

RECONNECTING WITH NATURE: THE IMPACT OF BIOPHILIC DESIGNS ON SUSTAINABILITY IN MODERN OFFICE BUILDINGS

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ABSTRACT

Biophilic design is an approach in the built environment that aims to reconnect people to nature through architectural and design strategies. This systematic review examines the environmental, social, and economic impacts of biophilic design, investigating how it advances sustainability in modern office buildings. Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology, the paper systematically analysed peer-reviewed literature published over the past decade to identify prevailing practices and benefits in the integration of biophilic attributes in sustainability development. The review finds that biophilic design enhances environmental sustainability by improving energy performance and indoor environmental quality, promotes social sustainability through enhanced occupant well-being and productivity, and improves economic sustainability through long-term cost savings and increased property value. Therefore, based on the findings acquired, this study recommends the development of a framework to guide the integration of biophilic design into sustainable building practice in the office sector.

Keywords: Attributes, Biophilic Design, Economics, Environmental, Social, Sustainability

INTRODUCTION

The term *biophilia* originates from the Greek words for “life-loving” and was popularised by Edward O. Wilson, who described it as humans’ innate connection to nature and their biological dependence on the natural world (Wilson E. O, 1984). Building on this concept, biophilic design seeks to reestablish this bond within the built environment by integrating natural elements and processes into spaces where people live and work (Kellert, 2018; Asim, Rai and Shree, 2021). Kellert (2018) emphasised that biophilic design benefits not only individuals but also the built environment by harmonising human activity with natural systems.

The built environment encompasses human-made settings such as cities, offices, and homes where daily life occurs (Yassein and Ebrahiem, 2018). Within these spaces, biophilic design has gained attention as an innovative approach to enhance well-being and performance by fostering connections with nature (Yassein and Ebrahiem, 2018). Many modern office buildings now incorporate biophilic features such as natural light, indoor greenery, fresh air circulation, and access to outdoor spaces (Elnaggar, 2023). These interventions have been shown to reduce stress, depression, and mental fatigue, while improving overall mental health (Sadick and Kamardeen, 2020; Zhang *et al.*, 2024). Furthermore, studies have highlighted that biophilic design enhances cognitive performance, reduces work-related stress, and supports employee productivity (Zhang *et al.*, 2024). Beyond individual benefits, such outcomes can translate into organisational gains, including increased productivity, reduced healthcare costs, and improved staff retention (Barnaby, et al. 2023) . As Kellert S.R & Calabrese E.F (2015) explain, biophilic design serves as a scientifically supported strategy for organisational growth by creating healthier workplaces.

Beyond its human-centric advantages, biophilic design also contributes to creating healthier and more sustainable buildings. Cacique & Ou (2022) noted that it plays a key role in promoting energy efficiency, improving air quality, and conserving resources. Sustainability itself involves preserving the natural environment to ensure the well-being of both current and future generations (Jeronen 2013).It encompasses reducing resource consumption, encouraging recycling, and improving community living standards (Ribeiro *et al.*, 2016). With the building industry accounting for a significant share of global energy consumption, carbon emissions, and resource utilisation (Min *et al.*, 2022), the integration of sustainable design principles has become increasingly urgent. Yet, many office buildings prioritise technological efficiency and visual appeal over long-term sustainability and occupant health (Elnaggar H.B, 2023).

In this context, biophilic design emerges as a practical solution that addresses both environmental and human needs (Alipour & Khoramian, 2023). While existing research has established its positive effects on employee well-being and performance, there is comparatively less focus on its contribution to the three pillars of sustainability: environmental, social, and economic. This paper aims to address this gap by examining how biophilic design can enhance sustainability in modern office buildings, identifying the benefits and opportunities for integrating natural design strategies into sustainable development, and recommending the development of a comprehensive framework to guide the integration of biophilic design into sustainable building practices in the office sector.

According to this study, the research questions are:

- How can biophilic design help improve sustainability in modern office buildings across environmental, social, and economic aspects?
- What opportunities and benefits can be identified for integrating biophilic design strategies into sustainable building practices, and how can a comprehensive framework guide this integration in the office sector?

LITERATURE REVIEW

Introduction to Biophilic Design

The term *biophilia* translates to “love of life” and is derived from the ancient Greek words *bios* (life) and *philia* (love) (Barbiero and Berto, 2021). The concept was first introduced by social psychologist Erich Fromm in 1964, who described it as the “love of life” and linked it to two fundamental human tendencies: preserving life in the face of threats and fostering positive integration with others (Fromm, E, 1964). Building on this foundation, the biophilia hypothesis was later popularised by Wilson E. O (1986), who emphasised humans’ innate tendency to seek connections with nature as part of their evolutionary development.

The application of this concept within the built environment gave rise to *biophilic design*, which was formally articulated in the early twenty-first century as a response to the psychological and physiological need for human-nature interaction in modern architecture (Kellert, 2018; Zhong, Schröder and Bekkering, 2022). According to Kellert (2018), biophilic design represents a deliberate effort to enhance physical and mental health, improve productivity, and fulfil the human need for contact with natural systems and processes. Similarly, Zhong et al. (2022) highlight that biophilic design promotes optimal health outcomes by shaping architectural and planning decisions based on the appreciation of nature and measurable biological responses.

In addition to its health and well-being benefits, biophilic design is recognised as a strategy that fosters constructive human-nature interactions and improves the quality of the built environment (Kellert S.R., Heerwagen J, & Mador M, 2008). To operationalise these ideas, Kellert, S.R., and Calabrese, E.F. (2015) proposed a set of guiding principles and attributes for biophilic design, which serve as practical frameworks for integrating natural patterns, elements, and processes into architectural and interior design. These principles continue to guide contemporary approaches to designing workplaces, homes, and public spaces that reconnect people with nature in meaningful ways.

Biophilic design is generally divided into three main categories: direct experience of nature, indirect experience of nature, and experience of space and place. Under these three categories, 24 attributes are included. (Kellert S.R. & Calabrese E.F., 2015). These categories are shown in Table 01 below.

Table 1: Attributes of biophilic design

Direct experience of nature	Indirect experience of nature	Experience of space and place
Nature light	Images of nature	Prospect and refuge

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Natural air	Natural materials	Organized complexity
Water	Natural colours	Integration of parts to whole
Plants	Simulating natural light and air	Transitional spaces
Animals	Naturalistic shapes and forms	Mobility and wayfinding
Weather	Evoking nature	Cultural and ecological attachment to place
Natural landscapes and ecosystem	Information richness	
Fire	Age, change and patina of time	
	Natural geometries	
	Biomimicry	

Source- (Kellert S.R and Calabrese E.F, 2015)

Incorporating Biophilic Design into the Built Environment

The integration of biophilic design into the built environment has accelerated significantly as designers and architects value the importance of reconnecting occupants with nature in urban landscapes(Kellert S.R. & Calabrese E.F., 2015). Modern architecture increasingly includes biophilic features not only for aesthetics but also because they can enhance occupant health, performance, and environmental sustainability(Browning, Ryan and Clancy, 2014). Applications of biophilic design vary according to building type, with residential uses focused on natural ventilation, daylight, and garden environments to provide comfort and relaxation (Kellert S.R., Heerwagen J, & Mador M, 2008). For schools, biophilic strategies like green courtyards, outdoor classrooms, and nature views have been shown to improve learning and concentration (Gillis & Gatersleben, 2015). Similarly, healthcare environments are also catered to by design features such as healing gardens, indoor plants, and natural light exposure, which enhance quicker recovery of patients and reduce stress among patients and staff (Zhao et al.2022)

In office building environments, biophilic design has become especially relevant due to the long hours employees spend indoors and the need for more sustainable, human-centred workplaces(Mason, 2021).

Key strategies include the generous use of natural light through large windows and skylights, proper ventilation via fresh air systems, and the incorporation of indoor plants, such as living walls and potted plants (Browning, Ryan, and Clancy, 2014; Ryan and Browning, 2020). The use of natural materials like wood and stone, combined with visual and physical access to the outdoors, further enhances employees' sense of connection with nature (Kellert S.R. & Calabrese E.F., 2015). These measures, in addition to improving workplace aesthetics, also reduce energy consumption, improve indoor air quality, and increase productivity and satisfaction among building occupants (Zhang *et al.*, 2024). For example, Biophilic design is gaining popularity in modern office spaces, exemplified by projects like the Amazon Spheres in Seattle(Amazon's Urban Conservatory, 2025). These structures feature over 40,000 plants from around the world, housed in large glass biomes, giving employees direct access to nature(Amazon's Urban Conservatory, 2025). This approach significantly boosts restoration, creativity, and collaboration among workers, demonstrating how integrating

natural elements benefits sustainability and occupant well-being (Amazon's Urban Conservatory, 2025). Likewise, the Bosco Verticale office complex in Milan showcases façade-integrated vegetation that lowers energy demands, boosts microclimate quality, and promotes biodiversity, all while offering employees refreshing green views (Stefano Boeri Architetti, 2025). Another example is the Apple park, California which uses daylighting, natural ventilation, timber materials, and landscaped atria to promote health, comfort, and sustainability for biophilic design (Foster Paterns, 2025). These examples show that biophilic design is more than just a theory; it is already effectively used in modern workplaces to improve environmental, social, and economic sustainability results.

METHODOLOGY

This study used the Systematic Literature Review Methodology (SLRM) to analyse existing research and explore how biophilic design influences sustainability in modern office buildings. The SLRM approach offers benefits, including identifying pertinent literature, highlighting knowledge gaps for future study, and ensuring a transparent, reproducible, and scientific process.

The review adhered to the PRISMA guideline to ensure thoroughness and clarity. Initially, literature on the impact of biophilic design on sustainability in modern office buildings was collected from one central database: Scopus, known for its extensive coverage of peer-reviewed research. A structured combination of keywords was used to identify relevant publications, focusing the search on titles, abstracts, and keywords only. The search string used in this study was as follows:

TITLE-ABS-KEY (("biophilic design" OR "biophilia" OR "nature-inspired design" OR "nature integration" OR "biophilic architecture") AND ("sustainability" OR "sustainable development" OR "environmental sustainability" OR "social sustainability" OR "economic sustainability" OR "triple bottom line" OR "TBL" OR "environmental impact" OR "social impact" OR "economic impact") AND ("modern office building" OR "office buildings" OR "office facilities" OR "workplace design" OR "corporate offices" OR "work environments"))).

To maintain a clear focus on modern office buildings, the search strategy was framed using a structured process based on three keyword clusters: (1) biophilic design terminology, (2) sustainability concepts, and (3) office-building-related terms. This clustering ensured that only studies situated at the intersection of biophilic design and sustainability in workplace contexts were captured. All retrieved articles underwent a two-stage screening process. First, titles and abstracts were reviewed to exclude papers centred on residential, educational, healthcare, or other non-office environments. Second, full-text screening verified that each study addressed biophilic design principles within office or workplace settings. The selected articles were then organised thematically according to the three sustainability dimensions such as environmental, social, and economic to align with the aims of the review. This structured approach ensured that the final dataset was directly relevant to biophilic applications in modern office buildings and enabled a focused and coherent analysis of their impacts and benefits.

Figure 1 shows the PRISMA guideline-based SLRM procedure. According to the figure, the initial search retrieved 117 papers from the Scopus databases. After eliminating duplicates, 114 articles remained for title and abstract review. Each was evaluated using specific inclusion and exclusion criteria, focusing solely on peer-reviewed English-language journal articles published from 2015 to 2025. This process narrowed the selection to 48 articles for further assessment. Ultimately, after examining the full texts for relevance and applicability, 48 articles were chosen for detailed analysis.

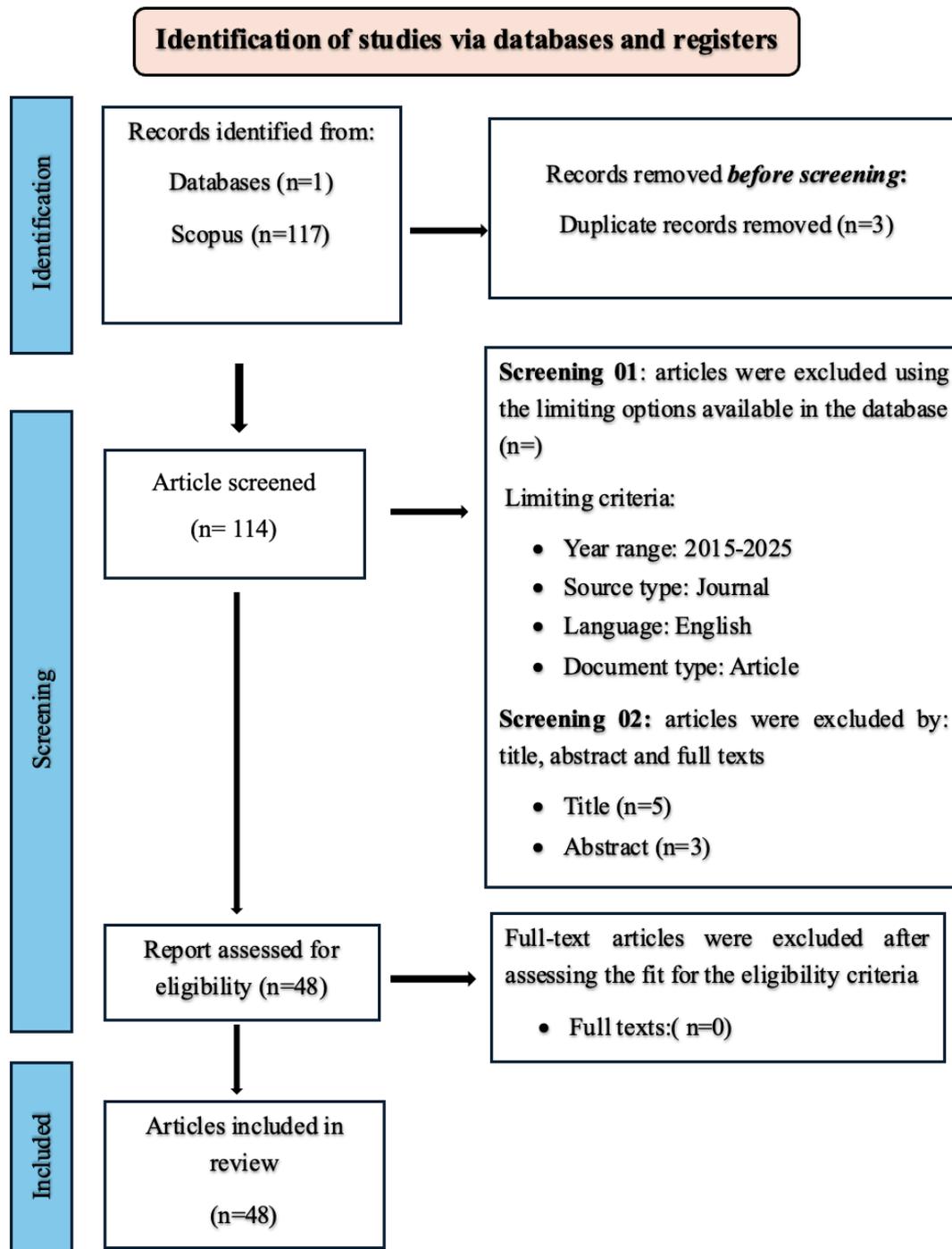


Figure 1: Prisma guideline-based SLRM Procedure
 Source: Li et al., 2022)

To address the two research questions examining the current state of research and assessing the impact of biophilic design on sustainability in modern office buildings, the collected data were systematically analysed

and synthesised to identify recurring themes, strategies, and gaps in the literature. Two complementary methods were employed: thematic analysis and bibliometric analysis using VOS viewer. Bibliometric techniques, including keyword co-occurrence networks and other mapping approaches, were used to generate and visualise research clusters, enabling the identification of influential articles and emerging topics within the field. Thematic analysis was subsequently applied to observe, interpret, and report key patterns and themes that emerged from the data. Together, these methods offered a comprehensive overview of the research landscape and provided more profound insights into the role and impact of biophilic design in advancing sustainability within modern office buildings.

RESULTS

Current state of research

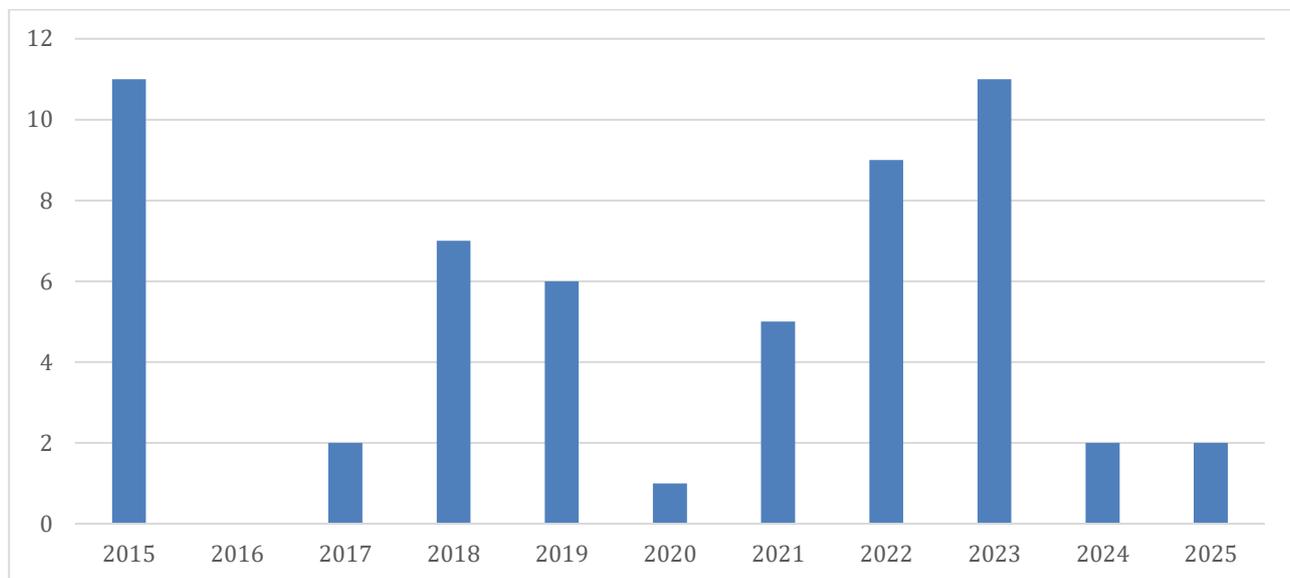


Figure 2: Trendline publication Year

The publishing trend regarding the impact of biophilic design on sustainability in modern office buildings has generally been increasing over the past decade, with fluctuations. The distribution of publications over the years emphasises a growing research interest in the topic, especially in recent years. The earliest relevant studies in this review date back to 2015, with only one publication, followed by minimal contributions between 2016 (no articles) and 2018 (one article). From 2019 onwards, however, a gradual increase is evident, with occasional fluctuations. Notably, the period from 2020 to 2023 demonstrates consistent contributions, ranging from four to seven publications each year, indicating a growing focus within the research community. The most notable growth appears in 2024 and 2025, with ten and nine publications respectively, marking the peak of scholarly focus to date. This pattern indicates that the research field is recent, gaining momentum particularly over the past five years, and is expected to continue attracting further academic interest in the future.

Table 2: Major sources of Publication

Journal name	Number of articles	Reference
Sustainability (Switzerland)	4	(Calvagna, 2020; Brand and Augustin, 2021; Butt and Dimitrijević, 2022; Asojo and Hazazi, 2025)

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Buildings	3	(Mehaffy, 2020; Whyte <i>et al.</i> , 2024; Bressane and de Castro, 2025)
Building and environment	3	(Bergefurt <i>et al.</i> , 2022; Lyu <i>et al.</i> , 2022; Awada <i>et al.</i> , 2023)
Arch net-IJAR: International Journal of Architectural Research	3	(Osama, 2020; Salama, 2022; Özgen Turan, Afacan and Surer, 2024)
Journal of Building Engineering	2	(Madias <i>et al.</i> , 2023; Jones, Fuertes and Bilverstone, 2025)
International Journal of Environmental Research and Public Health	2	(Mierzejewska <i>et al.</i> , 2023; Huntsman and Bulaj, 2025)

The studies analysed were published in a relatively small yet targeted group of journals, indicating that research on biophilic design and sustainability in office buildings is developing but still concentrated in specialised outlets. Sustainability (Switzerland) produced the most publications with four articles, reflecting its broad focus on environmental and sustainable development topics, closely related to biophilic design themes. Journals such as buildings, Building and Environment, and Archnet-IJAR: International Journal of Architectural Research each published three articles, showing that architecture and built-environment publications are key platforms for discussions on nature-based design strategies in workplaces. Additionally, the Journal of Building Engineering and the International Journal of Environmental Research and Public Health each featured two relevant articles, underscoring the interdisciplinary nature of the field across engineering, public health, and environmental performance. Overall, the clustering of studies within a few journals signals both increasing academic interest and the field's early development stage, offering more opportunities for future research contributions.

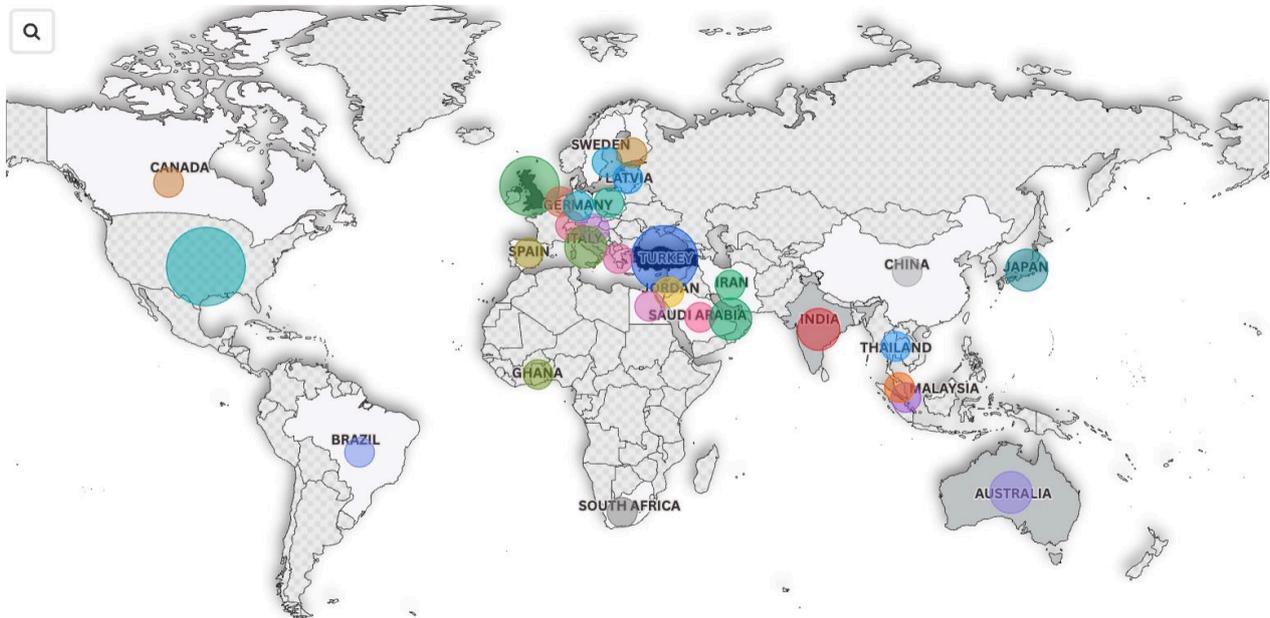
The reviewed literature was found to be concentrated within a relatively small group of journals, particularly those specialising in sustainability, environmental design, and the built environment (Bergefurt *et al.*, 2022; Lyu *et al.*, 2022; Madias *et al.*, 2023; Huntsman and Bulaj, 2025). This pattern shows that research on biophilic design and its role in sustainability for modern office buildings is still developing, with most scholarly work coming from specialised academic sources communities. Biophilic design remains an emerging topic and has not yet been broadly disseminated across significant architectural, engineering, or organisational research outlets. Its developing status underscores increasing interest in biophilic strategies and emphasises the need for more empirical and interdisciplinary research to enhance understanding and current practices (Gray and Birrell, 2014; Sadick and Kamardeen, 2020; Mierzejewska *et al.*, 2023; Sadick, Kamardeen and Vu, 2023; Jones, Fuertes and Bilverstone, 2025).

Table 3: Research context

Category	Countries	Number of Articles
Asia	United Arab Emirates (2), Turkey (5), Thailand (1), Singapore (1), Saudi Arabia (1), Malaysia (1), Jordan (1), Japan (2), Iran (1), India (2), China (1)	19
Africa	South Africa (1), Ghana (1), Egypt (1)	3

America	United States (7), Canada (1), Brazil (1)	9
Europe	United Kingdom (4), Switzerland (1), Sweden (1), Spain (1), Slovenia (1), Poland (1), Netherlands (1), Latvia (1), Italy (2), Greece (1), Germany (1), Finland (1)	15
Oceania	Australia (2)	2

- Turkey ■ Thailand ■ Singapore ■ Saudi Arabia ■ Malaysia ■ Jordan ■ Japan ■ Iran ■ India ■ China
- South Africa ■ Ghana ■ Egypt ■ United States ■ Canada ■ Brazil ■ United Kingdom ■ Switzerland
- Sweden ■ Spain ■ Slovenia ■ Poland ■ Netherlands ■ Latvia ■ Italy ■ Greece ■ Germany ■ Finland
- Australia ■ United Arab Emirates



Source: [World Bank Official Boundaries](#)

Figure 3: Distribution of the reviewed studies by publication country

Figure 3 presents the distribution of reviewed studies by publication country, indicating that research is concentrated primarily in Asia and Europe, which together account for the majority of contributions. Asia leads with 19 articles, with Turkey contributing the most (5), followed by Japan and India, each with two articles. Several countries, including the United Arab Emirates, Thailand, Singapore, Saudi Arabia, Malaysia, Jordan, Iran, and China, each produce 1–2 articles. Europe follows closely, with 15 publications, led by the United Kingdom with four studies and Italy with two. Switzerland, Sweden, Spain, Slovenia, Poland, the Netherlands, Latvia, Greece, Germany, and Finland each contributed one. The Americas produced nine articles, with the United States dominating with seven publications, and Canada and Brazil each contributing 1. Africa was represented by three articles from South Africa, Ghana, and Egypt, while Oceania’s contribution came solely from Australia, with two studies. Overall, this distribution highlights the dominance of Asia and Europe in the field, the strong individual role of the United States, and the comparatively limited but emerging research presence in Africa and Oceania.

Research on the impact of biophilic design on sustainability in modern office facilities is primarily concentrated in North America, Europe, and certain parts of the Asia-Pacific region, with the United States,

the United Kingdom, Australia, China, and Canada as the leading contributors. Collaboration networks exhibit strong regional clusters in Europe and the Asia-Pacific, with the USA serving as a central hub and the UK acting as a bridge to other regions. However, Africa and South America remain underrepresented, highlighting the need for more inclusive international collaborations to diversify perspectives and strengthen global research coverage.

The impact of biophilic design on sustainability in modern office buildings

Biophilic design, which involves incorporating natural elements and patterns inspired by nature into architecture, significantly influences the sustainability of modern office buildings. Its effects can be evaluated across the three pillars of sustainability: environmental, economic, and social aspects. The following sections review recent literature to systematically explore the impacts and benefits of biophilic design in each of these areas, with key findings highlighted.

Impact on environmental sustainability

Biophilic design has the potential to enhance the environmental performance of office buildings significantly (Grey & Birrell, 2014). Biophilic designs reduce resource consumption and maximise Indoor Environmental Quality (IEQ), by harnessing natural processes and materials (Asojo and Hazazi, 2025). Nature-based architectural solutions reduce energy consumption and emissions (Ryan & Browning, 2020).

Ding et al. (2024) mentioned that Biophilic design incorporates natural air, which positively influences by reducing carbon emissions through natural air and natural lighting. It also enhances both psychological and physical health in humans and promotes sustainable development, while supporting these goals. Also, Biophilic design optimises the indoor environmental conditions felt by occupants (Grey & Birrell, 2014).

Additionally, sufficient natural light is available, which not only saves energy but also creates more visually comfortable spaces, reducing glare and eye strain (Voordt & Jensen, 2023). Such IEQ improvements are not only healthier in the indoor setting but also limit reliance on mechanical systems (thus saving energy) (Asojo and Hazazi, 2025). Scientists point out that biophilic strategies improve the environmental quality of buildings, effectively harmonising the built environment with a healthy natural ecosystem (Ryan and Browning, 2020). Most biophilic designs incorporate green materials and live systems to enhance environmental efficiency. For instance, green walls or natural paint offer regenerative outcomes (e.g., utilising vegetation) (Allen et al. 2016). Furthermore, A study of a biophilic office building found high and sustained satisfaction with IEQ, including thermal comfort, acoustics, lighting, and air quality among employees (Asojo and Hazazi, 2025). Natural ventilation and indoor plants can enhance air quality and thermal comfort by permitting the entry of fresh air and humidity management (Hui J.W., 2010; Issa et al., 2011; Zhang, 2023).

Additionally, most office buildings incorporate natural materials such as wood, bamboo, rock, stone, and clay into their office spaces to enhance connectivity with nature (Sadick and Kamardeen, 2020). However, Whyte et al. (2024) identified that biophilic design incorporates natural materials, and timber (engineered wood) construction provides significant environmental benefits as a renewable resource that sequesters carbon, resulting in lower life-cycle CO₂ emissions compared to steel or concrete. Generally, incorporating natural elements and materials aligns with sustainable strategies for reducing the building's ecological footprint.

Most modern office buildings incorporate vegetation, such as indoor plants, green roofs, and landscaped atriums, which can boost biodiversity and offer ecosystem services (Zhang, 2023). The study of Ding et al. (2024) identified the primary areas for vegetation within office buildings as green roofs, vertical green systems, terrace gardens, and indoor plants in atriums. Studies indicate that greenery within the office environment can serve as an environmental cue, encouraging employees to engage in work (Hähn, Essah, & Blanusa, 2021). Adding indoor plants reduces ecological footprints and promotes employee health and well-being (Zhang, 2023). It also improves performance and aligns office design with natural systems through biophilic principles. This approach conserves energy, reduces emissions, and promotes healthier indoor environments (Allen *et al.*, 2016; Sadick and Kamardeen, 2020). Incorporating natural elements not only boosts health but also supports sustainable building practices, decreasing environmental impact over time (Sadick and Kamardeen, 2020). Biophilic design incorporates natural materials, light, water, and plants into buildings to create a harmony between modern urban life and nature. With their aesthetic appeal, economic value, and sustainability benefits,

plants are a central element of biophilic architecture (Ding *et al.*, 2024). These environmental advantages exemplify how biophilic offices directly contribute to environmental sustainability.

Impact on economic sustainability

The inclusion of biophilic design in offices can also yield substantial economic benefits for companies. The following improvements in employee health and building performance tend to provide tangible monetary benefits:

Most of the modern office buildings incorporate Biophilic design, which includes natural air through operable windows, vents, and narrower structures. At the same time, daylight is brought in via glass walls, clerestories, skylights, atria, and reflective colours or materials (Sadick and Kamardeen, 2020). As a result, reducing HVAC and lighting energy consumption reduces the energy cost of the organisation (Nitu *et al.*, 2022). Also, Ding *et al.* (2024) study proves that biophilic design positively influences energy efficiency by reducing energy consumption through natural air and natural lighting.

Most modern office buildings consist of the presence of natural scenes, plants, animals, water, landscapes or geological features in paintings, photographs, videos and fabrics, which are included in biophilic design (Sadick and Kamardeen, 2020). As a result, the economic benefits can be achieved include greater employee productivity (Barnaby J *et al.*, 2023), Improved environmental conditions and exposure to nature have been linked to increased focus, enhanced creativity, and improved productivity at work (Aristizabal *et al.*, (Aristizabal *et al.*, 2021). For instance, a multisensory biophilic workspace trial demonstrated that exposure to nature-inspired visuals and sounds resulted in improved cognitive functioning in the workplace (Aristizabal *et al.*, 2021). Studies have found that access to daylight through the windows, porches, balconies, terraces, and courtyards in offices can "boost productivity" quite significantly, and it helps to increase organisational financial growth (Sadick & Kamardeen, 2020). Alternatively, poor office environments reduce performance, and biophilic investment is an investment in employee performance, and it will contribute to the organisation's growth and profit (Alipour and Khoramian, 2023). Natural colour has a psychological impact through its active role in enhancing job satisfaction, performance and loyalty to the organisation (Kadhun L.K, Dabbagh S.M.W.A and Kadhun A.K, 2020). Biophilic design enhances employee productivity, directly contributing to a firm's bottom line through increased output and efficiency and lower absenteeism rates by reducing stress and illness (Young *et al.* 2021; Grey & Birrell 2014; Ryan & Browning 2020). For example, Exposure to daylight improves circadian function and mood, which can reduce absenteeism rates by several percentage points in the office (Asojo & Hazazi, 2025). Moreover, better air quality and comfort in biophilic offices can help avoid issues like Sick Building Syndrome, which may lead to decreased healthcare costs (Nimlyat, Inusa and Nanfel, 2023). Over time, these aggregate health benefits (fewer headaches, fewer burnout and fatigue, etc.) result in a healthier workforce at reduced medical and productivity-loss costs (Nimlyat, Inusa and Nanfel, 2023).

Furthermore, employees enjoy offices with natural light, plants, and views, and report higher levels of satisfaction and engagement (Nawaz, Javed and Raja, 2019). By investing in biophilic design, companies create a more appealing workplace and can increase loyalty and morale (Sadick & Kamardeen, 2020). Barnaby J *et al.* (2023) found that incorporating nature into office building design offers various economic advantages, including immediate boosts in productivity, increased asset value over time, reduced absenteeism, lower healthcare expenses (including insurance payments) and enhanced employee retention. Similarly, Elantary (2024) identified that while the measured effects of biophilic design on productivity are often examined, many advocates highlight its potential impact on individuals' perceived well-being, engagement, and sense of value in the workplace. These factors are even harder to quantify than productivity but could significantly influence costs and profits for businesses.

Impact on social sustainability

The social dimension of sustainability concerns itself with human well-being, health, and community, and it is here that the impact of biophilic design is most immediately felt. Modern offices with a strong connection to nature have been shown to offer a wide range of social and human-centred benefits.

One of the consistent findings in the literature is that workplace exposure to nature improves occupants' health and well-being (Alipour & Khoramian, 2023). Biophilic offices capitalise on the restorative power of nature, with stress reduction often identified as a primary benefit (Gray and Birrell, 2014). Research illustrates that even small amounts of natural elements can activate stress recovery (Sadick and Kamardeen, 2020). In an experimental study, occupants in a biophilic office setting had considerably lower stress levels compared to those in a conventional office (Aristizabal *et al.*, 2021). In a field experiment, occupants of a fully biophilic building showed sustained improvements in overall health and well-being (Aristizabal *et al.*, 2021). Other research suggests that environments featuring natural materials, such as wood, trigger more relaxed physiological reactions, decreased blood pressure and sympathetic nervous system arousal, and thereby mitigate chronic stress (Burnard and Kutnar, 2015). In short, biophilic design provides healthier workplaces that leave people feeling less stressed, more relaxed, and happier daily (Gray and Birrell, 2014).

In addition to stress alleviation, nature-integrating design supports mental restoration, mitigating fatigue and improving cognitive functioning and creativity (Gray and Birrell, 2014). A systematic review of studies on occupational exposure to nature concluded that biophilic design is associated with the restoration of well-being and psychological resources for office workers (Gonçalves *et al.*, 2023). Employees who have views of nature or can access internal plants and water features report faster recovery from mental fatigue and improved concentration and creativity (Gonçalves *et al.*, 2023). For example, one study found that exposure to natural sounds (e.g., birdsong and flowing water) during breaks significantly increased employees' self-reported alertness and reduced fatigue compared to exposure to urban noise (Sadick and Kamardeen, 2020). Another study noted immersive biophilic environments can improve employee satisfaction and cognitive performance, while reducing stress (Barbiero and Berto, 2021). Moreover, better air quality and comfort in biophilic offices can help avoid issues like Sick Building Syndrome (Nimlyat, Inusa and Nanfel, 2023). These cognitive improvements lead to improved problem-solving and innovation in the workplace (Alipour and Khoramian, 2023). Use of natural colours in workplace spaces has many psychological and physiological benefits that create a healthier, more productive work environment (Kadhun L.K, Dabbagh S.M.W.A & Kadhun A.K 2020).

Biophilic design has also been linked to increased job satisfaction, improved mood, and enhanced overall comfort in the workplace (Aristizabal *et al.*, 2021). Natural decor and indoor plants can help create a more relaxed and comfortable environment, which has a positive impact on the emotional well-being of employees (Zhang, 2023). For instance, wood surfaces have been shown to buffer physiological stress responses, thereby enhancing the well-being of building occupants, lowering blood pressure, improving mood, and contributing to a more relaxed state compared to synthetic alternatives (Burnard & Kutnar, 2015). This mood boost is connected to mental health; biophilic offices have even been researched as a means of decreasing depression and anxiety through the everyday access to nature's calming influence (Valour, Redondo & Carrero, 2025). By maximising daylight, air quality, aesthetics and comfort, biophilic design enhances many determinants of IEQ that influence occupant satisfaction and morale (Asojo and Hazazi, 2025). Animal-assisted intervention can play an especially valuable role for people with severe mental and physical health issues (Clements *et al.*, 2019). For instance, watching fish swim in an aquarium help reduce stress, relax, practice mindfulness alleviates loneliness, improve cardiovascular health and decrease blood pressure, a critical contributor to mental health, and most chronic diseases (Clements *et al.*, 2019; Rose, 2024). A whole-building case study found that the presence of the visual connection to nature, natural materials, and refuge spaces in an office building led to a measurable improvement in occupant comfort, emotional satisfaction, and perceived environmental support (Asojo and Hazazi, 2025). The social impacts of biophilic design, from healthier occupants to improved mood and social cohesion, contribute to a more sustainable workforce (Hutson and Hutson, 2023). They address the human factor of sustainability by ensuring that office buildings maintain well-being and productivity alongside employees' inherent desire for connection to nature. Improving mobility and wayfinding is one of the cornerstones of foundations of any comprehensive program for enhancing the health and well-being of occupants and used innovative new personal wayfinding technologies to improve wayfinding and mobility (Maus, Lindeman and Satariano, 2016). Also, incorporating nature-inspired features such as organic wall coverings, biomorphic patterns, and naturalistic forms in office environments enhances sensory experiences, stimulates creativity, and fosters employee well-being by evoking the innate human affinity for nature (Ryan & Browning, 2020).

Aside from its immediate impacts on the environment, economy, and humans, biophilic office design also aids in the advancement of broader sustainable development goals. Several of the United Nations Sustainable

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Development Goals (SDGs) align with the advantages above. By reducing stress and improving health, biophilic offices contribute to achieving SDG 3: Good Health and Well-being. The boosts in employee productivity and engagement support SDG 8: Decent Work and Economic Growth because healthier and happier employees work more efficiently and take less time off. The low carbon footprint and energy efficiency of biomimicry buildings align with SDG 7: Affordable and Clean Energy (through the reduction in energy demand) and SDG 13: Climate Action (through lower greenhouse gas emissions). Likewise, the integration of green spaces and natural features in cities aligns with SDG 11: Sustainable Cities and Communities, as this makes urban workspaces more sustainable and liveable.

In effect, biophilic design is a viable solution for creating sustainable workspaces that balance human well-being and environmental sustainability, a tangible contribution to the global sustainability agenda. Briefly, biophilic design in modern offices is a holistic strategy that provides ecological benefits (energy efficiency, lowered impacts, regenerative features), economic benefits (enhanced productivity, cost savings, asset value), and social benefits (health, well-being, satisfaction).

This research aims to develop a framework that aligns the impact of biophilic design on the sustainability of modern office buildings. Figure 4 illustrates how each biophilic attribute impacts sustainability in contemporary office buildings. This framework shows the SDGs relevant to biophilic design for sustainability and examines the effect of the three pillars of sustainability on modern office buildings.

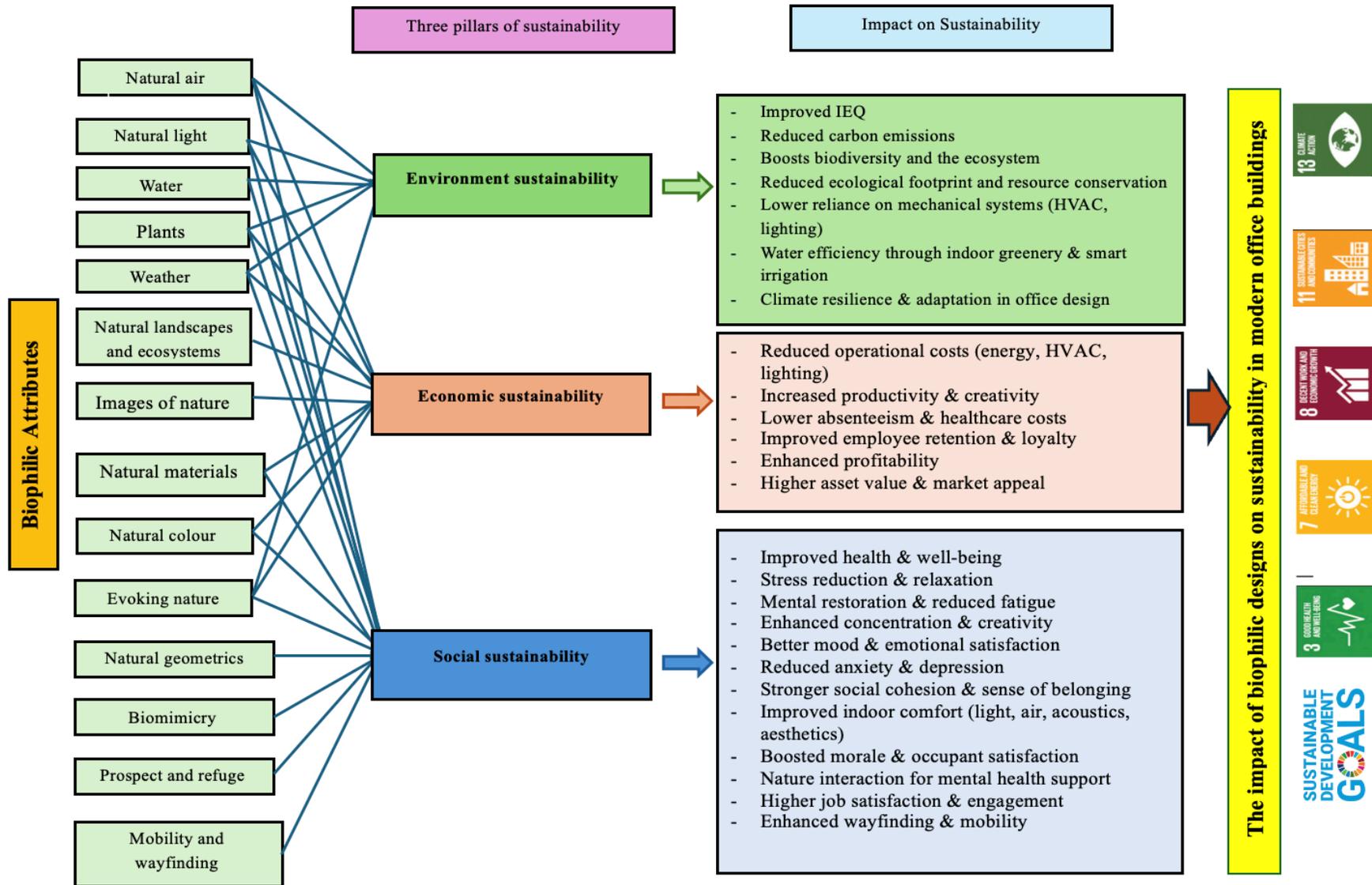


Figure 4: Framework for the impact of biophilic designs on sustainability in modern office buildings

CONCLUSION

This study indicates that biophilic design can significantly advance sustainability in modern office buildings by intervening in environmental, social, and economic factors. The use of natural processes and elements not only improves indoor environmental quality, energy efficiency, and resource efficiency but also encourages worker health, well-being, and productivity. At an organisational level, biophilic strategies promote lower absenteeism, improved staff retention, and operational cost savings, which underpin their substantial economic value. This research also explored how biophilic design helps achieve some of the Sustainable Development Goals (SDGs), specifically SDG 3 (Good Health and Well-being), SDG 7 (Affordable and Clean Energy), SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action). Finally, the study proposed a model demonstrating how biophilic design makes it easier to integrate sustainability principles into modern office buildings and offers theoretical and practical recommendations for future practice and research.

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