BIOMIMICRY AS AN URBAN CHALLENGE IN SHAPING THE FUTURE OF CULTURAL COMMUNITIES

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Abstract
The cultural identity of urban communities is the main expression of historical privacy and shapes societies’ past, present, and future. It is an entity of cultural and knowledge accumulation stemming from the community's traditions and customs, which help to consolidate the social fabric and play an important role in the lives of individuals and the planning and development processes. Urban areas with cultural and heritage values are the most important competitive advantages of urban cities that are considered as a primary nucleus for achieving sustainability on a broader scale for the neighboring regions. One of the most important of those regions is Azbakeya Park and Sur region; this area has heritage value and Egyptian identity together. Despite that, it suffers from neglect over the past years, resulting in the region's urban, environmental, economic, and social deterioration. So the research aims to solve these problems by adopting a green framework that revitalizes this historical area in a biomimicry manner that integrates nature and landscape with the built environment portfolio that meets human needs, reduces carbon emissions, and increases biodiversity. The research deals with two entrances, the first is the theoretical one, which includes a documentary study of the region and the identification of the most problems it faces. The second entrance is the applied one, which includes a field visit to the area to identify the most important needs for users to provide these needs in line with the proposed solutions to achieve sustainability. Based on the theoretical and applied study, the research comes up with three proposals for a biomimicry urban framework as a green map that preserves the cultural and heritage identity of this vital region as it is considered the nucleus for the beginning of a sustainable biophilic path at the most comprehensive level.

Keywords
Cultural identity, Cultural and historical returns, Biophilic Urban Spaces, Biomimicry

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1. INTRODUCTION
Urban communities' cultural identities, which influence societies' history, present, and future, are the primary manifestation of historical privacy. It is a body of knowledge and cultural accumulation derived from local traditions and practices, and it has set and rigid principles, characters, and traits. This serves as the foundation for close relationships that strengthen the social fabric and are crucial to both individual lives and planning and development processes. An issue of an intellectual, cultural, and social setting is cultural identity; The Azbakeya Sur region, which has cultural and historical importance as well as a current Egyptian identity, is one of those regions that are most significant, and one of Egypt's first botanical gardens that represent the green lung of downtown Cairo, which is crowded and crowded with cars and shops.

1.1. Research Problem
Azbakeya Park and Sur region is considered one of the most vital areas of heritage and historical value in Cairo. Despite this, the area suffers from deterioration and neglect in terms of urban, environmental, and social aspects that lead to the deterioration of urbanization in the region as a whole and an increase in environmental and visual pollution. Soor el-Azbakeya is only a shadow of its former self. Many book-stalls have closed, and few passers-by spare more than a glance at the lonely booksellers. Sales are at their lowest point in decades, with the remaining booksellers facing the prospect of the market closing, Due to urban degradation and environmental pollution of the area.

1.2. Research Objectives
The main objective of the research is incorporating a sustainable strategy by creating an urban design framework utilizing biomimicry concepts as solutions to solve the problem of global warming to revive the Azbakeia Heritage Garden and the surrounding area and restore the splendor of this historical civilizational area (Riebeek, 2003). As it is one of the oldest botanical gardens in Egypt that represents the green lung of downtown Cairo, which is crowded with people, cars, and shops. This objective can be achieved through:

- Using biomimicry as a tool to provide direction and design ideas as a basis for putting into practice a sustainable strategy, the major goal is to create a design solution for the Azbakeia Heritage Garden and the surrounding area. The following are the steps to accomplishing this:
  - Become familiar with biomimicry urban design principles and tactics.
  - Evaluate the ideas of biomimicry and "green" urbanization.
  - Gain an overview of the neighborhood to sure the upcoming plan fits with the local character.
  - Offer an overall site development framework.

1.3. Research Methodology
The research methodology is based on two approaches: theoretical, and analytical studies. The theoretical one begins with a documented analysis of the area and the identification of its most pressing issues. And the second entrance, which is the applied one, entails a field trip to the region and a questionnaire for visitors to the area, and random samples of bookstall owners in the Azbakeia wall to identify their top needs and meet those needs in accordance with the solutions that have been suggested to achieve sustainability. The study develops a proposal for a biophilic urban framework for the area based on theoretical and practical research. This framework would incorporate urban areas, roadways, and pedestrian routes as a green map that preserves the region's cultural and heritage identity.

1.4. Scientific Addition
Creating a biomimicry urban framework for the Azbakeya Heritage Garden region as a green map that preserves the cultural and heritage identity of this vital area. Because of its strong cultural, social, urban, and economic returns, which can be considered a primary nucleus for achieving sustainability on the broader scale of the neighboring regions.
1.5. Research Challenge

How can biomimicry principles be employed to develop an urban planning framework for the Azbakeia region? It entails “copying the functional basis of biological shapes, processes, and systems to generate sustainable solutions” while using nature as inspiration - Pawlyn, 2011. In contrast to biophilia, which is concerned with the relationship between nature and people, biomimicry is focused on learning from nature - Jana, 2011. In terms of urban design and master planning for a development site in the Azbakeia region, the study investigates the justification for utilizing biomimicry as a design technique. The primary idea is that by combining different urbanism models with inspiration from nature, biomimicry may be used to create an urban design framework and identify design difficulties. To ascertain the needs and goals for the possible development, the field research combines site inspection with user consultation. Along with knowledge of sustainable building design, auxiliary data was gathered and used to identify flaws in best practice case studies. The study's ramifications include showing how nature can be used as a model for designing the built world. Working in tandem with sustainable urban design gives landscape and urban designers a helpful tool in their toolbox. The possibility exists for the adoption of this text as a Supplementary Planning Document. There is a need to create a framework that is sustainable and will limit the consequences on the local ecosystems given the exponential expansion rate of our crowded cities. To solve these problems, creative solutions must be created. One such method that aims to address these issues is biomimicry, which "takes an underutilized and frequently undervalued asset in the community and develops a feasible and sustainable economic use. “The Azbakeia region is home to a unique ecosystem that is portrayed in the Azbakeia Garden thanks to its rich natural scenery. This is a crucial aspect of the concept that should be considered, along with adding more public green space.

2. URBAN BIOPHILIA

Urban biophilia is a concept that is recognized as a crucial remedy for raising living standards and achieving urban sustainability. Numerous benefits of biophilic urbanism include increased food production, clean water and air, less stormwater runoff, and urban cooling. Several initiatives, like designs for streetscapes. It is an innovative method of urban planning that was developed with the goal of incorporating nature into urban settings (Radha, 2021). It can turn lifeless urban settings into regenerative and hospitable surroundings. The main goal of biophilic urbanism is to maintain the daily experience of nature as an essential component of urban life and to strengthen the link between city people and urban nature.

3. BIOPHILIC URBAN SPACES

Biophilia is considered one of the urban greening projects. The biophilic spaces movement aims to reframe nature as a crucial urban infrastructure by seamlessly fusing the area with the natural world to give everyone plentiful, accessible nature and commensurate improvements in health and well-being (Yassine & Ebrahim, 2018). Increasing connectedness to the natural world using direct nature, indirect nature, and space and place conditions are crucial to creating more biophilic spaces. It is argued that this concept, when applied to both building clusters and entire cities, has positive effects on urban environments’ economies, environments, and health (Daniels, et. al., 2020). One of the biggest resilient effects of this approach will be greater resident adaptability by reaching Biophilic Urbanism and Adaptive Capacity. People grow healthier and more physically fit because resilience-spaces actions motivate them to go outside and engage in activities.

4. BIOMIMICRY

Biomimicry points to require motivation from normal determination arrangements embraced by nature and deciphering the standards the human building. The biomimicry approach points to favor “choices” tried by nature which had millions of a long time to it what works best and what doesn’t. Plans taken after biometrics will eventually permit human preparations to be more effective, flexible, and maintainable. It is an approach to innovation that seeks sustainable solutions to human challenges by imitating nature’s time-tested designs and methodologies (Sutton, 2000).
The objective is to form items, forms, and policies - new ways of living - that are well-adapted to life on soil over the long pull. Bios mean life and Mimesis mean to emulate. Biomimicry is defined as mirroring motivation from nature’s shapes and forms and processes to create solutions to human problems (Baum, 2020). As the planned community realizes the huge effect human” developments had on the world, natural architects see strategies like biomimicry to progress with feasible plans (Klein, 2009). Biomimicry proved to have the ability as a method leading toward sustainability. Looking to nature as a model for sustainable development was an idea that originated to create a more sustainable way of living. Biomimicry can be very helpful in developing ideas for environmental stewardship, as well as sustainability (Bakirlio-Ğlu, 2012). This research investigates the potential benefits of biomimicry for urban planning. Biomimicry is a technique that uses nature as a model to solve human problems. It takes inspiration from natural designs and processes to improve our lives. With a focus on function and an underlying ethos that sees humans as nature, Biomimicry goes beyond the mere imitation of Shapes, patterns, and structures found in nature (Gamage & Hyde, 2006). Biomimicry is the imitation of nature for the purpose of creating a better-designed environment that performs similarly to nature. There is growing interest in biomimicry, which can be helpful in planning urban areas, but we don't yet know all the potential benefits. It encourages planners to realize sustainable designs and it enables planning for complexity (Zari, 2007).

5. URBAN PLANNING AND BIOMIMICRY
Planning aims to create a better living environment and ensure an adequate quality of life. Urban planning, transportation system, and land use patterns that empower strolling and cycling are useful to community livability. In any case, the changing environment affects nearby biological systems. The urban environment progressively faces dangers such as dry seasons and surges, while arriving utilize plans can be a nonstructural degree that can diminish destructive designs and progress supportability. The spatial measurement of keeping up normal frameworks makes "forms and connections between diverse arrive employments, environments, and biotopes at diverse scales and times (Salvador, 2014). This mindfulness has driven numerous modern concepts inside arranging that point to join information around the normal world such as environment administrations, green foundation, characteristic arrangements, mental biology, and biophilia. Biomimicry approaches a problem from nature’s point of view, inquiring the address ‘What would nature do here?’ Biomimicry contends that 3.8 billion a long time of life advancement can serve as refined motivation for our built environment. With a solid center on normal work, biomimicry moves absent from the unimportant imitating of common shapes, designs, and structures (Sim, 2019).

6. THE THREE CORE VALUES OF THE BIOMIMICRY APPROACH
Emulate, Ethos, and (Re) Connect are the three key components that the science of the practice uses to translate natural tactics into the design (Vavan, et. al., 2019). These three elements, which permeate every facet of biomimicry, epitomize these fundamental principles, shown in figures 1 and 2.
7. CULTURAL IDENTITY IN URBAN AREAS
Based on the structure and function of city life, which is an amalgamation of local cultural, sociocultural, and physical elements of the urban environment as the container, it is possible to see local cultural characteristics as establishing the identity of urban areas. Urban places can be understood if the city's identity is widely known and comprehended in terms of culture, customs, and characteristics. Metropolitan and local cultural components have a significant influence on shaping identity in urban areas.

8. APPLIED STUDIES OF “SOOR EL AZBAKEYA AND AZBAKEYA PARK”

8.1. Location
The area is located in Egypt, Cairo-Attaba. It is an impressive used book market with more than 130 book stalls. It dates to the late 19th century. This data is indicated in figure 3.

8.2. Historical Background
Azbakeya Park is one of the most important historical areas in Cairo in general and downtown in particular. It was established in 1872 and is located between the Opera and Ataba Squares. Although it
was one of the most advanced and important international parks, it has witnessed a significant deterioration over the past decades. Its founding dates back to 1864 AD when the pond that was in the middle of Opera Square was filled in, and in the same place in 1872 AD, the Azbakeya Park was established by the French engineer Barel Deschamps Bey, on an area of 18 acres surrounded by a wall of construction and iron and opened with doors on all four sides (Ahmed & Ahmed, 2019). On its outskirts was the "Khedivial Opera", which was burnt down, and one of the most important theaters in Egypt and the most ancient, the "Comedian Francoise". Because this region has a cultural and historical heritage that must be preserved, the region must be revived and developed in a contemporary way that preserves this heritage, shown in figure 4.

A field visit was made to the study area to identify the most important problems which the users face, and to out find their needs through a questionnaire of random samples of the place visitors, shown in figures 5, 6, and 7.

Fig. 4: Documentation study of Al-Azbakeya book market area.

Fig. 5: Decreasing of green elements and green spaces Problems of Azbakeya book market area.

Source: The author through field trip
Fig. 7: Deterioration of urbanization in the region as a whole and an increase in environmental and visual pollution.
Source: the author
8.3. Problem Issues
Through the field visit to the study area, the research deduced a group of problems, addressed in the proposal represented through table 1 and figure 8.

Table (1): The problem issues of the region
Source: The author

| Urban Problems | - Along with the tendency of urban growth, poverty and environmental degradation have been prominent in the area.
 | - The tall buildings and small streets caused an increase in air pollution.
 | - A significant traffic snarl-up.
 | - The urban ecology is harmed by streetscape operations that are not sustainable. The main causes of this degradation are traffic jams and unexpected overlaps between the use of urban spaces for commercial and administrative purposes.

| Environmental Problems | - The loss of green characteristics.
 | - The air is quite thick and contains many types of air pollution, including carbon monoxide (CO), on the streets because of the excessive amount of car exhaust and other pollutants.
 | - Health concerns are present because of the alarming rise in noise pollution.
 | - The loss of green characteristics

| Social Problems | - Urban spaces are constructed without consideration for the principle of liveliness (Mohammed, 2015).
 | - Green space and social connection are greatly lacking.
 | - The area's quality of life is severely hampered by the extreme levels of traffic, pedestrian congestion, and noise pollution.
 | - There are no seats or a reading area.

| Economic Problems | - Lighting in most streets is energy inefficient, the “sky glow” produced by the over-illumination negatively affects energy consumption.
 | - Unsustainable materials are used for streetscape, no management of recycling papers (Zafar, 2012).
 | - The bookstores are in poor condition and the zones for pedestrians’ movement are so narrow that the area has become a slum.
 | - Many areas cannot be provided with efficient infrastructure.

Fig. 8: Photos glimpse the problems and difficulties faced by users to obtain books.
Source: Photos captured by the author through the field visit

The questionnaire that was conducted for random visitors of the place to get acquainted with their needs and requirements and their top priorities, was concluded by:
- Convenience, and Communication with the external environment.
- A composition inspired by the nature of the place.
- Cozy and comfy furniture as well as ideal lighting. Like how different book sections can be ornamented based on the books' genre and intended readership. Stores can include a distinct reading
corner with appealing natural lighting. - The children’s section, for instance, can have a vibrant theme with decorations that appeal to and attract children.
- Stores can add a separate reading corner with an attractive natural lighting.
- Shading for outdoor area while searching for books.
- Seating for the elderly
- Almost of users Prefer places with good natural ventilation and lighting.
- The color of the interior finishes is calm and pleasing to the eye.

According to the visitor’s questionnaire and their needs the research suggests a form - shown in figure 9 - for the book stall combines between users’ needs and the concept of biomimicry based on the following case studies.

Fig. 9: A diagram of the important users’ needs of random samples of the place visitors (Form & Function).
Source: The author

From studies of current situation and results of the questionnaire, the research concludes the approximate proportions of form, function, and user needs are 5%, 10%, and 25%.

Then the research dealt with a group of case studies of the principle of biomimicry to extract a set of criteria related to form, function, and needs to be used in the proposal.

9. BIOMIMICRY CASE STUDIES
The research sheds light on examples of how nature may be incorporated into the constructed environment, including its dendriform structures, fractal geometries, and transparency. The science and philosophy of biomimicry is to learn from nature, and how trees can maximize their strength in design concepts by employing branches and arranging their fibers in such a way that stress is decreased in vulnerable areas. It highlights how dendriform, where tree-like structures have been employed and used to support structures in various buildings which are influenced by the design and function of trees.
Table 2: Case studies applied the principle of biomimicry.
Source: the author

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<th>PROJECT</th>
<th>CONCEPT &amp; FUNCTION</th>
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| A. Serpentine Pavilion for London’s Serpentine Galleries, Gando, Burkina Faso | **Form & function**
Diébédo Francis Kéré 2017
In many African communities, the tree serves as a gathering place for discussions about village affairs and ceremonies and acts as a stage for performances and storytelling. The Serpentine building by Kéré has a broad, canopy-like roof made of wood slats encased in transparent skin. Like leaves, it offers protection from the rain while providing shade and light filtering. The pavilion’s main body is composed of steel, and it has a central gap that directs water into an entrance in the "trunk" of the structure called an oculus. The classic design on the outer wall’s perforations promotes airflow while maintaining clear sightlines through the room to the surroundings beyond. | **BIOPHILIC**

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| B. Sou Fujimoto’s House of Music in Budapest’s City Park | **Form & function**
Sou Fujimoto
He took inspiration from the trees in the area and was drawn to the building's overhanging roof because it replicates the tree canopy that surrounds the enormous structure, which was completed in January 2022. The building is supported by several poles, and its unusual roof is interrupted by 100 holes, some of which serve as light wells and others as passageways for trees. | **BIOPHILIC**

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| C. Bus Terminal Slavonki Brod in Croatia | **Form & function**
SANGRAD+AVP architects’
Transparency is also important in this situation, with glass walls assisting in improving sightlines throughout the site and its retail spaces.

To discourage disruptive behavior. | **BIOPHILIC**
From the previous case studies, we can conclude that nature is the greatest architect, and modern design is strongly influenced by it. Sometimes, organic shapes and biophilic principles are directly applied from nature to the built environment and use a "looser" approach to inspiration when creating the designs. Accordingly, a proposal was suggested for the development of "Sur Al-Azbekiya" region, based on the idea of biomimicry as follows.

10. **RESEARCH PROPOSAL**

The research suggests a proposal for a biomimicry urban framework, shown in figure 10, to achieve biomimicry and sustainable area. Finding Vital Sustainability is the goal of a Biomimicry Structural Form, which can be seen as a fundamental requirement for survival in urban cities. From this vantage point, a Biomimicry Structural Form is a development in architecture's growth that ensures the preservation of architecture as a typology. Before design, determine the goals of the biomimetic structural form and the circumstances in which it will be used. Discover - it was completed to explore the geometry and function of natural structural models. Bengali fig tree's natural structural model was selected as a viable contender for a structural shape with exceptional structural performance. The purpose of the flow system in the Bengal fig tree is that the structure contains two different types of movements (flows): horizontally represented by the flow of people and activities, and vertically represented by the vertical illumination from the upper openings. Shading and users' communication with nature through using glass in facades and providing a healthy environment by removing carbon dioxide and producing oxygen.
A BIOMIMICRY URBAN FRAMEWORK

PROPOSAL

“BENGALI FIG TREE”

BIOPHILIC

BIOMIMICRY

SUSTAINABILITY

Fig. 10: A diagram shows a proposal for a biomimicry urban framework.
Source: the author

The Proposal ‘Bengali Fig Tree’
Ficus benghalensis is an evergreen, fast-growing tree. It is primarily found in monsoon and rainforest regions and can grow as tall as 30 meters (KEW, 2022). It can withstand light frost and drought. On the branches that droop downward like lianas, it creates replicating roots that grow there as aerial roots. As soon as these roots touch the earth, they take hold, grow roots, and develop into sturdy trunks, as referred in figures 11 and 12. The tree’s enormous canopy offers helpful shade in hot climates because of its size. Investigating the tree trunk's structural structure reveals the model's various modes of composition and connecting geometry. The vascular bundles in the central core, which move nutrients up and down the tree, are extremely dense (Al-Sehail, 2017). Each of these vascular bundles has a connection to a root system that sends fibrous roots deep into the ground (Bejan & Zane, 2012). Architecturally, the initial concept of a biomimetic structural form includes establishing the flow system's shape and construction of the buildings. The cultural identity of urban communities is the main expression of historical privacy and shapes societies’ past, present, and future. The vibrant urban areas with cultural and heritage values are among the most important competitive advantages of urban cities. One of the most important of those regions is Azbakeya Park and Sur region; One of Egypt's first botanical gardens that represent the green lung of downtown Cairo.

Fig. 11: Proposal concept of Ficus Benghalens tree for achieving sustainability.
Source: The author
Preserve “the rare Bengal fig tree” and present this iconic tree to all people thus it does not confine only to the garden – figures 13 and 14.

Fig. 12: A diagram shows the main five benefits of Ficus Benghalens tree.
Source: The author

Fig. 13: Drawings show the proposal form in plan, elevation, section, and layout.
Source: the author
CURRENT SITUATION BEFORE APPLIED THE PROPOSAL

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<thead>
<tr>
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AFTER APPLIED THE PROPOSAL

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Supplementary geometry (Taper, twist, and wrap)

Fig. 14: The proposal form as an application of concept of “the rare Bengal fig tree “as a recommendation to bookstores
Source: The author

Table 3: A table shows before & after applied the proposal with approximate proportions - Source: the author.
11. CONCLUSION

Some parks in Cairo with historical and cultural significance have seen deterioration and neglect in terms of urban, environmental, and social aspects, which has increased local urbanization and increased environmental and visual pollution. To secure the preservation of the urban, environmental, social, and economic components, these parks must be protected in a way that is sustainable and proportionate to their value over generations. The research's objective is to develop a biophilic urban framework using biomimicry concepts as solution to these issues, revitalize the cultural parks and the neighborhood, and restore the beauty of this historically significant civilizational location. The submitted research updates the application of the biomimicry principle and concentrates on sustainability at the building level. By using branches and organizing their fibers such that stress is reduced in vulnerable regions, trees can maximize their strength in design concepts, according to the science and philosophy of biomimicry. It demonstrates how dendriform - where tree-like structures have been used to support structures in different buildings that are influenced by the form and use of trees - has been utilized. Urban areas, roads, and pedestrian paths would all be incorporated into this framework to create a "green map" that protects the region's cultural and historical identity. A biomimetic structural shape raises sustainability as a virtue from a conundrum in the creation of modern architecture. From the previous case studies, we can conclude that nature is the greatest architect, and modern design is strongly influenced by it. Accordingly, a proposal was suggested for the development of “Sur Al-Azbekiya” region, based on the idea of biomimicry as follows: Sur Al-Azbekiya was developed using this strategy in accordance with the region's historical and cultural significance. We can conclude from the earlier case studies that nature is the greatest architect, and that modern design is greatly inspired by it. Accordingly, a plan based on biomimicry was proposed for the development of the "Sur Al-Azbekiya" region as follows: This method was used to create Sur Al-Azbekiya in line with the region's historical and cultural value.

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