OPEN ACCESS

JOURNAL OF ARCHITECTURAL RESEARCH AND DESIGN STUDIES
Vol. 10, No. 2, 2026, pp 249-268
p-ISSN 2580-1252; *e*-ISSN 2580-1260
DOI: 10.20885/jars.vol10.iss2.art6

Biodiversity Improvement through Architectural Site Planning in Building Design and Construction

Rasheed Sekore Busari*[1], Abdulhameed Folorunso Busari[2]

[1] Department of Technical Education (Building), Emmanuel Alayande University of Education, Oyo, Nigeria
[2] Architecture and Building Division, ARKRAS Consultancy Services, Oyo, NIgeria

Correspondence*:
E-mail: sekorerasheed@gmail.com

Article History:

Submitted: August 31, 2025
1st Revised: December 12, 2025
2nd Revised: January 6, 2026
Accepted: January 14, 2026
Published: August 10, 2026

Abstract

Architectural site planning provides the link through which the design and construction of buildings can improve biodiversity for allocated sites in development projects. The study examines the role of site planning in enhancing biodiversity within the context of building and construction using a selected plot of land in an informal settlement of the Abojupa area, Oyo Town. A parcel of land was divided into plots and allocated for different building projects. Three particular sites in this settlement were carefully selected and measured using surveying instruments and plotted appropriately using AutoCAD software. The developed zones for the buildings and undeveloped areas were adequately calculated to identify areas and percentages of each lot in the landscape. The analysis revealed that about 20%, 40%, and 50% of the areas were used for buildings, while about 80%, 60%, and 50% were shared by green infrastructure and paved lawns respectively. The green-covered areas were allocated for native plants in the landscape to support local biodiversity, and blue areas were allocated for restoring the degraded ecosystem around the area. The site planning ensured improved biodiversity restoration by making the natural habitats, like green spaces, gardens, and ecological corridors on the site, to support biodiversity functions. The study concluded that the site planning of an area, on a plot-by-plot basis, has great potential for integrating natural systems and green spaces into architectural planning and design. These spaces, serving the area as green infrastructure, should be properly maintained for effective ecosystem service delivery in the settlement, and adequate spaces should be left as setbacks for open spaces. This research provides a framework for architects, planners, and policymakers to embed ecological considerations into the land development process, thereby contributing to long-term environmental sustainability.

Keywords: *architectural design representation; biodiversity improvement; landscape supports and biodiversity loss; site planning*

Introduction

Architecture is the design of buildings and spaces that integrate harmoniously with natural systems, promoting ecological balance and biodiversity, while enhancing human well-being. Architecture plays a vital role in giving the physical environment a shape and making an impact on society through its influence on cultural identity, economic activities, and overall well-being (Mona, 2025) and is a strong component of urban development. Architecture and urban development are deeply connected (Hakimi and Firoozabadi, 2018; Jozwik, 2024; Mouratidis, 2021), as they provide physical infrastructure and major economic growth areas in the cities (Olanusi, 2024), and have become the medium through which the impacts of urbanization are managed and expressed in physical form (Angel, 2023; Nabirye, 2024; Jozwik, 2024). Urbanization has several negative effects on biodiversity (Liu et al., 2025; Danmallam et al., 2024; Lazzarini et al., 2024; Ojo, 2024; Ponteado, 2023; Theodoru, 2022; Elmqvist, 2016, Li et al., 2022; Simkin et al., 2022; Chang et al., 2022; Ombeni et al., 2021; Liu et al., 2016) and urban development contributes to habitat loss and fragmentation through the conversion of natural areas into impervious surfaces for infrastructure and buildings, and interventions through development by man (Wang et al., 2024; Kassouri, 2021, Aronson et al., 2017; Li et al., 2022; Ren et al., 2023; Puplampu et al., 2021; Biella et al., 2025; Li et al., 2025; Huang et al., 2025), which poses a serious danger of human exposure to nature for health reasons (Lai et al., 2019; Yu et al., 2022; Cox et al., 2018; Wu et al., 2024, Kuddus et al., 2020; Sousa-Silva et al., 2025). Architecture can contribute immensely toward designing green habitats that can support and enhance local biodiversity (Li et al., 2024; Babalola et al., 2024, Keeve, 2023; Cheng et al., 2023) with proactive design strategies that integrate ecological considerations into the built environment (Garrah et al., 2017, Zari, 2019; Brown et al., 2025; MacKinnon et al., 2021). Incorporating biodiversity into the design process creates more sustainable and resilient cities that benefit both humans and nature by improving the livability of the environment.

Architects have crucial roles in creating designs for urban development through customized, functional, and aesthetic synthesis of the clients' needs. Architecture, as a process and a product of planning, designing, and constructing (Sledge, 2023; Conway and Roenisch, 2005), is perceived as the art and science of designing buildings and non-building structures. Intentions and ideas are presented through drawings and models in which the designs are envisioned with careful thought and articulation (Tomic et al., 2023 and Zee, 2008). Architectural representations are used for processing ideas and documenting those ideas for presentation. The architectural presentation goes through different stages in its preparation of various documents that explain the solution of the brief to the clients (Booth and Hiss, 2012). This architectural design presentation is made up of seven stages: predesign, schematic design, design development, construction documents, building permit, bidding and negotiation, and construction administration (Landau, 2022; Kilmer and Kilmer, 2009). These presentations are made through the use of plans, sections, and elevations as conventions common to the simulation of the horizontal and vertical configuration of all buildings. In the presentation of the stages of the building development process, the site plan, a subsection of the plan, plays an important role in achieving desirable results (Wakuta and Linde, 2003). The site plan is therefore produced as a component of the building production document through the creativity of technical skills and knowledge of the building codes and regulations to bring the design vision to reality (Gupta, 2024).

A site plan is an architectural plan which shows the bird's eye view of a property (Garg and Dewan, 2022; Zell, 2008) and also a scale drawing showing how a parcel of land is to be improved in order to serve any number of required functions (Jefferis et al., 2011; Madsen and Madsen, Zell, 2008; Kubba, 2009). It shows the configuration of buildings, roadways, landscape, garden, travel ways, utilities, parking, topography, water features, vegetation, building footprints, drainage facilities, water lines, trails, lighting elements, stormwater management systems, and other facilities associated with the development (Alagappan, 2015; Ayeni and Tukur, 2017). Site planning, which relates to the act of arranging and placing these infrastructures on site, the art of setting the structures on the land and shaping the distance between them according to their uses and by-laws guiding their replacement to achieve a workable design solution (Lynch and Garry, 1984; Lagrow, 2008; Ibrahim, 2022; Marsh, 2021; Panlasigui, 2021), and creation of various components to create a functional and sustainable space that integrates and achieves efficiency, environmental sustainability, and aesthetic balance (Johnson, 2015; Park, 2020). Site planning is an important stage in the building design process, as this gives details of developable areas and undevelopable areas that accommodate other services that support the building. In providing the site plan for any project, it must fit within the project parameters and meet the client project goals, and also meet the needs of the local community, support a healthy lifestyle, and create a sense of place (Green Building, 2014). The aesthetics and functionality of any development therefore rest on effective site planning not only of the building but also other landscape elements that provide ecosystem benefits and services. This site planning concept further metamorphosed into landscape planning, which is defined as an activity concerned with developing landscaping among competing land use while protecting natural processes and other significant resources (Zube, 2002). This blends the process of design and planning of man-made and natural environments.

This landscape planning is still the responsibility of architects in the development process through the design of open and green spaces outside the building. Landscape planning has to do with the process of shaping outdoor space based on planning decisions (Korkut et al., 2010) and production of harmony with ecological and natural processes (Bekiryazici, 2024). Architecture, nowadays, of which landscape planning is a subset, plays an interdisciplinary role of integrating art and science that produce viable, healthy, and reliable environments for biodiversity production (Gul, 2022). There is a strong relationship between architectural design and principles of minimizing human activities on nature (Koat, 2020) through appropriate designs. These layers of design are therefore integrated in an effective manner to create biodiversity functions that replicate the earlier arrangement in various sites at different settlements. This site planning technique plays a major role in reducing loss of biodiversity, by not contributing more to the loss and therefore integrates biodiversity into the development (Opoku, 2019).

Biodiversity in built areas is difficult to achieve as a result of the destruction of green infrastructure and the consequent loss of ecosystem and the services that it provides freely to humans (Zari, 2015), and subsequent expansion of urban ecosystems at the expense of natural habitats. The subdivision of lands into plots for development has actually been responsible for the likely extinction of thousands of species that make up the biodiversity (Parris et al., 2018). Architects and planners have central roles to play in the persistence of conserving urban biodiversity because of their direct influence on the well-being of the habitats (Ceballos and Ehlich, 2018; Enrique and Trinidad, 2022). Site planning, through its natural components, contributes to sustainability by combating the problem of lacking contacts with nature (Jiang et al., 2020; Kaythan, 2018, Zhong et al., 2022; Kellert, 2018), promotes human-nature connections (Abdelaal, 2018; Abdelaal and Soebarlor, 2019; Ryan and Browning, 2018), and provides multiple benefits such as improving air quality, water quality, acoustic insulation, noise reduction, and urban stormwater management (Zhong et al., 2021; Perez and Perini, 2018; Somarakis et al., 2019). The reflection of the coexistence of site planning with nature makes it one of the instruments used by architects to improve biodiversity from the building unit to block level and finally to the entire layout of a settlement.

Recently, in the design of new developments in the United Kingdom, it is recommended that architects must deliver a minimum of 10% uplift of biodiversity in the design (Cousins, 2024). This was enabled to ensure that species that are disappearing at an alarming rate are restored in development planning to promote natural elements through planning obligations (Royal Town Planning Institute, 2019). This in essence calls for the architects and planners to carry out surveys and measure the biodiversity value of the existing habitats before the development is placed on it. Architects need to set priorities at ensuring that vegetation is kept at a maximum percentage to ensure that habitats are restored in the development process. Biodiversity gain is now an approach that puts biodiversity in a better position to manage its components in the urban landscape in order to maximize the biodiversity value of the site. Architecture is very important in this regard, as it can play a crucial role in preserving, restoring, and creating innovative approaches in areas that are affected by habitat loss and fragmentation (Park et al., 2020; Hendaway, 2024), and as the conservation of biodiversity remains one of the potential levers to achieve sustainability, especially Sustainable Development Goals (SDGs) 15 (life on land), where nature is vital for human resilience, livelihoods, and well-being (Opoku, 2019; Obrecht et al., 2021), and provides inestimable benefits. These benefits align with broader global development by ensuring that global development in Oyo is ecologically responsible, socially inclusive, and economically viable, thereby advancing the sustainability of the town and improving the quality of life of its residents. Architects play roles from the conception to the demolition of various developments, therefore they should be a major stakeholder in promoting biodiversity enhancement and support, thereby delivering a biodiversity gain on building development through appropriate site planning efforts.

Plot-by-plot planning, which refers to the incremental development of land parcels on an individual basis (Adams et al., 2020; Karaman et al., 2020; and van der Krabban, 2022), often without an overarching master/layout plan is rampant, especially in parts of Africa, such as Nigeria, including Oyo Town. This results in informal settlements that lack cohesive design and can result in haphazard growth where people build without official planning or infrastructure support (Karaman et al., 2022; Agheyisi, 2018). The majority of these plots in the built-up areas are mostly dominated by hard landscape as a result of improper planning and a high density of buildings on the plot. Inappropriate land development has been responsible for destruction and devastating effects on biodiversity in the urban landscape (Cengiz, 2013; Petrik et al., 2015; Odekunle et al., 2019; Sarkheyli, et al., 2012; and Arimah and Adeagbo, 2000). The division of land into ubiquitous housing plots and the uncontrolled exploitation of resources made it difficult for planning of an effective and efficient site layout since these schemes are not approved before developments are made on them (Arimah and Adeagbo, 2000; Aribigbola, 2008; Bolokova et al., 2019; Olotuah and Bobadoye, 2009; Allan et al., 2022). Also, the buyers of the plots in most cases give the development of their projects to less qualified consultants who do not understand the importance of biodiversity to built-up areas, thus failing to give adequate respect to these elements in relation to the planning guidelines.

Invariably, the design produced by the architects or draughtsmen lacks adequate open space provision for restoring biodiversity (Roe et al., 2019; and Oladunjoye, 2016), despite the planning regulation codes of setting aside not less than forty percent of the land area as setbacks in Oyo State (Adebara et al., 2023). Some site planning developments were also conceived by qualified consultants, but the lack of monitoring and supervision did not allow the client to implement the placement of green infrastructure to be attached to the building in the respective areas and in line with the site plan given. The planning regulations in most cases stipulated a higher percentage allocation of the land area to the green/open spaces, which are expected to be restored as biodiversity that was earlier destroyed during the construction but were not properly constructed. These exacerbate biodiversity loss by fragmenting habitats, which negatively impacts ecosystems. The continued dominance of unregulated development not only threatens the ecological fabric of the town but also undermines the long-term livability and sustainability of its built environment. The main objective of the research therefore is to investigate the existing informal plots to determine the status of various components that make up the entire area and its implications on biodiversity and site planning, at the micro level of the building design process in Oyo Town.

Literature Review

Biodiversity loss is driven largely by land-use change and urban expansion, and the spatial pattern of urban development strongly influences local ecological outcomes (Cabernard et al., 2024; IPBES, 2019; Suppula et al., 2023; Kuang et al., 2021). In rapidly urbanizing West African towns such as Oyo Town (Oyo State, Nigeria), expansion often occurs incrementally - plot by plot - leading to piecemeal clearance of vegetation, fragmentation of remnant habitats, and declines in green covers without any regulatory measures guiding the developments (IPBES, 2019; Rafiu et al., 2018). Architectural/site planning as a component of the projects at the plot scale can contribute to biodiversity improvement as this provides locally-relevant prescriptions for provision of adequate green infrastructure on the site.

Landscape ecology shows that biodiversity outcomes in urban areas depend on three interrelated dimensions: the amount of habitat (quantity), habitat quality (native species, structural complexity), and spatial configuration (connectivity and fragmentation) (Mohamed et al., 2024; Rastandeh, et al., 2017)**,** on which site planning plays a significant role in urban development. Green infrastructure **is** critical habitats to support biodiversity and provides an operational framework for embedding biodiversity objectives into urban design by combining ecological function with social and climate benefits (Jato-Espino, 2023, Tzoulas et al., 2007; Kim and Song, 2019; Abdullahi et al., 2021). At the scale of individual plots, design decisions (tree retention, permeable surfaces, planting palettes, micro-water features) directly affect local species assemblages and—when aggregated across many plots—can produce landscape-scale ecological networks.

Private gardens and small green patches play enormous roles in urban biodiversity when they contain native species and structural heterogeneity (Goddard et al., 2010); Aronson et al. (2017) emphasize that urban space management (including small private and community plots) is a critical determinant of urban biodiversity, subject to socio-political and management controls that vary across cities. The various elements and components that make up these are part of illustrations that site planning makes adequate provisions for in the urban development projects.

Opportunities for biodiversity exist in domestic gardens, street trees, small public parks, and building-scale greening; but the uptake and effectiveness are limited by policy gaps, maintenance deficits, and insufficient use of native plant species (Adegun, 2021). The review explicitly highlights that small-scale, low-cost interventions such as vegetated setbacks, retention of mature trees on plots, and rain-water harvesting—are particularly suitable to the Nigerian context where plot-by-plot development predominates. These interventions can be scaled by regulations and incentives to create cumulative biodiversity benefits across neighbourhoods (Adegun, 2021). Analyses carried out in Oyo town revealed rapid expansion of the built-up area over recent decades, with vegetative loss and rising land surface temperatures consistent with the loss of green cover (Rafiu et al., 2018, and Salam, 2023). These spatial studies provide a crucial baseline for prioritizing where plot-level biodiversity intervention will be most effective in halting fragmentation and restoring functional biodiversity in the built environment.

The global evidence and region-specific studies converge on a clear conclusion that plot-level site planning, when guided by ecological principles, local species knowledge, and supportive governance, can cumulatively improve urban diversity in Oyo town. Plot-to-plot site planning can improve biodiversity if each plot is treated as a biodiversity unit, retaining vegetation, creating green setbacks, managing water, and connecting to neighbouring plots. While evidence shows that plot-by-plot site planning can collectively rebuild ecological networks in rapidly urbanizing towns like Oyo, research is still thin or non-existent on comprehensive biodiversity baselines, long-term performance tracking of ecological networks, and context-specific guides; addressing these gaps is essential to shift architects, planners, and households from ad-hoc construction toward plot-by-plot site planning practices that actively improve biodiversity.

Methodology

This research adopts a case study approach, focussing on three selected plots of land located in a developing residential area of Oyo, Nigeria. The methodology involves both qualitative and quantitative analyses, combining fieldwork, spatial analysis, and statistical data to evaluate the presence of green and gray infrastructure in the area. Oyo Town, located in the southwestern part of Nigeria, is a historically, culturally, and ecologically rich settlement experiencing fast urban development. The town is characterized by rapid urban expansion, fragmented settlements, and residential sprawl (Oyeyode et al., 2023; Rafiu et al., 2018; Okegbola, 2019; Salami, 2022).

The research study area is a residential parcel of land which was laid out for development and sold to buyers in the year 2001. The land was formerly used for subsistence farming, where crops and fruits were grown before the conversion to residential plots. The parcel of land, which is located along Akinmorin Road in Oyo East Local Government of Oyo town, was divided into common urban plots of 36 x 18 m. The area is purely an informal system of urban development, which is very common in Oyo Town. The entire parcel studied covered about one, two, and three plots. The area is now fully developed with various residential developments. The sites were purposively selected based on their semi-natural characteristics as a result of multifunctional natural elements that exist there with the structures, visibility of open spaces, landscaping elements, and accessibility for physical surveying.

An as-built survey of the plot was carried out using survey instruments with the assistance of a surveyor in order to obtain accurate knowledge of the features on the plots. Global positioning devices, measuring tapes, and digital cameras were used to acquire the coordinates of the point that make up the parameters of the parcel, taking measurements of the components and photographs of the component parcels. The parcel was adequately plotted using AutoCAD software. Therefore, different lots of the plot were measured using offsetting and plotted appropriately on the survey plan. AutoCAD software was also used to calculate the areas of each of the lots to determine the size and relationship with the buildings. Each lot was evaluated based on the percentage rating system of the entire surface area. Also, Google Maps with satellite imagery and site maps were also analysed to understand the broader environmental context, and photographs of important biodiversity features on the plot were taken, recorded, and used for analysis.

Results and Discussion

Site Location A

The measured site/landscape plan shows the various elements that make up the plot in figures 1 and 2 (Site Location A) and site statistical analysis shown in table 1. The table reveals the areas of the components in the plot.

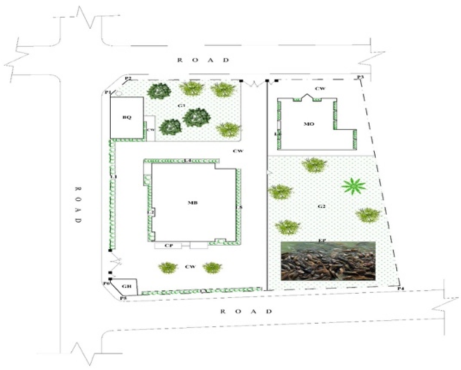

Figure 1. Site plan
Source: As-built Survey prepared by Authors (AutoCAD), 2025

Figure 2. Google map showing the grey and greenspaces
Source: Google Maps imagery, 2025

Table 1. Statistical Analysis of the plot

Index	Name	Area (sq. metre)	Subtotal (sq. metre)	Infrastructure	Percentage covered (%)
G1	Garden 1	235.403			
L1	Lot 1	21.758			
L2	Lot 2	9.836			
L3	Lot 3	11.520			
L4	Lot 4	15.963			
L5	Lot 5	13.346	1387.076	Green and Blue	80.46
L6	Lot 6	8.920			
EP	Earthen Pond	109.575			
CP	Concrete Pond	4.620			
G2	Garden 2	372.077			
CW	Paved Walkway	584.058			
BQ	Boys' Quarter	41.760			
MB	Main Building	194.357	336.788	Gray	19.536
MO	Mosque	96.061			
GH	Gatehouse	4.620			
	Total	**1723.864**	**1723.864**		**100.000**

Source: Author's analysis, 2025

The total area of the building and other structures is about 20%, while the green and blue spaces (green infrastructure) cover about 80% of the space. The entire plot is influenced by the various green lots that provide homes for many species and plants that enhance the aesthetic value of the area. The area was provided with many plant species, particularly those that were on the site before the development commenced. The site planning included the design by managing these species to support plant and animal species. The majority of the plants are native species that provide habitats and food for local animals and inhabitants of the structure. A diversified vegetation type, such as trees, shrubs, and grasses, were seen in various lots of the compound, which attracts birds and other animals into the area. The nature of the structure built also encourages birds and other flying animals to occupy the roof, the structure, as this is the tallest building in the environment.

The main building on the plot strictly obeyed the Building Planning Codes through observing adequate setbacks on various sides, which allowed optimum areas for open spaces. The main building was constructed in accordance with the approval given by the Oyo East Planning Authority, with the gatehouse. Others like the boys' quarters and mosque failed to set aside the minimum setbacks and were not submitted to the planning authorities for approval. These two appendages even reduced the area of open spaces left for green spaces. Green spaces with adequate setbacks play a crucial role in supporting biodiversity because they create habitats for plants and animal species. These sufficient spaces left on the plot afforded the opportunity to create a sizeable fish pond that maintains ecosystem services like air filtration and soil conservation, and also promotes connectivity between habitats. These ponds also provide habitats for various aquatic plants and animals that support biodiversity and improve access to clean water, enhance sanitation infrastructure, and reduce exposure to environmental hazards.

The site planning also encourages urban agriculture practices in the compound, which also promotes biodiversity. Planting of tomatoes, pepper, and onions in the recesses provides succour for the inhabitants to make use of them in preparing food. Fruits like mango, coconut, pineapple, cashew, plantain, bananas, and others were planted in different lots and are yielding benefits of fruit provision for the inhabitants. The placement of these plants creates connectivity between fragmented habitats and provides enough opportunities for the species to migrate and interact fully. The ponds provided in the two lots offer the benefits of promoting human-nature connections that foster appreciation and conservation of biodiversity. The pond also provides a habitat for aquatic plants, insects, amphibians, and fish and adds beauty and tranquillity to the landscape for the enhancement of human experience. It is also a food web by providing food for humans, animals, and serves as a breeding ground for many other species like frogs, toads. Individual plots have provision for many species and plants that bring multifarious benefits to the population through the biodiversity restoration implemented in this study.

These site planning principles in the design and construction of buildings are a powerful strategy for localizing the global SDG agenda. This planning supports the development of environmentally responsible infrastructure while enhancing the quality of life for residents, promoting biodiversity conservation, and ensuring the long-term ecological health of the town. The plot shows the unpaved cover of about 80%, which provides improved habitat connectivity by introducing native plants and enhancing water infiltration into the soil. The improved site layout supports goals related to life on land and clean water access. Notably, the design not only preserved natural features but also improved the microclimate and reduced potential runoff, thus reducing the risks of localized flooding. These results affirm that when site planning is guided by ecological principles, building projects can go beyond functionality to become active contributors to sustainability.

EP

G1

G1

L3

L1

G1

CP

L3

L3

G1

Plate 1 Green infrastructure in the spaces (Site Location A)
Source: Components' photographs, Author's field survey, 2025

Site Location B

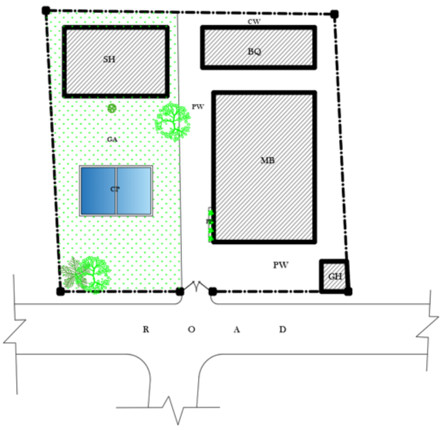

Figure 3. Site plan of Location B
Source: As-built Survey prepared by Authors (AutoCAD), 2025

Figure 4. Google map showing the gray and greenspaces on Location B
Source: Google Maps imagery, 2025

Table 3. Statistical Analysis of the Location B

Index	Name	Area (sq. metre)	Sub-area (sq. metre)	Infrastructure	Percentage covered (%)
MB	Main building	264.267	469.750	Grey	38.51
BQ	Boys' Quarter	86.874			
GH	Gate House	13.685			
SH	Shed	104.924			
PW	Paved Walkway	391.003	751.214	Green & Blue	61.49
CP	Pond	51.770			
FP	Flower Pot	2.477			
GA	Garden	305.964			
	Total	**1221.764**	**1221.764**		**100.00**

Source: Authors' analysis

The Site Location B covers about two standard plots of 36 x 36m, with 38.51% of the land developed for building structures, leaving about 61.49% as open and semi-open space. Despite being built in a former neighbourhood farm settlement, the relatively lower development intensity offers moderate opportunities for biodiversity protection and improvement. The existing landscape exhibits fragmented vegetation patches, compacted soil surfaces, limited shade trees, and a dominance of impervious surfaces around the building footprints. A portion of the land was left for landscape elements which accommodate fruits like mango, coconut, bitter leaf, and some other perishable greens, which have functional effects on the immediate surroundings. Parts of the open space accommodate domestic perishable agricultural farming like small poultry, fishing, and arable farming.

The buildings (main and boys' quarter) lack adjoining vegetation, as no patches were seen closer to the structures that could cool the surroundings through shade and evapotranspiration. The absence of these flowers and vegetation reduces the visual quality of the building and reduces ecological connectivity in the plot. The planning of the buildings made adequate provisions for setbacks on all sides, but lacked adequate vegetation, which diminishes the aesthetic and psychological quality of the building environment, creating a harsh and uninviting appearance while reducing opportunities for visual relief, relaxation, and improved mental well-being. Apart from the portion left for planting separately, the absence of plants eliminates their roles as natural buffers that soften noise, moderate wind, and regulate microclimatic conditions. This also led to a hotter, dustier, ecologically poorer, and less comfortable environment with reduced quality and sustainability. The site planning here was adequately designed, but the available green infrastructure on the site fell short of required ecological standards in a building layout.

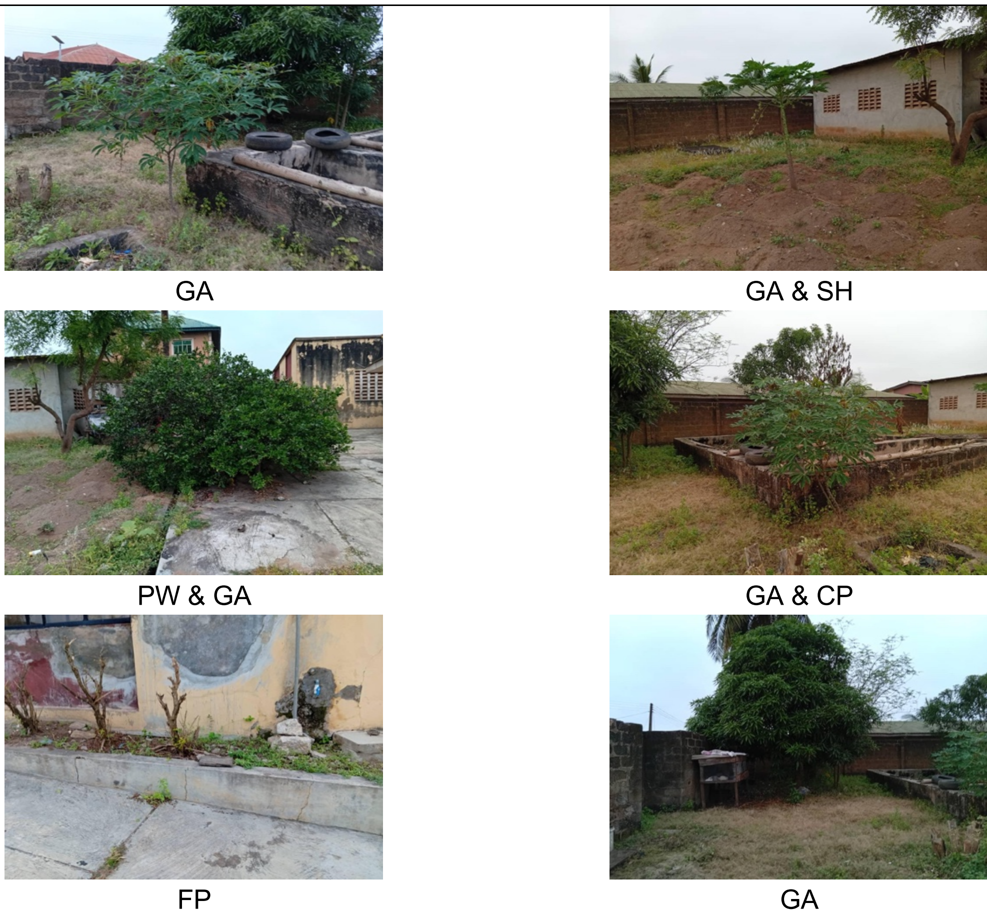

Plate 2. Green infrastructure in the spaces (Site Location B)
Source: Components' photographs, Author's field survey, 2025

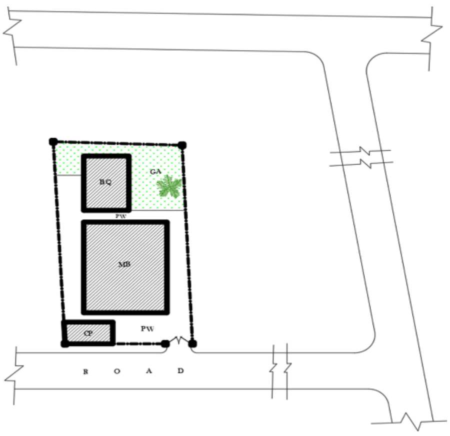

Figure 5. Site plan of Location C
Source: As-built Survey prepared by Authors (AutoCAD), 2025

Figure 6. Google map showing the grey and greenspaces on Location C
Source: Google Maps imagery, 2025

Table 3. Statistical Analysis of the Location C

Index	Names	Area (sq. metre)	Sub-area (sq. metre)	Infrastructure	Percentage covered (%)
MB	Main building	197.868			
BQ	Boys' Quarter	69.747	302.882	Grey	48.43
CP	Car Park	35.597			
CW	Paved Walkway	230.014	322.530	Green & Blue	51,57
GA	Garden	126.186			
	Total	**625.412**	**625.412**		**100.00**

Source: Authors' analysis

The assessment of Site Location C, with more than 50% of its landmass occupied by buildings, revealed that despite the high level of development, the remaining undeveloped portions continued to support a modest and ecologically meaningful mix of vegetation. This high-density development results in maximum impervious surfaces, which significantly reduce vegetation cover, circulation spaces, and limited opportunities for supporting nature and biodiversity. The planning restricts the amount of continuous natural ground surface; however, the presence of existing vegetation, besides the boys' quarters, provides a valuable foundation for ecological restoration, microhabitat creation, and sustained biodiversity improvement and protection. The existing vegetation, though limited and spatially fragmented, plays an important role in moderating the local microclimate, providing green space at the rear, supporting small invertebrates, and contributing to the overall environmental quality of the plot. This shows that even compact residential sites can retain ecological value when vegetation is intentionally preserved or incorporated into landscape design.

The primary implications of this high development density are reduced habitat size and continuity, which limits the types of flora and fauna that can flourish. Vegetation patches at the back of the building are constrained due to the lack of adequate spaces that limit the growth of larger native species. These minor vegetative types still provide essential ecosystem functions, such as offering foraging materials for butterflies and beneficial insects and supporting basic nutrient cycling within the site. These limited biodiversity values are also enhanced by container-based planting like movable pots or raised boxes that attract insects, birds, and pollinators.

Plate 3 Green infrastructure in the spaces (Site Location A)
Source: Components' photographs, Author's field survey, 2025

The study concurs with Kirk et al. (2021) and Kowarik (2020) that biodiversity needs to be integrated into the planning right from the preliminary stages of the development to enhance the preservation of the components that could produce ecosystem services. This is also in line with Chitkara University (2023), with the study on integrating all essentials of biodiversity into the design through the use of local species in order to improve the local ecosystem. The study is also in concordance with Adebara et al. (2023), which established that adequate setbacks in building design and construction must be observed to ensure adequate open spaces for biodiversity restoration. Severijnen (2018) also made a recommendation that architects should integrate biodiversity goals at the core of the projects so that designs arrived at will be able to conserve, protect, and manage the habitat. Weisser (2021) also conducted research which emphasized that architecture should not be human-centered alone, and that adequate attention and support need to be given to the integration of ecology into the design concepts of architectural development. The study also corroborated seven ecological principles that building professionals (planners, architects, and landscape architects) need to bridge in biodiversity planning (Parris et al., 2018). All the seven principles were adequately attended to in the study just investigated, with adequate integration of nature and natural processes into the city planning. Architectural site planning can significantly enhance biodiversity and contribute to achieving SDGs by integrating ecological considerations into the built environment (Opoku, 2024; Hendaway et al., 2024). This study particularly supports SDG 15, emphasizing that thoughtful site planning—incorporating green spaces, vegetative covers, and the conservation of native plant species—is highly relevant to Oyo's informal settlements and expanding residential areas, as it can assist in managing sprawl, reducing environmental degradation, and creating healthier living conditions.

Conclusion

The findings from this study underscore the critical role of architectural site planning as a tool for biodiversity improvement in building design and construction. In Oyo, where urbanization continues to alter the natural landscape, integrating ecological principles into land development processes presents a practical pathway towards sustainable urban growth. The case study demonstrated that by preserving and enhancing natural site features, strategically locating buildings, and incorporating green infrastructure, it is possible to transform conventional building plots into ecologically responsive and biodiversity-friendly environments. Comparatively, the three sites illustrated that maintaining vegetation, even in heavily built-up residential plots, contributes significantly to biodiversity protection and ecological stability, ranging from small scale to large scale improvement.

The solution to a series of urban problems can be achieved through various types of interventions that include green, gray, and hybrid in developmental projects. Architects, since time immemorial, have been busy with the design of both gray and green infrastructure to ensure a viable solution to any brief, but more attention has always been given to gray infrastructure. In most production drawings, architects do not bother about the design of green areas in the site planning, which provide diversity functions for ecosystem services. Also, less attention is also given to green infrastructures on the site for effective restoration after the completion of the project. The site plan should also be a reflection of green plants/vegetation on the site to ensure that the structure harmonizes with the environment to support local biodiversity. Although site planning alone cannot guarantee biodiversity net gain, as recently enacted in the United Kingdom, open spaces surrounding the building should be adequately planned to create a balance between human-made structures and the natural environments. This reinforces the potential for replicating such approaches across other plots and communities in Oyo, supporting a localized response to global environmental challenges.

The study also offers a replicable framework for architects, planners, developers, and local authorities in Oyo and beyond, encouraging them to view site planning not only as a spatial or functional process but as an environmental stewardship strategy. Biodiversity improvement through architectural site planning should be positioned as a core component of sustainable development efforts, especially in areas and localities experiencing rapid urbanization and ecological decline.

Recommendations

Based on the studies carried out, it is hereby recommended that architects, who are the beginner and the finisher of a project, should guide and protect natural components of the site in the building development process. Architects' efforts should be geared towards reducing the buildable areas to the minimum and ensuring the restoration of vegetation and plants destroyed during construction. Architects are deeply involved in the built environment; planners who approve developmental projects should always put a check on this area in order to ensure biodiversity protection in the environment. This involves leaving a large percentage of land area for green infrastructure and making the design compact. The site planning procedure can be applied to building concepts at various scales, from individual buildings to the entire layout of subdivided land and to the entire city landscape. The development control agencies should mandate biodiversity-sensitive site planning during the building approval process. This includes minimum green cover percentages, use of native plant species, and incorporation of habitat-supportive features. All these should be checked to ensure compliance with drawings and production documents approved by the local planning authorities. Development control authorities, urban planners, architects, and construction professionals should integrate the integration of natural features into site layout plans from the earliest stages of design.

Efforts should be made to ensure compliance with open space regulations and plot sizes in the planning of drawings and approval in the communities. The Town Planning Authorities must strengthen the enforcement of existing building regulations regarding open spaces, setbacks, and landscaping. Continuous monitoring and routine site inspections need to be carried out, and appropriate penalties for non-compliance should be institutionalized. Also, substandard plots for urban development, which are based on profit for the vendors, should be discouraged through appropriate sanctioning by the planning authorities. The layout/master plan of any urban development that fails to meet the standards adopted by various tiers of planning authorities should be disapproved and prevented from being implemented. This should also be implemented through sensitization of the residents and building owners about the environmental and health benefits of adequate plot sizes that can help to sustain biodiversity initiatives. The curriculum in architecture and urban planning schools should also emphasize ecological site planning, sustainable landscaping, and biodiversity conservation to shape future professionals. Capacity-building programmes and workshops should be organized to train local professionals, sub-professionals, and community developers on low-impact development techniques and nature-based design strategies. Also, urban planning policies should be revised to include biodiversity conservation in land use development and monitored for effective and efficient implementation, thereby creating resilient, inclusive, and environmentally sustainable built environments.

Acknowledgement

The authors gratefully acknowledge the residents of Abojupa Community, Oyo, for their co-operation and support during field data collection. We sincerely extend our appreciation to the three community members who granted access to their residential buildings to capture the details of the green infrastructure used in the study. Special thanks for the time and local knowledge, which were invaluable to the successful completion of this research. Their willingness to collaborate really assisted in carrying out the assessment of the greens in their various quarters.

References

Abdelaal, M. S. and Soebarto V. (2019). Biophilia and Salutogenesis as radiative design approaches, in healthcare architectures. *Architectural Science Review*, 62, 195-205 DOI: 10.1080/00038628.2019-1604215

Abdetaal, M. S. (2019). Biophilic campus: An emerging planning approach for a sustainable innovation-conducive University. *Journal of Clean Production*, 215, 1445- 1456. DOI: 10.1016/j.jcbepro-2019.01.185

Abdullahi, A., Audi, I.A., Dangyi, A.I.S., Gadanya, H.S. and Garba, N. (2020). Green infrastructure from economic, social and environmental perspective: A tool for achieving sustainable cities in Nigeria. *Sokoto Journal of Geography and the Environment*, 2, 34–48.

Adams, D., Tiesdell, S. and White, J. T. (2013). Smart parcelization and place diversity: Reconciling real estate and urban design priorities. *Journal of Urban Design*, 18(4), 459-477 https://doi,org/10.1080/13574809.2013.824367

Adebara, T. M., Adebara, O. B., Odufuwa, B. O., Badiora, A. I., Taiwo, A. O., Dada, O. T. and Odunsi, O. M. (2023). Compliance with open space standards in Residential area of Oyo, Nigeria. *Journal of Asian and African Studies*, 60(3) https://doi.org/10.1177/0021909623119772

Adegun, O. B. (2021). Urban Green Infrastructure in Nigeria: A review. *Scientific African*, 13, e01044. https://doi.org/10.1016/j.sciaf.2021.e01044

Adejumo, S. A. and Badiru, F. O. (2024). Residents' compliance with building setbacks in Ibadan North Local Government Area of Oyo State, Nigeria. *Wukari International studies Journal*, 8(5), 64-75

Agheyisi, J. E. (2018). Land subdivision in peri-urban areas of sub-saharan African cities: Conceptual definitions and policy guidelines. *Ghana Journal of Geography*, 18(1), 98-128 https:dx.doi.org/10.4314/gjg.v10i1.6

Alagappan, V. (2015). Appropriate pedagogical approaches for conduct of site planning and built environment studio in spatial planning education programs. *International Journal of Built Environment and Sustainability*, 2(3) 211-218

Allan, J. R.; Possingham, H. P.; Atkinson, S. C.; Waldron, A.; Di Marco, M.; Butchart, S.; Adams, V. M.; Kissling, W. D.; Worsdell, T. S.; Sandbrook, C.; Gibbon, G.; Kumar, K.; Mehta, P.; Maron, M.; Williams, B. A.; Jones; K. R.; Wintle, B. A. and Reside, A. E. (2022). The minimum land area requiring conservation to safeguard biodiversity. *Science*, 376(6597), 1094-1101 DOI: 10:1126/science.abl9127

Angel, S. (2023). Urban expansion: Theory, evidence and practice. *Buildings and Cities*, 4(1), 124-138 https://doi.org/10.5334/bc.348

Aribigbola, A. (2008). Improving urban land use planning and Management in Nigeria: The case of Akure. *Theoretical and Empirical Researches in Urban Management*, 3(9), 1-14

Arimah, B. and Adeagbo, D. (2000). Compliance with the urban development and planning regulations in Ibadan, Nigeria. *Habitat International*, 24(2000), 279-294

Aronson, M. F. J., Lepczyk, C. A., Evans, K. L., Goddard, M. A., Lerman, S. B., Maclvor, J. S., Nilon, C. H. and Timothy, V. (2017). Biodiversity in the city: Key challenges for urban green space management. *Frontiers Ecological Environment* 15(4), 189-196 https://doi.org/10.1002/fee.1480

Aronson, M. F., Lepczyk, C. A., Evans, K. L., Goddard, M .A., Lerman, S. B., MacIvor, J. S., Nilon, C. H. and Vargo, T. (2017). Biodiversity in the City: Key challenges for urban green space management. *Frontiers in Ecology and the Environment*, 15(4), 189–196, DOI: 10.1002/fee.1480

Ayeni, D. A, Olalusi, C. A. and Tukur, R. B. (2017). Sustainable site planning and the architect's role. *Academic Journal of Science*, 7(3), 47-56

Babalola, O., Ndimako, O. and Nduka-Kalu, C. (2024). A snapshot of Nigeria's biodiversity loss: Architecture implications. *Arts and Humanities*, doi:10.20944/preprints202408.1557.v1

Bekiryazici, F. (2024). Short note - Ecological approaches m Landscape design and planning, *International Journal of Progressive Research in Engineering Management and Science*, 4(1), 49-52 www.djprems.com

Biella, P., Bani, L., Caprio, L., Cochis, F., Dondina, O., Fiorilli, V., Genre, A., Gentili, R., Orioli, V., Ranalli, R., Tirozzi, P. and Labra, M. (2025). Bio-diversity friendly practices to support urban nature across ecosystem levels in green areas at different scales. *Urban Forestry and Urban Greening*, 105(128682) https://doi.org/10.1016/j.ufug.2025.128682

Bolokova, E., Marcus, L., Pont, M. B., Stavroulaki, I. and Bolin, D. (2019). Structure of plot systems and economic activity in cities: Linking plot types to retail and food services in London, Amsterdam and Stockholm. *Urban Science*, 3(66), 1-22 doi: 3390/urbansci3030066

Booth, N. K. and Hiss, J. E. (2012). Residential landscape architecture design process for the private residence. Prentice hall, New York.

Brown, J. D., Vega, K., Grossinger, R. and Scuto, L. (2025). Catalysing biodiversity on buildings: A review of supporting initiatives in European cities. Gland, Switzerland

Cabernard, L., Pfister, S. and Hellweg, S. (2024). Biodiversity impacts of recent land-use change by increases in cropland imports. *Nature Sustainability,* 7, 1512–1524. https://doi.org/10.1038/s41893-024-01433-4

Ceballos, G. and Ehlich, P. (2018). The misunderstood mass extinction, Science, 08 Jun, 2018, 360 (6393), 1080-1081

Cengiz, A. E. (2013). Impacts of proper land uses in cities on the natural environment and ecological landscape planning. In M. Ozyavuz (ed.) Advances in landscape architecture, 19-52 http:dx.doi.org/10.5772/55755

Chang, S., Su, K., Jiang, X., You, Y., Li, C. and Nang, L. (2023). Impacts and predictions of urban expansion on habitat connectivity networks: A multi-scenario Simulation approach. *Forests*, 14(11), 2187 https://doi.org/10.3390/f14112187

Chitraka University, (2023). The role of architecture in shaping cities and communities http://www.chitraka.edu.in

Conway, H. and Roenisch, R. (2005). Understanding architecture. An introduction. Routledge, New York

Cousins, S. (2024). How to boost your site biodiversity's net gain. RIBA Journal https://www.rtpl.org.nk

Cox, D. T. C., Shanahan, D. F., Hudson, H. L. Fuller, R. A. and Gaston, K. J. (2018). The impact of urbanization on nature dose and the implications for human health. *Landscape and Urban Planning*, 179, 72-80 https://doi.org/10.1016/j.landurbplan.2018.07.013

Danmallam, B. A., Ngila, P. M., Iniunam, I. A., Kuria, A., Tende, T., Ngugi, S., Njoroge, P., Jackson, C., Okoth, B., Ottosson, B., Chaskda, A. A. and Trevelyan, R. (2024). Ecological consequences of Urbanization in Afrotropical bird community. *Frontiers Conservation Science*, 5(15034080) doi:10.3389/fcosc.2024.1503408

de Ledesma, A. P. (2021). Biodiversity. The challenge for architects https//mybeautiful adventures.com

Elmqvist, T., Zipperer, W. C. and Guneralp, B. (2016). Urbanization, habitat loss and biodiversity decline: Solution pathways to break the cycle. In K. C. Seto, W. D. Solecki and C. A. Griffiti, Routledge Handbook on Urbanization and Global Environmental Change, 139-151, London, Taylor and Francis Group.

Enriquez, M. O., and Trinida, D. R. (2022). A biodiversity conservation area using holistic and modular architecture. Civil engineering and architecture, 10(7), 2809-2819.

Garg, A. and Dewan, A. (2022). Site Plan, in Manual of Hospital Planning and designing, Springer, Singapore.

Garrah, J., Berton, K. and Chen, S. (2017). Urban biodiversity through sustainable architecture and urban planning. *McGill Undergraduate Research Journal*, 12(1), 25-28 https://doi.org/10.26443/msurj.v112i1.40

Goddard, M. A., Dougill, A. J. and Benton, T. G. (2010). Scaling up from gardens: Biodiversity conservation in urban environments. *Trends in Ecology and Evolution*, 25(2), 90–98 https://doi.org/10.1016/j.tree.2009.07.016

Green Building Council, (2014). Sustainable sites www.cabrillo.edu

Gul, A., Dinc. G. and Gul, H. E. (2022). Relationship and integration of building and landscape design project in design. International Architectural Sciences and Application Symposium, Sept 9-11, 2022, Baku, Azerbjan 788 – 814

Gupta, J. K. (2024). Identifying, analysing and planning sites for architectural projects. College of Architecture IET Bhaddal, Punjab. https://www.academia.edu>identifying

Hakimi, H. and Firoozabadi, S. Y. (2018). Urbanism, architecture and urban development. *European Journal of Sustainable Development*, 7(1), 265-278 DOI:10.14207/ejsd.2018.v7n1p265

Hendaway, M., Junaid, M. and Amin, A. (2024). Integrating sustainable development goals into architectural curriculum: Experiences and perspectives. *Cities and Environment Interactions*, 21(100138) https://doi.org/10.1016/j.cacint.2023.100138

Huang, Z., Su, K., Yu, S., Jiang, X., Li, C., Chang, S. and You, Y. (2025). Reconciling urban expansion with biodiversity: Habitat dynamics and ecological connectivity in Xiong'an new area's full-cycle development. *Land*, 14(3), 533 https:doi.org/10.3390/land14030533

Ibrahim, A. (2022). Architectural projects design methodology process: Design drawimg sequence band general notions. Lambert Architectural Publishing, Latvia

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), 2019. Global assessment report on biodiversity and ecosystem services: Summary for policy makers.https://files.ipbes.net

Jato-Espino, D., Capra-Ribeiro, F., Moscardo, V., Bartome del Pino, L.E., Mayor-Victoria, F., Gallardo, L.O., Carracedo, P. and Dietrich, K. (2023). A systematic review of ecosystem services provided by green infrastructure. Urban Forestry and Urban Greening, 86. https://doi.org/10.1016/j.ufug.2023.127998

Jefferis, A., Madsen, D .A. and Madsen, D. P. (2011). Architectural drafting and design. Delmar Cengage Learning, News York

Jiang, B., Song, Y., Li, X., Lau, S. S. Y. and Lei, Q. (2020). Incorporating biophilic criteria in green building rating tools: Case study of Green Mark. *Environment Impact Assessment Review*, 82, 10630 https://doi.org/10.1016/j.elar. 2020.106380

Johnson, B. J. 2015. Site planning for planners: The view from the other side. *Journal for Education in the Built environment*, 4(1), 31-56 https://doi.org/10.11120/jebe.2009.04010031

Jozwik, R. (2024). Architectural and urban changes in a residential environment – Implications for design science. *Sustainability*, 16(10) https://doi.org/10.3390/su16103987

Karaman, O., Sawyer, L. Schmid, L. and Wong, K. P. (2020). Plot by plot: Urbanism as an ordinary process of urbanization. *Antipode*, 52(4), 1122-1151 DOI:10.1111/anti.12626.hal-0310270

Kassouri, Y. (2021). Managing the spatial spill-over effects on water, built-up land and ecological footprints in Sub-Saharan Africa. *Journal of Environmental Management*, 300(113690) doi:1016/j.jenvman.2021.113690

Kaythan, K. S. (2019). Examination of biophilia phenomenon in the context of sustainable architecture proceeding 2nd International Sustainable Buildings Symposium (ISBS 2017 https: // www. springer professional. de

Keeve, N. (2023). Towards multispecies spaces: Rethinking architectural practice in the context of urban biodiversity loss. Master Thesis submitted to School of Arts, Design and Architecture, Aalto University.

Kellert, S. R. (2018). Nature by Design: The practice of biophilic design, Yale University Press, New Haven and London https://dokumen.pub> nature-by-design.

Kilmer, W. O and Kilmer, R. (2009). Construction drawings and details for interiors: Basic Skills. John Wiley and Sons: New Jersey

Kim, D. and Song, S. (2019). The multifunctional benefits of green infrastructure in community development; An Analytical Review Based on 447 Cases. Sustainability, 11(14), 3917. https://doi.org/10.3390/su11143917

Kirk, H., Garrard, G. E., Croeser, T., Backstron, A. Berthon, K., Furlong, C., Hurley, J., Thomas, F., Webb, A. and Bekessy, S. A. (2021). Building biodiversity into the urban fabric: A case study in applying biodiversity sensitive urban design. *Urban Forestry and Urban Greening,* 62, 1-14.

Koat, J. (2020). Biodiver_cities: Supporting native biodiversity in the built environment. A thesis submitted to Victoria University of Wellington for the degree of Master of Architecture.

Korkut, A., Kiper, T., Topal, T. 4. (2017). Ecological approaches in urban landscape design. *Artium*, 5(1), 14-26

Kowarik, I., Kendal, D. and Fisher, L. K. (2020). Biodiversity Conservation and sustainable urban development. *Sustainability*, 12, 4964. Doi: 10.3390/ Su/12124964

Kubba, S. A, (2009). Blueprint reading: Construction drawings for building trades. McGraw-Hill Companies, New York.

Kuddus, M. A., Tynan, E. and McBryde, E. (2022). Urbanization: A problem for the rich and the poor? *Public Health Reviews*, 41(1) https://doi.org/10.1186/s40985-019-0116-0

Kwang, Y., Zhou, H. and Yin, L. (2024). Assessment of the impact of land use on biodiversity based on multiple scenarios: A case study of South-west China. *Diversity,* 16(10), 630. https://doi.org/10.3390/d16100630

Lagrow, J. A. (2008). Site Analysis: A contextual approach to sustainable land planning and site design. Canada, John Wiley and Sons, Inc.

Lai, H., Flies, E. J., Weinstein, P. and Woodward, A. (2019). The impact of greenspace and biodiversity on health. *Frontier Ecological Environment*, 17(7), 383-390 https://doi.org/10.1002/fee.2027

Landau, P. (2022). Architecture design process: A quick guide. Construction Resource Management https://www.project manager.com

Lazzarini, L., Mahmoud, I. H. and Pastore, M. C. (2024). Urban planning for biodiversity. TeMA *Journal of Land Use Mobility and Environment*, 19(2024), 45-60 https://dx.doi.org/10.6093/1970-9870/10197

Li, X., Ou, X., Sun, X., Li, H., Li, Y. and Zheng, X. (2024). Urban biodiversity conservation: A framework for ecological network construction and priority areas identification considering habitat differences within species. *Journal of Environmental Management*, 365(2024) https://doi.org/10.1016/j.jenvman.2024.121512

Li, X., Stringer, L. C. and Dallimer, M. (2022). The impacts of urbanization and climate change on the urban thermal environment in Africa. *Climate*, 10(11), 163 https://doi.org/10.3390/cli10110164

Liu, G., Fang, C., Li, Y., Wang Z., Sun, S., He, S., Qi, W., Bao, C., Ma, H., Fan, Y., Feng, Y. and Liu, X. (2022). Global impacts of future urban expansion on terrestrial vertebrate diversity. *Nature Communications*, 13(1628) https://doi.org/10.1038/s41467-022-29324-2

Liu, N., Liu, Z. and Wu, Y. (2025). Direct and indirect impacts of urbanization on biodiversity across cities. *Remote Sensing*, 17(6) https://doi.org/10.3390/rs17060956

Liu, Z., He, C. and Wu, J. (2016). The relationship between habitat loss and fragmentation during urbanization: An empirical evaluation from 16 world cities. *PLOS One*, 11(4):e0154613 DOI:10.1371/journal.pone.0154613

Lynch, K. and Garry, H. (1984). Site Planning, Massachusett USA, MIT Press

MacKinnon, M., Zari, M. P. and Brown, D. (2021). Architecture as habitat: Enhancing urban ecosystem services using building envelopes, *Advances in Environmental and Engineering Research*, 2(4) doi:10.21926/aeer.2104029

Madsen, D. A. and Madsen, D. P. (2017). Modern residential Construction practices. Routledge, Taylor and Francis Group, London and New York.

Marsh, M. (2021) 1/what-is-site-planning. https://marsh-Partners.com?blog.

Mohamed, A., DeClerck, F., Verburg, P. H., Obura, D., Abrams, J.F., Zafra-Calvo, N., Rocha, J., Estrada-Carmona, N., Fremier, A., Jones, S. K., Meier, I. C. and Stewart-Koster, B. (2024). Securing nature's contribution to people requires at least 2%–25% (semi-) natural habitat in human-modified landscapes. *One Earth*, 7(1), 59–71. https://doi.org/10.1016/j.oneear.2023.12.008

Mona, M. (2025). How architecture impacts society: Influences on culture, economy and well-being. INJ Architects https://injarch.com

Mouratidis, K. (2021). Urban planning and quality of life: A review of pathways linking the built environment to subjective well-being. *Cities*, 115(103229) https://doi.org/10.1016/j.cities.2021.103229

Nabirye, K. (2024). The impact of architecture on urban spaces and community interaction. *Research Output Journal of Education*, 4(3), 17-20 DOI:10.59298/ROJE/2024/431720

Obrecht, A. Sphen, E. M., Pham-Truffert, M. and Payne, D. (2021). Achieving sustainable development goals with biodiversity. *Swiss Academy of Sciences*, 16(1) DOI:10.5281/zenodo.4457298

Odekunle, J. F., Adebayo, G. O., Onabanjo, E. O. and Sekoni, S. O. (2019).The problems and challenges of development in south-west zonal Planning area, Ogun State, Nigeria. *Africa Journal of Economics and Sustainable Development*, 2(1), 9-27

Ojo, B. O. (2024). Urban design and planning: Integrating nature and built environment. *Landscape Architecture and Design*. DOI:10.5772/intechopen.1006805

Okegbola, M. O. (2019). Urban sprawl dynamics of Oyo Town, Unpublished Master of Science Thesis in Remote Sensing, University of Nigeria, Enugu Campus, Nigeria.

Oladunjoye, K. G. K. 2016. Roles of open spaces to environmental safety in Nigeria. *Journal of Environmental Sciences and Resources Management*, 8(1), 78-91

Olanusi, J. Akingbohungbe, D. O. and Adamu, M. (2024). Architecture as stimulus for growth and economic development in Nigeria. *Global Journal of Science Frontier Research: Environment and Earth Science*, 15(2), 23-29 https:journalofscience.org/index-php/GJSFR

Olotuah, A. O. and Bobadoye, S. A. (2009). Sustainable housing provision for the urban poor: A review of public intervention in Nigeria. *The Built and Human Environment Review*, 2, 51-63.

Ombeni, S., Mbosha, D. and Mpyanga, S. (2021). Urbanization and vulnerability of architectural heritage: The case of Dar es Salam CBD. *Conservation*, 1, 216-227 https://doi.org/10.3390/conservation1030017

Opoku, A. (2019). Biodiversity and the built environment: implication for sustainable development goals. *Resources Conservation and Recycling,* 14, 1- 7

Oyeyode, A. O., Alaigba, D. and Ajani, A. O. and Ilesanmi, O. I. (2023). Spatio-temporal measurements of urban sprawl in Oyo Town. *African Journal on Land Policy and Geospatial Sciences*, 6(1), 094-196 https://doi.org/10.48436/IMIST.PRSM/ajlp-gs.v6ij.34547

Panlasigui, S., Spotswood, E., Beller, E, and Grossinger, R. (2021). Biophilia beyond the building: Applying the tools of urban biodiversity planning to create biophilic cities. *Sustainability,* 13(2450) https://doi.org/10.3390/su13052450

Park, S. Chang, P. and Ali, Z. S. 2020. Landscape architecture solution to biodiversity loss. American Society of Landscape Architects.

Parris, K. M., Amati, M., Bekessy, S. A., Dagenais, D., Fryd, O., Hahs, A. K., Hes, D., Imberger, S. J., Livesley, S. J., Marshall, A. J., Rhodes, J. R., Threlfall, C. G., Tingley, R., van der Ree, R., Walsh, C. J., Wilkerson, M. and Williams , N. S. G. , (2018). The Seven lamps of planning for biodiversity in the city. *Cities*, 83(2018), 44- 53. https://doi.org/10.1016/j.cities. 2018.06.007

Perez, G. and Perini, K. (2018). Nature-based strategies for urban and building sustainability. Butterworth-Heinemann, Genoa https:// doi.org/10.1016/C2016-0-03181-9

Petrik P., Fanta, J. and Petryl, M. (2015). It is time to change land use and landscape management in Czech Republic. *Ecosystem Health and Sustainability*, 1(9), 1-6 DOI:10.1890/15-0016.1

Ponteado, H. M. (2023). Effects of open space configurations and development patterns on future urban wild life habitats and populations. *City and Environment Interactions*, 19(100106) https://doi.org/10.1016/j.cacint.2023.100106

Puplampu, D. A. and Boafo, Y. A. (2021). Exploring the impact of urban expansion on green spaces availability and delivery of ecosystem services in the Accra metropolis. *Environmental Challenges,* 5(100283) https://doi.org/10.1016/jenvc.2021.100283

Rafiu, J. A., Afonja, Y. O., Albert, C. O. and Amoo, N. B. (2018). Spatio-temporal urban expansion analysis in a growing city of Oyo Town, Oyo State, Nigeria using remote sensing and GIS tools. *International Journal of Environment and Geo-informatics*, 5 (2), 104 – 113.

Rastandeh, A., Brown, D. and Zari, M. P. (2017). Biodiversity Conservation in urban environments: A review on the importance of spatial patterning of landscapes. *Ecocity World Summit,* 12-14 July. Melbourne, Australia https://www.researchgate.net/publication/318744800

Ren, Q., He, C., Huang, Q., Zhang, D., Shi, P, and Lu, W. (2023). Impact of global urban expansion on natural habitats undermine the 2050 vision for biodiversity. *Resources Conservation and Recycling*, 190(1), 106834 doi:10.1016/j.resconrec.2022.106834

Rios-Touma, B., Rosero, P., Morabowen, A., Guayasamí, J. M., Carson, C., Villamarin-Cortez, S., Solano-Ugalde, A., Tobes, I. and Cuesta, F. (2023). Biodiversity responses to land-use change in equatorial Andes. *Ecological Indicators,* 156. https://doi.org/10.1016/j.ecolind.2023.111100

Roe, D., Seddon, N. and Elliot, J. (2019). Biodiversity loss is a development issue: A rapid review of evidence. International Institute for Environment and Development. London https://pubs.iied.org

Royal Town Planning Institute, (2019). Biodiversity in planning, RTPI Planning advice. www.stpi.org.uk>biodiversity

Ryan, C. O. and Browning W. D. 2018. Biophilic design. Encyclopedia of Sustainability Science and Technology. In R. Meyers (Ed.). New York, Springer Zhong Chitkara University, 2023. Stephens, C. 2024. 10% biodiversity net gains: Planning requirements for new homes.

Salami, R. D., Oluwatimilehin, I. A. and Ayanlade, A. (2023). Spatial analysis of urban expansion, land-use dynamics and its effect on the surface temperature in Oyo town, Southwestern Nigeria. *City and Built Environment*, 1(15) https://doi.org/10.10775442132023-00017-w

Sarkheyli, E., Sharifi, A., Rafieian, M., Bemanian, M. and Murayamo, A. (2012). An investigation of the reasons for non-compliance with FAR regulations in Tehran. *Cities*, 29(4), 223-233 https://doi.org/10.1016/j.cities.2011.09.004

Severijnen, P. (2018). Biodiversity by design: Maximizing the biodiversity of Rivierenwuk, Utrecht by land scape architecture design. M.Sc. Thesis Submitted to Wageningen University, Landscape Architecture Group.

Simkin, R. D., Seto, K. C., McDonald, R. I. and Jetz, W. 2021. Biodiversity impacts and conservation implications of urban land expansion projected to 2050. *PNAS*, 119(12) e2117297119 https://doi.org/10.1073/pnas.2117297119

Sledge, D. A. (2023). Understanding architecture. https://www.researchgate.net

Somarakis, G., Stagakis, S., Chrysoulakis, N., Mesimaki M. and Lehvarırta, S. (2019). Think Nature-based solutions Handbook, European Union. https://doi.org/10.26225/jerv-w202

Sousa-Silva, R., Kestens, Y., Stephens, Z. P., Thierry, B., Schoeny, D., Fuller, D., Winters, M. and Smargiassi, A. (2025). Urban vegetation and well-being: A cross-sectional study in Montreal, Canada. *People and Nature*, 7(2), 398-414 https://doi.org/10.1002/pan3.10771

Suppula, M., Hallfors, M. H., Agapala, K., Aalto, J., Kemppainen, E., and Leikola, N., Pirinen, P. and Heikkinen, R. K. (2023). Climate and land-use change drive population declines in a red-listed plant species. *Global Ecology and Conservation,* 45. https://doi.org/10.1016/j.gecco.2023.e02526

Theodorou, P. (2022). The effects of urbanization on ecological interactions. *Current Opinion in Insect Science*, 52(100922) https:/doi.org/10.1016/j.cois.2022.100922

Tomic J., Krasic, S. and Kocic, N. 2023. The influence of generative design on the process of architectural space planning. SINARG 2023 Conference Proceeding, 543-564. 14-15 September, 2023 held at Science and Technology Serbia.

Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A., Niemelä, J., and James, P. (2007). Promoting ecosystem and human health in urban areas using green infrastructure: A literature review. *Landscape and Urban Planning*, 81(3), 167–178 doi:10.1016/j.landurbplan.2007.02.001

Van der Krabban, E., Tiwari, P. and Shuklar, J. (2022). A review of land development strategies for urban development: Technical function and rationales. *Town Planning Review*, 94(2) https://doi.org/10.3828/tpr.2021.52

Wakita, O. A. and Linde, R. M. (2003). The professional practice of architectural working drawings. John Wiley and Sons, New York.

Wang, D., Xu, P., An, B. and Guo, Q. (2024). Urban green infrastructure: Bridging biodiversity conservation and sustainable urban development through adaptive management approach. *Frontiers Ecological Evolution*, 12(144049) doi:10.3389/fevo.2024.1440477

Weisser, W. W., Hensel, M., Barath, S., Culshaw, V., Grobman Y. J Hauck, T.E., Jaschinsky J., Luding, F., Munet, A. Perini, K., Enrica, R., Schlofer, M., Scwartz, A., Hensel, D. S. and Volger, V. (2022). Creating ecologically sound buildings by integrating ecology architecture and computation design. *People and Nature*, 5, 4-20

Wu, S. Chen, B., Webster, C., u, B. and Gong, P. (2023). Improved human greenspace exposure equality during 21st century urbanization. *Nature Communications*, 14(6460) https://doi.org/10.1038/s41467-023-41620-z

Yu, P., Wei, Y., Ma, L., Wang, B., Yung, E. H. K. and Chen, Y. (2024). Urbanization and urban critical zone. Earth *Critical Zone*, 1(1), 100011 https://doi.org/10.1016/j.ecz.2024.100011

Zari, M. P. (2015). Ecosystem science analysis: Mimicking ecosystem services for generative urban design. *Journal of Sustainable Built environment*, 2001 (2015) 1- 4 https://dx.doi.org/10.1016/03. Ijsbe.2015.02.004

Zari, M. P. (2018). The importance of urban biodiversity: An ecosystem approach. *Biodiversity International Journal*, 2(4), 357-360 DOI:10.15406/bij.2018.02.00087

Zell, M, O. (2008). Architectural drawing course. Quarto Publishing, New York.

Zhong, W., Schroeder, T. Designing and Bekkering, J. (2022). Designing and nature: Advancing three-dimensional spaces in architecture through frameworks for biophilic design and sustainability. *Frontiers of Architectural Research*, 12 (2023), 732-753 https://doi.org/10.1016/j. foar. 2023.03.001

Zube, E. H. (2002). The significance and impact of contributions to environment-behaviour studies. In P. H Gobster, J. F. Palmer and J. Crystal, Environment and Behaviour 2003 http://eab. sagepub.com/cgi/content/abstract/35/2/165