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BIOPHILIC URBANISM IN DEVELOPING REGIONS: A SUSTAINABILITY FRAMEWORK FOR BAHRIA TOWN, KARACHI

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Abstract:

Urbanization in developing nations has accelerated construction activities, often creating adverse effects on environmental quality and human well-being. This research explores how integrating biophilic design principles with stakeholder engagement can foster sustainable construction practices, particularly in Karachi, Pakistan. The study critically examines the biophilia hypothesis, stakeholder theory, and sustainable stakeholder value creation frameworks, resulting in the development of an inclusive sustainability model that integrates environmental, economic, and social benefits. Using Bahria Town, Karachi as a case study, surveys were conducted to understand stakeholder perceptions, identify barriers, and evaluate the feasibility of biophilic design implementation in urban development. The findings emphasize the necessity of inclusive, multi-stakeholder collaboration and policy support to realize sustainable urban development. The proposed framework offers practical recommendations for policymakers, developers, and urban planners, positioning biophilic design as a viable strategy to achieve resilient, eco-friendly, and health-enhancing urban environments in developing regions.

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Biophilic Urbanism, Developing Regions, Stakeholder Engagement, Sustainable Construction, Urban Development.

Introduction

Urbanization in developing regions has accelerated at an unprecedented pace, driven by population growth, economic expansion, and increasing demand for housing and infrastructure. While this growth contributes to economic development, it often occurs at the expense of environmental sustainability, ecological balance, and human well-being (UN-Habitat, 2020; World Bank, 2023). Cities in the Global South, including Karachi, Pakistan, face mounting challenges such as the loss of green spaces, urban heat island effects, air pollution, and declining quality of life for residents (Rana et al., 2021; Qureshi et al., 2022).

Biophilic urbanism, derived from the biophilia hypothesis, emphasizes the innate human affinity for nature and advocates for integrating natural elements into the built environment to enhance both ecological performance and human well-being (Kellert et al., 2019; Beatley, 2021). Empirical studies have demonstrated that biophilic design contributes to improved psychological well-being, reduced stress, enhanced environmental quality, and greater urban resilience (Browning et al., 2020; Xue et al., 2023). Despite these documented benefits, the majority of biophilic urbanism research and implementation frameworks remain concentrated in developed countries, with limited contextual adaptation for developing regions where socio-economic constraints, governance limitations, and stakeholder dynamics differ significantly (Sharifi et al., 2021; Zari & Hecht, 2024).

This study aims to bridge this gap by examining how biophilic design principles can be integrated into urban development within a developing-country context through inclusive stakeholder participation. The primary objectives are to (i) assess stakeholder perceptions of biophilic urbanism, (ii) identify barriers and enablers to its implementation, and (iii) develop a sustainability framework that aligns environmental, social, and economic outcomes. Bahria Town, Karachi was selected as a representative case due to its scale, planned urban structure, and growing influence on contemporary urban development trends in Pakistan (Mahmood & Rana, 2020; Khan et al., 2023).

Despite biophilic urbanism being the topic of great academic interest in the last ten years, the current literature is not only geographically focused but also conceptually divided. Recent empirical studies have largely focused on psychological wellbeing, environmental performance or design typologies in the context of developed countries (Sharifi et al., 2021; Xue et al., 2023; Zari & Hecht, 2024). Although these studies demonstrate the environmental and human-health

applicability of biophilic settings, seldom do they combine the stakeholder governance mechanisms or quantify the sustainability results as a single analytical perspective.

At the same time, the studies of sustainability in developing areas have focused on regulatory obstacles, urban heat islands, and performance indicators of green infrastructure (Rana et al., 2021; Qureshi et al., 2022; Khan et al., 2023). Nevertheless, there is a lack of research on the intervening influence of perception of stakeholders and their involvement in the translation of biophilic design intentions into the quantifiable environmental, economic, and social sustainability goals in large-scale residential developments.

This conceptual misalignment of the biophilic theory with stakeholder governance and empirically tested, sustainability performance has evoked one important research gap: not empirically tested, stakeholder-mediated biophilic sustainability model is tested in an urban setting, in a developing country.

Literature Review

The high rate of urbanization in developing countries has triggered an increase in the construction process, which in most cases has compromised environmental sustainability and human life. The challenges faced by urban centres like Karachi are rising, and they comprise loss of green space, urban heat islands, widespread environmental pollution and an objective fall in the quality of life. The conventional forms of urban development have failed to address these complex issues, and the need to adopt alternative formats of planning and designing has become inevitable.

Biophilic urbanism, which is an established concept based on the biophilia hypothesis, highlights the innate human relationship with nature and encourages the inclusion of natural elements within the built environment to enhance the ecological performance and human well-being (Kellert et al., 2008; Beatley, 2011). It is based on the empirical evidence that the biophilic environments have positive impacts on mental health, thermoregulatory comfort, and social cohesion (Ulrich et al., 1991; Gehl, 2010). With the above benefits, there is still limited adoption of biophilic principles in the developing countries, mainly because of institutional, economic and governance barriers.

The beneficial effects of biophilic environments on human health and well-being have always been proven with the help of empirical data. Initial experimental research demonstrated that a view of nature has a negative effect on stress and speeding up the psychological recovery (Ulrich et al., 1991). Later studies established that exposure to greenery, natural light and ventilation enhance the mental health, cognition and general quality of life especially in residential contexts of dense urban areas (Kaplan and Kaplan, 2011; Houlden et al, 2019; Bratman et al, 2021). Moreover, biophilic landscapes promote social engagement and community integration, enhancing social sustainability in residential communities (Gehl, 2010; Rashid et al., 2022).

On top of well-being, biophilic design directly leads to sustainability results in terms of environmental, economic, and social aspects. Biophilic strategies reduce the effects of urban heat islands, clean the air, and cut down energy use through passive design elements (Gomez-Baggethun and Barton, 2019; Sharifi et al., 2024). Economically, research shows that biophilic housing projects are linked to higher property prices, a better market response, and saved

operational costs in the long term (Zhang et al., 2020; Global Wellness Institute, 2024). The development, in social terms, facilitates healthier living patterns, place attachment, and extended residential contentment, which strengthens the sustainability of urban communities (Mousapour&Makaremi, 2023).

Nevertheless, in spite of this advantages, biophilic design is not popular in developing nations. Barriers to much more widespread implementation are institutional and regulatory (such as poor policy frameworks, absence of biophilic standards, and insufficient enforcement systems) (Sharifi and Yamagata, 2021). The high cost of implementation and the unpredictability of gross economic benefits in the long term make incorporating biophilic elements even less viable to developers due to economic limitations (Zhang et al., 2020). Also, the problem of the lack of technical expertise and low knowledge of the stakeholders can decrease the possibility of applying biophilic approaches to local situations (Mousapour, 2023; Qureshi et al., 2021).

The stakeholder theory offers a serious perspective in the context of these issues of implementations. Freeman (1984) also observes that achievement of sustainable development requires the effective participation of various stakeholders, such as the developers, residents, planners, and policymakers. As demonstrated in recent studies, there is a mediating role of stakeholder engagement between sustainability-oriented design intentions and the real outcomes of a project by increasing collaboration, resource allocation, and acceptance of innovative approaches (Reed et al., 2018; Jha, 2024). The stakeholder engagement is especially relevant in the framework of biophilic urbanism, since the market demand, preferences of residents, and institutional support have a critical impact on the decision to adopt (Khanzadeh et al., 2024; FCIQ, 2025).

Although there is an increasing concern about the relevance of urban biophilic design perception in relation to urban sustainability, empirical research on the overall effectiveness of the perception of urban biophilic design and stakeholder involvement in the sustainability outcome in developing countries, and especially in Pakistan, is limited. To fill this gap, the current paper puts forward and empirically attempts to validate a sustainability model that includes biophilic urbanism and stakeholder participation within a residential context. Based on the case study of Bahria Town, Karachi, the study examines the effects of perception of biophilic design on sustainability performance by involving the stakeholders.

Conceptual Framework

The conceptual framework of the study is depicted in figure 1 and it describes the relationships of biophilic design perception, stakeholder engagement and sustainability outcomes of residential developments.

Within the proposed framework, the biophilic design perception is the independent variable and thus, this variable is conceptualized by depicting the level of awareness, valuation, and understanding of using natural elements in residential setups among the stakeholders. It is hypothetically expected that this perception itself has a direct effect on the sustainability outcomes, including environmental, economic and social benefits, including positive environmental quality, cost efficiency in the long-term, and better quality of life.

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The framework also provides the stakeholder engagement argument as a mediating variable, in explaining the translation of biophilic design perception into the sustainability results. Stakeholder involvement defines the degree of collaboration, involvement, market sensitivity and involvement in decision making between developers and residents. The hypothesis is that an increased degree of stakeholder engagement enhances the success of biophilic design implementation, therefore, improving the level of sustainability.

Also, the framework recognizes that contextual challenges exist that can affect the intensity of these relationships such as institutional, economic, technical and awareness-based barriers. Although these issues are not represented as a key factor of causality, they form a significant contextual framework through which the viability and success of biophilic urbanism in developing nations can be understood.

In general, the conceptual framework represents a combined strategy where the biophilic design perception affects the sustainability outcomes directly and indirectly as a result of the stakeholder involvement providing a detailed explanation of how biophilic urbanism can be implemented into the residential development in Karachi.

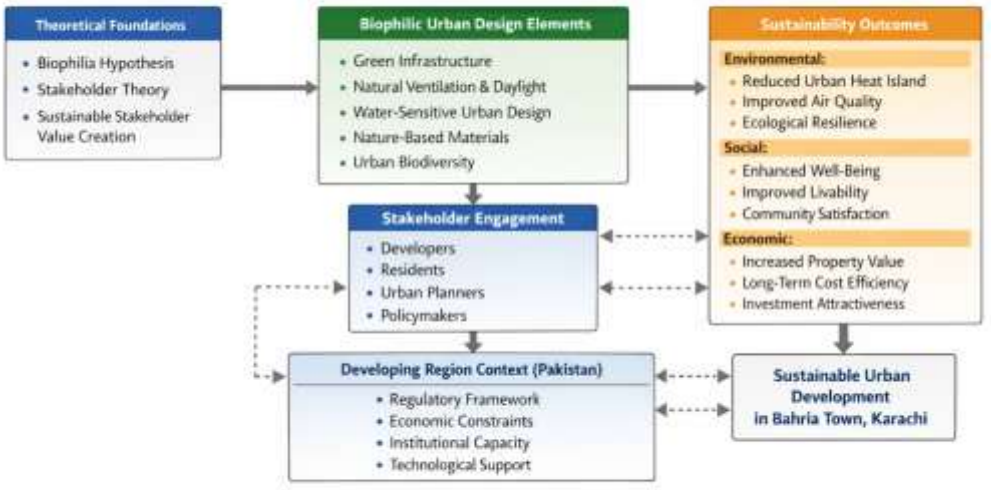

Figure 1. *Conceptual framework illustrating the integration of biophilic urban design principles and stakeholder engagement to achieve environmental, social, and economic sustainability outcomes in developing urban contexts.*

Figure 1. Model Of Factors Influencing Entrepreneurial Intention: Relationship Between RBV Resources and TBP Structure

Methodology

The design of the study adopted quantitative cross-sectional case-study design to explore interrelationships between biophilic design perception, stakeholder engagement, and sustainability in a massive residential development setup. The primary data were collected using a structured questionnaire that was given to important stakeholder groups which were the developers, planners, consultants and inhabitants of Bahria town, Karachi. The questionnaire was carefully designed on the principles of the biophilia hypothesis, stakeholder theory, and the triple bottom line sustainability model.

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A structured questionnaire survey was employed to collect primary data from key stakeholder groups involved in Bahria Town, Karachi, including developers, residents, consultants, and urban planning professionals. The valid responses were total300 with 150 developers and 150 residents. The purposive sampling was used in order to have the stakeholders who are directly interested in the residential planning, development, and occupancy represented. The self-administered questionnaires were used to collect data with a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Any responses that were incomplete and inconsistent were filtered out before analysis. All questionnaires that were not filled in were not kept. The survey instrument was developed based on established biophilic design indicators, stakeholder engagement literature, and sustainability assessment frameworks.

The questions used in the questionnaire were modified out of the known biophilic design indicators, literature on stakeholder engagement, and sustainability assessment models (Kellert et al., 2019-2018; Elkington, 1997-1984).

The questionnaire comprised four sections: demographic information, awareness and perception of biophilic design, perceived benefits and challenges, and feasibility of implementation strategies. A purposive sampling technique was applied to ensure representation of relevant stakeholder categories. Data were analysed using descriptive statistics and exploratory factor analysis (EFA) to identify dominant challenge dimensions and stakeholder priorities.

These results indicate that there is good internal consistency and convergent validity of the measurement constructs that can be used to affirm the strength of the proposed analytical framework.

Ethical considerations were addressed by ensuring voluntary participation, informed consent, and confidentiality of respondents' identities. The methodological approach enabled the systematic evaluation of stakeholder-driven sustainability challenges and opportunities associated with biophilic urbanism in a developing urban context.

Analysis of data included descriptive statistics to rank perceived challenges then exploratory factor analysis (EFA) on SPSS. EFA was done to reveal latent constructs that lie behind the biophilic design, stakeholder engagement, and sustainability outcomes. Kaiser Meyer Olkin (KMO) and Bartlett Test of Sphericity were used to ensure that data was suitable when doing a factor analysis. Principal Component Analysis with Varimax rotation was utilized where factors that have eigenvalues of 1 or above and factor loadings of 0.50 or above are retained (Hair et al., 2019; Pallant, 2020).

Results And Discussion

The results show that there is a good degree of stakeholder consciousness about the environmental and well-being advantages of biophilic design and especially among the residents and urban professionals. The respondents had a strong linkage of biophilic features to better thermal comfort, better mental health, and higher property value. The findings indicate measurable connection among biophilic design perception and sustainability outcomes within the study context. Nevertheless, developers were worried about the high cost of initial implementation, regulatory uncertainty, and technical inadequate guidelines.

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Table 1. Demographic Respondent Characteristics.

Variable	Category	Frequency (n)	Percentage (%)
Stakeholder Group	Residents	150	50
	Developers	150	50
Gender	Male	192	64
	Female	108	36
Age Group (Years)	18–30	86	28.7
	31–40	104	34.7
	41–50	72	24
	Above 50	38	12.6
Education Level	Bachelor's	112	37.3
	Master's	138	46
	Doctorate	50	16.7

Table 1 provides the demographic profile of the respondents and assures the balance of the representation of the various categories of stakeholders. The sample was balanced with residents and developers (150 each), implying that all points of view were comparable. In general, the demographic picture shows that there is sufficient diversity in gender, age, and education, which contributes to the strengthening of the generalizability of the findings to the stakeholder population under consideration. Such profile justifies the suitability of purposive sampling as one that will be able to gather opinions based on groups that are directly involved in residential planning, development, and lived experience.

Table 2. Descriptive Analysis for Each Construct

Item Code	Statement	Mean	Std. Deviation
AWP1	Awareness of biophilic design principles	3.92	0.86
AWP2	Understanding of nature–wellbeing link	4.1	0.78
AWP3	Familiarity with biophilic elements in housing	3.74	0.91
AWP4	Perceived importance in urban housing	4.21	0.72

The descriptive statistics of the awareness and perception items that are measured using five-point Likert scale are shown in Table 2. The averages indicate that the respondents were moderately-highly aware of biophilic design and had positive perceptions of the design. This finding aligns with the recent literature that documents the growing awareness of nature

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integrated design as an approach to improve the wellbeing of urban living and the quality of the environment (Browning et al., 2020; Xue et al., 2023).

The products connected to perceived significance in urban housing and the knowledge of the nature-wellbeing relationship ranked the highest, which meant that the stakeholders are overall aware of the applicability of biophilic principles to enhance the quality of residential places. The comparatively less (but still significant) means of familiarity with particular biophilic elements suggest the possibility of a stronger conceptual acceptance than technical knowledge, which results in a possible necessity of a specific dissemination and training.

The findings also indicate that the stakeholders tend to accept the association between natural environments and psychological wellbeing which are consistent with previous empirical evidence to demonstrate the restorative benefits of nature in built settings (Ulrich et al., 1991; Kaplan and Kaplan, 2011).

The exploratory factor analysis found out that there were four main dimensions of challenges including institutional and policy constraints, economic feasibility, technical capacity, and stakeholder coordination. Among them, institutional barriers (deficiency of supportive regulations in planning and absence of biophilic standards) proved to be the greatest challenges. These conclusions demonstrate the importance of integration and governance of the policy to mainstream biophilic urbanism.

Table 3. Benefits of Biophilic Design as Perceived

Item Code	Benefit Statement	Mean	Rank
PB1	Improved mental wellbeing	4.34	1
PB2	Enhanced environmental quality	4.18	2
PB3	Increased residential satisfaction	4.05	3
PB4	Better thermal and visual comfort	3.96	4
PB5	Strengthened social interaction	3.81	5

The perceived benefits were rated as strongly overall as it is demonstrated in Table 3, with the mean scores presenting general agreement regarding biophilic design in addition to residential settings. The most preferred outcome was better mental wellbeing, which indicated the focus of the stakeholders on health and psychological outcomes. The quality of environment and residential satisfaction was also the top priority, which indicates that the respondents associate biophilic approaches to an improvement of the ecology, as well as to an experience of the user. The order of ranking implies that both human oriented and environmental performance results are valued by the stakeholders, and this supports the idea behind the promotion of biophilic housing in urban settings.

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Table 4. Arguments against Biophilic Design Implementation.

Item Code	Challenge Statement	Mean	Std. Deviation
CH1	High initial construction cost	4.29	0.81
CH2	Lack of policy and regulatory support	4.15	0.85
CH3	Limited professional expertise	3.98	0.89
CH4	Maintenance concerns	3.87	0.93
CH5	Limited stakeholder awareness	3.76	0.97

Table 4 displays the statistics of perceived implementation challenges. Although there are encouraging views about biophilic advantages, the results indicate that there are numerous obstacles to adoption. The most severe limitation was a high startup cost of building and the lack of regulatory backing. The results can be related to the prior research that has shown that financial constraints and ineffective policy frameworks tend to slow down the implementation of sustainable designs in developing nations (Sharifi and Yamagata, 2021; Zhang et al., 2020). Moreover, professional knowledge and maintenance issues were also found to be limited and were also cited as an issue and indicated that institutional capacity and technical knowledge are still critical issues that can determine whether biophilic implementation is viable. Much the same obstacles have been noted in studies of sustainable urban development in cities with high growth rates (Qureshi et al., 2022; Khan et al., 2023).

Table 5. Test of Sphericity (EFA Suitability) KMO and Bartlett.

Test	Value
Kaiser–Meyer–Olkin (KMO) Measure	0.812
Bartlett's Test of Sphericity (χ^2)	1246.32
Degrees of Freedom	120
Significance (p-value)	0.000

As reflected in table 6, the data used is apt in studying using exploratory factor analysis. The KMO value is greater than the standard level of the adequacy of sampling, which means that the correlations between the items are too close to yield reliable factors. The test of the sphericity conducted by Bartlett is significant ($p < 0.001$), and this proves the correlation matrix is not an identity matrix, and meaningful latent dimensions can be extracted. All these tests combined warrant EFA to establish main areas of challenge and patterns of priority among the stakeholders.

Table 6. Rotated Component Matrix (EFA Factor Structure)

Challenge Items	Factor 1Economic & Policy	Factor 2Technical Capacity	Factor 3Social Awareness
CH1	0.821	—	—
CH2	0.794	—	—
CH3	—	0.812	—
CH4	—	0.776	—
CH5	—	—	0.834
CH6	—	—	0.801

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Table 7 indicates the rotated component matrix (Varimax), which states that the challenge items are meaningful when loaded on different factors. The exploratory factor analysis showed that there are three main dimensions of the challenges of the implementation: economic and policy constraints, technical capacity and social awareness barriers. This framework means that impediments to biophilic adoption are not unidimensional and confined to the disposition of the individual stakeholders. Past research also highlighted that the effective implementation of urban design based on nature presupposes the supportive governance frameworks, professional knowledge, and population awareness (Sharifi et al., 2021; Beatley, 2021). Thus, the findings indicate that mainstreaming biophilic urbanism in developing urban environments is necessary, which can be achieved by addressing policy and institutional factors.

Conclusion

This paper has shown that biophilic urbanism has a lot of potential as a sustainability-based urban development in developing areas. The case study based on Bahria Town, Karachi confirms that the biophilic principles have strong stakeholder support and exposes the critical barriers to implementation based on the policy, economic, and governance. The suggested sustainability model incorporates the three aspects of environment, social and economic aspects with involvement of stakeholders to provide a context sensitive approach to sustainable urban development.

The study has limitations in that it is based on self-reporting survey data and uses a single case study even though it has made its contribution. To further confirm the framework, future studies can use longitudinal measures and compare and contrast case studies as well as performance-based environmental measures.

Contribution And Practical Implications

This research contributes to the body of knowledge in three important aspects: Theoretical contribution, methodological contribution, and practical Contribution

Theoretical Contribution

This research work adds value to the literature that has been done by combining the biophilia hypothesis, stakeholder theory and the triple bottom line sustainability framework into the same analytical model. Although the environmental and psychological benefits of biophilic design are already investigated by the previous research, most of them consider stakeholder governance and the sustainability results as independent fields. The introduction of stakeholder perception as a mediating variable makes this study a more holistic exposition of the way through which biophilic design awareness can be translated as a sustainability-related outcome of residential developments. Moreover, the paper extends the research of biophilic urbanism to the context of developing countries, as existing empirical sources on the topic are geographically biased, being located predominantly in developed areas.

Methodological Contribution

As a methodological contribution, this study will be useful in its contribution to the application of a quantitative stakeholder-based assessment framework to assess the plausibility of biophilic design implementation in a massive residential development. The study integrates descriptive

statistics, exploratory factor analysis (EFA)and SPSS-based exploratory factor analysis gives a systematic method to consider sustainability-related perceptions in construction research. The methodological framework provides a repeatable method of analysis that could be utilized in other studies on sustainable urban development and stakeholder involvement in other developing urban settings.

Practical Implications

Practically, the findings will provide evidence-based information to the urban planners, developers, and policymakers engaged in residential development. The findings indicate that although the stakeholders are aware of the positive environmental and well-being impacts of the biophilic design, the barriers to implementation still belong to policy support, economic viability, and technical capacity. To overcome these obstacles, the regulatory frameworks, the professional knowledge, and stakeholder understanding of the long-term worth of biophilic design should be enhanced. As a result, the study creates a reference framework that can be used to shape the policy development, planning policies, and sustainable construction strategies to improve the quality and liveability of rapidly rising cities.

The findings prove that biophilia sustainability in developing areas is not merely a design problem but also an inherent governance and coordination is a stakeholder challenge.

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Author Contribution Statement:	Qurat-ul-ain Anwar conceptualized the study and supervised the research methodology. Wan Azlina Wan Ismail contributed to the research design and theoretical framework. Shardy Bin Abdullah assisted in data analysis and interpretation. Tamkeena Aftab supported manuscript drafting and literature synthesis. All authors reviewed and approved the final version of the manuscript.

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