.02

Table 4.9 Likert Scale

Source: Author's Computation, 2024

V. CONCLUSION

The study investigated biophilic design strategies in university libraries across Southwest Nigeria, with a focus on the proposed design of a biophilic library for LAUTECH College of Agriculture, Iseyin. The following conclusions are drawn:

i. Biophilic design enhances user comfort, academic performance, and mental well-being in university libraries, confirming its importance as a sustainable design strategy in educational environments.

ii. Key nature-based design features identified include natural lighting (58.6%), indoor plants (49.3%), and outdoor study areas (46.3%), which represent users' most desired environmental elements for academic spaces.

iii. Major challenges to biophilic design implementation in the study area include structural limitations (46.4%), climate adaptation concerns (44.6%), and maintenance difficulties (41.8%), highlighting the need for innovative and context-specific solutions.

iv. The proposed library design for LAUTECH College of Agriculture integrates passive cooling, green spaces, natural ventilation, energy-efficient systems, and culturally relevant features such as traditional Yoruba architectural elements and locally sourced materials.

v. The study provides a replicable framework for designing sustainable academic libraries in Nigeria, emphasizing the role of biophilic design in fostering environmental responsibility, cultural identity, and user-centered learning environments.

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