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APPLICATION OF BIOPHILIC DESIGN IN THE PLAN OF URBAN CITY: A CASE STUDY OF DANJUMA GOJE STREET, BAUCHI, NORTH-EASTERN NIGERIA.

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ABSTRACT

Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural environment. This research was aimed at exploring the application of biophilic design in the plan of urban city, conducted at Danjuma Goje street Bauchi Metropolis. A quantitative research method was employed with a descriptive survey approach as the method of data collection. A descriptive statistics analysis was employed for the analysis of data using Statistical Package for Social Sciences (SPSS). The data were collected with a closed ended or structured questionnaire. About one hundred and one (101) questionnaires were distributed and eighty (80) returned which is about79%. The result was presented in tables. After the analysis, the results show that the respondents prepare natural features such as trees, shrubs, and grasses within the surrounding than paved surfaces. The respondents strongly agree that there is a natural connection between human beings and nature. The responses also reveal other impact of biophilic design to include aesthetics in the built environment, thermal comfort, etc. recommendation include enforcement on landscape plan in building plans submission, supervision and monitoring by development control authorities/ office at the three tiers of government to ensure compliance.

Key words: *Biophilic, City, Design, Plan, Urban*

1.0 INTRODUCTION

Biophilia is the innate affiliation of human beings to the natural environment (Kellert & Wilson, 1995). Biophilic design is the application of biophilia in the plan of the built environment. It can reduce stress, enhance creativity and clarity of thought, improve our well-being and expedite healing. Human beings thrive in natural environment and suffer in it absence (Wilson, 2017). Wilson postulated the biophilia hypothesis in 1984, which state that: (1) Human beings are affiliated to life and life like process and (2) this affiliation is in our genetic make-up. The philosophy of some architects reveal the application of this affiliation to nature, such work could be seen in the works of Frank Llyod Wright in his famous work of falling water Pennsylvania, design at the bear run for the kaufmann's family in 1936. Wright believe that building should be curve out of and integrated to its surrounding environment. Technology and advancement in construction are considered as the major factors that hinder the application of biophilic design in the plan of residential buildings. With the introduction of building materials such as interlocking, use of asphalt, concrete paving and other ground finishes in buildings, designers tend to eliminate the use of natural features such as trees, shrubs, grasses, water features and other natural elements that are considered part of the ways in which people interact with nature in their surrounding environment (Wilson, 2017).

1.1 The Need for the Research

In recent times, architects, town planners and their clients especially in high and medium density areas tend to omit and pay less attention on the integration of nature with the built environment. This led to environmental problems such as erosion, pollution, global warming, flooding etc. this lack of integration with the built environment distort the aesthetics qualities of the environment. Problems such as air contamination, high temperature, may be experienced in any environment with less or no landscape features such as trees, shrub and grasses (Marcus & Barnes, 1999).

The aim of this research is to explore the application of biophilic design in the built environment. The research tends to achieve the following objectives:

a) To investigate respondents' preference and understanding of biophilic design.
b) To explore the benefits of biophilic design in the built environment.
c) To recommend ways for improvement, implementation, orientation and enforcement of laws governing the application of biophilic design in the built environment.

2.0 LITERATURE REVIEW: HISTORICAL OVER-VIEW: INTEGRATION OF NATURE IN THE PLAN OF RESIDENTIAL BUILDINGS

Nature themes can be found in the earliest human structures: Stylized animals characteristic of the Egyptian sphinx or the acanthus leaves adorning Greek temples and their Vitruvian origin story; from the primitive hut to the delicate, leafy filigrees of Rococo design (Peters & Schmidt, 2004). Representations of animals and plants have long been used for decorative and symbolic ornamentation. Beyond representation, cultures around the world have long brought nature into homes and public spaces. Classic examples include the garden courtyards of the Alhambra in Spain, porcelain fish bowls in ancient China, the aviary in Teotihuacan (ancient Mexico City), bonsai in Japanese homes, papyrus ponds in the homes of Egyptian nobles, the cottage garden in medieval Germany, or the elusive hanging gardens of Babylon (Peters & Schmidt, 2004)..

The consistency of natural themes in historic structures and places suggests that biophilic design is not a new phenomenon; rather, as a field of applied science, it is the codification of history, human intuition and neural sciences showing that connections with nature are vital to maintaining a healthful and vibrant existence as an urban species. Prior to and even after the Industrial Revolution, the vast majority of humans lived an agrarian existence, living much of their lives among nature. American landscape architect Frederick Law Olmsted argued in 1865, that "…the enjoyment of scenery employs the mind without fatigue and yet exercises it, tranquilizes it and yet enlivens it; and thus, through the influence of the mind over the body, gives the effect of refreshing rest and reinvigoration to the whole system" (Olmsted, 1922).

The term 'biophilia' was first coined by social psychologist (Fromm, 1964) and later popularized by biologist Edward Wilson (Wilson, 2017). The sundry denotations which have evolved from within the fields biology and psychology, and been adapted to the fields of neuroscience, endocrinology, architecture and beyond all relate back to the desire for a reconnection with nature and natural system.

2.1 Nature-Design Relationships

Biophilic design can be organized into three categories: Nature in the Space, Natural Analogues, and Nature of the Space, providing a framework for understanding and enabling thoughtful incorporation of a rich diversity of strategies into the built environment (Kellert & Wilson, 1995).

Nature in the Space addresses the direct, physical and ephemeral presence of nature in a space or place. This includes plant life, water and animals, as well as breezes, sounds, scents and other natural elements. The strongest Nature in the Space experiences is achieved through the creation of meaningful, direct connections with these natural

elements, particularly through diversity, movement and multi-sensory interactions (Wilson, 2017).

Natural Analogues addresses organic, non-living and indirect evocations of nature. Objects, materials, colors, shapes, sequences and patterns found in nature, manifest as artwork, ornamentation, furniture, décor, and textiles in the built environment. Mimicry of shells and leaves, furniture with organic shapes, and natural materials that have been processed or extensively altered. The strongest Natural Analogue experiences are achieved by providing information richness in an organized and sometimes evolving manner (Wilson, 2017).

Nature of the Space addresses spatial configurations in nature. This includes our innate and learned desire to be able to see beyond our immediate surroundings, our fascination with the slightly dangerous or unknown; obscured views and revelatory moments; and sometimes even phobia inducing properties when they include a trusted element of safety.

3.0 METHODOLOGY

This research was conducted using a quantitative research method. A descriptive survey design approach was employed, with a structured/closed questionnaire as the main research instrument/tool for data collection. Data analysis was carried out using correlation analysis to explore the relation between application of biophillic design in the built environment and the planning process of residential buildings. The second method of analysis employed was the use of descriptive statistical method i.e. central tendency method, mainly mean and standard deviations. SPSS V21 software was used for all evaluations and analysis.
The respondents' were male and female of not less than 18 years of age. This collection of opinions, views, and perceptions would be achieved through the support of two research assistants or enumerators.

3.1 The population of the study area

The study was conducted at Danjuma Goje street, in Bauchi metropolis. The area is within Jahun ward of Bauchi L.G.A. in Bauchi state. It is considered as one of the most preferred medium density areas recommended for the study. The population/number of houses on the street is estimated at about one hundred and thirty five (135) with an average of 7-10 persons per house hold (researcher's field survey, 2017).

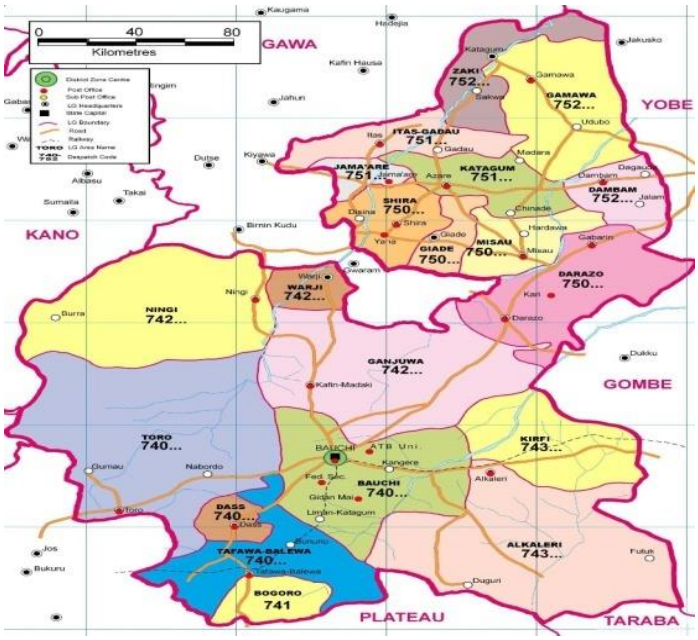


Figure 1: Map of Bauchi state. retrieved from www.google.com/map of Bauchi town. GMT 16:05, 31st July, 2017.



Figure 2: Google earth map showing the study area, Danjuma Goje street, retrieved from www.google.com/map of Bauchi/danjuma goje street. GMT 16:17, 28th August, 2017

The panoramic view of the street makes it a criterion for selection and consideration as the area for the study.

3.2 Sampling method and sample size

The study was conducted using a simple random sampling procedure, so that each member of the population has a chance of being selected. The sample size was determined using Yamane's formula for determining sampling size. Due to complexity of research, Taro Yamane in (Yamane, 1973) give out a simplified formula for determining sample size, it is as follows:

$n= N/1+N (e)^2$, where n is the sample size to be determined, N is the population of the study area, e is the level of precision assumed to be 95% confidence level i.e. 95/100=0.05 using the above formula, the sample size for this study shall be, $n=135/1+135 (0.05)^2$ $=135/1+135x0.0025 = 135/1.3375 = 100.93$ approximately 101 houses

3.3 Data collection instrument

A structured/closed-ended questionnaire was employed. It consists of four sections. The first section capture the respondent's demographic data , section B was set to investigate the preference and understanding of respondents' on the application of biophilic design in the built environment. Section C was set to explore the benefits of biophilic design in the built environment, while section D was preferred to determine the ways for improvement, implementation, orientation and enforcement of applying the use of landscape elements in the architectural design of residential buildings, especially the connection between Architecture and Urban planning. The questions were straight forward and easy for the respondents' to answer. Ambiguity and leading questions were avoided as much as possible. Likert scale was used as a parameter to access the degree of response of each respondents, it was on a range of 1-5. This is to allow for flexibility of response to the lowest level.

4.0 Data Analysis, Presentation and Discussion

Section A of the questionnaire consist of the respondents' background which include sex, profession, age and ownership. All these demographic characteristics have an effect on the application of Biophillic design in the built environment. For instance, the ownership of a property may have an effect as to whether the tenant would think of maintaining the soft landscape features within the surrounding to keep it green or not.

House ownership include personal, rent, free stay for a period and free stay for unspecified period. The table below shows the categories of ownership accordingly.

Table 1: house ownership in the study area

	Frequency	Percent	Valid Percent	Cumulative Percent
PERSONAL	32	37.2	37.6	37.6
LEASE/RENT	19	22.1	22.4	60.0
FREE STAY FOR A PERIOD	7	8.1	8.2	68.2
FREE STAY FOR AN UNSPECIFIED TIME	27	31.4	31.8	100.0

Section B of the measuring instrument coded "PBD" are set of constructs to measure the respondent's understanding and preference on Biophilic design. PBD1 ask the respondents whether if they admire natural features such as trees, shrubs and grasses with water features. 16.3% strongly disagree, 4.7% disagreed, 11.6% were neutral, 18.6% agree and 47.7% almost half of the respondents strongly agree to have natural features within their surroundings.

Table 2: PBD1 Table showing percentages of respondents' opinion

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	14	16.3	16.5	16.5
DISAGREE	4	4.7	4.7	21.2
NEUTRAL	10	11.6	11.8	32.9
AGREE	16	18.6	18.8	51.8
STRONGLY AGREE	41	47.7	48.2	100.0
Total	85	98.8	100.0	

PBD5 seeks the opinion of the respondent on whether Biophillic design should be integrated in the plan of urban centres. 5.8% strongly disagreed, 12.8% disagreed, 9.3% were neutral in their opinion, 27.9% agreed while 40.7% strongly agreed that Biophillic design should be integrated in the plan of urban cities.

Table 3: PBD 5 Frequencies of respondents responses

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	5	5.8	6.0	6.0
DISAGREE	11	12.8	13.3	19.3
NEUTRAL	8	9.3	9.6	28.9
AGREE	24	27.9	28.9	57.8
STRONGLY AGREE	35	40.7	42.2	100.0
Total	83	96.5	100.0	

PBD6 seek the opinion of the respondents on whether Biophilic design has an impact to the built environment. 1.2% strongly disagreed, 7.0% disagreed, 9.3% were neutral in their opinion, 26.7% agreed and 50% strongly agreed that Biophilic design has an effect in the plan of urban centres and the built environment in general.

Table 4: PBD6 Frequencies of responses of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	1	1.2	1.2	1.2
DISAGREE	6	7.0	7.4	8.6
NEUTRAL	8	9.3	9.9	18.5
AGREE	23	26.7	28.4	46.9
STRONGLY AGREE	43	50.0	53.1	100.0
Total	81	94.2	100.0	

Section C coded as “BBD” are constructs that seek to determine and evaluate the benefits of Biophillic design in the built environment.
BBD1 is a construct that seeks the opinion of the respondents on whether human beings do well in the presence of natural environment. 2.3% strongly disagreed, 4.7% disagreed, 3.5% were neutral in their opinion, 23.3% agreed while 65.1% strongly agreed that humans do well in the presence of landscape.

Table 5: BBD1 Frequencies of responses of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	2	2.3	2.4	2.4
DISAGREE	4	4.7	4.7	7.1
NEUTRAL	3	3.5	3.5	10.6
AGREE	20	23.3	23.5	34.1
STRONGLY AGREE	56	65.1	65.9	100.0
Total	85	98.8	100.0	

BBD2 seek to know whether the absence of natural environment affects humans. 7.0% strongly disagreed, 3.5% disagreed, 15.5% were neutral, 34.9% agreed and 38.9% strongly agreed that lack of natural environment adversely affect humans within the surroundings.

Table 6: BBD2 Frequencies of respondents responses

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	6	7.0	7.1	7.1
DISAGREE	3	3.5	3.5	10.6
NEUTRAL	13	15.1	15.3	25.9
AGREE	30	34.9	35.3	61.2
STRONGLY AGREE	33	38.4	38.8	100.0
Total	85	98.8	100.0	

Section 'D' coded as "LGB" are construct that seeks to outline a set of recommendations to improve implement, orientate and enforce laws governing the integration of Biophillic design in the plan of urban centres.

LGB1 seeks to know the opinion of the respondents on whether landscape architects and urban designs be involved in city scaping or urban city landscape. 5.8% strongly disagreed, 2.3% disagreed, 2.3% were neutral in their opinion, 30.2% agreed while 57% strongly agreed with the opinion.

Table 7: LGB1 Frequencies of responses of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	5	5.8	6.0	6.0
DISAGREE	2	2.3	2.4	8.3
NEUTRAL	2	2.3	2.4	10.7
AGREE	26	30.2	31.0	41.7
STRONGLY AGREE	49	57.0	58.3	100.0
Total	84	97.7	100.0	

LGB2 seeks to know the opinion of the respondents on whether landscape architects are to be involved in the design of site plan of residential buildings. 1.2% strongly disagreed, 4.7% disagreed, 9.3% were neutral in their opinion, 40.7% agreed and 41.9% strongly agreed with the opinion.

Table 8: LGB2 Frequencies of responses of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	1	1.2	1.2	1.2
DISAGREE	4	4.7	4.8	6.0
NEUTRAL	8	9.3	9.5	15.5
AGREE	35	40.7	41.7	57.1
STRONGLY AGREE	36	41.9	42.9	100.0
Total	84	97.7	100.0	

LGB3 seeks to know the opinion of the respondents on whether all plans of buildings should be checking landscape plans by the planning authorities. 2.3% strongly disagreed, 2.3% disagreed, 10.5% were neutral in their opinion, 18.6% agreed and 64% strongly agreed with the opinion.

Table 9: LGB3 Frequencies of responses of respondents

	Frequency	Percent	Valid Percent	Cumulative Percent
STRONGLY DISAGREE	2	2.3	2.4	2.4
DISAGREE	2	2.3	2.4	4.8
NEUTRAL	9	10.5	10.7	15.5
AGREE	16	18.6	19.0	34.5
STRONGLY AGREE	55	64.0	65.5	100.0
Total	84	97.7	100.0	

4.0 DISCUSSION AND COMPARISON OF RESULTS

4.1. Landscape Preferences: Greenery vs. Hard Landscape Elements

The finding that residents strongly prefer green spaces and natural vegetation over hard, paved surfaces fits perfectly into the existing literature on urban planning and environmental psychology. In many Nigerian cities, rapid urban growth has led to a "concrete jungle" phenomenon, where natural landscapes are routinely replaced by massive concrete structures and high perimeter walls. The fact that the residents of Danjuma Goje Street would rather have minimal walkways than extensive interlocking pavements highlights a clear community desire to reconnect with nature.

Furthermore, the specific preference for trees over low-lying grasses and shrubs aligns with broader empirical research. In the hot, semi-arid climate of North-Eastern Nigeria, trees provide essential canopy cover and deep shade, which are vital for cooling down neighborhoods and improving the local microclimate. This sentiment mirrors findings by Agboola et al. (2024), whose study on the Nigerian built environment revealed that respondents ranked an "increased connection to nature" as their most critical environmental priority.

4.2. Local Skepticism Toward Water Features

One of the most notable insights from this study is that participants showed little interest in, and even actively resisted, adding water features to their surroundings. This hesitation stems from a very practical fear of mosquito breeding and the associated risk of malaria. In global design frameworks, such as the 14 Patterns of Biophilic Design developed by Browning et al. (2014), water is almost always praised as a primary tool for lowering stress and restoring mental clarity.

However, this international design standard runs into unique local health realities in Sub-Saharan Africa. While Western research highlights the calming effects of water, local studies show that standing or poorly maintained water features in tropical climates quickly become health hazards. This contrast highlights the urgent need for what planners call "context-sensitive strategies", meaning design choices must be tailored to address regional health challenges like malaria rather than blindly copying global trends.

4.3. Health, Well-being, and Psychological Restoration

The widespread agreement among respondents that being around trees and plants lowers stress, clears the mind, and helps people heal supports the core ideas of Biophilic Design Theory and Attention Restoration Theory (ART). On a local level, these findings match recent data from Caleb University in Nigeria, where researchers discovered that neighborhoods with high biophilic elements saw a remarkable 54% drop in psychological distress compared to areas completely stripped of nature.

The mental and physical health benefits noted by the Bauchi residents, especially around stress relief and emotional recovery, are also backed by systematic reviews from Dimuna et al. (2025). These studies confirm that even brief interactions with nature significantly lower cortisol levels, reduce blood pressure, and ease mental fatigue.

4.4. Urban Governance, Institutional Enforcement, and Public Awareness

The community's call for stricter institutional oversight, such as tougher enforcement of building codes, careful vetting of site plans by town planners, and penalties for violators, points to a major missing link in how Nigerian cities are currently managed. Dimuna et al. (2025) pointed out that fewer than 20% of modern residential projects in Nigeria actually include green spaces, largely due to weak enforcement, a lack of awareness among developers, and poor institutional structures.

The residents' suggestion to use media campaigns, radio jingles, and television seminars to educate the public is also highly supported by current research. Built environment scholars consistently argue that turning biophilic design from a nice idea into an actual residential standard requires immediate policy backing, developer incentives, and widespread professional training to shift the focus away from concrete paving toward sustainable green spaces.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

The study demonstrated that application of biophilic design in the plan of urban cities has an impact on health and well-being of humans and other living organisms within the environment as well as improving the aesthetic design and qualities of the built environment. Adverse effects such as solar radiation, sun glare, surface and gully erosion,

thermal comfort, air ventilation and quality, creation of barrier and buffer zone, aesthetics appreciation of the surrounding environment, sense of direction, health and well-being were among other benefits of biophillic design in human environment.

5.1 Recommendations

1. All building plans must include landscape plan before approval by the development control.
2. Health personnel, nursery men and development control to advice on plants that improve health status of human beings within the environment and should have high draught resistance.
3. Water reticulation should form part of the site plan to ease the maintenance and upkeep of the green area.
4. Planning authorizes should encourage the incorporation of sit-out and sitting areas within the green area to ensure optimal benefits.
5. Government should involve professional architects and urban designers in the planning of open spaces and public landscape in cities.
6. Landscape architects and urban designers should be the ones to check submissions for approval in development control offices.
7. All site plans of buildings must be approved by development control offices.
8. A mobile monitoring team consisting of professionals and all stakeholders to monitor compliance by building owners.
9. Fines and sanctions should be imposed by planning authorities for those that fail to comply with the laws.
10. Public seminars and orientation should be organized by stakeholders to enlighten and orient people on the importance of Green Environment and adherence to extant law.

5.2 Acknowledgement

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