2025
September

coou African Journal of Environmental Research *Vol 6, No. 2 2025. pp 78-92*

ENHANCING THE DESIGN OF ORTHOPEDIC HOSPITALS USING BIOPHILIC ELEMENTS: THE CASE OF SOME SELECTED HOSPITALS IN SOUTH-EAST NIGERIA

Confidence C. Azinwa[1], Ndidi U. Okolo[2], Charles Munonye[3], Chukwunonso O. Umeora[4]

[1,2,3,4] Department of Architecture, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Nigeria

Email: confidynamic55@gmail.com[1], arc.ndidi@gmail.com[2], cc.munonye@coou.edu.ng[3], co.umeora@coou.edu.ng[4]

Abstract

The quality of healthcare facility design plays a critical role in influencing patient recovery, staff efficiency, and overall healthcare outcomes. In Nigeria, orthopedic healthcare facilities often face design challenges that limit their effectiveness in promoting healing environments. This study explores the current design conditions of selected orthopedic hospitals in the southeastern region of Nigeria, with a particular focus on identifying opportunities for improvement through the integration of biophilic design elements. Using a case study approach, data was collected through field observations, architectural analysis, and interviews with healthcare professionals and facility users across selected hospitals. The findings highlight prevalent issues such as overcrowded wards, poor ventilation, inadequate access to natural light, and limited incorporation of natural elements. These challenges not only affect patient comfort but also hinder staff performance and overall operational efficiency. The study underscores the urgent need to re-evaluate the design of orthopedic healthcare facilities in the region and recommends the adoption of biophilic principles as a practical and sustainable approach to enhancing healing environments. The outcomes provide context-specific insights that can inform future healthcare design policies and architectural interventions in Nigeria.

Keywords: Biophilic elements, healthcare design, healing environments, Orthopedic hospitals, Patient recovery, southeastern Nigeria

INTRODUCTION

Healthcare environments significantly impact patient recovery, staff performance, and overall treatment outcomes (Ulrich, 2008) . In particular, the design of orthopedic facilities which typically handle patients requiring long-term care and physical rehabilitation must go beyond functional adequacy to include features that promote healing and psychological well-being. The traditional clinical focus of hospital design in Nigeria often overlooks the important environmental factors that support patient recovery, such as access to natural light, fresh air,

greenery, and aesthetically soothing spaces (Babalola, et al (2023) . For instance, allowing enough air to enter indoors through building envelopes helps to remove excess heat accumulated indoors, thereby minimizing discomfort. (Munonye et al, 2021).

Biophilic design, a concept that involves incorporating nature and natural elements into built environments has been widely acknowledged for its therapeutic benefits in healthcare settings (Kellert, Heerwagen, & Mador, 2013). Green spaces have social, ecological and health benefits (Okolo, 2019). Research has further shown that contact with nature can reduce stress, lower blood pressure, and improve recovery times among patients, while also boosting morale and performance among healthcare staff (Beukeboom, Langeveld, & Tanja-Dijkstra, 2012). However, the implementation of such design strategies in Nigeria's healthcare infrastructure remains minimal, especially in specialized facilities like orthopedic hospitals.

In the southeastern region of Nigeria, orthopedic facilities continue to face issues of poor ventilation, limited access to daylight, overcrowded wards, and inadequate landscape integration. These challenges necessitate a comprehensive examination of current facility design and exploration of opportunities for incorporating biophilic elements tailored to local contexts. (Ekpo, 2023).

LITERATURE REVIEW

Theoretical Framework

Biophilic design is a concept derived from the term "biophilia," which refers to humans' innate affinity for the natural world (Wilson, 1984) .The theory, popularized by Edward O. Wilson, suggests that people thrive physically and psychologically when exposed to nature. In architectural practice, biophilic design translates this theory into principles that integrate natural elements such as sunlight, vegetation, water features, and natural ventilation into the built environment (Kellert, Heerwagen, & Mador, 2013) . It moves beyond mere aesthetics and emphasizes creating environments that foster a multisensory connection to nature, even within urban or clinical settings. Biophilic design is not merely about inserting plants into buildings; it involves strategic use of forms, materials, spatial configurations, and environmental conditions that replicate or simulate the natural world (Browning,Ryan, & Clancy,, 2014) . Incorporating biophilic elements in hospitals has been associated with reduced stress, improved patient outcomes, and enhanced staff satisfaction. For instance, exposure to natural light and views of nature can lower blood pressure, decrease pain perception, and shorten hospital stays, (Ulrich, 1997) . Despite these benefits, many Nigerian hospitals lack biophilic features, often due to budget constraints and limited awareness of their importance (Ekpo, 2023).

History and Theory Behind Biophilic Architecture

The concept of biophilic design can be traced back to ancient civilizations that designed buildings and cities with nature in mind, such as Persian gardens and Roman courtyards (Beatley, 2017). However, it gained formal academic attention in the late 20th century through Wilson's biophilia hypothesis and was later integrated into design theory by scholars such as Stephen Kellert.

Biophilic design is not optional but essential for human health, productivity, and well-being (Kellert, Heerwagen, & Mador, 2013). In recent years, biophilic architecture has been supported by studies in environmental psychology, neuroscience, and public health, which show that built environments affect behavior, cognition, and stress levels. The "14 Patterns of Biophilic Design" (Visual Connection with Nature, Non-Visual Connection with Nature, Non-Rhythmic Sensory Stimuli, Thermal & Airflow Variability, Presence of water, Dynamic & Diffuse Light, Connection with Natural Systems, Biomorphic Forms & Patterns, Material Connection with Nature, Complexity & Order, Prospect, Refuge, Mystery, Risk/Peril) framework is one of the most widely used models in contemporary architectural practice and includes patterns such as visual connection with nature, non-rhythmic sensory stimuli, and material connection with nature (Browning,Ryan, & Clancy,, 2014).

Benefits of Biophilic Design in Healthcare

Numerous studies have linked biophilic environments to faster patient recovery, reduced stress, lower medication usage, and improved staff performance (Ulrich, 1997). According to patients recovering from surgery in rooms with views of natural scenery had shorter hospital stays and required fewer painkillers than those facing a blank wall. Similarly, exposure to daylight has been shown to improve mood and circadian rhythms, benefiting both patients and healthcare workers. (Ulrich, 1997).

In orthopedic healthcare, where patients often spend extended periods in recovery and rehabilitation, these benefits are particularly valuable. Incorporating elements such as healing gardens, natural ventilation, and nature-inspired artwork can create a more therapeutic and less clinical environment, fostering both emotional and physical healing.

Orthopedic Facility Design Standards

Orthopedic hospitals require specific architectural considerations, including spatial layouts for surgery, rehabilitation, and mobility support. According to the Facility Guidelines Institute FGI (2018), orthopedic centers must be designed to accommodate assistive technologies, promote accessibility, and reduce fall risks through spatial clarity and lighting. However, many Nigerian orthopedic facilities are designed without these guidelines in mind, resulting in outdated layouts, poorly ventilated wards, and inadequate waiting areas.

Incorporating biophilic elements can improve user experience without compromising medical functionality. For instance, large windows for daylighting, use of natural materials in interiors, and integration of green spaces around mobility trails can promote healing while meeting orthopedic care requirements.

While global research supports the benefits of biophilic design in healthcare, there is a paucity of studies focusing on its application in Nigerian orthopedic hospitals. Most existing research in Nigeria centers on general healthcare infrastructure, with limited attention on the integration of

natural elements in hospital design. This gap underscores the need for context-specific studies that explore how biophilic design can be effectively implemented in Nigerian orthopedic hospitals to enhance patient outcomes and staff well-being.

RESEARCH METHODOLOGY

Research Design

This study employs a case study research design, focusing on direct engagement with the spatial and experiential realities within selected orthopedic hospitals. This approach allows for a rich, context-sensitive exploration of how architectural features particularly biophilic elements impact patient healing and staff perception. It prioritizes narrative, observational, and experiential data.

Study Area

The study centers on three hospitals within South-East Nigeria: National Orthopedic Hospital, Enugu; Federal Teaching Hospital, Owerri; and Amanda Hospital, Owerri. These facilities were selected due to their relevance in orthopedic care and their architectural differences. The population of interest includes orthopedic inpatients, healthcare workers (such as doctors, nurses, and physiotherapists), and facility managers or design staff familiar with the hospital layout and operational flow.

Figure 1: National Orthopedic Hospital, Enugu Location Map
Source : Google Map (2025)

Figure 2: Federal Teaching Hospital, Owerri, Location Map
Source : Google Map (2025)

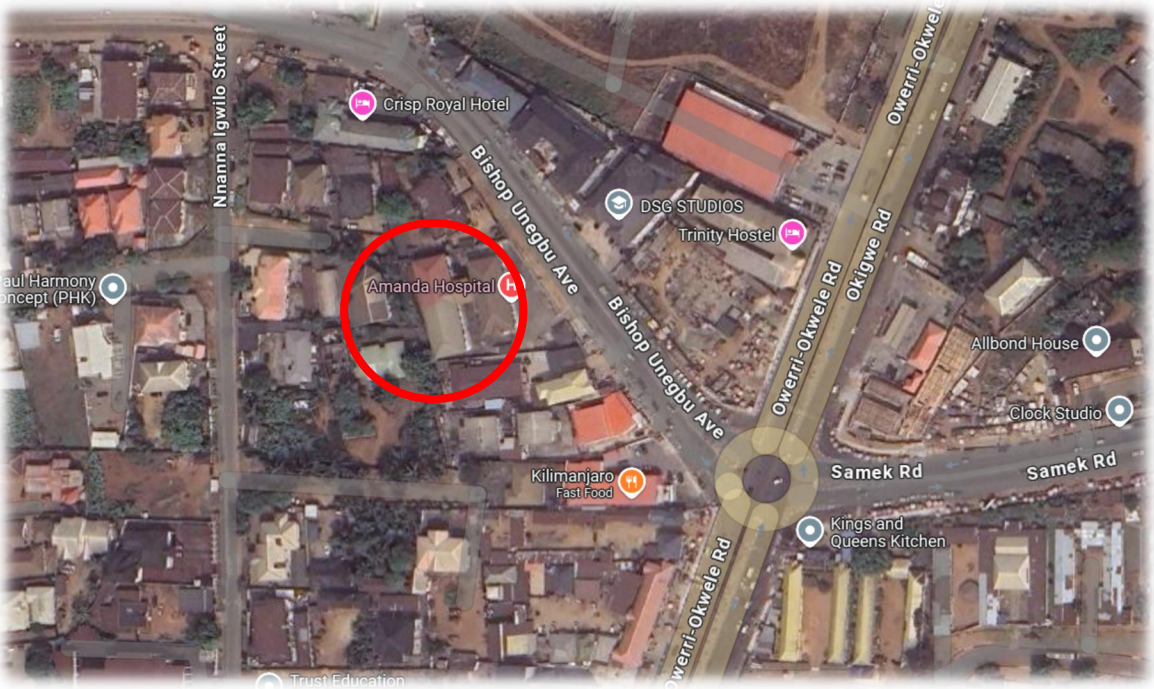

Figure 3: Amanda Hospital, Owerri, Location Map
Source : Google Map (2025)

Methods of Data Collection

Data in this research was obtained through a case study approach from primary and secondary sources. Secondary data was obtained from exisitng books published and unpublished related materials and maps. Field studies through interviews and direct site observations. The collection of data was to explore the current design conditions of selected orthopedic hospitals in the southeastern region of Nigeria, with a particular focus on identifying opportunities for improvement through the integration of biophilic design elements. The researcher observed the physical environment and interacted with staff, caregivers, and patients' relatives in the selected hospitals.

1. Case Studies

Each hospital was studied carefully. observations and interviews were conducted with facility personnel. The case study method helped situate each hospital within its broader architectural and healthcare context.

2. Interviews

Structured interviews were conducted to each participant. These interviews explored perceptions of spatial comfort, environmental satisfaction, emotional well-being, and opinions about nature-related features in the hospital environment. Interviews were conducted in quiet areas within the hospitals. Each lasted between 20 to 45 minutes, depending on participant willingness and health status.

3 Non-Participant Observations

The researcher conducted systematic field observations during multiple visits to each facility. Observations focused on spatial layout, visual and physical access to green areas, lighting conditions, ventilation design, noise levels, use of natural materials, and presence of aesthetic or sensory features. An observation checklist was used to ensure consistency. Where permitted, photographs were taken to document spatial characteristics.

Data Analysis Method

Interview transcripts and observation notes were carefully read and coded manually to identify recurring patterns, contrasting experiences, and unique environmental features. Key themes were derived through inductive reasoning and later grouped into categories such as environmental stress, sensory comfort, spatial design satisfaction, and awareness of biophilic features.

DATA PRESENTATION AND ANALYSIS

Introduction

Data was collected through case studies, interviews, and structured site observations conducted across three orthopedic hospitals in South-East Nigeria: National Orthopedic Hospital Enugu,

Federal Teaching Hospital Owerri, and Amanda Hospital Owerri. The aim is to understand the existing state of biophilic design implementation, its perceived impact on healing, and the spatial experiences of both patients and healthcare staff. Thematic analysis was used to code responses and field notes, while observational data helped contextualize and verify interview findings.

1.Case Study Overview

Each hospital was examined as an individual case with regard to architectural layout, biophilic features, and patient comfort.

Case Study One:

Name: The National Orthopedic Hospital, Enugu (NOHE)

Location: Abakpa junction Abakiliki Road, P.M.B.01294, ENUGU.

Hospital Overview: National Orthopedic Hospital, is a federal specialty hospital that was established on January 17, 1975, The hospital serves as a critical healthcare institution.

Clinical Services and Facilities

NOHE offers a comprehensive range of medical services, including:

a) Orthopedic Surgery: Specializing in the treatment of musculoskeletal disorders and injuries.
b) Trauma Care: Providing emergency services for accident victims and other trauma-related cases.
c) Burns and Plastic Surgery: Offering advanced care for burn victims and reconstructive surgeries.
d) Rehabilitation Services: Including physiotherapy and prosthetic/orthotic services to aid in patient recovery.

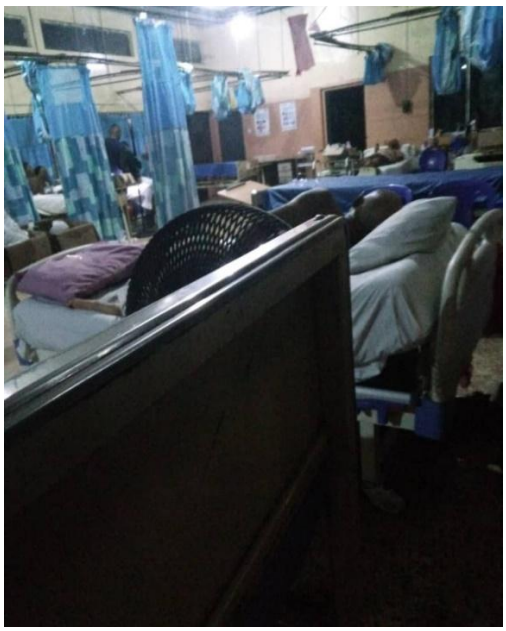

Plate 1: Showing inside the Male Surgical ward
Source: Fiedwork, 2025

Plat**e 2: Showing the Accident and Emergency**
Source: Fiedwork, 2025

Merits

1.Many parts of the hospital, such as the waiting rooms corridors, wards and offices have adequate natural lighting.

2. Shrubs were planted but few in Nunbers

Demerits

1. Much hardscape over softcape

2. The hospital is located in a busy area and traffic can be a problem for patients arriving by ambulance or personal transport.

Deductions

1. Well-designed landscape should be introduced.

2. Softscape should be used over hardscape within the landscape.

Limitations

Restrictions were placed to some areas as a result of critical operations that occur there.

Case Study Two:

Name: Federal Teaching Hospital, Owerri (FUTHO)
Location: Located along 105 Hospital Road, Orlu Rd, Owerri, Imo State, Nigeria.
Hospital Overview: Federal Teaching Hospital, Owerri (FUTHO) was founded in 1995 by the federal government. FUTHO attends to various medical services which includes orthopedic, pediatric, maternity, physiotherapy, accident and emergency services etc. to the general public. The Federal Teaching Hospital, Owerri (FUTHO) has different units, that is dedicated to attending to the needs of children under the care of the hospital. These facilities include:

Plate 3: Showing the Out-Patient Department
Source: Fiedwork, 2025

Plate 4: Showing the Reception
Source: Fiedwork, 2025

Merit:

1. Large walkways of 3000mm were introduced which allow for free flow of natural air.

2. The wards were properly ventilated and had proper natural lighting.

Demerits

1. There was no introduction of biophilic element within the facility

2. The facility hosts no outdoor relaxation areas.

3. Poor lighting within the reception.

Deductions

1. Large walkways should be adopted for free flow of natural ventilation

2. Facility should be properly ventilated

3. There should be considerations for natural lighting within spaces

Limitations

Restrictions were placed to some areas as a result of critical operations that occur there.

Case Study Three:

Name: Amanda Hospital, Owerri
Location: It is located along Works Layout, Imo, Owerri, Nigeria

Overview: Amanda hospital was established in 1991, to provide comprehensive medical services, the hospital caters to a wide range of healthcare needs, including Orthopedic, obstetrics and gynecology, endocrinology, cardiology, pediatrics, general surgery, optometry, nutrition, and physiotherapy

Plate 5: Showing the Approach View
Source : Fiedwork, 2025

Plate 6: Showing the entrance to the Emergency Department
Source : Fiedwork, 2025

Merits

1. The hospital corridor measures about 2400m wide, which is quite appropriate.

Demerits

1. It has a poor landscape, majorly hardscape with no softscape

2. There was no Biophilic element within the Hospital except for the wooden wall cladding used in the interiors

Deductions

1. Provision of adequate biophilic element which will help in the healing process of the patiants and the comfort of the staff.

2. healing garden should be introduced within the hospital environment.

3.Proper Landscaping should be adopted.

Limitations

Restriction were placed to some areas as a result of critical operations that occur there.

2. Observational Data Summary
A structured checklist was used to document biophilic design elements across all three sites. Key findings include:

Table 1: Structured Checklist

1.	**Natural Lighting**: NOHE and FUTHO had insufficient natural lighting in patient wards. Amanda Hospital had moderate daylight access in its units.
2.	**Greenery**: None of the hospitals provided patient access to gardens. Moderate green spacses at NOHE, Weak green spaces at FUTHO and very weak green spaces at AMANDA
3.	**Ventilation**: NOHE and FUTHO used cross-ventilation effectively; AMANDA relied on fans / air conditioning systems.
4.	**Visual Access to Nature**: Views were largely of other buildings or boundary walls. No therapeutic visual links to green spaces existed in any of the wards.
5.	**Use of Natural Materials**: All facilities used predominantly synthetic or hard surfaces such as tiles, and metal beds except for AMANDA that integrated wooden cladding along the wall surfaces.

Source : Fiedwork, 2025

3.Themes from Interviews
After analyzing transcripts from patients, staff, and facility managers, three recurring themes were identified:

Table 2: Recurring themes

S/n	Focus	Description
Theme 1	Environmental Stress and Psychological Fatigue	Caregivers in all three hospitals repeatedly described the environment as "depressing," "tight," or "lifeless." Many equated recoveries with not just physical healing but mental endurance. Several noted difficulty sleeping due to artificial lighting, ward noise, and lack of fresh air.
Theme 2	Absence of Nature and Desire for Relief	There was a strong desire for even minimal natural interventions like potted plants, views of trees, or the sound of flowing water.
Theme 3	Readiness for Change if Supported	Despite infrastructural and funding limitations, all three hospitals expressed willingness to integrate biophilic elements if guided and supported with resources.

Source : Fiedwork, 2025

Table 3: Cross-Case Comparative Highlights

Feature	NOHE	FUTHO	Amanda Hospital
Natural light in wards	Very Good	Very Good	Moderate
Airflow / Ventilation	Functional (cross-vent)	Moderate	Moderate
Green views or gardens	Moderate	weak	Absent
Indoor plants	None	None	None
Use of wood/natural finishes	None	None	Moderate
Staff satisfaction with workspace	Good	Good	Good
Patients' psychological complaints	Less frequent	Less frequent	Less frequent

Source : Fiedwork, 2025

Interpretation of Findings

This study confirms that biophilic design is severely lacking across all three orthopedic hospitals studied. Both physical and emotional discomfort were repeatedly traced back to environmental features. Healthcare professionals recognized that natural elements could improve patient recovery and staff endurance. The three orthopedic hospitals: National Orthopedic Hospital, Enugu; Federal Teaching Hospital, Owerri; and Amanda Hospital only slightly improved on environmental design. The implication is clear: biophilic design is not integrated as a system or policy across healthcare infrastructure in South-East Nigeria.

The alignment of observational evidence and personal testimonies suggests that healing environments in orthopedic care cannot be optimized through clinical resources alone. Environmental design matters and its neglect has visible effects on recovery, well-being, and morale.

DISCUSSION

Discussion of Key Findings

The findings from this study underscore a pressing need to re-evaluate how orthopedic hospitals in South-East Nigeria are designed, especially through the lens of biophilic design. Across all three hospitals studied: National Orthopedic Hospital Enugu, Federal Teaching Hospital Owerri, and Amanda Hospital Owerri, a common pattern emerged: patients are recovering in environments that do not support emotional resilience, psychological calm, or sensory comfort.

Caregivers often described their environment as "dry," "closed in," or "lifeless." This wasn't merely discomfort it represented a deeper emotional and psychological burden placed on individuals already experiencing physical pain. These testimonies support what existing literature already confirms: built environments that incorporate nature or natural analogs can significantly reduce stress and enhance healing (Ulrich, 1997; Umeora, Onwuzuligbo, & Ononuju, 2025). In this study, natural light and fresh airflow were either insufficient or inconsistently available in spaces. Visual and physical access to nature was entirely missing, and no biophilic design principles were intentionally implemented in patient care areas.

Staff also validated these shortcomings. Their responses reflected not only concern for patient recovery but also their own well-being. Nurses, doctors, and administrators described high noise levels, enclosed spaces, and poor ventilation as contributing to fatigue, stress, and lower productivity. Some expressed frustration at how little emphasis is placed on environmental quality during renovations or infrastructure upgrades a problem rooted in top-down design decisions that prioritize capacity over comfort. Perhaps most telling was the readiness for change. Every hospital despite operational constraints expressed a willingness to explore biophilic improvements.

Implications for Hospital Design in Nigeria

The findings of this research reveal that the absence of biophilic design is not due to outright resistance, but rather to lack of awareness, professional integration, and budget prioritization. In other words, the problem is structural, not cultural. Hospitals in Nigeria have long been planned and constructed based on clinical efficiency and financial feasibility. Healing environments, however, require more than medical equipment and square footage they demand thoughtful spatial programming that acknowledges the human side of healing.

Designing for orthopedic care in particular requires sensitivity to patient immobility, long stays, and emotional vulnerability. A ward with sufficient daylight, calming textures, natural ventilation, and a view of plants or sky is not an aesthetic luxury it is a functional necessity for holistic recovery. Furthermore, a healthier environment also benefits staff retention, morale, and productivity. Spaces that allow brief visual rest, emotional decompression, and acoustic comfort help staff remain alert, and focused.

Recommendations for Stakeholders

i. Architects and Facility Designers should incorporate sensory and nature-based considerations into every stage of hospital design from master planning to finishes.
ii. Healthcare Administrators must advocate for renovations that improve environmental comfort, even with limited budgets.
iii. Academic Institutions should introduce biophilic principles into architectural and environmental design curricula.
iv. Government and NGOs should support biophilic pilot projects in selected public hospitals to serve as national models.

CONCLUSION

Using a case study design, the research employed interviews and non-participant observations to gather firsthand insights from Caregivers, healthcare workers, and facility administrators. Through thematic analysis, several patterns emerged: a severe lack of natural elements in hospital design, widespread environmental discomfort among patients, and a staff consensus that existing layouts do not support healing optimally.

The study found that while clinical services are functional, architectural features remain rigid, outdated, and emotionally taxing. The absence of biophilic features like daylight, plants, fresh air, soothing colors, and green outdoor access contributes to a hospital environment that is physically sterile and mentally draining. Hospital architecture must do more than house beds and machines it must contribute actively to the healing process. This research has shown that in all three orthopedic hospitals studied, there is a profound disconnect between spatial design and patient needs. Despite overwhelming global evidence on the benefits of biophilic design in healthcare settings, these Nigerian institutions have yet to embed such thinking into policy, planning, or construction.

Yet, the study also revealed hope: staff at every hospital recognized the limitations of their current environments and expressed readiness for change. There is no resistance to biophilic principles but rather a lack of direction, funding, and implementation frameworks. This work calls on health planners, architects, and policymakers to rethink how spaces of care are created. Biophilic design is not about beautification it's about healing, dignity, and recognizing the human need for connection with nature, even in moments of pain and recovery.

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