NANGARHAR UNIVERSITY
INTERNATIONAL JOURNAL OF BIOSCIENCES
ORIGINAL ARTICLE
NUIJB
e-ISSN: 2957-9988
Special Issue, 2024

Received: 18 Dec 2023 Accepted After Revision: 22 Jan 2024 Published Online: 10 Feb

Climate-Responsive Urban Design: Innovations and Strategies for Sustainable Buildings and Construction in Afghanistan

Safi Hedayat Ullah[1*], Behsoodi Mohammad Mukhlis[2], and Shirzad Wafiullah[1]
[1]Department of Research & Development, Spinghar Institute of Higher Education, Nangarhar, Afghanistan
[2]Department of Academic Division, Spinghar Institute of Higher Education, Nangarhar, Afghanistan
*Corresponding author email: hedayatullah.safi92@gmail.com

ABSTRACT
The global challenge of climate change resonates profoundly across diverse sectors, notably urban development and construction standing prominently in its ripple effects. The complex integration of architecture, planning, and landscape elements in urban development aims to sculpt functional and sustainable cities. Within the context of Afghanistan, the responsibility for applying climate-responsive regulations and policies falls upon the National Environmental Protection Agency (NEPA). This study employs a descriptive research method to scrutinize the implementation and alignment of NEPA's regulations, policies, and strategies in the current urban landscape. The findings show a significant shift from past building practices to contemporary global norms, indicating a noteworthy exploration and adaptation within the construction industry. There is also a significant deficiency in local awareness, leading to shortcomings in climate innovations and strategies, revealing a notable gap between construction practices and the adoption of climate-responsive measures. Furthermore, a remarkable shortfall exists in aligning urban elements with sustainable building principles, prompting concerns regarding the sustainability and construction standards established by NEPA. A critical focal point emerges in the form of uncontrolled carbon emissions in urban areas, primarily originating from heating and cooling systems, transportation, waste management, and industrial factories, leading to significantly impactful high emissions that affect local temperature and precipitation, resulting in changes to living conditions.

Keywords: Climat Change, Climate-Responsive, Urban Design, Innovations Strategies

INTRODUCTION
Climate change is a substantial global challenge with broad consequences affecting multiple sectors, including urban development and construction (Smith, 2000). Afghanistan, a mountainous landlocked country in Central and South Asia, hosts approximately 42 million people across 652,860 square kilometers, experiencing notable demographic changes with a 2.7% annual natural population growth rate (Hanif et al., 2021), (Worldometer, 2023). Notably, over 60% of the population is under the age of 20, carrying significant implications for the country's development, but also leading to heightened consumption, increased waste production, and rising CO2 emissions (UNDP, 2015). A key approach to addressing the aforementioned issues is the implementation of climate-responsive strategies in urban design. To effectively implement climate-responsive and sustainable urban design principles in the region, it is vital to comprehend essential terminology (João *et al*., 2020).

Urban design integrates architecture, planning, and landscape to shape functional, sustainable cities (Gehl, 2010). Thus Climate-responsive architecture harmonizes urban planning and building design with local climates, reducing energy use and improving comfort (HCG, 2023). It creates sustainable buildings with substantial heating and cooling reductions (Tavel, 2011). Sustainability refers to a system's ability to persist and operate over an extended period, often used interchangeably with sustainable development (Behsoodi *et al*., 2023). In the context of building, sustainability means structures with zero or positive impacts, while sustainable construction responsibly sources, operates, and maintains buildings, meeting user needs throughout their lifespan and minimizing environmental impacts for overall progress (Thomas & Jeffery S, 2007). Sustainability involves ecological, economic, and social aspects (Nguyen, 2013). This paper centrally explores the ecological aspects of buildings and construction, assessing the compatibility of NEPA's innovations and strategies with current practices, and exploring solutions for ongoing challenges.

Afghanistan's Vulnerability to Climate Change

Afghanistan's climatic diversity, emphasizes successful climate-responsive urban design that requires a deep understanding of local climate conditions and the integration of indigenous building techniques and materials (Mustonen & Ayanlade, 2022). Afghanistan faces significant climate change impact, with a noticeable rise in mean annual temperatures by 1.8°C since the 1950s. Remarkably, the central and southwestern regions have borne the brunt of this change, witnessing a more substantial temperature increase of 2.4°C, surpassing the national average. Specifically, the central region recorded a mean annual temperature rise of 1.6°C, while the northern regions, registering a 1.7°C increase, closely align with the national mean temperature changes (VNR Afghanistan, 2021). The scenario signals that Afghanistan will undergo a warming of approximately 1.5°C by 2050, followed by a period of stabilization, and then an additional warming of approximately 2.5°C by the year 2100 (UNEP, 2016).

NEPA's Innovations and strategies for Sustainable buildings & Construction in Afghanistan (NEPA, 2020)

The National Environmental Protection Agency (NEPA) is an independent entity overseeing environmental conservation, rehabilitation, and law enforcement in Afghanistan.

Innovations: Enhancing resilience, integrating climate considerations into planning, and fostering sustainable development, including improved water access, sustainable buildings, technical capacity, and awareness in Afghanistan.

Strategies:

Promoting sustainable construction with clean energy, upkeep of agricultural lands, and designing efficient pathways to buildings. Emphasizing soundproof, thermal, and fire-resistant structures, allocating green spaces, and implementing eco-friendly features. Prioritizing energy-efficient lighting, modern technology, and sustainable development in infrastructure planning. Establishing minimum distances from sensitive areas, industrial zones, and hazardous sites for enhanced safety and environmental protection.

MATERIALS AND METHODS

Study Area, Samples Collection and Statistical Analysis

This research employs a descriptive approach, relying on multiple data collection methods, including site visits, interviews, questionnaires, and Google forms to comprehensively examine existing buildings, construction practices, and urban design in diverse Afghanistan climate zones, including Arid, Temperate, and Cold (Continental) regions. To exemplify these climate zones, our research centers on Nangarhar province for Arid, Kunar province for Temperate, and Kabul province for the Cold (Continental) climate zone.

The findings were derived from the mixed-method approach, incorporating both qualitative and quantitative data analyzed by MS. Excel using Excel. The outcomes are presented through the tables to effectively communicate the research results.

RESULTS

The research engages a diverse group of 311 participants, including specialists, organizations' employees, and local citizens. The intriguing findings from this collaborative effort are presented in the following tables.

Table 1. Exploration of Building Construction Practices.

Provinces (City)	Previous Practices (%)				Current Practices (%)	
	Rammed Earth	Mud Brick	Brick	Stone Masonry	RCC	Brick
Kabul (Kabul)	39.4	55.3	5.3		67.1	32.9
Kunar (Asadabad)	60.9	12.2	12.2	14.7	68.3	31.7
Nangarhar (Jalalabad)	65.7	34.3			74.6	25.4

Table 2. Understanding Climate Change and Climate-Responsive Design.				
Provinces (City)	**Involvement in Climate change Training Programs (%)**		**Familiarity with Climate-Responsive Design Concepts (%)**	
	Yes	**No**	**Yes**	**No**
Kabul (Kabul)	17.1	82.9	56.4	43.6
Kunar (Asadabad)	14.6	85.4	51.2	48.8
Nangarhar (Jalalabad)	37.3	62.7	68.7	31.3

Table 3. Key Elements in Climate-Responsive Urban Design.					
Provinces (City)	**Deficient in energy efficiency (%)**	**Green spaces (%)**	**Urban Forestry (%)**	**Cultivated Land (%)**	**Temperature Variations (%)**
	Urban Architecture	Less	Deciduous	Near	Increased
Kabul (Kabul)	38.3	81.9	36.1	28.7	97.9
Kunar (Asadabad)	51.2	53.7	58.5	90.3	95.1
Nangarhar (Jalalabad)	44.8	80.6	55.2	79.1	92.5

Table 4. Assessment of Sustainable Building Construction Practices.				
Provinces (City)	**Valuation of Energy Sources (%)**	**Building Orientation (%)**	**Construction Material Choice (%)**	**Structure Insulation (%)**
	Petroleum	East-West	Cheap Materials	None
Kabul (Kabul)	22.4	48.9	61.7	95.7
Kunar (Asadabad)	9.8	58.5	65.9	100
Nangarhar (Jalalabad)	2.9	40.3	52.2	100

Table 5. Environmental Impact of Urban Development (Carbon Footprint).					
Provinces (City)	**Heating Method for Buildings (%)**		**Transportation System (%)**	**Waste Management System (%)**	**Industrial Factory (%)**
	Wood	Coal & Wood	Local Transport	Not Satisfied	Active
Kabul (Kabul)	23.4	74.5	97.9	46.8	93.6
Kunar (Asadabad)	78.1		92.7	48.8	31.7
Nangarhar (Jalalabad)	55.2	4.5	89.5	7.5	83.6

DISCUSSION

Table 1 highlights the significant evolution in house construction, with traditional dwellings transforming into contemporary structures characterized by reinforced concrete. This shift underscores substantial advancements in the construction industry. The question arises: has this progress aligned with the modern global landscape, or have urban dwellers proactively considered climate conditions in constructing buildings?

Examining Table 2 reveals that across various climate zones, buildings have largely been constructed based on personal preferences and experiences, with limited awareness about climate change. The data suggests a weak incorporation of climate-responsive design, indicating a potential gap in adapting construction practices to environmental considerations.

Referring to a city as climate-responsive entails more than just electricity savings; it involves an intricate balance, from adhering to green area regulations to ensuring appropriate flora aligned with the local climate. Table 3 underscores a collective weakness across three zones in implementing these principles, leading to temperature spikes, untimely precipitation, and subsequent droughts and floods.

Beyond this, constructing sustainable buildings is pivotal for regional climate balance. Sustainable structures utilize clean or renewable energy, correct building orientation, climate-appropriate materials, and effective insulation. Regrettably, Table 4 reveals that buildings in all three climatic zones lack alignment with stable climates, requiring additional energy for adaptation.

A crucial aspect of achieving climate equilibrium is curbing carbon dioxide emissions. Table 5 sheds light on high carbon production in urban environments across all three climate zones, emphasizing the urgent need for measures to reduce emissions. Ensuring a healthy environment for future generations hinges on controlling and potentially eliminating carbon output from various sources, including heating systems, transportation, waste management, and industrial processes.

CONCLUSION

After a comprehensive exploration and evaluation of results through a descriptive approach to Afghanistan's arid, temperate, and cold (continental) climatic zones, the following conclusions are made.

- The NEPA administration's climate strategies were found to be overly generalized, lacking specific considerations for each climate zone.
- The lack of awareness highlights a significant gap between the evolving construction landscape and the adoption of climate-responsive practices.
- Urban elements crucial to the cityscape have not been adequately adjusted to adhere to the principles of climate-responsive urban design.
- The sustainability and construction of contemporary buildings fall short of meeting the stringent standards set by the National Environmental Protection Agency.
- A pressing concern is the uncontrolled carbon production in cities, with high emissions significantly impacting living conditions.

Acknowledgment: Thanks to researchers and mentors for driving climate change knowledge. Special appreciation to advisors for their key role in organizing the 2024 International Climate Change Conference at Nangarhar University, Afghanistan.

Conflict of Interest: All authors express no conflict of interest in any part of the research.

Funding: This research received no external funding.

Authors Contributions: All authors equally contributed to the conception, drafting, and revision of the manuscript, sharing equal responsibility for its content and integrity.

REFERENCES

Behsoodi, M. M., Aslam, M. S., & Latifi, E. (2023). Assessing sustainability of WASH projects in public and private schools of Jalalabad City, Nangarhar, Afghanistan. *European Journal of Sustainable Development Research*, *7*(4), em0231. https://doi.org/10.29333/ejosdr/13475

Gehl, J. (2010). Cities_For_People_-_Jan_Gehl. In *Jan Gehl* (pp. 1–269). ISLANDPRESS.

Hanif, A., Jalil, ;, Pouya, A., Ahmadi, S., & Loodin, N. (2021). *An Analysis of the urban development process in six major cities in Afghanistan from 1978-2018*. *August*, 1–12. www.preprints.org

HCG (Hyper Consulting Group). (2023). *Community Driven Processes for Climate Responsive*. *15th February*.

João, C., Sanda, L., Jochen, M., Lisette, K., Cor, J., & Jeroen, K. (2020). Visual guidelines for climate-responsive urban design. *Sustainable Cities and Society*, *60*, 102245.

Mustonen, T., & Ayanlade, S. (2022). The Role of Indigenous Knowledge and Local Knowledge. *IPCC Climate Change 2022: Impacts, Adaptation and Vulnerability.*, *August*, 2713–2768.

NEPA. (2020). *Government of the Islamic Republic of Afghanistan National Environmental Protection Agency Technology Needs Assessment for Climate Change Adaptation*.

Nguyen, A.-T. (2013). *Sustainable housing in Vietnam: climate responsive design strategies to optimize thermal comfort*. 305.

Smith, P, Friedman, A. (2000). Sustainability and urban design. *Building Hong Kong: Environmental Considerations*, 17–42.

Tavel, M. (2011). Climate Responsive Urbanism: Historic Precedents and Progressive Practice. *International Portland Urban Architecture Research Lab (PUARL) Conference*, *2011*, 52–58.

Thomas, D., & Jeffery S, M. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing*, *22*(1), 50–76.

UNDP. (2015). *Afghanistan Country report for Habitat III, Islamic Repulic of Afghanistan*. 9.

UNEP. (2016). Climate Change , and Governance in Afghanistan. *NEPA*, *16*(3), 397–414.

VNR Afghanistan. (2021). *Afghanistan VNR 2021 Sustainable Development Goals*. 47.

Worldometer. (2023). Retrieving Data. *Online Web*, 419–456. https://doi.org/10.1007/978-1-4302-0804-4_14