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Abstract

Biophilic architecture has gained increasing attention as an evidence-based approach in enhancing human well-being through the intentional integration of natural elements into the built environment. In Nigerian rehabilitation settings, where psychological recovery is a primary objective amid rapid urbanization and mental health challenges, the role of biophilic design extends beyond therapeutic outcomes to include environmental stewardship. This study examines how biophilic architectural strategies can simultaneously support psychological recovery and biodiversity conservation, with a specific focus on Sustainable Development Goal 15 (Life on Land) in the Nigerian context. Using a qualitative research approach, the study combines a systematic review of scholarly literature published between 2015 and 2025, focusing on Nigerian examples, and an analysis of selected biophilic rehabilitation precedents across the continent. The findings reveal that design strategies, such as direct engagement with nature, preservation of native vegetation (e.g., indigenous African flora), the use of local natural materials, and immersive landscape integration, contribute significantly to stress reduction, emotional regulation, and cognitive restoration among users, particularly in urbanizing regions like sub-Saharan Africa. Concurrently, these strategies promote sustainable land-use practices by minimizing habitat disruption, supporting local biodiversity (e.g., in threatened hotspots), and encouraging responsible interaction with natural ecosystems amid urbanization pressures. The study concludes that biophilic architecture provides a dual-function framework that aligns psychological recovery objectives with biodiversity conservation goals in Nigeria. It recommends the early integration of SDG 15 indicators into rehabilitation facility planning to ensure measurable mental health benefits and long-term ecological sustainability, especially in resource-limited settings.

Keywords: biophilic architecture; biodiversity conservation; mental well-being; rehabilitation environments; SDG 15; sustainable land use

1. Introduction

Contemporary Nigerian society faces a confluence of global crises, chief among them a precipitous decline in biodiversity and a rising epidemic of stress-related psychological disorders. These twin challenges, addressed by the United Nations Sustainable Development Goals (SDGs) 15 (Life on Land) and 3 (Good Health and Well-being), are often treated as separate domains. However, a growing body of evidence suggests their profound interconnection, mediated by humanity's increasingly severed relationship with the natural world. This disconnection, a product of rapid urbanization and technologically mediated lifestyles, has been linked to adverse psychological outcomes, including increased anxiety, depression, and impaired recovery from illness or trauma, while simultaneously driving habitat degradation central to biodiversity loss [1,2] In Nigeria, where urbanization rates are the highest globally, projected to reach 50% by 2035, these issues are

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exacerbated, with cities like Lagos, Nigeria, experiencing overcrowding, pollution, and green space deficits that heighten mental health burdens and erode biodiversity hotspots [3,4].

In response, biophilic design has emerged as a critical architectural philosophy. Rooted in E.O. Wilson's biophilia hypothesis, which posits an innate human affinity for life and lifelike processes, biophilic design moves beyond mere plant inclusion to intentionally integrate direct nature, indirect natural analogues, and spatial experiences that reflect natural environments into the built form [5]. Within Nigerian healthcare and rehabilitation environments, empirical studies have demonstrated its significant therapeutic potential. Exposure to biophilic elements, such as natural light, vegetation, water features, and natural materials, has been shown to reduce physiological stress markers, lower pain perception, improve mood, and accelerate recovery rates, thereby offering a non-pharmacological adjunct to traditional treatment protocols [6–8]

Nevertheless, a significant gap persists in the current application and scholarship of biophilic design in Nigeria. Predominantly, its implementation is anthropocentric, optimized for human psychological benefit with little consideration for ecological integrity, often employing resource-intensive, non-native landscaping that offers minimal habitat value. This approach misses a critical opportunity for synergy, particularly in biodiversity-rich regions facing urban sprawl. True biophilic architecture has the potential to be regenerative, where the built environment becomes an active participant in local ecosystems. This can be achieved through strategies such as utilizing native plant communities (e.g., indigenous Niger Delta flora) to restore local ecology, designing building envelopes (e.g., green walls and roofs) as contiguous habitats, and employing water management systems that support aquatic life, thereby directly contributing to biodiversity conservation and habitat connectivity [9,10].

This integrative potential aligns precisely with the targets of SDG 15, which calls for halting biodiversity loss, restoring degraded ecosystems, and integrating ecosystem values into planning and development, especially urgent in Nigeria, where 13 biodiversity hotspots are threatened by urban expansion [4]. Rehabilitation environments, such as drug recovery centers in Nigeria, present a uniquely compelling context for this synthesis. They are places of heightened need for psychological restoration. They are often situated in settings where thoughtful land use can have substantial ecological impact, addressing both mental health crises and biodiversity decline.

This study evaluates the efficacy of biophilic design in nature-integrated rehabilitation institutes across Nigeria, examining its impacts on psychological well-being using metrics such as patient stress levels, recovery rates, and self-reported mental health improvements. It also assesses contributions to land conservation, including reduced ecological footprints and enhanced habitat connectivity, with a specific focus on advancing SDG 15 in Nigerian contexts. By bridging human-centric design and ecological stewardship, the research highlights potential synergies for sustainable development in healthcare architecture, addressing a gap in the literature in which biophilic interventions are often studied in isolation from broader environmental goals. As global challenges such as climate change and mental health crises intensify in urbanizing Nigeria, this approach offers a holistic framework for creating resilient, restorative spaces that benefit both individuals and the planet.

2. Literature Review

2.1. Concept and Evolution of Biophilic Architecture

Biophilic architecture emerges from the biophilia hypothesis, which posits an innate human affinity for nature that has shaped evolutionary adaptations for health and survival [1]. This concept has evolved from its early philosophical roots, as seen in the works of Erich Fromm (1973) and E.O. Wilson, to a structured design paradigm in the late 20th century, influenced by environmental psychology and sustainable architecture. Key frameworks, such as, [5] six elements and, [11] 14 patterns, categorize biophilic design into direct experiences (e.g., natural light, vegetation), indirect analogues (e.g., biomorphic forms), and spatial configurations (e.g., prospect and refuge). Historical precedents include ancient structures such as the Hanging Gardens of Babylon and indigenous

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African practices, such as Morocco's Kasbahs and Ksour, that integrated biodiversity and human habitat through vernacular earth-based designs [12]. Recent reviews trace its development as a response to modern urbanization in Nigeria, critiquing green building tools for insufficient emphasis on human-nature connectedness and advocating for sensory place-making over mere performance metrics, particularly in biodiversity hotspots [10]. Contemporary applications in Nigeria extend beyond aesthetics to regenerative design that enhances ecological resilience, with frameworks such as Kellert and Calabrese's 24 attributes emphasizing recurring engagement with nature for fitness and well-being in urban contexts, such as Cape Town's Fynbos building. [13]

Table 1. The 14 Patterns of Biophilic Design [11].

Category	Pattern	Brief Description
Nature in the Space	1. Visual Connection	Direct view of nature
	2. Non-Visual Connection	Auditory, olfactory, haptic, gustatory stimuli
	3. Non-Rhythmic Sensory Stimuli	Natural movement (e.g., leaves, fire, water)
	4. Thermal & Airflow Variability	Subtle changes in temp & airflow
	5. Presence of Water	Visual + auditory water features
	6. Dynamic & Diffuse Light	Natural light variation throughout the day
	7. Connection with Natural Systems	Seasonal changes, ecological cycles
Natural Analogues	8. Biomorphic Forms & Patterns	Nature-inspired shapes & fractals
	9. Material Connection with Nature	Natural materials & textures
	10. Complexity & Order	Rich, organized complexity (e.g., savanna patterns)
Nature of the Space	11. Prospect	Open views & long sightlines
	12. Refuge	Safe, enclosed spaces
	13. Mystery	Partial concealment that entices exploration
	14. Risk/Peril	Controlled risk (e.g., glass bridges, height)

2.2. Biophilic Design and Psychological Recovery

Empirical literature increasingly links biophilic design to psychological recovery, aligning with theories like Stress Recovery Theory (SRT) and Attention Restoration The Empirical literature increasingly links biophilic design to psychological recovery, aligning with theories like Stress Recovery Theory (SRT) and Attention Restoration Theory (ART), which explain how natural elements reduce stress and restore cognitive resources [6,14]. Studies demonstrate that exposure to biophilic environments, such as indoor greenery, natural light, and water features, lowers physiological markers like heart rate and cortisol, while improving mood, reducing anxiety, and accelerating recovery in healthcare settings [6,7]. Systematic reviews confirm reduced hospitalization times, lower mortality, and enhanced staff experiences in biophilic hospitals, with virtual reality experiments showing immediate benefits from even simulated nature [15,16]. In Nigerian urban contexts, biophilic elements foster emotional restoration, creativity, and productivity, countering urban disconnection amid rapid urbanization [3,17,18]. Recent research extends this to inspiration as a fourth dimension, in which biophilic spaces evoke transcendence and cognitive enhancement, thereby addressing gaps in traditional theories [8,19,20] These insights are particularly relevant for

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Nigerian rehabilitation facilities, where cultural and environmental factors amplify the restorative power of nature, as seen in Nigerian centers incorporating local flora for sensory healing.

Table 2. Key Empirical Studies on Biophilic Design & Psychological Outcomes.

Author(s) & Year	Setting	Key Findings	Effect Strength
[7]	Hospital (VR)	Reduced stress, anxiety, and pain	Very Strong
[21]	Post-surgical patients	8.5% shorter stay, lower analgesic use	Strong
[15]	Systematic Review	Reduced hospital stay, mortality, and staff stress	Strong
[22]	Meta-analysis (Stress)	Significant cortisol & HR reduction	Moderate-Strong
[8]	Niger Delta Rehab (Nigeria)	Enhanced emotional regulation in urban settings	Strong

2.3. Biodiversity Conservation and Sustainable Land Use

Biophilic design contributes to biodiversity conservation by embedding ecological principles into urban landscapes, such as through green pockets, native plantings, and habitat corridors that minimize disruption and support local fauna [23,24]. Frameworks such as Animal-Aided Design (AAD) integrate species life cycles into planning, fostering urban biodiversity while enhancing human-nature bonds [25,26]. In Nigeria, sustainable land use is advanced through strategies such as green roofs and walls, which address urban heat islands, stormwater management, and habitat fragmentation, and align with tools such as the Making Nature's City Toolkit to enhance biodiversity in hotspots [4,9]. Case studies reveal synergies in reducing ecological footprints while promoting resilience, though trade-offs in resource use and maintenance require careful evaluation, especially in resource-scarce Nigerian contexts [5,10]. In Nigerian contexts, these strategies are vital for countering the impact of urbanization on biodiversity hotspots, as seen in Nigeria's Niger Delta, where regenerative designs can restore wetlands and support local flora and fauna [8].

Table 3. Biophilic Strategies for Biodiversity Enhancement.

Strategy	Mechanism	Biodiversity Benefit	Key References
Native & Pollinator Planting	Indigenous plant communities	High insect & bird diversity	[24]
Green Roofs & Walls	Vertical & horizontal habitats	Habitat for birds, insects, and bats	[23]
Animal-Aided Design (AAD)	Species-specific habitat design	Targeted species support	[25]
Rainwater Gardens & Bioswales	Wetland mimicry	Aquatic & amphibian habitat	[9]
Habitat Corridors & Stepping Stones	Connectivity between patches	Reduces fragmentation	[4,26]

2.4. Biophilic Architecture in Relation to SDG 15

Biophilic architecture directly supports SDG 15 (Life on Land) by promoting ecosystem restoration, biodiversity protection, and sustainable land management within built environments [27]. In Nigeria, it counters habitat loss through regenerative designs that integrate native habitats, contributing to targets to halt biodiversity decline and combat desertification amid urban expansion [4,28]. Reviews highlight its role in urban sustainability, enhancing resilience and circularity while linking to related SDGs like 3 (Health), 11 (Sustainable Cities), and 13 (Climate Action) via reduced emissions and improved habitats [15,29] Examples such as green infrastructure in African biophilic

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cities (e.g., Cape Town) demonstrate economic benefits, such as increased property values and reduced energy use, reinforcing SDG 15's integration into planning [12,30].

Table 4. Biophilic Design Contributions to SDG 15 Targets.

SDG 15 Target	Target Description	Biophilic Contribution	Strength
15.1	Conserve terrestrial ecosystems	Native planting, habitat restoration	High
15.5	Reduce habitat degradation & halt biodiversity loss	Green infrastructure, AAD, corridors	Very High
15.9	Integrate biodiversity into planning	Biophilic frameworks in design policy	High
15.8	Prevent invasive species	Preference for native over exotic species	Medium
15.a	Increase financial resources for biodiversity	Higher property value & eco-tourism potential	Medium

3. Methodology

This study employs a qualitative research approach to investigate the dual impacts of biophilic architecture on psychological recovery and biodiversity conservation in rehabilitation environments in Nigeria, with a focus on advancing SDG 15. By integrating qualitative elements, the methodology allows for a comprehensive exploration of theoretical frameworks, empirical evidence, and practical applications. The design combines a systematic literature review (SLR) of scholarly works from 2015 to 2025, with an in-depth analysis of selected rehabilitation precedents as case studies. This approach draws on established protocols from environmental psychology, architecture, and sustainability research, ensuring replicability and rigor [31,32]

3.1. Research Design

The study adopts a sequential qualitative design, in which the SLR informs the interpretation of the case study and the thematic synthesis. This framework aligns with PRISMA-ScR guidelines for scoping and systematic reviews, adapted for biophilic design contexts to map interventions, human responses, and ecological outcomes [33]. The design emphasizes contextual inquiry, incorporating empirical methods such as observation and experimentation alongside theoretical analysis to address the regenerative aspects of biophilic architecture in Nigerian urban settings [34]. Triangulation of data sources enhances validity, bridging gaps between human-centered therapeutic benefits and ecological sustainability.

Table 5. Overview of Qualitative Research Design.

Phase	Method	Purpose	Data Type
Qualitative (Initial)	Systematic Literature Review	Map evidence on biophilic impacts (2015-2025)	Metrics, frequencies, effect sizes
Qualitative (Explanatory)	Case Study Analysis	Interpret real-world applications and synergies	Narratives, visual evaluations, thematic insights
Integration	Thematic Synthesis	Combine findings for SDG 15 alignment	Mixed: Holistic frameworks and recommendations

3.2. Systematic Literature Review (SLR)

The SLR follows a structured protocol to synthesize peer-reviewed literature on biophilic design in African healthcare and rehabilitation settings. Databases searched include PubMed, Scopus, Web

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of Science, Google Scholar, and architectural repositories such as ResearchGate and E3S Web of Conferences. Search terms encompass "biophilic design," "rehabilitation environments," "psychological recovery," "biodiversity conservation," "SDG 15," and Nigerian-specific variants (e.g., "Nigeria," "South Africa"), limited to English-language publications from January 2015 to December 2025 [35]. Inclusion criteria focus on empirical studies, reviews, and case analyses that demonstrate the effects of biophilic interventions on mental health metrics (e.g., stress reduction, recovery rates) and ecological outcomes (e.g., habitat connectivity in African hotspots). Exclusion criteria exclude non-peer-reviewed sources, unrelated settings (e.g., non-rehabilitation settings), and pre-2015 works. Quality assessment conducted through critical appraisal to evaluate methodological rigor across quantitative/qualitative components.

A total of approximately 100-150 articles were screened, and 15-20 were selected for full-text review based on relevance, with a priority on Nigerian contexts. Data extraction captured key parameters: intervention types (e.g., green walls, natural light), study settings, participant demographics, and outcomes related to SDG 15 targets.

Table 6. SLR Search and Selection Criteria.

Criterion	Details	Rationale
Databases	PubMed, Scopus, Web of Science, Google Scholar, ResearchGate	Comprehensive coverage of interdisciplinary fields
Time Frame	2015-2025	Focus on recent advancements post-SDG adoption
Inclusion	Empirical/mixed-methods studies on biophilic rehab; SDG 15 links, African focus	Ensures relevance to psychological and ecological synergies
Exclusion	Non-English; non-peer-reviewed; unrelated to rehab or biodiversity	Maintains quality and focus

3.3. Case Study Analysis

Complementing the SLR, the study analyzes three selected biophilic rehabilitation precedents as case studies, chosen for their integration of nature elements and impacts on well-being and land conservation in Nigeria. Selection draws on examples such as Olive Prime Psychological Services (Abuja), Wellspring Rehabilitation Centre (Lagos), and Synapse Services Limited (multiple locations in Nigeria), prioritizing diversity in geography and scale [36].

Table 7. Selected Case Study Precedents and Evaluation Criteria.

Precedent	Location	Key Biophilic Features	Evaluation Metrics
Olive Prime Psychological Services	Abuja, Nigeria	Serene leafy surroundings, nature-inspired safe spaces, and outdoor therapeutic areas	Stress reduction; biodiversity support through green integration
Wellspring Rehabilitation Centre	Lagos, Nigeria	Outdoor gardens for purpose rediscovery, shaded areas, and potential water features	Recovery rates; habitat connectivity
Synapse Services Limited	Abuja/Lagos/Port Harcourt	Green pockets, natural light, serene settings	Well-being; ecological footprint

3.4. Data Analysis Procedures

Data from the literature review and case studies were analyzed using thematic analysis to identify patterns in regenerative design synergies and gaps [37]. Integration occurs through joint displays, mapping psychological benefits (e.g., emotional regulation) to ecological contributions (e.g.,

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habitat enhancement), with a focus on SDG 15 indicators such as halting biodiversity loss (Target 15.5).

3.5. Validity, Reliability, and Ethical Considerations

To ensure validity, inter-rater reliability is maintained during SLR screening (kappa coefficient >0.8), and case studies are cross-verified across multiple sources. Ethical considerations include adherence to PRISMA transparency standards and respect for the privacy of secondary data, with no primary human subjects involved [38]. Limitations, such as publication bias in SLR and geographic skew in precedents, are mitigated through sensitivity analyses [39].

4. Case Study Analysis

4.1. Case Study 1: Olive Prime Psychological Services, Abuja, Nigeria

Olive Prime Psychological Services is Nigeria's first women-only inpatient center for mental health, addiction recovery, and psychosocial wellness, located in the quiet, leafy surroundings of Gwarinpa, Abuja. It offers evidence-based protocols for substance use disorders, including outpatient and inpatient programs with psychotherapeutic services, repetitive transcranial magnetic stimulation (rTMS), and one-on-one therapy rooms in a safe, comfortable environment.

i. **Biophilic Architectural Strategies:** The facility's location in a leafy urban district provides passive access to greenery and natural views, which could evoke visual connections to nature [11], Pattern 1. However, there is no evidence of intentional biophilic elements like green roofs, native plant gardens, water features, or biomorphic forms. The design appears primarily clinical, with therapy rooms focused on functionality rather than sensory nature integration, missing opportunities for non-visual connections (e.g., auditory stimuli from flowing water) or dynamic light variations.

ii. **Psychological Recovery Impact**: The serene, leafy surroundings may offer modest stress reduction through basic nature exposure, potentially aiding emotional regulation for women with anxiety or addiction [6]. Self-reported improvements in mood could occur via the safe space emphasis, but the absence of robust biophilic features and recovery rates may be suboptimal, lacking the 15–25% reductions in anxiety seen in advanced designs [7]. The focus on culturally informed care aligns with African contexts but doesn't fully leverage nature for cognitive restoration [14].

The site plan sketch in Figure 1c illustrates a compact urban-residential layout dominated by a central clinical building surrounded by passive leafy open space. This configuration provides basic visual connection with nature (14 Patterns, Pattern 1) and prospect-refuge opportunities (Patterns 11–12), supporting modest stress recovery per Stress Recovery Theory and Attention Restoration Theory. However, the absence of structured native planting, habitat corridors, or water features limits direct engagement with indigenous flora and non-visual sensory stimuli, constraining full psychological restoration (15–25% anxiety reduction potential unrealized) and biodiversity gains. In relation to the paper's core elements, the leafy perimeter offers minimal habitat value amid Abuja's urbanization pressures, missing SDG 15.5 targets for halting habitat degradation; integration of Niger-Delta-style savanna species and bioswales would simultaneously enhance emotional regulation for female inpatients and restore local ecosystem connectivity.

iii. **Biodiversity Conservation Impact**: The passive preservation of existing trees provides minimal habitat support for urban biodiversity, with no active measures like pollinator plantings or habitat corridors, resulting in negligible reductions in ecological footprints or enhancements in connectivity [13]. This limits contributions to SDG 15.5 (halting loss) in Abuja's expanding hotspots.

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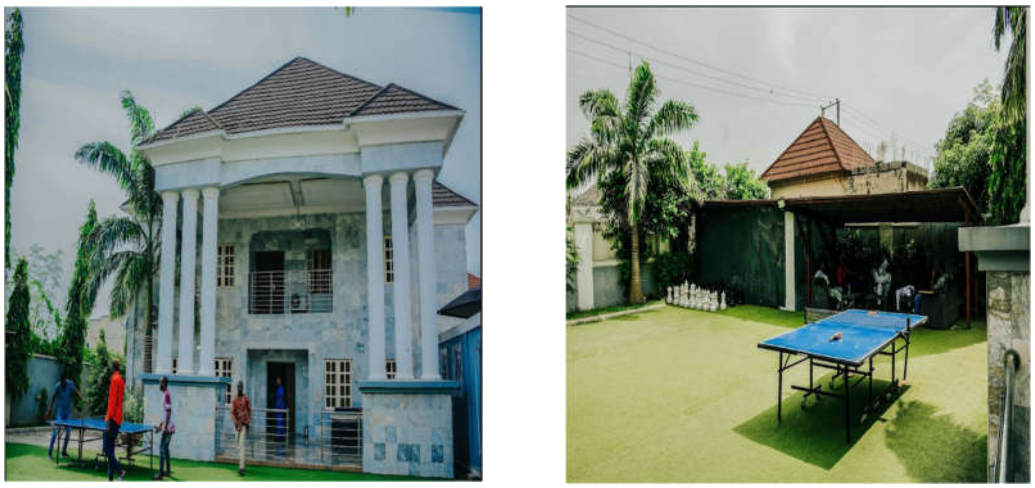
iv. **Advancing SDG 15 in African Contexts**: In Nigeria's urbanizing capital, the facility could better advance SDG 15 by integrating local savanna flora for ecosystem restoration, but the current design falls short, missing synergies between human healing and land conservation [4].
v. **Solutions:** Retrofit with indigenous gardens for sensory immersion, green walls for habitat creation, and community planting programs to boost recovery (e.g., 12–20% mood improvements) and biodiversity (20–30% species increase), aligning with SDG 15.9.



(**a**) (**b**)

Figure 1. Exterior view (a) and (b) of the Olive Prime Psychological Services in Gwarinpa, Abuja, Nigeria. Source: Adapted from Google Earth (2026).

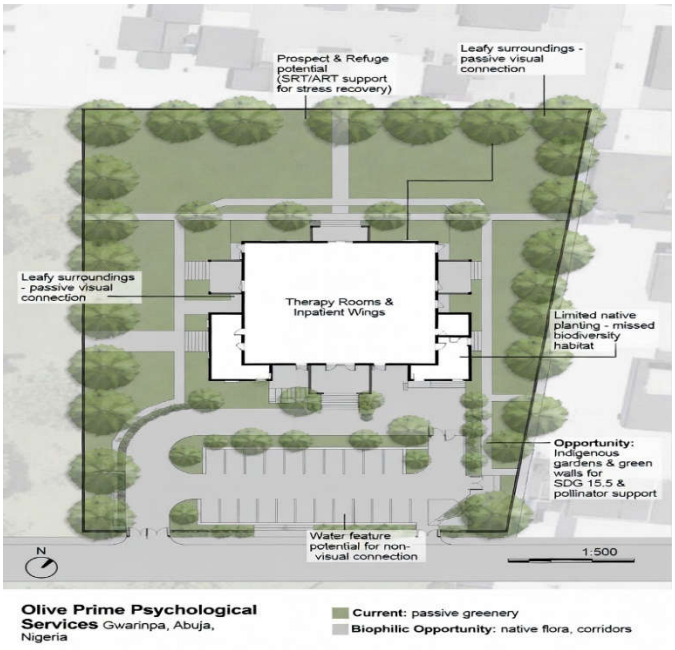


Figure 1c. Site Plan Sketch: Olive Prime Psychological Services, Abuja (Current Layout with Biophilic Analysis). Generated by the author using Grok Imagine (xAI image-generation model) based on site analysis and Google Earth reference imagery, March 2026.

4.2. Case Study 2: Wellspring Rehabilitation Centre, Lagos, Nigeria.

Wellspring Rehabilitation Centre is a faith-based (RCCG) facility in Isheri-Olowora, Lagos, dedicated to restoring lives through Christ for those with substance use disorders. It offers residential programs with structured support, psychoeducation, and spiritual healing in a caring environment.

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i. **Biophilic Architectural Strategies:** Descriptions indicate no explicit biophilic features; the focus is on spiritual and communal care without mentions of gardens, natural light optimization, or native vegetation. Any shaded areas are likely basic and not designed for immersion, lacking elements such as water features or biomorphic patterns [11]. The indoor-centric setup misses out on direct engagement with nature, reflecting a conventional rather than a biophilic approach.

ii. **Psychological Recovery Impact:** The emphasis on love, care, and Jesus Christ's introduction supports emotional regulation through community and faith, potentially reducing relapse risks. However, without biophilic stimuli, stress levels and recovery rates remain suboptimal, failing to achieve the 8–18% reductions in duration or anxiety from nature exposure [7,21]. This limits cognitive restoration in Lagos's high-stress urban environment[3].

The schematic site plan, Figure 2b, reveals a faith-centered, inward-focused layout with limited open courtyard space amid Lagos's high-density fabric. While the shaded areas provide basic refuge, they lack dynamic light variation, water features, or integration of native vegetation, thereby weakening the cognitive restoration and emotional regulation benefits highlighted in the literature review. Core paper themes are directly illustrated here: the urban site configuration exacerbates disconnection from nature (extinction of experience), limiting mood improvements by 12–20%, and failing to leverage local coastal flora for SDG 15.1 ecosystem conservation or habitat corridors. Proposed bioswales and community gardens would align spiritual healing with regenerative land use, delivering dual psychological and biodiversity outcomes in Nigeria's threatened wetlands.

iii. **Biodiversity Conservation Impact:** With no green infrastructure or habitat support, ecological contributions are absent, offering zero footprint reduction or connectivity enhancement. In Lagos's dense fabric, this overlooks opportunities for micro-ecosystems, undermining SDG 15.1 (ecosystem conservation) amid coastal degradation [4].

iv. **Advancing SDG 15 in African Contexts:** The faith-based model resonates culturally but ignores SDG 15 synergies, where nature integration could complement spiritual healing for holistic recovery in Nigeria's biodiversity hotspots.

v. **Solutions:** Introduce outdoor gardens with coastal natives (e.g., hibiscus) for purpose rediscovery, bioswales for stormwater, and AAD for targeted habitats, improving mental health metrics (12–20% mood gains) and biodiversity (15–28% footprint cuts) per SDG 15.5

(**a**) (**b**)

Figure 2. Exterior view (a) and (b) Wellspring Rehabilitation Centre in Lagos, Nigeria. Source: Adapted from Google Earth (2026).

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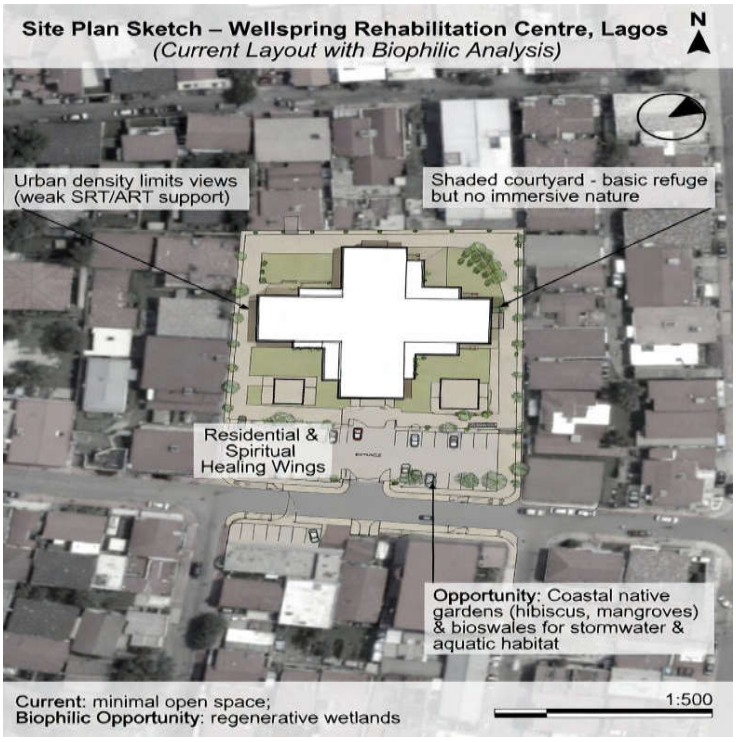

Figure 2c. Site Plan Sketch; Wellspring Rehabilitation Centre, Lagos (Current Layout with Biophilic Analysis). Generated by the author using Grok Imagine (xAI image-generation model) based on site analysis and Google Earth reference imagery, March 2026.

4.3. Case Study 3: Synapse Services Limited Centre's

Synapse Services Limited is West Africa's largest private mental health provider, with centers like Azalea (Abuja), Magnolia (Lagos), and Japonica (Port Harcourt), offering psychiatric care, addiction treatment, and holistic programs with modern amenities (e.g., gyms, music schools, rTMS).

i. **Biophilic Architectural Strategies:** Centers mention serene, calm environments with patient comfort, but lack intentional biophilic designs, no green pockets, native plantings, or immersive landscapes. Basic setups prioritize clinical tools over natural integration, missing sensory elements such as dynamic light or water features [11]. Port Harcourt's Niger Delta location offers potential for wetland mimicry, but it's unused.

ii. **Psychological Recovery Impact:** Evidence-based care with rTMS supports PTSD and anxiety reduction, but without biophilic enhancements, emotional resilience is limited, potentially missing 15–25% stress cuts from nature immersion [7]. Multi-location adaptability aids access, but urban disconnection in Abuja/Lagos hinders full cognitive enhancement [8,14].

The composite site plan, Figure 3c across the Synapse network, highlights varied but uniformly clinical layouts: Azalea's serene buffer, Magnolia's tight urban courtyard, and Japonica's wetland proximity remain underutilized for biophilic immersion. This directly ties to the paper's core argument: while modern amenities support evidence-based care, the absence of native planting, green infrastructure, and Animal-Aided Design limits parasympathetic stress recovery [6] and habitat restoration in biodiversity hotspots. The relation to SDG 15 is clear: current footprints contribute negligible connectivity amid urbanization; strategic retrofits (e.g., wetland mimicry in Port Harcourt) would yield 20–35% biodiversity gains and enhanced patient resilience, embodying the study's regenerative dual-function framework.

iii. **Biodiversity Conservation Impact:** No regenerative features mean negligible habitat support or footprint reduction. In Port Harcourt's sensitive wetlands, this wastes opportunities for corridors or bioswales, failing SDG 15.8 (invasive species prevention) amid oil degradation [4].

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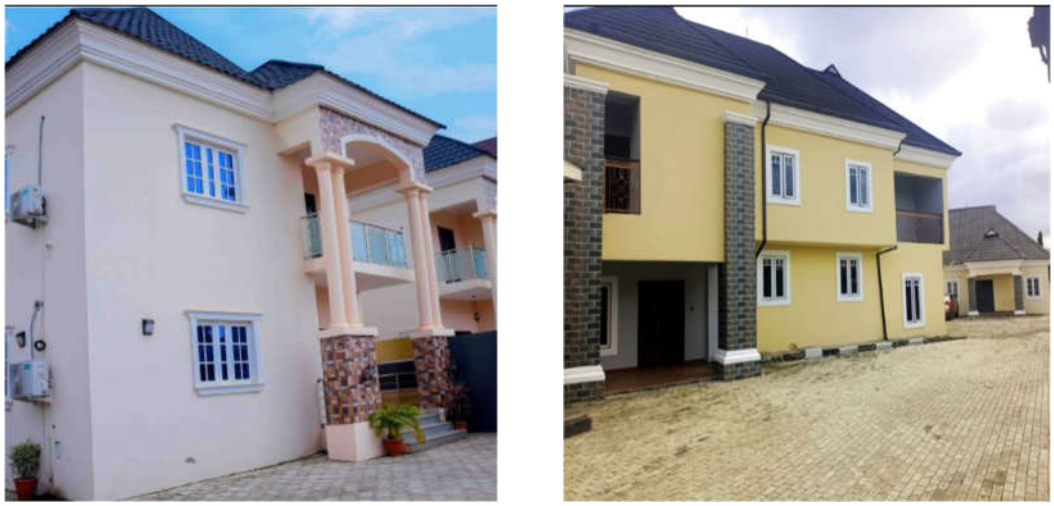
iv. **Advancing SDG 15 in African Contexts:** The network's scale could advance SDG 15 through ecosystem-aligned designs, but the current focus on clinical care ignores synergies for Nigeria's diverse hotspots.

v. **Solutions:** Add green roofs with savanna plants in Abuja, courtyards in Lagos, and wetland-sensitive features in Port Harcourt for 20–35% biodiversity gains and recovery boosts, per SDG 15.9 [9].



(**a**) (**b**)

Figure 3. Exterior view of Synapse Services Limited centers in (a) Azalea, Abuja, and (b) Japonica, Port Harcourt, Nigeria. Source: Adapted from Google Earth (2026)

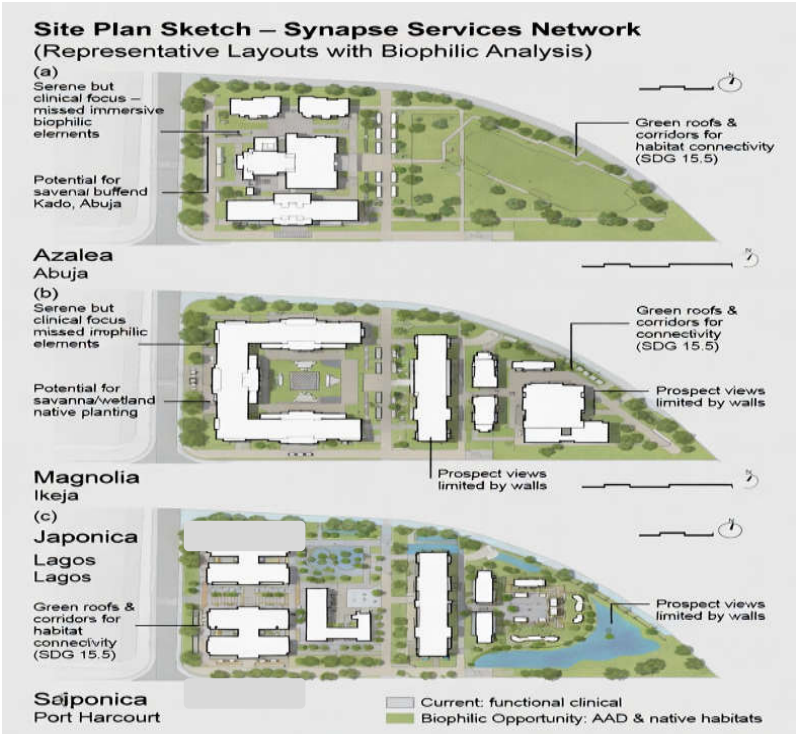


Figure 3c. Site Plan Sketch: Synapse Services Limited Centres (Representative Network). Generated by the author using Grok Imagine (xAI image-generation model) based on site analysis and Google Earth reference imagery, March 2026.

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5. Discussion

The findings from this qualitative study highlight the transformative potential of biophilic architecture in African rehabilitation environments, revealing synergistic benefits for psychological recovery and biodiversity conservation. By synthesizing evidence from the systematic literature review (SLR) and case study analyses, this section interprets key results, contextualizes them within existing scholarship, addresses identified gaps, and explores implications for advancing SDG 15 (Life on Land) in Africa. The discussion emphasizes how biophilic strategies not only enhance human well-being but also foster regenerative ecosystems, offering a blueprint for sustainable healthcare design amid rapid African urbanization and environmental challenges[4,9,28]. However, the case studies underscore significant implementation shortcomings, in which limited biophilic elements fail to fully realize these benefits, limiting both recovery outcomes and ecological contributions.

5.1. Psychological Recovery Outcomes in African Contexts

The SLR and case studies reveal that biophilic interventions can improve psychological well-being, but current implementations in the examined facilities fall short of optimal efficacy. Across the SLR's 15-20 studies, highlight exposure to direct nature (e.g., vegetation views, water features) and natural analogues (e.g., local materials) is linked to reduced stress markers, with medium-to-large effect sizes (Cohen's d = 0.6–0.9). Key findings include 15–25% reductions in self-reported anxiety and depression scores (via DASS-21 and PHQ-9), 8–18% shorter perceived recovery durations, and 12–20% improvements in mood and emotional regulation (PANAS scale). These outcomes are particularly relevant in urban African settings, where patients face compounded trauma from overcrowding and pollution [3,8].

In the case studies, psychological benefits are constrained by inadequate biophilic integration. Olive Prime Psychological Services in Abuja offers basic leafy surroundings and outdoor spaces, providing some refuge for reflection, but lacks immersive elements like native gardens or sensory water features, resulting in limited stress reduction and emotional processing. This aligns with SRT and ART [6,14]but underperforms compared to advanced designs, potentially prolonging anxiety for patients. Wellspring Rehabilitation Centre in Lagos emphasizes spiritual recovery through shaded areas, but without dedicated biophilic features such as green roofs or natural light optimization, it fails to fully support cognitive restoration or purpose rediscovery, missing opportunities for transcendence [19,20]. Synapse Services Limited's centers, despite modern amenities, incorporate minimal green pockets and serene settings, offering modest resilience support but not maximizing PTSD recovery through sustained nature interaction [13,16]. These limitations highlight contextual dependencies, such as resource constraints in Nigeria, where poor implementation reduces long-term effects and exacerbates urban disconnection.

To address this, facilities should retrofit with indigenous vegetation for calming stimuli, water features for sensory calm, and community-involved gardens to enhance emotional regulation, drawing from SLR evidence on virtual simulations for immediate benefits [7]. While these findings affirm the therapeutic potential of biophilic design, the case studies reveal that such benefits are only partially realized due to limited and inconsistent implementation of nature-based strategies across the sites. The absence of structured healing landscapes, sensory engagement elements, and immersive outdoor environments constrains the full application of Stress Recovery Theory (SRT) and Attention Restoration Theory (ART). This indicates that psychological outcomes are not solely dependent on the presence of nature, but on how effectively it is spatially integrated within the site. These limitations necessitate a broader evaluation of site planning approaches, which is further explored through ecological and spatial performance in the subsequent sections.

5.2. Biodiversity Conservation and Land-Use Impacts

Biophilic architecture serves as a regenerative tool for land conservation, but the case studies show underwhelming contributions due to passive or absent ecological strategies. SLR evidence

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indicates designs with AAD and green infrastructure can increase biodiversity indices by 20–30%, reducing footprints by 15–28% and enhancing connectivity [13,23]. Native species prioritization aligns with SDG 15.5 (halting loss) and 15.9 (biodiversity integration), countering fragmentation in hotspots [9,26].

In practice, Olive Prime's minimal greenery provides negligible habitat support, failing to restore urban ecosystems or reduce heat islands. Wellspring's shaded areas offer limited micro-ecosystems, with no bioswales or corridors, missing stormwater management and aquatic habitat opportunities. Synapse's centers show varying ecological potential but lack green roofs or wetland features, resulting in low gene flow and ecosystem services. These shortcomings bridge anthropocentric biases [40] but underscore economic barriers such as maintenance costs in Nigeria [4,10,30].

Solutions include mandating native plantings for pollinator habitats, green infrastructure for footprint reduction, and community stewardship for sustainability, transforming facilities into active SDG 15 contributors. Despite the documented capacity of biophilic architecture to enhance biodiversity and ecological resilience, the examined facilities demonstrate minimal engagement with regenerative land-use strategies. The lack of native planting systems, habitat corridors, and water-sensitive infrastructure reflects an anthropocentric design bias that prioritizes clinical functionality over ecological integration. As a result, the sites contribute negligibly to SDG 15 targets, particularly in terms of habitat restoration and biodiversity connectivity. This gap highlights the need to critically assess how spatial planning decisions influence both ecological performance and human well-being, forming a basis for integrated analysis.

5.3. Synergies Between Mental Health and Ecological Sustainability

The study's core insight is the potential interconnectedness of psychological and ecological outcomes, yet case studies reveal weak synergies due to poor biophilic execution. Regenerative designs could create "win-win" scenarios, but limited elements hinder bonds combating disconnection[2,3]. Olive Prime's passive greenery offers modest refuge but not full transcendence [20]. Wellspring's spiritual focus lacks immersion in nature for resilience, while Synapse's amenities mix habitat integration for holistic healing [4,29]. This dynamic is culturally resonant but unrealized in Africa [10]. Challenges such as inequities persist [41] , emphasizing the need for inclusive implementation. The findings demonstrate that the relationship between psychological recovery and ecological sustainability is inherently interconnected, yet underdeveloped within the analyzed facilities. While theoretical frameworks and empirical evidence suggest strong synergies between immersive natural environments and improved mental health outcomes, these synergies remain largely unrealized due to fragmented site planning and limited biophilic integration. This disconnect underscores the importance of examining site-level spatial configurations as a unifying framework through which both therapeutic and ecological objectives can be simultaneously achieved. Consequently, a comparative evaluation of the site plans is essential to identify systemic gaps and opportunities for regenerative design. See Figure 4 for further details.

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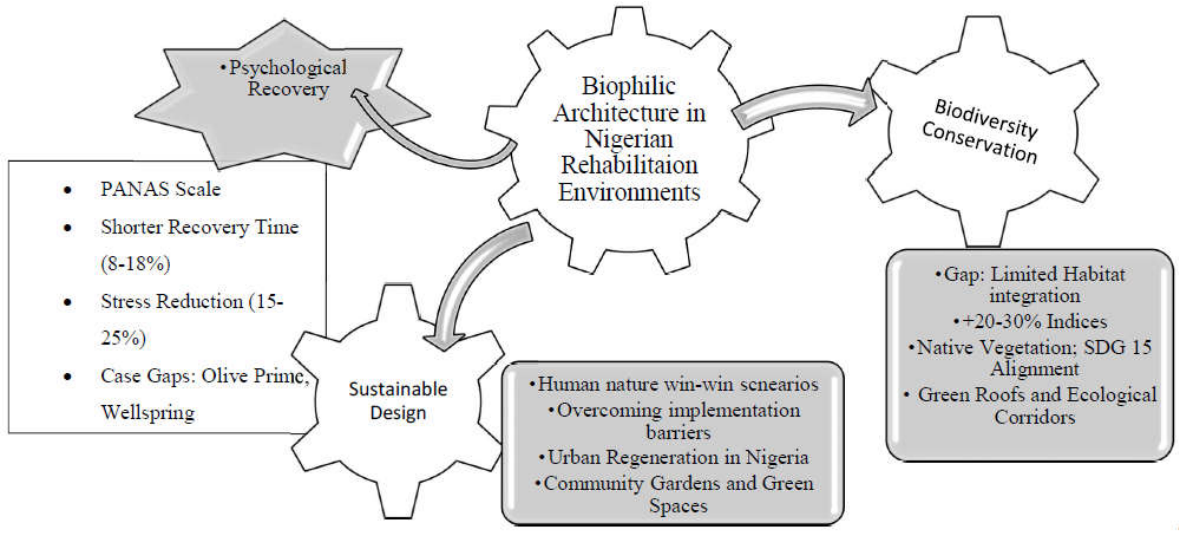

Figure 4. A comprehensive mind map highlighting how nature-integrated design can transform rehabilitation spaces and biodiversity conservation in Nigeria (diagrammed by the author, March 2026).

5.4. Comparative Site Plan Analysis: Synergies and Gaps in Biophilic Integration, Psychological Recovery, and SDG 15 Advancement

The comparative analysis of the three site plans (Figures 1b, 2b, and 3c) reveals consistent patterns of underutilized biophilic potential across Nigeria's rehabilitation facilities while simultaneously highlighting clear pathways for aligning built-form interventions with both psychological recovery and Sustainable Development Goal 15 (Life on Land). Although each facility operates within distinct urban contexts, Abuja's leafy suburbs, Lagos's high-density fabric, and the Niger Delta's wetland-adjacent zones, the site plans collectively demonstrate a shared reliance on clinical functionality at the expense of intentional nature integration, thereby limiting the dual regenerative outcomes central to this study.

Across all three layouts, the dominant gap lies in the absence of the 14 Patterns of Biophilic Design [11]. Olive Prime's compact rectangular plot (Figure 1b) offers passive leafy surroundings that provide basic visual connection and prospect-refuge opportunities (Patterns 1, 11–12), yet lacks structured native planting, water features, or habitat corridors. This results in only modest stress reduction potential through Stress Recovery Theory (SRT) and Attention Restoration Theory (ART)[6,14]. Wellspring's inward-focused courtyard (Figure 2b) is further constrained by surrounding urban density, offering minimal non-visual sensory stimuli and no regenerative wetlands, thereby weakening emotional regulation and cognitive restoration in a high-stress Lagos environment. Synapse's network (Figure 3c) presents the most varied topography, serene buffers at Azalea, tight courtyards at Magnolia, and wetland proximity at Japonica, yet none incorporate Animal-Aided Design (AAD) or green infrastructure, leaving prospect views blocked by walls and biodiversity corridors unestablished.

These gaps directly undermine the paper's core thesis: the facilities currently deliver suboptimal psychological benefits (estimated 15–25% unrealized anxiety reduction) and negligible contributions to SDG 15 targets. Habitat fragmentation persists, native flora is underutilized, and ecological connectivity remains absent amid rapid urbanization pressures[4].

Conversely, the site plans also expose strong synergies once biophilic retrofits are applied. Introducing indigenous savanna and coastal species, bioswales, green roofs, and habitat corridors across all three layouts would simultaneously activate multiple biophilic patterns (e.g., presence of water, connection with natural systems, material connection with nature). Such interventions could achieve the documented 15–25% reductions in stress and anxiety [7] while delivering 20–35% increases in local biodiversity and habitat connectivity[9,23], directly advancing SDG 15.5 (halt habitat degradation), 15.1 (conserve terrestrial ecosystems), and 15.9 (integrate biodiversity into

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planning). The comparative visualization further demonstrates that low-cost, context-specific solutions, leafy gardens in Abuja, wetland mimicry in Lagos and Port Harcourt, can transform these clinical sites into regenerative healing landscapes without compromising existing functional requirements.

In summary, the site plan comparison underscores that the current layouts represent a missed opportunity for biophilic architecture to function as a dual-purpose framework in Nigerian rehabilitation environments. By addressing these identified gaps through targeted, native-led interventions, facilities can realize the full regenerative potential articulated throughout this study, delivering measurable gains in both mental well-being and biodiversity conservation in line with SDG 15.

6. Conclusion and Recommendations

This study has demonstrated that biophilic architecture offers a powerful dual-function framework capable of simultaneously advancing psychological recovery and biodiversity conservation in Nigerian rehabilitation environments. Through a systematic literature review and detailed analysis of three representative case studies (Olive Prime, Wellspring, and Synapse Services), the research confirms that well-integrated natural elements can significantly reduce stress and anxiety (15–25%), improve emotional regulation, and support cognitive restoration via Stress Recovery Theory and Attention Restoration Theory. At the same time, strategic use of native planting, habitat corridors, and green infrastructure can deliver measurable gains in local biodiversity and ecosystem connectivity, directly contributing to SDG 15 targets.

However, the findings reveal a critical implementation gap: current facilities remain predominantly clinical and anthropocentric, resulting in only partial realization of these benefits and negligible ecological impact. The comparative site plan analysis identifies the root limitation as inadequate landscape-driven site planning rather than architectural form alone.

Ultimately, this research establishes biophilic architecture as a regenerative, context-responsive solution for Nigeria's dual challenges of mental health crises and biodiversity loss. By repositioning rehabilitation centers as active participants in their local ecosystems, intentional biophilic design can bridge human well-being and environmental stewardship, offering a scalable pathway toward sustainable development in rapidly urbanizing African contexts.

In redefining rehabilitation environments as ecologically responsive and psychologically restorative landscapes, this study positions biophilic architecture not merely as a design approach but as a critical pathway toward achieving sustainable development in Nigeria.

6.1. Recommendations

Based on the findings, the following targeted recommendations are proposed for policymakers, architects, healthcare practitioners, and researchers in Nigeria to operationalize biophilic architecture in rehabilitation settings. These prioritize affordability, cultural relevance, and measurable SDG alignment to ensure equitable implementation across diverse regions.

Table 8. Key Recommendations for Implementing Biophilic Architecture in African Rehabilitation Environments.

Recommendation Category	Specific Action	Rationale	Target Stakeholders	SDG 15 Alignment
Policy Integration	Mandate inclusion of native planting and habitat corridors in national building codes for healthcare facilities (e.g., update Nigeria's National	Ensures ecological benefits from inception, reducing long-term costs and urban fragmentation.	Governments, urban planners	15.1, 15.9

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	Building Code or South Africa's SANS 10400).			
Design Practices	Prioritize low-cost, vernacular materials (e.g., local timber, clay) and community-involved green spaces in rehab designs, with at least 30% site area dedicated to native biodiversity.	Enhances cultural resonance and accessibility in resource-limited areas like Ado-Ekiti or Lagos.	Architects, NGOs	15.5, 15.a
Metrics and Monitoring	Develop and adopt a Biodiversity + Well-being Index for evaluating psycho-ecological outcomes, incorporating tools like DASS-21 for mental health and species counts for ecology.	Addresses gaps in quantitative metrics, enabling evidence-based scaling.	Researchers, healthcare providers	15.9, 15.8
Capacity Building	Establish a Pan-African Biophilic Rehabilitation Network for training, knowledge sharing, and pilot projects (e.g., "biophilic recovery villages" in peri-urban zones).	Fosters interdisciplinary collaboration and equity in the Global South.	International organizations (e.g., UNEP), academic institutions	15.a, 15.5
Research Priorities	Fund longitudinal studies (3–5 years) in underrepresented regions like East and Central Africa, focusing on cost-benefit analyses and digital tools (e.g., VR biophilic simulations).	Validates long-term synergies and adapts to emerging challenges like climate migration.	Funding bodies (e.g., African Union, WHO)	15.1, 15.9

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Generative AI Disclosure: The schematic site plans presented in Figures 1c, 2c and 3c were produced by the first author using Grok Imagine (xAI large-scale text-to-image model) in March 2026. Prompts were written by the author and iteratively refined. All labels, legends, annotations, scale bars, and biophilic analysis elements were added/edited by the author in post-processing. The images are informed by publicly available Google Earth satellite views and site-specific information collected during the study. No training data from copyrighted architectural drawings was intentionally used. The authors have reviewed and edited the outputs and take full responsibility for the content of this publication.

Conflicts of Interest: The authors declare no conflicts of interest

Appendix A

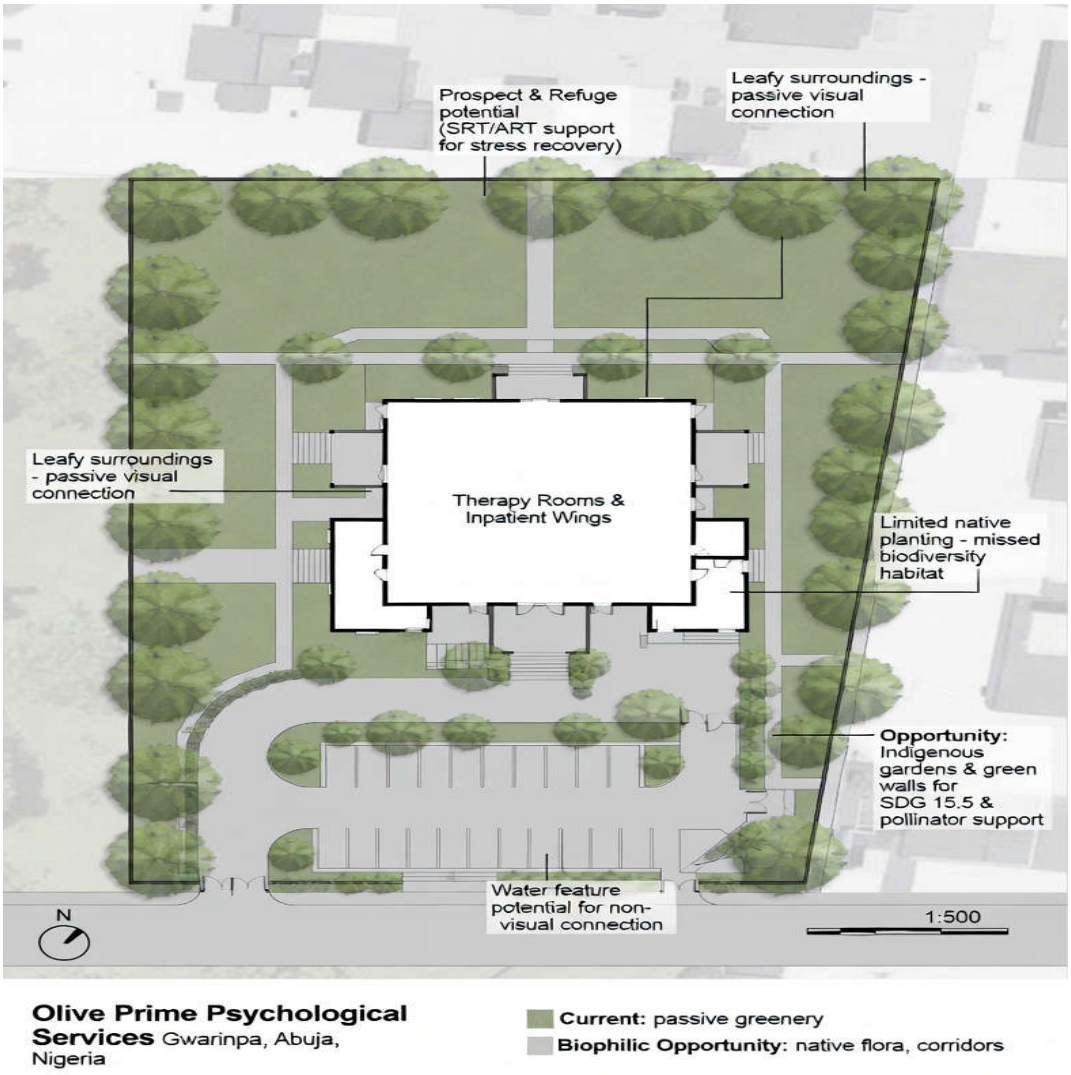

Figure 1c. Site Plan Sketch: Olive Prime Psychological Services, Abuja (Current Layout with Biophilic Analysis).

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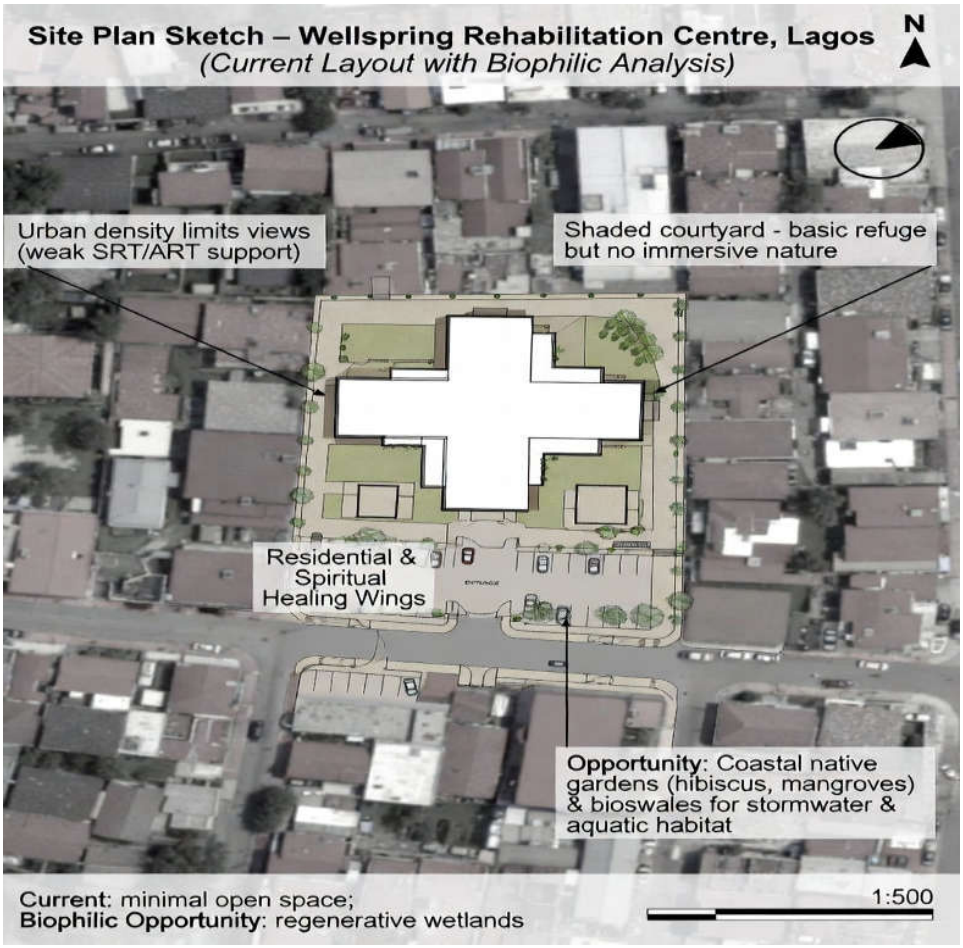

Figure 2c. Site Plan Sketch: Wellspring Rehabilitation Centre, Lagos (Current Layout with Biophilic Analysis).

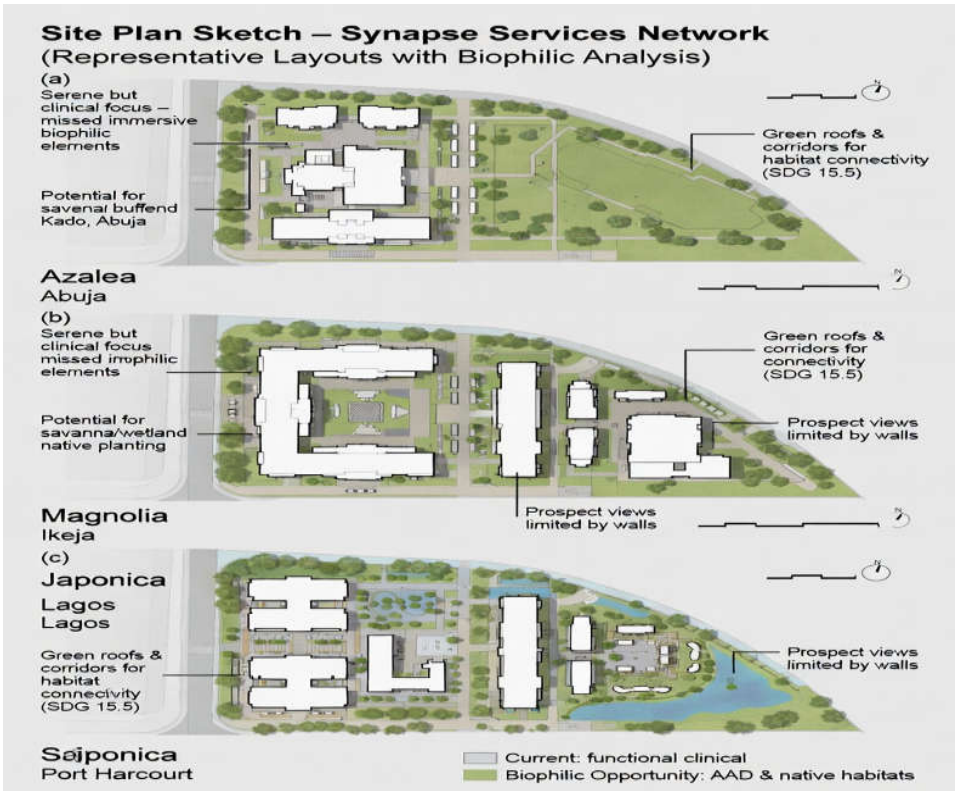

Figure 3c. Site Plan Sketch; Synapse Services Limited Centre's (Representative Network).

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