Eco-Friendly Urban Design: Investigating Innovative Approaches and Sustainable Construction Practices Across Afghanistan's Diverse Climate Zones

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ABSTRACT

Climate change serves as a pervasive catalyst globally, significantly influencing urban growth and construction dynamics. The interplay of population growth, heightened consumption, increased waste production, and rising CO2 emissions presents a substantial threat to biodiversity and plant life. Creating vibrant, environmentally conscious cities requires integrating architectural, design, and landscape components into the urban development process. This study employs a descriptive approach to examine the intricate dynamics among urbanism, urbanization, and climate-responsive design across Afghanistan's diverse climatic zones. The findings reveal a significant shift from traditional to contemporary global standards, marking a significant evolution within the construction sector. However, there remains a notable lack of climate awareness, resulting in a gap between evolving construction features and climate-responsive methodologies. The Afghanistan National Environmental Protection Agency's strategies are often too generalized, failing to address specific climatic requirements effectively. Unplanned urban growth has led to limited access to proper housing, increased poverty, and greater vulnerability to climate impacts. Key issues include uncontrolled carbon emissions from heating, transportation, waste management, and industrial activities, severely affecting precipitation patterns and living quality. The research emphasizes the necessity for tailored climate-responsive design and sustainable construction practices, advocating for integrating green technologies and enhancing regulatory frameworks to promote energy efficiency and reduce the environmental footprint of urban developments in Afghanistan.

Keywords: Climate Variation, Eco-Friendly, Urban Design, Innovative approach, Sustainable construction

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1. Introduction

Climate change is a global wrecking ball, smashing through sectors, comprising urban growth and construction. Get real, it's a planet-wide crisis (Smith & Friedman, 2000). To create resilient urban designs in response to climate issues, it's crucial to grasp key terminology (João et al., 2020). Population growth, increased consumption, rising waste production, and escalating CO2 emissions are four interconnected forces reshaping our world. As population growth drives higher consumption, it leads to increased waste generation and carbon dioxide emissions, posing a significant threat to biodiversity and plant life (Adhya et al., 2010). A holistic and sustainable urban design, integrating urbanism and urbanization thoughtfully, can play a crucial role in mitigating that threats.

1.1. Urbanism and Urbanization

Urbanism and urbanization, as interconnected forces, play a key role in shaping the dynamic landscape of the modern biosphere (King, 2015). Urbanism involves the study, development, and application of design and planning practices for urban areas, emphasizing the creation of functional and sustainable environments that enhance the quality of life for inhabitants in cities and towns (Pozoukidou & Chatziyiannaki, 2021). Sustainable urbanism, as defined recently, encompasses walkable and transit-friendly urban environments that incorporate high-performance buildings and infrastructure within cities (Cervero & Murakami, 2008). On the other hand, urbanization is the phenomenon where populations concentrate in urban areas, leading to the expansion and growth of cities and towns as people from rural areas migrate to urban regions (Aliyu & Amadu, 2017). By 2030, nearly two-thirds of the world's population is projected to live in urban areas. Urbanization presents significant opportunities for social and economic development, promoting more sustainable lifestyles. Yet, it concurrently strains infrastructure and resources, particularly in the realm of energy (UNIDO, 2018).

1.2. Urban Design

Urban design is a multidisciplinary field focused on shaping the physical layout, organization, and functionality of cities, towns, and urban areas (Gehl, 2010). It integrates elements of architecture, planning, landscape architecture, and urbanism to create environments that are visually appealing, functional, sustainable, and conducive to the well-being of their inhabitants. Urban design considers various aspects, including spatial arrangement, land use, transportation, public spaces, and aesthetics, to enhance the quality of urban life (Duany & Talen, 2002). While urban design has traditionally been an integral part of city development, it is a relatively new contemporary theoretical and professional discipline when compared to related fields such as architecture, urban planning, and civil engineering (Inam, 2002).

1.3. Climate Responsive Design

Climate-responsive design blends climatology, biology, and ecology into urban-scale master planning and building design, aiming to improve the environment, elevate living conditions, and reduce energy consumption. Climate-responsive design has the potential to result in substantial reductions in heating and cooling demands for buildings, while simultaneously fostering the creation of comfortable outdoor spaces year-round (Malekafzali, 1923; Tompson, 2012).

The increasing awareness of climate change highlights the crucial role of climate-responsive building design in achieving a sustainable energy future. Yet, challenges persist due to limited awareness, insufficient energy efficiency regulations, and the gradual erosion of traditional knowledge. Climate-responsive design remains crucial for curbing energy

consumption and carbon emissions in the building sector. Achieving low energy usage necessitates early consideration of local climate conditions. The establishment of a climate classification system is paramount for advancing energy efficiency and addressing these challenges (Bodach, 2016). Climate-responsive design demands the utilization of natural energy sources such as sunlight and wind, which influence our built environment. The combination of green technologies within these passively designed environments helps to decrease resource consumption (Tavel, 2011).

1.4. Sustainable Buildings and Construction

Sustainable construction involves responsibly sourcing, operating, and maintaining buildings to meet owner and user needs throughout their lifespan while minimizing environmental impact and fostering economic, social, and cultural progress (Baloi, 2003). Sustainability embodies the enduring functionality and resilience of a system, frequently utilized synonymously with the concept of sustainable development (Behsoodi et al., 2023)

In the context of buildings, sustainability signifies the achievement of structures with either zero or positive impacts, ones that do not generate adverse environmental, social, or economic consequences. These sustainable buildings not only produce a surplus of energy, exceeding their own needs, but also cultivate communal agriculture, and offer quality employment opportunities to foster healthful living and working environments for their inhabitants. It's important to acknowledge that buildings inherently possess an environmental footprint and contribute to carbon emissions. They consume natural resources during both the construction and occupancy phases, and their design significantly influences how occupants utilize and maintain the building throughout its lifespan (Thomas & Jeffery S, 2007; Camaren Peter, 2012).

Worldwide, buildings account for 40% of annual energy consumption and contribute to as much as 30% of all energy-related greenhouse gas (GHG) emissions (Camaren, 2012). The building sector stands out as having the highest potential for achieving substantial emission reductions at minimal or even cost-saving investments for economies. In aggregate, the building sector consumes one-third of the world's resources, including 12% of global freshwater, and generates approximately 40% of solid waste. Furthermore, the sector employs, on average, over 10% of the global workforce. Given the rapid urbanization trends in the world's most populous nations, adopting sustainable building practices becomes imperative for advancing sustainable development (UNEP, 2010), (Del Rio et al., 2022; Baloi, 2003).

Sustainable buildings are designed to minimize resource use, including energy, water, and materials, leading to lower environmental impacts and providing better indoor air quality, contributing to occupant health and well-being (Li et al., 2020), (Brennan, 2015). Energy-efficient buildings emit fewer greenhouse gases, helping combat climate change (Feng et al., 2019). Sustainable construction can reduce land use and habitat destruction (Lucon et al., 2014).

Sustainability is interconnected with three fundamental dimensions: ecological (Environmental), economic, and social well-being (Nguyen, 2013). This paper delves into the ecological dimensions of construction, passionately exploring the sustainability of Afghanistan's current urbanization across diverse climate zones. The goal is to unveil solutions for environmental pollution, a key driver of climate change, and pave the way for a greener future.

2. Literature Review

Afghanistan, a landlocked country in south Asia with diverse mountainous terrain, encompasses approximately 42 million people across 652,860 square kilometers. Currently

experiencing notable demographic shifts, the nation boasts a natural population of growth rate around 2.7% per annum (Hanif et al., 2021), (Worldometer, 2023). Significantly, more than 60% of Afghanistan's populace is under 20, indicating substantial implications for the nation's development.

2.1. A Brief Overview of Four Decades Conflict Impacts on Multiple Sectors in Afghanistan

Afghanistan's diverse sectors have suffered in the last four decades of war, spanning from the Soviet invasion in 1979 to the latest Taliban takeover in 2021. These sectors include but are not restricted to the areas of education, economic infrastructure, public health, environmental conservation, and sustainability practices (Sopko, 2021). Each sector has encountered its own set of particular demanding situations. It has been the state of affairs to massive changes because of the sustained hostilities and continual political instability that have characterized the vicinity (Bennett et al., 2009). This enduring battle scenario has necessitated a complicated and adaptive response from those social structures, that have been forced to evolve in the face of ongoing adversity and disruption (Sopko, 2021).

2.1.1. Education

Afghanistan's education sector over the past four decades, has experienced substantial fluctuations. During the Soviet control from 1979 to 1989 educational system introduced Marxist ideologies, leading to resistance (NESA, 2011). In 1978, there were roughly 4,185 schools throughout Afghanistan, but by 1980, about 2,000 of them had been destroyed, and by 1986, approximately 2,000 teachers had lost their lives (Ruttig, 2001). Post-Soviet withdrawal concluded the civil conflict from 1989 to 1996, the educational infrastructures were shuttered or destroyed due to protection worries, significantly proscribing instructional opportunities. With the coming Taliban rule from 1996 to 2001, no fundamental work has been done and they confined girls' education beyond the age of Eight (Syariah & Ilmu, 2004). For the past two decades, about 80% of all educational sectors, supplies, facilities, books, and equipment have been destroyed (R. McKown, 2024; Ruttig, 2001). Moreover, Afghanistan experienced the loss of approximately 20,000 experts and academics, and its 17 universities and institutes suffered extensive devastation due to ongoing war. Thousands of teachers and education administrators in Afghanistan either fell victim to the conflicts, faced intellectual segregation or were compelled to leave the country (WordPress, 2003).

From 2001 to 2021, under the United States-led assistance, there were enhancements in educational infrastructures, even though demanding situations remained (Easar et al, 2023). By 2021 Afghanistan had 20000 schools, 165 universities nearly 10 million students, and 220000 teachers (MOH, 2020). The Taliban came back in 2021, and added necessary modifications to the educational curriculum, reflecting Afghan inevitabilities and culture, but female education past 6th grade continues to face uncertainties up to now, May 2024.

2.1.2. Economy

Sustainable economic growth cannot be attained at the expense of the environment and natural resources. Rather, such degradation emphasizes underlying issues such as environmental differences, weak institutional structures, population and urbanization growth, poverty, and inadequate training with an emphasis on the environment and sustainable use of natural resources (ANDS, 2008).

Until 1978, Afghans economically were in better figure and were somewhat ahead of many others in the region. The SAUR Revolution led Afghanistan to a persistent war and poverty in the area. Over the last 40 years, Afghanistan has again and again gone through periods of conflict, state collapse, coup de tat, and fragile recuperation approaches (Roy, 2020).

Since 1979 Afghanistan's economic system significantly disrupted and heavily depended on overseas aid. During the Soviet Union occupation, any semblance of financial stability was carefully tied to them (Sopko, 2021). The Soviet engagement, coupled with the following civil warfare, led to widespread damage to all financial infrastructure. The number one supply of economic stability remained entirely from illicit activities, such as the opium trade (Roy, 2020).

Following the U.S. Invade in 2001, Afghanistan economically got economic thriving and stabilization, because of international aid. Significant improvements were observed in diverse sectors, inclusive of telecommunications, construction, mining, agriculture, and trade (Inspector, 2018). However, pervasive corruption, UN intervention, and unprofessionally the usage of international aid, remained the economic system closely dependent on aid.

After the Taliban takeover in 2021, all international help became suspended, plunging Afghanistan another time into monetary turmoil. Although efforts had been made to restore the financial system via domestic revenue from mines, taxes, and commerce, some goals had been executed, however, the severance of international ties and sanctions remains a significant impediment to Afghanistan's capability to stand on its very own economically (Byrd, 2023). At the same time, the economic situation from home to home in Afghanistan has been negatively impacted by way of United States' decision to restrict access to around $9 billion of Afghanistan's foreign currency reserves (Human Rights Watch, 2022). Afghanistan can recover its economy through diverse nearby opportunities, including contracts with local suppliers and transport vendors, bilateral and regional power change, gasoline trade with neighboring international locations, and powerful water assets management (Natsios and Howe, 2002).

2.1.3. Public Health

The public health support in Afghanistan from 1978 up to now is on outsiders for four reasons. Poverty, limits to healthcare provisions, culture, and non-health-related agendas are the key terms for its dependency (Jones, 2006). The Soviet Union made a few tries to modernize Afghanistan's healthcare system, but facilities were regularly targeted during the war, leaving infrastructure in ruins. The civil war period brought about a similar degradation of healthcare services, with many health experts fleeing the country (Dye, 2007). During the resistance against the Soviet Union, many international Nongovernment Organizations that entered Afghanistan were motivated by political reasons (Jones, 2006).

After 2001, Afghanistan’s health infrastructures were rebuilt and access to healthcare was improved by international aid. Between 2001 and December 2002, about 904 healthcare supporters had been existing to improve the healthcare system in the central and rural regions (Jones, 2006). Currently, approximately 3000 healthcare facilities and 17000 health posts exist throughout Afghanistan (WHO, 2023). In common, almost 87% of the population ensured access within 2 hours’ distance to the medical health center or health post. From 2001 to 2021, Afghanistan experienced enhancements in its health system, with life expectancy growing from 56 to 64 years and the current life expectancy in 2024 is 66.25 years (WHO, 2024).

2.1.4. Environmental Conservation and Sustainable Practices

Wars and armed conflicts seriously disrupt sustainable improvement both regionally and globally. In Afghanistan, conflicts have induced poverty, food shortages, health problems, financial losses, business, urban destruction, and social inequalities. They have moreover caused environmental harm, such as water and air pollution, deforestation, and adjustments in land use and cover, which originate carbon emissions (Jiang et al., 2023). Overall, wars undermine peace, justice, economic stability, trade, food safety, employment, biodiversity, and public health, at the same time as exacerbating demanding situations associated with security, resource management, and corruption (Easar et al, 2023).

After almost forty years of conflict, a significant portion of Afghanistan's infrastructure and energy facilities lie in ruins (World Bank, 2019). Presently, domestic energy production mirrors levels observed just before the Soviet Union's invasion in 1978, with the added detriment of severely deteriorated energy infrastructure. The data shows that, in 2022, merely 28 percent of Afghan households have access to power supply systems (UNDP, 2015). Afghanistan heavily relies on electricity from neighboring countries. It's contributing more than three-quarters of its total electricity consumption. The country's lavish water resources provide enough capacity for hydropower development, estimated at 23,310 MW, which almost accounts for half of the current installed capacity. In addition to hydropower, Afghanistan has wind and solar power energy capacity, estimated at 66,726 MW and 222,852 MW respectively, which provides a great opportunity for sustainable energy, especially in rural regions (NEPA, 2017).

The depletion of forest cover appears to have halved since 1978 in Afghanistan due lack of alternatives for timber production and firewood (ANDS, 2008). In the 1970s, Afghanistan's forest cover was between 3.5 and 4.5 percent, but has since declined to 2% now. Despite the need to conserve forests due to their ecological importance, about 80% of Afghanistan's population relies on natural resources for daily livelihoods, posing a challenge for forest management so well (Strategy et al., 2017).

Drought and deteriorated water supply systems have reduced water levels in many areas. A growing population is polluting the country's aquifers and water resources, leading to water quality degradation (ANDS, 2008). Approximately, 79% of the Afghanistan populace consumes contaminated water (UN SDGs, 2023).

Security is also a prerequisite for the success of our national housing program. Security includes the nation's security, the security of our public servants, the security of transportation and employment, and social and property security. During the invasion of the Soviet Union from 1979 to 1987, nearly 1.5 million Afghans died, 80% of them were civilians (Ruiz, 2004), and 46% of the deaths were caused by Soviet bombs (Foundation, 2025). The United States invasion also directly claimed 241000 lives, including 71344 civilians, 3586 US and NATO allies, 78314 National military and police, 84191 opposition fighters, 136 journalists, 3936 US Contractors, 549 humanitarian aid workers, and 6 US civilians (Haddad, 2021).

For now, Afghanistan is actively involved in global and regional environmental efforts, being a signatory to 16 multilateral environmental agreements and in addition, a regional member of 6 cooperative groups focused on sustainable environmental development (VNR Afghanistan, 2021). The Taliban takeover in 2021, has led to the suspension of somewhat 32 environmental projects by the United Nations, due to the political situation and international pressure, causing too many environmental hardships (Zawia, 2024).

2.2. Urbanization Challenges and Trends in Afghanistan

Urban form refers to the physical layout of towns, including open spaces and transportation. Transformative planning requires an integrated approach to ensure these elements contribute harmoniously to a shared vision (North Somerset Council, 2007). While urbanization inevitably brings opportunities for social development and economic growth, addressing the expectations of a rapidly expanding urban population for a secure and healthy living and working environment poses significant challenges (Un-Habitat, 2014).

Urbanization in Afghanistan presents a dual scenario of opportunities and challenges. On one hand, it has the potential to foster social development and economic prosperity; on the other, it brings significant obstacles in meeting the needs of a rapidly growing urban population for a secure and healthful living environment. Currently, Afghanistan is experiencing its most

substantial urbanization surge in history, marked by rapid expansion in cities and towns. This momentum is driven by factors like rural-to-urban migration, the return of Afghan nationals, and the extension of urban boundaries to neighboring towns and villages. The annual urbanization rate in Afghanistan is estimated to be approximately 4% (Loft, 2021).

Similar to the global trend, urbanization is on the rise in Afghanistan. In 1950, only 8% of the population, or 1 in every 20 Afghans, resided in cities. By 1975 and 2000, these numbers had grown to 13% and 21%, respectively. In 2014, 24% of Afghans, or 1 in 4, called cities home. As of 2023, approximately 25.9% of the population, equivalent to around 11 million Afghans, resides in urban areas. Projections indicate that by 2025, this figure will increase to 31%, and by 2060, it will reach an estimated 50%, signifying that by 2060, 1 in every 2 Afghans will be an urban dweller (Worldometer, 2023).

Afghanistan's urbanization has largely occurred informally, marked by rapid urban expansion without effective urban special planning and limited access to formal land and housing (Schütte, 2009). This situation has contributed to rising poverty levels and exacerbated the pace of climate change. According to data from 2014, approximately 2.2 million people, equivalent to 28% of the urban population, were living below the poverty line (Un-Habitat, 2014).

2.3. Afghanistan in the Outlook of Climate Vulnerabilities

Afghanistan's climatic diversity, spanning from arid deserts in the south to high mountain regions in the north, presents a multifaceted challenge for urban planners and architects (BRILL, 2023). Emphasizing that successful climate-responsive urban design necessitates a thorough comprehension of local climate conditions and the incorporation of traditional building techniques and resources (Mustonen & Ayanlade, 2022).

Afghanistan is notably impacted by climate change, marked by a significant increase in average annual temperatures, rising by 1.8°C since the 1950s. Particularly noteworthy are the central and southwestern regions, experiencing a more pronounced surge of 2.4°C, transcending the national average. In detail, the central region registered a 1.6°C rise, while the northern regions nearly mirror the national average with a 1.7°C increase in mean temperatures (VNR Afghanistan, 2021). The situation indicates that Afghanistan is poised for a temperature increase of about 1.5°C by 2050, tracked by a phase of stabilization, and subsequently, an additional warming of approximately 2.5°C by 2100 (UNEP, 2016).

Among the primary contributors to climate change in Afghanistan, as in many other nations, lies the emission of greenhouse gases, chiefly carbon dioxide (CO2). In 2019, Afghanistan's CO2 emissions reached 28.79 million tons, equivalent to a mere 0.06% of global emissions. These emissions were distributed as follows: 15.54 million tons from agriculture, 8.27 million tons from the energy sector, 3.61 million tons from waste management, 1.21 million tons from industrial processes, and 154.66 thousand tons from land-use change and forestry (Zaki & Lederer, 2023).

2.4. Priority and Strategic Vision of Afghanistan National Environmental Protection Agency (NEPA)

The Afghanistan National Environmental Protection Agency was established in 2005 and is the central authority in shaping and overseeing environmental policies, taking charge of regulating, coordinating, monitoring, and enforcing environmental laws in the nation (Qazi, 2009).

Priorities: Improving resilience, bounce-back capacity, integrating climate-conscious elements into planning, promoting sustainable progress, Incorporating enhanced water

availability, sustainable construction, technical expertise, and increased awareness of climate change in Afghanistan.

Strategies: Promoting eco-friendly building practices with renewable energy, care of agrarian territories, and building design with effective pathways. Prioritizing the creation of sound-proof, thermal insulated, and fire-resistant structures, alongside strategic allocation of green spaces and incorporation of climate-responsive features. Additionally, emphasizes energy-efficient lighting, new technology, and ecological development in infrastructure design. Setting minimal distances from vulnerable, industrial, and risky zones, to improve safety measures and strengthen environmental protection efforts (NEPA, 2020)**.**

3. Research Methodology

This study adopts a descriptive methodology, utilizing a range of methods for data acquisition such as Interviews with administrations and experts, site visits, questionnaires, and Google Forms. The research aims to thoroughly investigate the sustainability of the current state of buildings, construction techniques, and urban design across various climate zones in Afghanistan, incorporating Cold, Temperate, and Arid zones. In showcasing these diverse climate zones, our research concentrates on Jalalabad city to represent the Arid climate, Asadabad city for the Temperate climate, and Kabul city for the Cold (Continental) climate region.

The results obtained from the mixed-method approach, integrating both quantitative and qualitative data, will be analyzed with MS. Excel. The findings will be conveyed through Figures and tabular representations, enhancing the effectiveness of communicating the research outcomes.

4. Findings and Discussion

This research brings together diverse perspectives, featuring active participation from specialists, city employees, officials, and citizens. The outcomes of this collective effort are presented in the following Figures and tables, providing a visually accessible platform for enhanced comprehension.

4.1. Afghanistan Population and its Related Trends from 1978-2023

A higher growth rate, an increased life expectancy, and a lower death rate lead to a growing population, which increases the demand for resources, and services. It is also affecting resource allocation and long-term sustainability. The trend requires careful planning in Urban design to minimize environmental impacts and resource consumption, to ensure that, the cities remain livable. On the other hand, a higher literacy rate leads to better awareness and sustainable practices adoption. They are excellent in the incorporation of green technology, and smart city concepts and can engage in environmentally friendly behaviors easily.

As illustrated in Figure 1, Afghanistan has experienced a diverse demographic journey and a gradual recovery period in the last 45 years. Moreover, every indicator tells a story that describes resilience and reconstruction in the face of hardship.

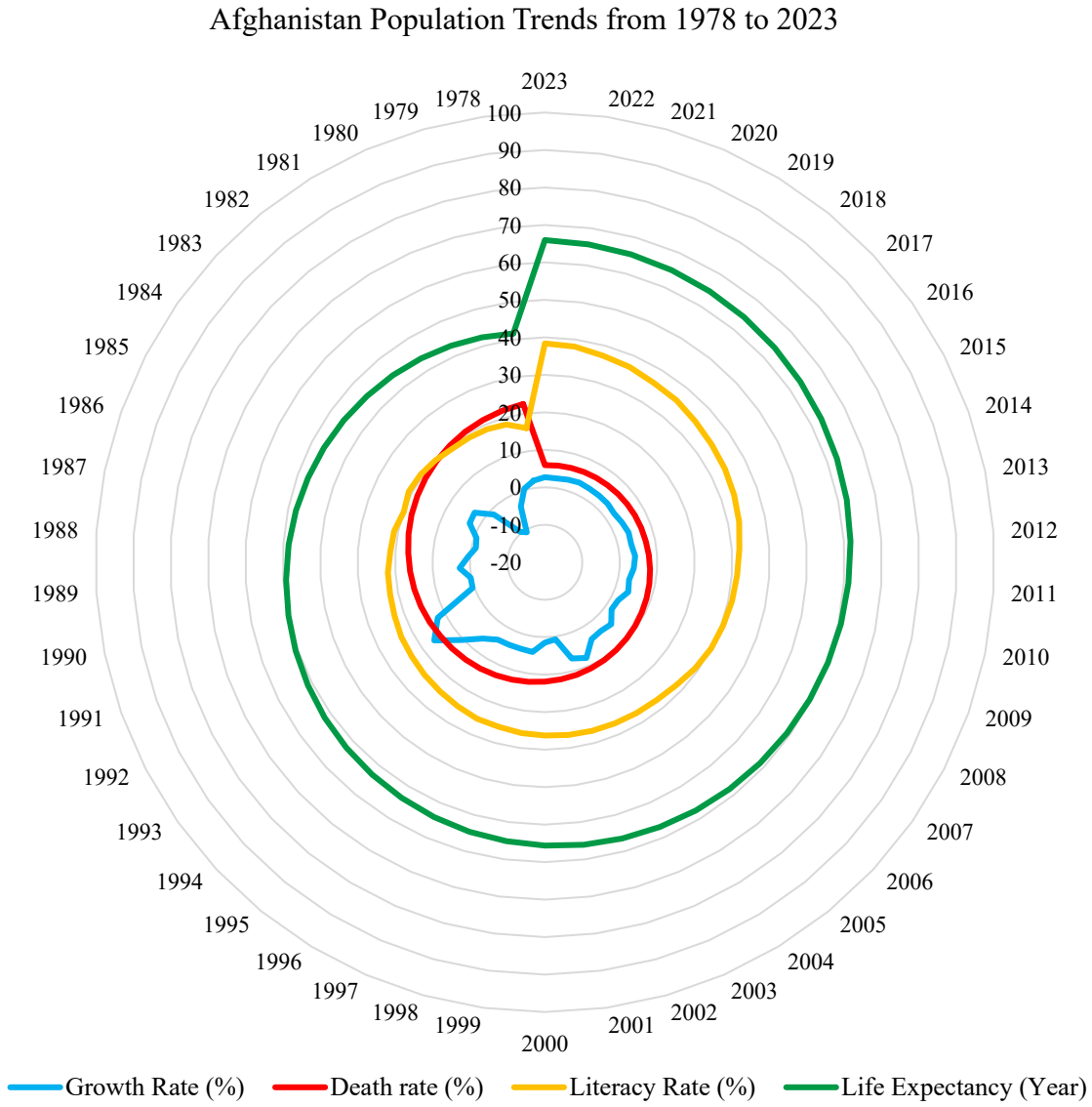

Figure-1. Afghanistan Population Growth Rate, Death Rate & Life Expectancy from 1978-2023

Blue color which indicates the population growth rate of Afghanistan, has seen momentous variations during the past 45 years. In the late 1970s and 1980s, the growth rate experienced periods of negative growth specifically -10.66% in 1981 and -9.56% in 1982. The scenario shows the impact of severe socio-political disorder. The Soviet invasion in 1979, followed by years of conflict, led the country extensively to population displacement, migration, and mortality, which caused the growth rate to fall. Moving into the 1990s, the growth rate began to show signs of stabilization and reached its surge of 16.14% in 1993. Although, it was still influenced by ongoing conflict, particularly during the civil war that followed the withdrawal of Soviet forces. The rise of the Taliban in the mid-1990s brought a form of stability for demographic patterns to return. In the early 2000s, after United States interventions and the establishment of a new government led to improvements that contributed to a more stable

growth rate. As the chart moves into the 2010s and 2020s, the growth rate continues to stabilize and shows positive trends with an average of 3.49%.

The death rate which shown with red color has revealed a declining history over the observed period. The death rate was high during the 1970s and 1980s due to the Soviet invasion and subsequent civil unrest. The infrastructure destruction, lack of access to medical care, and widespread violence contributed to high mortality rates. Through the 1990s and early 2000s, international efforts to rebuild and advance healthcare services led to a more significant decrease in the death rate. 1978 had the highest mortality rate with 22.62% but 2023 has a much lower death rate of 5.89%. Better healthcare services, vaccination programs, improved nutrition, and combatting infectious diseases were the remarkable factors for a decline in the death rate.

The yellow color shows improvements in literacy rate over the four decades. It rose from a very low level of 18.16% in 1979 to a significant height of 38.39% by 2023. Initially, literacy rates were exceedingly low, affected by the lack of educational infrastructure and the socio-political instabilities. Another factor was the disruption during the Soviet invasion and the subsequent years of civil war. Many schools and universities were destroyed and the children and youth were unable to attend classes. In the early 2000s, efforts were made to rebuild the education system, with international support. Numerous initiatives were launched to improve education access, new schools and universities were built, teacher training programs were initiated, and educational materials were distributed widely.

The green color in Figure 1, shows life expectancy in Afghanistan with remarkable improvements from 1978 to 2023. In 1978, life expectancy was only 41.63 years, heavily impacted by high mortality rates due to conflict, poor healthcare, and inadequate living conditions. The Soviet invasion and civil war submitted many people to violence, disease, and lack of medical care. Through the 1990s and 2000s life expectancy continued to rise with an average of 52.68 and 63.89 years, respectively. From 2010-2023 it reaches an average of 63.96 years. The 2023 shows the highest life expectancy rate with 65.97 years. Key rolling factors include better access to healthcare services, improved maternal and child health, widespread vaccination campaigns, better management of infectious diseases and living conditions, nutrition, and overall stability all over the country.

4.2. Evaluation of GDP Growth and GDP Per Capita Over the Past Four Decades

GDP which stands for Gross Domestic Product, is a primary metric for understanding the economic health, activity, and standard of living of a nation. Both the GDP growth rate and GDP per capita effectively influence sustainable processes, construction practices, and urban design. A higher GDP growth creates opportunities to boost economic resources for infrastructure development and urban areas. A higher GDP per capita leads us to a high-quality education and a better living condition. A higher level of income persuades us to have energy-efficient buildings and smart cities.

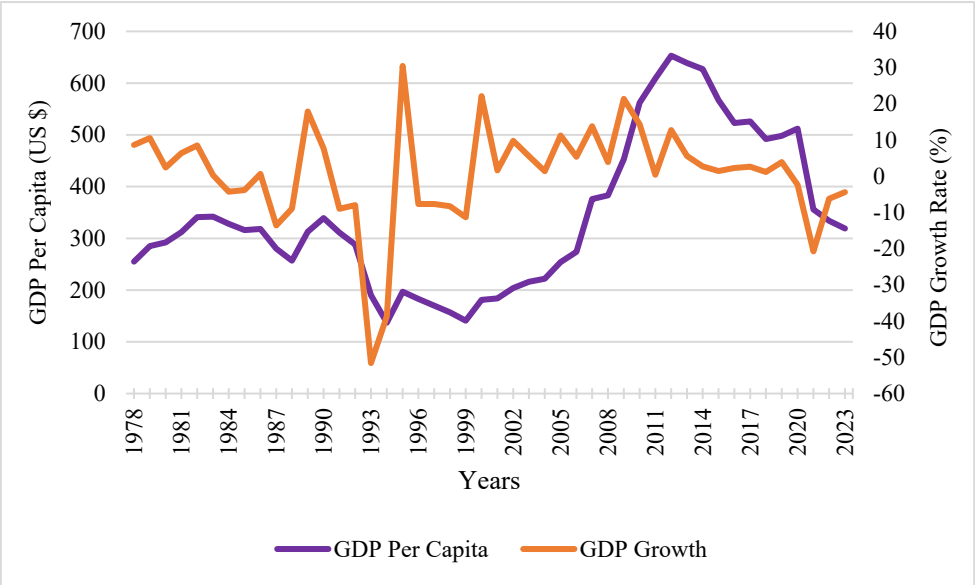

Figure-2. Afghanistan's GDP growth rate and GDP per Capita from 1978-2023

The GDP growth rate, shown in orange color in Figure 2, indicates the annual percentage change in the country's economic output. In 1979 the Afghanistan GDP growth rate was 10.53%, and up to 1983, it was in decline but in positive form. The Soviet invasion led to a negative form -4.3% in 1984. The Civil War added to it, and the nation's GDP growth rate reached its lowest rate of -51.6% in 1993. With the coming Taliban regime, the Afghanistan GDP growth rate was in fell and rise, -7.7% in 1996 and 22.1% in 2000. After the US-led invasion in 2001, the GDP growth got a positive form because of international intervention, aid, and reconstruction efforts. The GDP growth rate remained relatively high throughout the years, but in 2020 due to political upheavals the GDP growth, once again got its negative form of -2.35%. In 2021, COVID-19 and the change in governmental shape directed the GDP growth rate to -20.7%. Currently, The Taliban's efforts caused a slight recovery. The GDP growth rate improving from -6.2 in 2022 to -4.4% in 2023 as the economy begins to stabilize.

GDP Per Capita, as illustrated in purple color in Figure 2, describes the average economic output per person in the country. From 1978 to the mid-1990s, the GDP per capita relatively remained stable but low. It fluctuates between about $200 and $350, which indicates a modest economic base. The Soviet invasion and the civil war severely disrupted the economy, but the GDP per capita did not drop immediately, because of Soviet efforts to stabilize the country's economy. At the last moment of the civil war in 1994, a notable decline occurred with a $137 GDP per capita, because of infrastructure destruction, a decrease in agriculture activity, and significant displacement. By the first takeover of the Taliban in 1996, the GDP per capita had a slight recovery but remained at a low level due to international sanctions and dropped again to $141 in 1999. In 2001 Afghanistan following the US-led invasion and a new Islamic Republic Government was established. With international support, reconstruction processes, and investments in infrastructures, the GDP per capita recovered once again, especially in 2012 it reached its highest level of $653. In the early 2020s, the GDP per Capita was a sharp decline due to the COVID-19 pandemic and the Takeover of the Taliban which was followed by international sanctions. In 2020 the GDP per capita was $512 but it drops to $356 in 2021, $334 in 2022, and $319 in 2023.

4.3. Investigation of Past and Present Buildings Construction Techniques

Unlocking economic potential and strategically positioning communities in less-developed regions within the dynamic urban development landscape requires a revolutionary shift in

construction techniques. This evolution must prioritize adherence to sustainability principles and stringent governmental regulations to ensure the preservation of our precious environment.

Table-1. Investigation of Building Construction Techniques.

City (Province)	Earlier Practices (%)				Latest Practices (%)	
	Mud	Raw Brick	Bricks	Stone	Reinforced cement concrete	Bricks
Asadabad (Kunar)	60.4	18.9	9.4	11.3	67.9	32.1
Jalalabad (Nangarhar)	66.2	33.8			68.8	31.2
Kabul (Kabul)	38.4	54.3	7.3		69.5	30.5

Table 1 underscores the remarkable evolution of building construction, showcasing the graceful transition from traditional dwellings to modern structures fortified with reinforced concrete. In Asadabad, Jalalabad, and Kabul climate zones, the conventional construction methods predominantly used Mud with a rate of 60.4%, 66.2%, and 38.4%, followed by raw bricks with a rate of 18.9%, 33.8% and 54.3% respectively. The earlier practices have extremely shifted to the latest RCC materials, comprising 67.9%, 68.8%, and 69.5% for all three zones separately. This transition reflects a substantial modernization in building techniques and highlights an advancement in construction technology. The modernization offers benefits such as; strength enhancement, durability, fire resistance, seismic resilience, structural integrity, and longevity, and provides better living conditions. The query arises: Does this progress align with the contemporary global scenario, and do urban residents actively consider climate conditions when constructing buildings?

Addressing the aforementioned question necessitates an assessment of local awareness regarding climate change and the principles of climate-responsive design.

4.4. Awareness Evaluation for Climate Change and Climate Responsive Design

For sustainable building development, individuals must align with their local environmental conditions. Modifying building designs to the unique characteristics of each zone fosters environmentally conscious and harmonious structures capable of withstanding the challenges of our ever-evolving world.

Table-2. Awareness of Climate Change and Design Responsiveness.

City (Province)	Participation in Climate Change Training Series (%)		Understanding Concepts of Climate Responsive Design (%)	
	Yes	No	Yes	No
Asadabad (Kunar)	13.2	86.8	50.9	49.1
Jalalabad (Nangarhar)	36.4	63.6	65	35
Kabul (Kabul)	16.6	83.4	50.3	49.7

A detailed examination of Table 2 paints a revealing picture across Asadabad, Jalalabad, and Kabul which represent the Temperate, Arid, and Cold continental climate zones of Afghanistan respectively. The participation rates in the climate change training series are

13.2% for Asadabad, 36.4% for Jalalabad, and 16.6% for Kabul. The case indicates a considerable portion of the population in each climate zone, lacks exposure to climate change education initiatives. However, there is a comparatively higher familiarity with climate-responsive design concepts in Asadabad, Jalalabad, and Kabul with a rate of 50.9%, 65%, and 50.3%. In climatic zones like Jalalabad where there is both higher training participation and understanding of climate-responsive design, exists a better foundation for implementing sustainable construction approaches and urban design strategies. Conversely, in areas with lower participation rates like Asadabad and Kabul, efforts to enhance climate change education and awareness of climate-responsive design are imperative to promote sustainable practices in construction and urban planning. Closing this gap can lead to more resilient infrastructure, energy-efficient buildings, and environmentally conscious urban development, ultimately fostering sustainable and climate-resilient cities.

In all three climate zones, the buildings have primarily emerged based on personal inclinations and experiences, often with a limited understanding of climate change. These findings highlight the critical need for targeted interventions to bridge the gap between climate change education and familiarity with climate-responsive design.

4.5. Key Aspects for Climate-Responsive Urban Design

To create a climate-responsive city design, one must prioritize elements such as energy-efficient urban planning, sustainable architecture, eco-friendly infrastructure, and the incorporation of green spaces with lush greenery and trees. The proximity of agricultural land to the city further enhances its environmental adaptability.

Table-3. Key Aspects of Climate-Responsive Urban Design.

City (Province)	Weak in Energy Efficiency (%)			Green Areas (%)			Urban Greenery (%)			Agriculture (%)			Temperature Instabilities (%)		
	Urban Design	Buildings	Infrastructures	Enough	Less	Dissatisfied	Evergreen	Deciduous	Miscellaneous	Nearby	Remote	None	Increase	decrease	Unchanged
Asadabad (Kunar)	45.3	34	20.7	34	56.6	9.4	26.4	56.6	17	86.8	13.2		96.2		3.8
Jalalabad (Nangarhar)	44.2	29.8	26	13	75.3	11.7	37.7	58.4	3.9	77.9	22.1		91		9
Kabul (Kabul)	38.4	35.1	26.5	7.3	76.8	15.9	39.7	32.5	27.8	25.1	39.2	35.7	98.7		1.3

As illustrated in Table 3, Energy efficiency in urban design for all three climatic zones exhibits notable shortcomings. In Asadabad, a staggering 45.3% weakness in energy efficiency is reported in urban design, with similar trends observed in Jalalabad at 44.2% and Kabul at 38.4%. These figures underline a pressing need for improved energy management strategies across urban design, buildings, and infrastructure especially for urban design.

Green areas and urban greenery, essential for climate resilience and biodiversity conservation, vary across the zones. In all three climatic zones, the greenery was found to be lacking and should be increased to ensure environmental safety. Specifically, in the Temperate zone, it should be enhanced by 56.6%; in the Arid climate zone, by 75.3%; and in the Cold continental zone, by 76.3%.

The Urban greenery should be aligned with the climate zone temperature, while the temperate climates feature a diverse array of trees, warmer climates thrive on evergreen varieties, and colder zones flourish with deciduous trees. Asadabad claims 26.4% evergreen, 56.6% deciduous, and 17% miscellaneous urban greenery, a composition that is suitable for the temperate climate. This mix aids in regulating temperature and supporting biodiversity, making it well-suited for the region. However, for the remaining two climate zones, the urban greenery composition is unsuitable for their respective climates. Jalalabad, which represents the Arid climate zone, the urban greenery should predominantly consist of evergreen vegetation to align with its climate requirements. Conversely, in Kabul, which represents the Cold continental climate zone, deciduous urban greenery would be more suitable to match its climate characteristics. The findings reveal a discrepancy in the urban greenery composition for Jalalabad and Kabul, contrary to the ideal distributions for their respective climate zones. In Jalalabad, evergreen greenery accounts for only 37.7%, whereas deciduous vegetation is predominant at 58.4%. Similarly, in Kabul, the evergreen greenery is at 39.7%, while deciduous vegetation is lower at 32.5%. This discrepancy suggests a misalignment between the current urban greenery and the climate needs of climate zones. However, all three zones fall short of optimal levels. This organizational flaw exacerbates temperature shifts, unexpected precipitation, and subsequent droughts and floods.

Another concern is the proximity of agricultural land to urban areas, typically beneficial for lower energy needs in the food supply. Asadabad and Jalalabad allocate considerable portions of land to agriculture, with 86.8% and 77.9%%, respectively. This allocation reflects the agricultural heritage and economic significance of these regions. In Kabul, despite its urbanization, only 25.1% of agricultural land is nearby. This closeness appears insufficient, potentially hastening climate change in the city.

Temperature instabilities emerge as a key concern across all three zones, with varying degrees of dissatisfaction and observed trends. Asadabad, Jalalabad, and Kabul report high levels of dissatisfaction, with 96.2%, 91%, and 98.7% of respondents experiencing temperature increases and instabilities, respectively. Addressing these challenges requires a holistic approach that integrates energy-efficient technologies, green infrastructure development, and climate adaptation strategies tailored to the unique context of each climate zone. By prioritizing climate resilience in urban planning and design, these urban zones can mitigate the impacts of climate change and create more sustainable and livable environments for their residents.

4.6. Sustainable Approaches in Building Construction

In maintaining the city's temperature balance, sustainable buildings are key. They generate their energy, share the surplus, and have zero or minimal impact on the urban environment.

Table 4, provides insight into the sustainability practices within building construction across three climatic zones; Asadabad, Jalalabad, and Kabul. The assessment includes various parameters, including energy source assessment, building alignment, material selection, and the presence of insulated sections within buildings.

Buildings in all three climate zones overwhelmingly utilize clean and renewable energy. In the climatic zones of Asadabad, Jalalabad, and Kabul, the usage of contaminating energy sources stands at 7.6%, 3.9%, and 2.6%, respectively, highlighting a notable reliance on clean energy. This widespread adoption is attributed to the contemporary embrace of solar energy, a compelling alternative to conventional petroleum sources.

Table-4. Evaluation of Sustainable Approaches in Building Construction.

City (Province)	Energy Source Assessment (%)					Buildings Alignment (%)		Buildings Material Selection (%)				Insulated Section of Buildings (%)		
	Hydro Power	Solar Power	Hydro & Petroleum	Hydro & Solar	Petroleum & solar	East –West and vice versa	North-South and vice versa	Anti-heat	Anti-cool	Anti-heat & Cool	Low-cost Materials	Windows	Entire Building	None
Asadabad (Kunar)	11.3	56.6		24.5	7.6	60.4	39.6	34		1.9	64.1	24.5		75.5
Jalalabad (Nangarhar)	55.8	28.6		11.7	3.9	44.2	55.8	49.4			50.6	6.5		93.5
Kabul (Kabul)	47	4	24.5	21.9	2.6	53.6	46.4		24.5	7.9	67.6	30.5	2.6	66.9

Regarding building alignment, the table illustrates different trends in how buildings are oriented. In the temperate zone, 60.4% of buildings are oriented east to west or vice versa, while 39.6% are aligned north to south or vice versa. This distribution is suitable for the temperate climate, where building alignment is not critically important during summer and winter. In the Arid climate zone, buildings should ideally be aligned east to west or vice versa, to minimize direct solar exposure. However, the data shows that only 44.2% of buildings follow this alignment, while 55.8% are oriented north to south or vice versa. This misalignment means a significant number of buildings are exposed to maximum sunlight, leading to increased energy demands for cooling during the summer season. In the Cold continental climate zone, buildings should be aligned north to south or vice versa, to maximize sunlight exposure for warming. Nevertheless, Table 4 shows that 53.4% of buildings are misaligned east to west or vice versa, while only 46.6% are correctly oriented. This misalignment results in increased energy consumption for heating during the winter season.

Material selection emerges as a critical factor in sustainable building construction. In all three climate zones, people prefer low-cost materials. In the temperate zone, 34% of buildings use anti-heat materials, while only 1.9% use both anti-heat and cooling materials, which is not considerable due to the moderate temperatures. The Arid zone demonstrates a higher percentage of buildings utilizing anti-heat materials at 49.4%, due to the warmer climatic conditions. Additionally, Kabul shows a significant proportion of buildings incorporating anti-cool materials at 24.5%, due to its cooler climate. While these measures are appropriate, but are not sufficient. In the temperate zone, 64.1% of buildings, in the Arid zone, 50.6%, and in the cold continental zone, 67.5% of buildings are constructed with low-cost materials. The use of low-cost materials results in inadequate insulation, necessitating additional energy for both cooling in summer and heating in winter. Material choices that align with the specific climate reflect a balance between affordability, durability, and thermal performance, which are essential aspects of sustainable construction.

The presence of insulated sections within buildings is crucial for enhancing energy efficiency and thermal comfort. In both the Temperate and Arid zones, no buildings were found to be entirely insulated. In the Cold Continental zone, only 2.6% of buildings are fully insulated, which represents the lowest rate. For window insulation, the percentages are 24.5% in the Temperate zone, 6.5% in the Arid zone, and 30.5% in the Cold continental zone. However, the overall percentage of buildings with insulated sections remains relatively low

across all zones, highlighting a significant need for improvement to adopt energy-efficient building practices.

4.7. Carbon Footprint and Ecological Impact of Urban Growth

At the core of urban design lies the crucial task of managing carbon-producing elements. This incorporates optimizing building heating systems, revolutionizing transportation networks, streamlining efficient waste disposal, and strategically relocating factories away from the urban area.

Table 5. Carbon Footprint and Ecological Impact of Urban Growth

City (Province)	Buildings Heating System (%)				Transit System (%)			Waste Disposal System (%)				Industrial Plant (%)		
	Firewood	Natural Gas	Coal and Wood	Hydropower	Public transport	Local transport	Others	Strong	Good	Weak	Dissatisfied	Active	Inactive	Not Considerable
Asadabad (Kunar)	62.3	37.7				94.3	5.7		22.7	37.7	39.6		62.3	37.7
Jalalabad (Nangarhar)	51.9	27.3	3.9	16.9		100			19.5	67.5	13	54.5	20.8	24.7
Kabul (Kabul)	23.8	4	72.2			98.7	1.3		11.9	53	35.1	68.9	10.6	20.5

Table 5 provides data on buildings' heating systems, transit systems, waste management systems, and industrial plants. If not controlled, these elements collectively contribute significantly to the carbon footprint.

In terms of building heating systems, the temperate zone heavily relies on firewood 62.3% and natural gas 37.7%. The arid zone presents a more diverse energy mix, utilizing firewood 51.9%, natural gas 27.3%, and a combination of coal and wood 3.9%. The cold continental zone predominantly uses coal and wood 72.2%, firewood 23.8%, and gas 4%. These heating practices across all three zones indicate a significant environmental burden due to deforestation and carbon emissions, which are highly polluting.

The transit systems in these zones also rely heavily on local transport, primarily consisting of small vehicles, which are more harmful to the environment compared to public transport options like buses and metro systems. In the temperate zone, 94.3% of the transit system relies on local transport, while in the Arid zone, it is 100%, and in the Cold continental zone, it is 98.7%. These systems primarily use less efficient, smaller vehicles, contributing to higher emissions and urban congestion. Public or governmental transport is entirely inactive, highlighting an insistent need for improvements in sustainable urban mobility.

Waste disposal systems are another critical component affecting urban sustainability. In the Temperate, Arid, and Cold continental zones, the waste disposal system is considered dissatisfactory by 39.6%, 13%, and 35.1% of residents, respectively. Furthermore, 37.7%, 67.5%, and 53% of residents in these zones regard the system as weak. Only 22.7%, 19.5%, and 11.9% of residents, respectively, rate the waste disposal system as good. This situation points to significant challenges in managing urban waste sustainably.

Industrial activity significantly contributes to the carbon footprint and ecological impact in these zones. In the Temperate zone, 62.3% of industrial plants are outside the city, and another 37.7% are located in the city but not considerable, resulting in minimal impact on greenhouse gas emissions and pollution. However, in the Arid and Cold continental zones, 54.5% and 68.9% of industrial factories are active within the cities. Compounding the issue, factories continue to operate within urban areas, leading to uncontrolled carbon production. This amalgamation of challenges stands as the culprit behind the disruption of urban temperature equilibrium, perpetuating global climate anxieties and environmental woes.

4.8. Afghanistan Current Capabilities for Sustainable Urbanization Process

Although Afghanistan continues to face ongoing conflict and political instability. Along with significant challenges in achieving sustainable urbanization, there are opportunities for progress through targeted interventions, capacity building, and partnerships with the international community.

The following administrations and ministries, including the High Council of Water, Ministry of Urban Development and Housing (MUDH), Afghanistan Urban Water Supply and Sewage Corporation, Ministry of Mines and Petroleum (MoMP), Ministry of Public Health (MoPH), Ministry of Rural Rehabilitation and Development (MRRD), Ministry of Ecomomics (MoE), National Environment Protection Agency (NEPA), and Non-Governmental Organizations (NGOs), are collaborating to establish a policy framework and implement initiatives for infrastructure development, urban planning, public services, economic development, social inclusion, environmental protection, and capacity building. Furthermore, Afghanistan is a signatory to 16 multilateral environmental agreements and is also a member of 6 cooperative groups.

5. Conclusion

After a thorough examination of advancements, innovations, sustainability, and climate responsiveness in cities across Afghanistan's diverse climatic zones, including arid, Temperate, and cold (continental) regions, the following decisions were made.

- Afghanistan has experienced diverse demographic changes over the past 45 years, influenced by socio-political turmoil.
- Higher growth, improved life expectancy, and lower death rates drive population growth, which impacts resources demand.
- Afghanistan's GDP growth fluctuated due to conflicts and interventions, with recent negative trends attributed to political upheavals.
- Afghanistan's GDP per capita reflects economic resilience and recovery efforts post-conflict, although recent declines pose challenges and urban sustainability.
- Afghanistan National Environmental Protection Agency's climate priorities and strategies were identified as excessively generalized, Absence of precise considerations uniquely crafted for each distinct climate zone.
- Afghanistan's urban growth lacks formal planning, causing rapid expansion and limited access to proper housing, leading to increased poverty and heightened climate change impacts.
- The lack of climate awareness reveals a notable gap between the changing construction features and the adoption of climate-responsive approaches, presenting massive challenges for improvement.

- The key aspects of climate-responsive urban architecture are lacking, with weaknesses in energy efficiency, insufficient green spaces, and poorly managed urban greenery contributing to temperature increases.
- Despite utilizing clean energy, buildings often suffer from poor alignment, low-cost materials, and a lack of insulation, making them unsustainable and ill-suited to local climates
- Uncontrolled carbon emissions stem from building heating, transportation, waste management, and industrial factories significantly affect precipitation patterns, residential environment, and living quality.
- Despite the challenges, Afghanistan demonstrates a commitment to sustainable development through policy frameworks and international cooperation.

6. Suggestions

- We strongly urge the United Nations to expedite the implementation of the 32 delayed projects related to environmental protection due to political circumstances and to foster increased cooperation in this critical area.
- Afghanistan National Environmental Protection Agency (NEPA), as Afghanistan's environmental guardian, needs to fine-tune its protection strategies, harmonizing priorities with the diverse climatic tapestry of our nation.
- NEPA must launch impactful climate change awareness campaigns, integrate relevant topics into the curriculum, and leverage social media to elevate public consciousness.
- The Ministry of Urban Development and Housing should integrate sustainable practices like building orientation, energy conservation, green space adherence, and climate-specific urban forestry into city regulations for a greener, smarter urban design.
- Municipalities should promote clean energy systems in buildings, encourage carbon-free transportation with dedicated bike lanes, enhance waste disposal management, and relocate factories away from urban zones to curb carbon emissions in urban areas.

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References

Adhya, A., Plowright, P., & Stevens, J. (2010). Defining Sustainable Urbanism : towards a responsive urban design. *Proceedings of the Conference on Sustainability and the Built Environment*, *Inam*, 1–11. http://ipac.kacst.edu.sa/eDoc/2010/183239_1.pdf

Aliyu, A. A., & Amadu, L. (2017). Urbanization, cities, and health: the challenges to Nigeria–a review. *Annals of African Medicine*, *16*(4), 149.

ANDS. (2008). *Afghanistan national development strategy: An interim strategy for security, governance, economic growth &poverty reduction*. *I*, 288.

Baloi, D. (2003). Sustainable construction: challenges and opportunities. *19th Annual ARCOM Conference*, *1*, 289–297.

Behsoodi, M. M., Aslam, M. S., & Latifi, E. (2023). Assessing the 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

Bennett, J., Alexander, J., Saltmarshe, D., Phillipson, R., & Marsden, P. (2009). *Evaluation*

Report Ev696 Country Programme Evaluation Afghanistan. *May*.

Bodach, S. (2016). *Climate-responsive building design for low-carbon development in Nepal*. https://mediatum.ub.tum.de/node?id=1328678%0Ahttp://nbn-resolving.de/urn/resolver.pl?urn:nbn:de:bvb:91-diss-20161206-1328678-1-6

Brennan, M. C. E. (2015). *Sustainable Construction In the 21st Century: An Educational Perspective To Shifting The Paradigm*. Liverpool John Moores University (United Kingdom).

BRILL. (2023). *AFGHANISTAN*. https://referenceworks.brillonline.com/entries/encyclopaedia-iranica-online/afghanistan-COM_4803

Camaren Peter, M. S. (2012). *S sustainable, R resource E efficient C cities – M aking it Happen !*

Cervero, R., & Murakami, J. (2008). *Rail+ Property Development: A model of sustainable transit finance and urbanism*.

Del Rio, D. D. F., Sovacool, B. K., Griffiths, S., Bazilian, M., Kim, J., Foley, A. M., & Rooney, D. (2022). Decarbonizing the pulp and paper industry: A critical and systematic review of sociotechnical developments and policy options. *Renewable and Sustainable Energy Reviews*, *167*, 112706.

Duany, A., & Talen, E. (2002). Transect planning. *American Planning Association. Journal of the American Planning Association*, *68*(3), 245.

Dye, S. (2007). Public Health and Conflict Series: Rebuilding a Nation's Health in Afghanistan. *Peace Brief*.

Easar et al. (2023). Education in Afghanistan since 2001: Evolutions and Rollbacks. *2023 Research Series of Rumi Organization for Research*, *1*(1), 41. https://rumi.academy/10101010101.pdf

Feng, W., Zhang, Q., Ji, H., Wang, R., Zhou, N., Ye, Q., Hao, B., Li, Y., Luo, D., & Lau, S. S. Y. (2019). A review of net zero energy buildings in hot and humid climates: Experience learned from 34 case study buildings. *Renewable and Sustainable Energy Reviews*, *114*, 109303.

Foundation, W. P. (2025). *Afghanistan: Soviet invasion and civil war*. https://sites.tufts.edu/atrocityendings/2015/08/07/afghanistan-soviet-invasion-civil-war/

Jones, S. G. (2006). *Securing Health*. RAND Corporation. https://www.jstor.org/stable/10.7249/mg321rc.15

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

Haddad, M. (2021). *Afghanistan, Visualising the impact of 20 years of war*. https://interactive.aljazeera.com/aje/2021/afghanistan-visualising-impact-of-war/index.html

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

Human Rights Watch. (2022). *Afghanistan: Economic Roots of the Humanitarian Crisis*. https://www.hrw.org/news/2022/03/01/afghanistan-economic-roots-humanitarian-crisis

Inam, A. (2002). Meaningful urban design: teleological/catalytic/relevant. *Journal of Urban Design*, *7*(1), 35–58.

Inspector, S. (2018). *PRIVATE SECTOR DEVELOPMENT AND ECONOMIC GROWTH : April*.

Jiang, Q., Xu, Z., Cui, Y., & Liu, J. (2023). *Complex Impacts of Wars on Global Sustainable*

Development in a Metacoupled World.

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.

King, A. D. (2015). *Urbanism, colonialism, and the world economy*. Routledge.

Li, C. Z., Lai, X., Xiao, B., Tam, V. W. Y., Guo, S., & Zhao, Y. (2020). A holistic review on life cycle energy of buildings: An analysis from 2009 to 2019. *Renewable and Sustainable Energy Reviews*, *134*, 110372.

Loft, P. (2021). Afghanistan: Refugees and displaced people in 2021. *Online.] In: House of Commons Library*.

Lucon, O., Ürge-Vorsatz, D., Ahmed, A. Z., Akbari, H., Bertoldi, P., Cabeza, L. F., Eyre, N., Gadgil, A., Harvey, L. D., & Jiang, Y. (2014). *Buildings*.

Malekafzali, A. (1923). The future of architecture. *Nature*, *111*(2782), 268. https://doi.org/10.2307/348326

MOH. (2020). *Education Institutions*. mohe.gov.af

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

Natsios, A. and Howe, S. (2002). *Afghanistan, 's Economic Opportunities in the Central Asian and South Asian Regions*. https://www.albany.edu/~dkeenan/isp523/economy.html

NEPA. (2017). *SECOND NATIONAL COMMUNICATION UNDER THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE (UNFCCC)*. *December*.

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

NESA. (2011). *Soviet Influence on Afghanistan education.pdf*.

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

North Somerset Council. (2007). Core strategy. *Strad*, *114*(1360), 820.

Pozoukidou, G., & Chatziyiannaki, Z. (2021). 15-Minute City: Decomposing the new urban planning eutopia. *Sustainability*, *13*(2), 928.

Qazi, A. (2009). *National Environmental Protection Agency (NEPA)*. https://doi.org/10.29171/acku_nobati_td171_5_alif77_daal449_v1395_n2

R. McKown, T. (2024). *Afghanistan Educational Overview*. https://www.aacrao.org/edge/country/afghanistan

Roy, T. (2020). *Reading the Economic History of Afghanistan*. *44*(October), 0–29.

Ruiz, H. A. (2004). *Afghanistan : conflict and displacement 1978 to 2001*. 8–10. http://www.fmreview.org/sites/fmr/files/FMRdownloads/en/FMRpdfs/FMR13/fmr13.3.pdf

Ruttig, T. (2001). *Schools on the Frontline*.

Schütte, S. (2009). Informal (in) security in urban Afghanistan. *Iranian Studies*, *42*(3), 465–491.

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

Sopko, J. F. (2021). What we need to learn: Lessons from twenty years of Afghanistan reconstruction. *Sigar*, *August*, 1–123.

Strategy, C. P., Nations, U., Programme, D., Report, H. D., Development, H., York, N., & Framework, D. (2017). *Afghanistan Inclusive and Sustainable Growth Assessment*.

2017–2021.

Syariah, K. B., & Ilmu, G. (2004). *Education in the Doldreums Afghan Tragedy* (Issue September 2016).

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.

Tompson, J. (2012). *Shahama & Bahia Abu Dhabi Hot & Dry 2008 Suzhou EcoTown China*. *44*(0).

Un-Habitat. (2014). *Afghanistan s Urban Future*. 6–9.

UN SDGs, D. of E. and S. A. (2023). *Sustainable Development Goals*. UN SDGs.

UNDP. (2015). *Afghanistan Country Report for Habitat III, Islamic Republic of Afghanistan*. 9.

UNEP. (2010). *Action COMMON PLATFORM*. www.unep.org/sbci/resources/Tools.asp

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

UNIDO. (2018). *Today's Cities Into Livable*. www.unido.org

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

WHO. (2023). *Universal Health Coverage Partnership*.

WHO. (2024). *Afghanistan Health System*. https://www.emro.who.int/afg/programmes/health-system-strengthening.html#:~:text=Afghanistan's health system has the population within an hour's distance.

Byrd, W. (2023). *Two Years into Taliban Rule, New Shocks Weaken Afghan Economy*. https://www.usip.org/publications/2023/08/two-years-taliban-rule-new-shocks-weaken-afghan-economy

WordPress. (2003). *Afghanistan Education in Conflict*. https://afghanistaneducationinconflict.wordpress.com/history-of-education-in-afghanistan/#:~:text=Most of the foundation for, the country's first Minister of Education.

World Bank. (2019). *Building Confidence Amid Uncertainty*. *July*.

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

Zaki, N., & Lederer, M. (2023). *An Overview of Climate Change in Afghanistan: Causes, Consequences, Challenges and Policies*. *January*.

Zawia. (2024). *The UN has suspended Environmental Projects*. https://twitter.com/zawianews?lang=en