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Mitigating Strategy for Urban Heat Island: Biomimicry Approach Case of Delhi

Anushka Dhankhar 1, Anway Kundu 2, Neha Basumatary 3, Sanika Khune 4, Amit Kumar Jaglan 5*

1 Department of Architecture, School of Planning and Architecture, New Delhi -110002, India; thedoer03@gmail.com
2 Department of Architecture, School of Planning and Architecture, New Delhi -110002, India; anwaytunak291102@gmail.com
3 Department of Architecture, School of Planning and Architecture, New Delhi -110002, India; nehabasumatary123@gmail.com
4 Department of Architecture, School of Planning and Architecture, New Delhi -110002, India; sanikakhune11@gmail.com
5* Department of Architecture, School of Planning and Architecture, New Delhi -110002, India; footprint1109@gmail.com

INTRODUCTION & AIM

The increasing population has raised the demand of large-scale urbanisation. This has given rise to a phenomenon known as Urban Heat Island (UHI), which refers to higher surface or air temperatures in the city centres as compared to the surrounding countryside. UHI is characterised by the local climatic conditions, urban fabric, materials and surfaces. Architects (2014) reported that for every 0.6 °C increase in summertime temperature, peak hour electricity demand rises 1.5 to 2% for Delhi. Mortality for populations in the European Union has been estimated to increase by 1 to 4% for each degree increase of temperature above a (locally specific) cut-off point (WHO 2011). But amidst the scorching streets and sweltering buildings, nature offers a wealth of ingenious solutions we can mimic to cool our cities down. Bioinspiration, also known as biomimicry, is a creative problem-solving approach that draws inspiration from nature to design and innovate in various fields. It provides not only functional but also aesthetic solutions.

Some of the bio-inspired processes include implementing high-reflectance materials, akin to the Saharan ant skin, mimicking the colour and reflectance differences found in zebra skin for differential heating, and incorporating vegetation and water features, inspired by evapo-transpiration in human skins.

These biomimetic principles find applications in various building elements. Kinetic facades dynamically protect from the sun. Use of high reflectance materials reduces the albedo. Incorporation of high and low reflectance materials of different colours induces convection currents through differential heating. Interspersed green walls and water features and porous, water retaining materials provide localized evaporative cooling.

This research explores the application of biomimetic principles, such as bio-inspired materials and green infrastructure, to create sustainable urban spaces that reduce UHI effects. The study examines the potential of biomimicry in promoting thermal comfort, energy efficiency, and overall resilience in urban landscapes.

METHOD

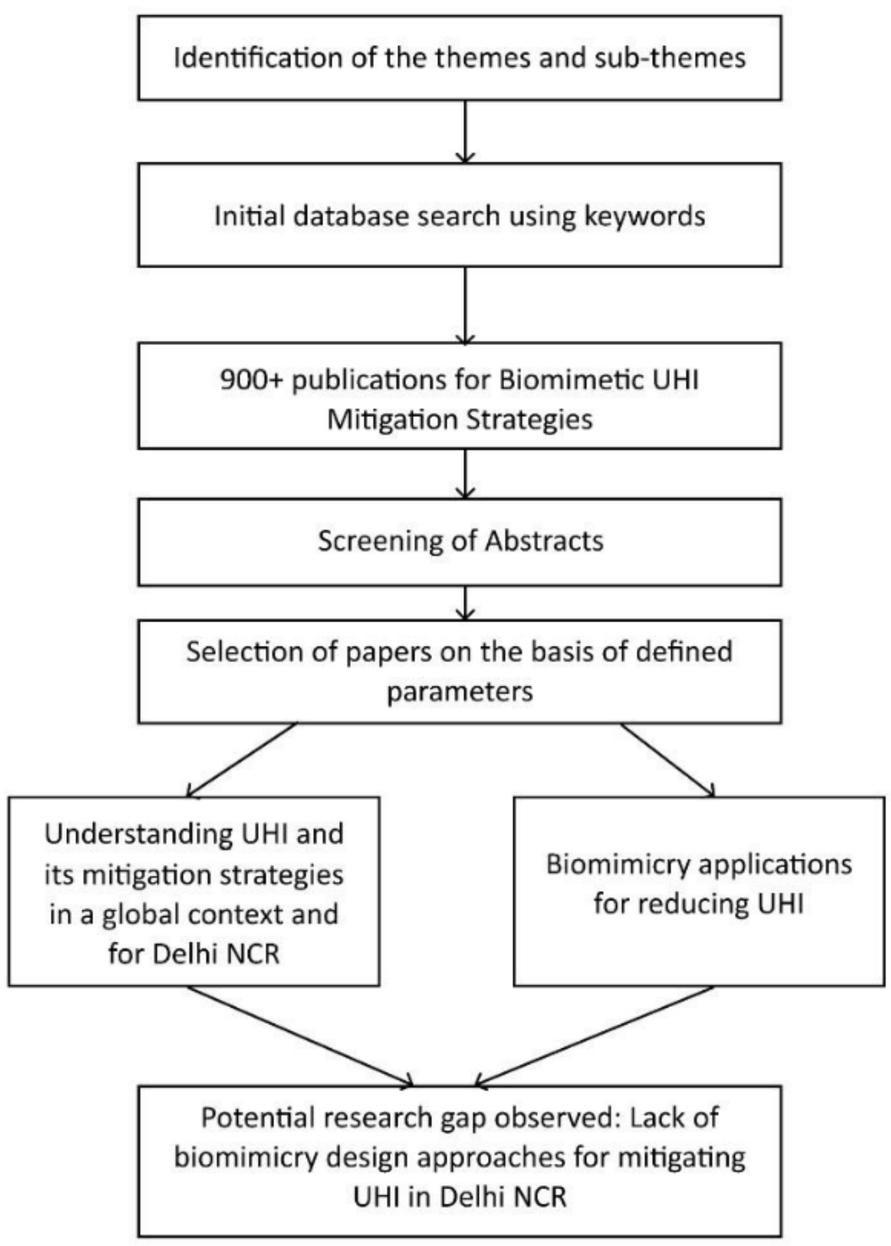

Figure 1. **Methodology**

The paper will examine **the impact of building design on the impact of urban heat islands** (UHI) **and explore biomimicry as a mitigation strategy**. To conduct extensive literature searches using academic databases such as ScienceDirect, Scopus, and Web of Science. Search terms include "building design," "urban heat island," "biomimicry," "passive cooling," and "urban sustainability."

RESULTS & DISCUSSION

	Principles	Description	Secondary Principles
1	**Resource (material and energy) efficient**	This is skilfully and conservatively taking advantage of resources and opportunities.	using multifunctional design using low energy processes (minimise energy consumption by reducing requisite temperatures, pressures, and/or time for reactions) recycling all materials Fitting form to function (select shape or pattern based on need).
2	**Evolve to survive**	This is the continuous incorporation and embodying of information to ensure enduring performance.	replicating strategies that work (repeat successful approaches) integrating the unexpected (incorporate mistakes in ways that can lead to new forms and functions) Exchange and alter information to create new options.
3	**Adapt to changing conditions**	This is appropriately responding to dynamic contexts	maintaining integrity through self-renewal embodying resilience through variation redundancy decentralisation incorporating diversity
4	**Integrate development with growth**	This entails optimally investing and engaging in strategies that promote both development and growth.	combining modular and nested components building from the bottom up self-organising
5	**Been locally attuned and responsive**	This is fitting into and integrating with the surrounding environment.	using readily available materials Use of solar/renewable energy. cultivating cooperative relationships leveraging cyclic processes using feedback loops
6	**Using life friendly chemistry**	This entails the use of chemistry that supports life processes.	building selectively with a small subset of elements breaking down products into benign constituents Doing chemistry in water (use water as solvent).

Table: 1 The major principles of Biomimicry,
Source: (Abd El-Rahman et al. 2020)

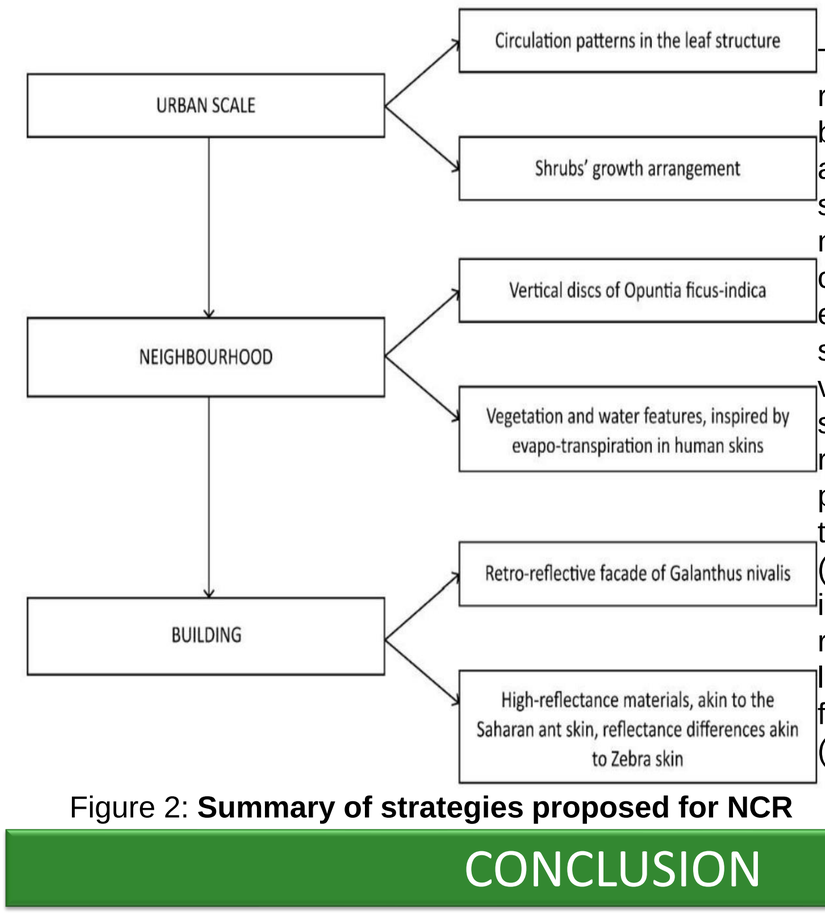

Figure 2: **Summary of strategies proposed for NCR**

The positive impact of green roofs and facades in reducing building heat absorption and ambient temperatures is significant. Reflective materials inspired by nature could demonstrate effectiveness in deflecting solar radiation. Natural ventilation strategies could show promise in reducing reliance on air conditioning. A positive correlation between traditional building materials (concrete, asphalt) and UHI intensity is observed by many researchers. Dense urban layouts with limited vegetation further amplify the effect (Giridharan et al., 2007

CONCLUSION

Large-scale urbanization has led to an increase in LST, contributing to the formation of UHI. It is characterized by the local climatic conditions, built-forms, materials and surfaces. Various mitigation strategies have been adopted across the world, biomimicry being one of the emerging solutions. However, it has not yet been applied in the Indian context. This study presents a set of strategies that can be applied at various levels of planning and designing the future cities

FUTURE WORK / REFERENCES

The cost-effectiveness of biomimicry in different climates and building types should be researched. Biomimicry solutions may incur initial cost challenges compared to conventional materials. However, long-term savings in reduced energy use for cooling can be figured out through life cycle analysis. Insights into the practical applications of biomimicry in the built environment should be included in policy making.

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