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Adapting historic sites: Konya-Sille's approach to climate resilience

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Abstract

Climate change represents an increasingly significant threat worldwide, particularly affecting cities, with historic urban areas encountering this issue on a more profound and complex scale. Although contemporary cities are susceptible to natural calamities due to rapid urban growth and rising population density, historic urban structures, marked by their historical legacy, show a unique vulnerability to the effects of climate change. This is especially pertinent considering their distinctive construction materials and settlement layouts. In this regard, the Sille Neighborhood in Konya, boasting a 5000-year-old history and abundant cultural heritage, emerges as an essential example. It demands detailed scrutiny in the face of environmental challenges like the urban heat island phenomenon, sudden flooding, and drought conditions. The traditional construction materials in Sille, such as wood and adobe, exacerbate this vulnerability, emphasizing the vital need to balance the preservation of historic heritage with climate adaptation strategies.

Keywords: adaptation/resilience, climate change, urban heat island, Sille, historic city

1. Introduction

Climate change is presently one of the gravest threats on a global scale. Cities are particularly vulnerable to this danger due to their high levels of urbanization and growing populations. As major contributors to global greenhouse gas emissions, urban centers face the risk of natural disasters if sufficient measures are not implemented. This issue affects not only contemporary cities but also urban heritage sites of significant historical and cultural importance. These historic urban areas, which reflect the identity of societies, are at great risk from extreme temperatures, sudden heavy rainfall, floods, and droughts resulting from climate change.

In this regard, the Sille Neighborhood, situated in the Selçuklu district of Konya, is a noteworthy urban area for examination. This is due to its rich historical and cultural heritage as well as its susceptibility to climate change impacts. With a history spanning approximately 5,000 years, Sille bears the imprints of the Hittite, Phrygian, Roman, Byzantine, Seljuk, Ottoman, and Republican eras. Recognized as a significant bishopric centre during the Byzantine period, Sille houses monumental structures such as the Hagia Eleni Church, constructed in 327 AD. It also thrived as a hub for culture, education, and handicrafts during the Seljuk and Ottoman times. In 1995, Sille was designated as an urban heritage site to ensure its preservation (Özyurt & Dişli, 2021).

Clearly, an ancient city like Sille, with its extensive history showcasing the legacy of numerous civilizations, inherently possesses a delicate structure that necessitates protection. However, it is also unavoidable that this historic city, given its long history and unique material choices (such as timber and adobe), is particularly susceptible to the effects of climate change, including the urban heat island effect, floods, and droughts. These factors heighten the delicate balance between preserving historical heritage and adapting to climate change to a more critical level. While modern adaptation solutions might compromise the qualities of historic structures or fabric, neglecting climate adaptation would equally jeopardize the heritage itself. Traditional conservation methods often aim to maintain a structure in a static, time-specific condition, but as climate change is a

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dynamic and continuously evolving threat, static conservation approaches are proving inadequate. This also raises the question of how conservation laws and practices can be integrated with current climate change considerations.

This article seeks to propose policies for enhancing the climate adaptation and resilience of historic areas, specifically focusing on Konya-Sille. To achieve this objective, the study adopts a holistic case study approach based on a qualitative research design. The analytical framework of the study relies on a multi-layered data synthesis: in this context, the theoretical background was established through an academic literature review, while Sille's current condition and vulnerabilities were identified by examining local government documents, such as the Conservation-Oriented Development Plan and existing data, as well as reports from institutions like the Turkish State Meteorological Service (TSMS) and the General Directorate of State Hydraulic Works (DSI). This data was further enriched and supported by on-site observations in the area. The core finding from these analyses is that Sille's traditional architecture and settlement fabric embodies time-tested passive design principles and resilience strategies that should not be overlooked in combating climate change. Accordingly, the article's main contribution to the literature is its presentation of a holistic planning framework that integrates this traditional knowledge with innovative adaptation strategies, such as green and blue infrastructure, thereby both preserving cultural heritage and enhancing climate resilience.

2. Geographical and Architectural Characteristics of Konya-Sille

Situated to the west of Konya, Sille is a distinctive settlement with a history spanning around five thousand years. The area's rugged landscape has played a major role in shaping Sille's settlement characteristics. Buildings are arranged in terraces on the steep slopes flanking the stream that runs through the centre (Figure 1). This terraced layout enables cubic, flat-roofed structures to enjoy clear views and ample sunlight, which also enhances privacy. Streets running perpendicular to the slope feature staircase pathways, and most buildings are constructed directly adjacent to the street, lacking front gardens.

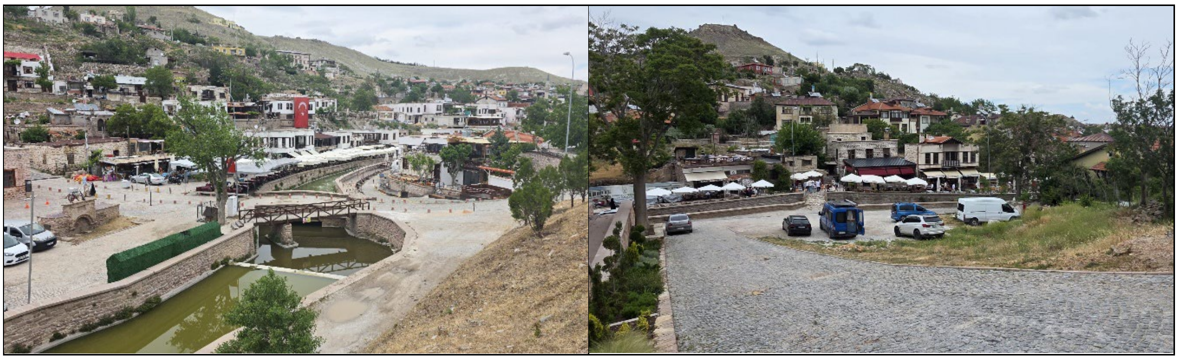

Figure 1 Photographs of Sille's general building layout (From personal archive, June 1, 2025)

The distinctive settlement pattern of Sille clearly demonstrates the successful application of passive climate control in traditional architecture. The houses, arranged like an amphitheater on the area's rugged terrain, are tiered to ensure they do not obstruct each other's views, sunlight, or wind. This clever arrangement not only provided privacy but also enabled the optimization of natural ventilation and solar exposure. Unlike the dense and unplanned concrete developments in Konya's city centers, Sille's organic fabric has the potential to naturally mitigate the Urban Heat Island (UHI) effect, owing to its lower building density and higher proportion of natural surfaces. Although no direct comparative study exists between Sille and central Konya, it has been established in the literature that such organic fabrics in traditional settlements create cooler microclimates compared to modern cities (Gago et al., 2013). Indeed, Waseem et al. (2021) also highlight the influence of urban fabric on microclimates and the role of green spaces in mitigating the UHI effect. These findings offer valuable insights into how topography and architectural formations can be leveraged as fundamental elements for climate adaptation in contemporary urban planning. However, the current decline in population and the abandonment of streets, particularly in the upper parts of Dere Caddesi (Stream Street), pose a threat to this natural resilience. Therefore, preserving and enhancing Sille's existing topographical advantages should be central to climate interventions in its urban development plans.

Most buildings in Sille are one or two storeys high, with earthen roofs. Although only a few are built from adobe, the vast majority are constructed using stone. The primary building material is a unique type of rock sourced from the volcanic area to the south of the region (granite, syenite, and andesite), known as "Sille Stone." This stone has been extensively used in many old buildings, churches, and mosques across the region, particularly in Seljuk-era structures in Konya (Aklanoğlu, 2009; Kuyrukçu & Yıldız Kuyrukçu, 2015).

In addition to Sille Stone, timber (pine, juniper, poplar) was used as horizontal reinforcement within stone walls, as the main material in Baghdadi construction, and for interior and exterior door and window frames, room flooring, cabinets, shelves, beams, braces, eaves, and stairs. Earthen roofs were constructed with timber beams covered with matting and earth, made durable against snow and rain by a layer of 'çorak', a mixture of salt and ash, and compacted with stone rollers (Közoğlu et al., 2022, p.19).

Beyond being merely a building material, Sille Stone's compatibility with the region's climatic conditions makes it a critical material for climate resilience. Research shows that volcanic stones of andesitic origin, like Sille Stone, have a thermal conductivity coefficient in the average range of 1.7–2.5 W/mK (Ekinci & Aydin, 2016). Although this value is higher than that of modern insulation materials, the stone's primary climatic advantage stems from its high thermal mass (heat storage capacity). This property allows the thick stone walls to slowly absorb heat during the day and gradually release it at night, helping to keep buildings cool in summer and warm in winter. This is one of the main reasons why the energy efficiency of traditional buildings exhibits results comparable to those of modern buildings (Közoğlu et al., 2022, p.17). However, the extent to which this unique material is used in current restorations, and the thermal performance implications of its replacement with modern materials, require further investigation. These attributes of Sille Stone highlight the importance of the "local material use" strategy, which integrates cultural heritage preservation with climate adaptation, serving as an exemplary model for modern sustainable architecture.

Sille is home to significant historical structures such as the Hagia Eleni Church, Çarşı Hammam, and Sille Museum. Main streets with dense settlement, like Karataş Street and Hacı Ali Ağa Street, define the urban fabric alongside the bazaar that has developed on both sides of Sille Stream. The streets are generally narrow; as is common in traditional Turkish-Islamic urban fabric, their widths typically range from 3 to 5 meters, wide enough for a pack animal to pass (Günay, 2013). This narrowness creates a cooler environment, particularly during hot summer months, by ensuring the streets remain shaded for longer periods. The streets are stone-paved and equipped with central gutters to channel runoff water; neighborhood fountains are located at corners where multiple streets converge. Although some old streets have been abandoned due to population decline, the architectural elements of old Sille residences hold the potential for revitalization through future renovation projects (Konya Metropolitan Municipality, n.d.).

Sille was registered as an urban heritage site by the Konya Cultural and Natural Heritage Preservation Board in 1995. These registration and protection decisions aim to prevent new construction from diminishing the town's authenticity and integrity. Selçuklu Municipality and Konya Metropolitan Municipality are actively engaged in restoration efforts in Sille, aiming to transform it into a major attraction through facade improvements and street revitalization. Restoration and reconstruction projects are ongoing in line with the Conservation-Oriented Development Plan, prepared in 2001 and revised in 2024. Notably, extensive rock stabilization works have been undertaken to mitigate disaster risks posed by natural rock formations impacting parts of Sille's historic settlement area. These efforts aim to both preserve Sille's cultural heritage and enhance its resilience to natural disasters (Selçuklu Municipality, n.d.).

In summary, Sille's geographical location, topography, settlement fabric, and traditional building materials do not merely present a historical and cultural identity, but also constitute a holistic system of passive climate control and natural resilience formed through centuries of experience. Each element, from the terraced settlement to the high thermal mass stone walls, is part of a local adaptation strategy developed in response to the region's climatic challenges. This section has described Sille's deep-rooted legacy of resilience. However, the critical question is the extent to which these traditional strategies remain adequate in the face of today's increasing and intensifying climate change threats, such as extreme heat, flash floods, and prolonged droughts. Therefore, the following section will analyze in detail Sille's current vulnerabilities to these modern climatic pressures.

3. Climate Change Impacts and Vulnerability Analysis in Sille

Although Sille shares similar climatic traits with Konya, it benefits from a unique microclimate due to its valley position, sparse population, and rural nature. The nearby mountains, such as Takkeli, Gevenli, and Büyük Gevele, help Sille to have milder winters and cooler summers, shielding its vineyards and gardens from frost damage. Konya's climate statistics show average temperatures of -0.2 °C in January and 23.6 °C in July, with recorded extremes of 40.9 °C and -28.2 °C. Additionally, with an annual rainfall average of 327.6 mm, Konya is one of the driest provinces in Turkey (Turkish State Meteorological Service (TSMS), n.d.).

The valley location and mountainous terrain provide Sille with a natural microclimatic benefit, crucial to the climate-responsive nature of its traditional settlement. However, the unregulated expansion and fragmented design from Konya city centre towards Sille threaten this microclimatic benefit and its inherent resilience. The increase in concrete construction significantly worsens the Urban Heat Island (UHI) effect. Maintaining this microclimate not only offers environmental advantages but also is integral to Sille's cultural identity and quality of life. The traditional settlement's low population density and rural character support this microclimate, yet unchecked urban sprawl disrupts this fragile equilibrium. This highlights the necessity of restricting urban development in historic areas and implementing comprehensive planning strategies to protect existing microclimatic benefits (Aklanoğlu & Erdoğan, 2011).

3.1. Urban Heat Island Effect and Local Observations

The Urban Heat Island (UHI) effect refers to the situation where urban areas experience higher temperatures than their rural surroundings. This temperature difference is especially noticeable at night and during times of low wind (Oke, 1982). Key factors contributing to UHI include urban materials like concrete and asphalt, which absorb and store more solar energy. Additionally, urban structures such as tall buildings and narrow streets enhance heat retention, while a lack of green spaces and human-generated heat further amplify this effect (Oke, 1982; Voogt & Oke, 2003). As a result, UHI is a significant concept affecting environmental quality, public health, and the sustainability of cities.

The extensive use of concrete and asphalt, along with dark-coloured materials, heightens the UHI effect by increasing solar energy absorption and heat release. With fewer natural surfaces, urban temperatures can surpass those in rural areas by several degrees (Oke, 1982; Voogt & Oke, 2003).

In the specific case of Sille, no direct measurement data or detailed local observations on the Urban Heat Island (UHI) effect are available. However, the settlement's unique physical structure directly influences this risk. The earthen roofs in the traditional fabric help to mitigate thermal stress, thanks to their high thermal mass, by storing daytime heat and releasing it slowly at night, and by providing evaporative cooling through their retained moisture. In contrast, coating these roofs with synthetic materials like membranes for waterproofing during modern restorations could eliminate this natural cooling effect. Similarly, while the narrow, shaded streets help maintain cooler conditions during the day, paving them with modern asphalt could lead to higher night-time temperatures by causing greater heat absorption compared to traditional stone paving.

To validate these qualitative observations, conducting a Land Surface Temperature (LST) analysis based on satellite data for Sille and its surrounding urban areas would clearly reveal the extent of the UHI effect and identify high-risk zones. Such a visualization would provide strong evidence for policy-making processes, particularly by illustrating the temperature differentials between the historic fabric and newly developed areas.

3.2. Flood and Flash Flood Risks: Sille Stream and Infrastructure Deficiencies

Climate change, by increasing atmospheric water vapor, modifies precipitation patterns, resulting in more frequent sudden and intense flooding in certain areas (IPCC, 2021). Sille Stream, located in the Konya Closed Basin, was once an essential water supply, irrigating local vineyards and gardens. However, after the Sille Dam was constructed between 1953 and 1960, coupled with a decline in rainfall, the stream bed dried up, a situation mirrored by many smaller streams and rivers in the vicinity (Aklanoğlu, 2009, p.83).

In urban areas, especially in historic settlements, existing drainage systems often struggle to cope with sudden, intense rainfall. The prevalence of impermeable surfaces like asphalt and concrete prevents water from being absorbed into the ground, leading to flooding in streets, underpasses, and residential zones (Grimm et al., 2008). Sille's architectural and planning characteristics directly influence this risk. Within the terraced fabric of the settlement, the narrow, stone-paved streets with their central gutters have historically functioned as a drainage system, channeling rainwater to the stream bed in a controlled manner. However, the sudden and severe downpours associated with climate change have the potential to exceed the capacity of this traditional system. Surface runoff, flowing rapidly due to the increase of impermeable surfaces at higher elevations, can turn these narrow streets into channels, thereby increasing the risk of flooding in flat areas near the stream bed and in building basements.

Sille employs a combined sewage system, where both wastewater and stormwater are discharged together. Although detailed records of past flood events in Sille are scarce, this setup suggests that the drainage systems may become overwhelmed during sudden downpours (Aklanoğlu, 2009, p.83). A flood risk map, developed by considering the topography of the Sille Stream bed and its surroundings, would be a critical tool for identifying potential flood zones and the most vulnerable structures (e.g., historic residences with basements).

The Sille Stream, once a crucial water source, has turned into a dry riverbed due to dam construction and reduced rainfall. While the dam aimed to prevent floods and aid irrigation, the drying of the stream bed has significantly altered the local ecosystem and water cycle. This arid stream bed, while worsening drought conditions, also increases the risk of flooding by obstructing the natural flow of water during sudden and severe rainfall, a result of climate change. Dry beds may be inadequate for handling sudden water surges, a problem further exacerbated by the combined sewage system. This situation highlights a 'water management paradox,' where both drought and flood risks are heightened. It emphasizes that relying solely on one-dimensional water management solutions, such as dam construction, may not be sufficient to address the complex challenges posed by climate change (Ministry of Agriculture and Forestry, General Directorate of Water Management, Department of Flood and Drought Management, 2023). Therefore, integrated water management strategies and 'blue infrastructure' solutions are crucial for building resilience against both water scarcity and excessive rainfall.

3.3. Drought Impacts and Water Resources Management Issues

Konya is acknowledged as one of Turkey's driest provinces, having faced its most intense drought period, especially over the past ten years (Şarış & Gedik, 2021). The shortage of water, mainly due to inadequate rainfall, presents significant social and economic difficulties, potentially resulting in reduced agricultural output, nutritional shortfalls, and even cases of famine and deaths.

The water reserves in the Konya Basin have greatly decreased. For example, figures from the State Hydraulic Works (DSI) reveal that the water levels in Altınapa Dam have dropped to 37%, and in Bağbaşı Dam to just 15% (General Directorate of State Hydraulic Works [DSI], n.d.). This critical situation threatens not only the supply of drinking water but also agricultural irrigation, which is the region's economic cornerstone. In addition to current dam occupancy rates, long-term quantitative data showing changes in regional groundwater levels and precipitation trend analyses based on updated climate projections for Konya are necessary to understand the future extent of the drought risk.

The Konya Basin Drought Management Plan highlights Sille Stream as a major surface water source, noting that the Sille Dam, built in 1960, was primarily designed for irrigation and flood control, although it clearly states that the dam does not provide drinking water (DSI, 2019). At the same time, the irregular and excessive use of groundwater resources in the area emerges as a key factor in water scarcity. Despite having only about 2% of Turkey's total surface water resources, the Konya Basin accounts for 17% of the country's groundwater potential (DSI, 2019). This imbalance clearly demonstrates the region's heavy reliance on groundwater for its water management, along with the inherent risks of such dependency.

3.4. Current Infrastructure's State Against Climate Change

Sille's existing sewage system functions as a combined network, handling both wastewater and stormwater. This setup can place significant pressure on drainage capacities during sudden, heavy rainfalls, resulting in increased incidents of waterlogging and flooding (Aklanoğlu & Erdoğan, 2011). More generally, poor infrastructure, the dominance of impermeable surfaces, and a lack of green spaces make urban areas susceptible to climate-related disasters (UN-Habitat, 2011). To address these vulnerabilities, Selçuklu Municipality is undertaking several projects in Sille to reduce disaster risks. These efforts include rock stabilization, extensive infrastructure upgrades, and improvements to superstructures, all aimed at boosting Sille's overall resilience to climate change (Selçuklu Municipality, n.d.). (Figure 2). The primary vulnerabilities of Sille to climate change and their relationship with the current infrastructure status are summarized in Table 1.

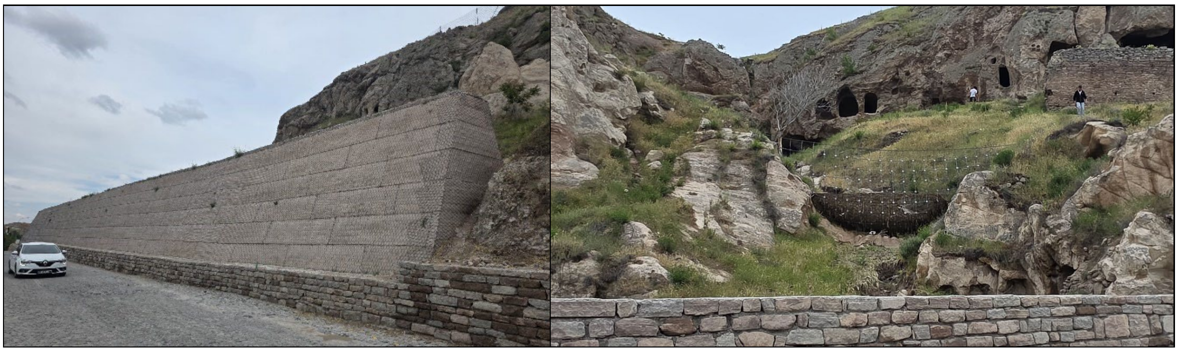

Figure 2 Photographs of rockfall mitigation measures, including stone walls and wire mesh applications, implemented in Sille to reduce rockfall hazard (From personal archive, June 1, 2025)

Table 1 Sille's Climate Change Vulnerabilities and Impacts

Vulnerability Area	Situation/Observation in Sille	Current Infrastructure Status	Expected/Observed Impacts
Urban Heat Island Effect	Risk of urbanization from Konya despite microclimate, narrow streets, stone structures	Presence of impermeable surfaces, lack of green spaces	Increased temperatures, negative impacts on human health, increased energy consumption
Floods and Flash Floods	Dry bed of Sille Stream, past floods	Combined sewage system, inadequate drainage, impermeable surfaces	Waterlogging during sudden and intense rainfall, infrastructure damage, risk to life and property
Drought and Water Scarcity	Konya is one of the driest regions, most severe drought in the last 10 years	Decreased water levels in dams, overuse of groundwater	Reduction in water resources, decline in agricultural production, negative impacts on ecosystems and human health

4. Traditional Architecture and Settlement Fabric's Climate-Adaptive Features

Over the centuries, Sille's traditional architecture and settlement patterns have developed in response to the area's climatic conditions and geographical features. These buildings display notable elements that reflect passive design principles, providing important insights for modern strategies aimed at adapting to climate change.

4.1. Passive Design Principles (Orientation, Form, Building Envelope)

The architecture of Sille homes is characterized by a compact design that adapts to the sloping landscape, with the aim of reducing heat loss. Buildings are generally located on south-facing slopes to optimize the use of solar energy. Larger windows on the southern sides of the buildings allow for effective capture of sunlight. This arrangement ensures that no house blocks another's access to sunlight, views, or wind, thereby maintaining a harmonious integration with the natural environment. While these strategies build resilience against energy costs by reducing the fuel consumption required for heating in winter, they work in conjunction with other passive cooling strategies to prevent overheating during the summer months.

4.2. Natural Ventilation and Shading Strategies

Sille’s traditional settlement, with its terraced design on sloping land, provides significant benefits for passive climate strategies. This configuration ensures that buildings are positioned to prevent obstructing each other's exposure to wind, allowing cool breezes to flow freely. As Knowles (2006) discusses in 'The Solar Village: Living for the Future,' such tiered layouts and the strategic positioning of structures on inclined terrain are essential for optimizing environmental advantages, including natural ventilation and sunlight exposure. These principles align with the adaptive techniques seen in traditional settlements like Sille. This natural ventilation enhances thermal comfort and reduces the need for mechanical cooling by helping to cool the buildings, especially during hot, still summer nights when the urban heat island effect is most intense. Givoni (1969) also noted that the intentional arrangement of trees and walls around buildings creates a windbreak, promoting a more temperate microclimate and thereby lowering the need for heating energy. It is suggested that these environmental modifications play a vital role in enhancing the energy efficiency of homes in Sille.

The windows in Sille homes are generally small, narrow, and tall, featuring wooden shutters. Arnaoutakis and Katsaprakakis (2021) pointed out that such small windows and their wooden shutters help manage solar gain in summer while offering protection from wind and cold in winter. These simple yet effective architectural elements directly contribute to maintaining liveable indoor temperatures during extreme heatwaves, one of today's most significant climate vulnerabilities. Additionally, the open-air areas in front of the main living spaces, known as 'ön damlar' act as eaves over the entrance doors, connecting with the outdoors and aiding in solar control. Research by Hyde (2000) on comparable traditional structures supports the effectiveness of such open or semi-open spaces in improving solar management and regulating the local microclimate.

4.3. Thermal Performance of Sille Stone and Earthen Roofs

The walls of Sille houses were built with notable thickness, using a masonry method that primarily utilized Sille Stone. This high thermal mass plays a critical role in stabilizing the building's interior temperatures, acting as a natural buffer against contemporary challenges such as extreme temperature increases and heatwaves. Studies on similar traditional structures confirm that wall thickness greatly enhances thermal performance (Asadi et al., 2012). Additionally, Sille Stone's low thermal conductivity and natural air-filtering capabilities help maintain comfortable indoor conditions, consistent with the climate control advantages seen in other natural stone materials (Asadi et al., 2012). The flat earthen roofs, constructed with timber beams overlaid with matting and earth, also served functional purposes such as drying food for winter. These roofs significantly contribute to indoor comfort due to their high thermal mass effect. Additionally, they function as a primitive form of green roof; by absorbing a portion of the water during sudden, intense rainfall and providing evaporative cooling, they help to both reduce flood risk and mitigate the urban heat island effect. The thermal mass effect of earthen roofs is recognized as a crucial passive climate control strategy in traditional architecture (Terman, 1985).

4.4. Climatic Benefits of Courtyard and Terraced Structures

Sille homes are constructed following a plan that includes courtyards and terraces. Most of these residences feature courtyards with large seating spaces and rooms that open directly to them. Courtyards, particularly in arid and hot climates, create shaded and cooler microclimates, which reduces the building's cooling load and offers sheltered outdoor living spaces against extreme heat. The tiered terrace design helps to channel cool breezes into the buildings and ensures that airflow is not blocked by neighbouring structures.

These climate-adaptive lessons from traditional Sille architecture offer a rich source of inspiration for contemporary quests in sustainable and bioclimatic design. Each feature examined—in areas such as high thermal mass materials, passive cooling and heating strategies, natural ventilation, and water management, which are detailed in Table 2—demonstrates that effective solutions can be achieved without relying on modern technology. This body of local knowledge serves as a model for designing structures that are highly energy-efficient, have a low carbon footprint, and are more resilient to climatic shocks.

Table 2 Climate Adaptation Features of Traditional Sille Architecture

Architectural Feature	Climate Adaptation Benefit
Terraced and Tiered Settlement	Natural ventilation, solar control, windbreak effect, privacy, and microclimate creation
Sille Stone Walls	Thermal insulation with high thermal mass, protection against heat and cold, air filtration
Flat Earthen Roofs	Indoor comfort via thermal mass effect, water retention potential, functional use (drying)
Small, South-Facing Windows	Passive heating, natural lighting, reduction of energy losses
Wooden Shutters	Solar control, protection from wind and cold
Courtyard House Types	Microclimate creation, natural ventilation, spacious living areas
Narrow Streets	Windbreak effect, shading, reduction of urban heat island effect

However, realizing this potential requires more than individual architectural applications; it demands a holistic planning approach that integrates these principles into conservation and development processes. Therefore, building upon the traditional experience analyzed in this section, the following section will detail the modern, climate-adaptive conservation and planning strategies that can be developed for Sille.

5. Planning Approach: Climate-Adaptive Conservation Strategies

Enhancing the climate change resilience of areas with historical and cultural importance, such as Sille, can be achieved through a holistic and integrated planning approach that goes beyond traditional conservation methods. While numerous solutions can be proposed, their effectiveness depends on their implementation through an integrated strategy, prioritized according to Sille's specific vulnerabilities. Therefore, this section presents an action framework for Sille, ranging from the most urgent and highly feasible interventions to medium- and long-term strategies, which are detailed in Table 3.

Priority 1: Urgent and Foundational Interventions (Water Management and Flood Risk Reduction)

Considering Sille's geographical location and the climatic realities of the Konya Basin, water management is the most urgent area for intervention. Strategies in this area must address both drought and flash flood risks simultaneously.

- **Expansion of Permeable Surfaces:** As a direct intervention against the risk of flash floods in Sille Stream and the potential for narrow streets to rapidly channel water, it is vital to use permeable materials instead of impermeable surfaces like asphalt and concrete, especially in areas near the stream and in large spaces like car parks. This practice will allow rainwater to infiltrate the soil, replenishing groundwater and alleviating the load on the sewage system during sudden downpours, thereby reducing flood risk. This is a highly feasible priority with low costs and high impact.
- **Rainwater Harvesting and Greywater Systems:** To combat drought, the most fundamental vulnerability of the Konya Basin, the integration of rainwater harvesting systems into the historic fabric should be encouraged. Traditional earthen roofs and courtyards, combined with modern filtration and storage (cistern) systems, can create a valuable water source for uses such as garden irrigation. Integrating these systems with greywater recycling systems is one of the most urgent and strategic steps towards reducing the pressure on potable water supplies and increasing resilience against water scarcity.
- **Ecological Restoration of Sille Stream:** The dry state of the stream bed both reinforces the perception of drought and poses a risk during flash floods. The ecological revitalisation of the stream—by planting vegetation that acts as a water retainer and natural filter and creating small pools to slow water flow—will both reduce flood risk and positively affect the area's microclimate. This is a medium-term yet fundamental improvement step.

Priority 2: Medium-Term Strategies (Combating the Urban Heat Island Effect and Architectural Adaptation)

Once water management is addressed, the priority shifts to combating extreme temperatures and the Urban Heat Island (UHI) effect, which directly impact the quality of life in Sille.

- **Promoting Green Roofs and Vertical Gardens:** As a direct solution to mitigate the UHI effect, green roof applications should be encouraged, especially in new or restored buildings. The tradition of earthen roofs can facilitate the cultural adoption of this modern practice. Green roofs using drought-resistant native plants will lower building cooling costs while helping to balance Sille's overall temperature.
- **Preserving Traditional Materials and Passive Design Principles:** To maintain the natural protection offered by Sille's traditional architecture against extreme heat, the use of local materials with high thermal mass, such as Sille Stone, should be mandated in restorations. Preserving architectural elements that provide passive cooling, such as thick walls, small windows, and courtyards, is the most effective and sustainable method for reducing dependency on mechanical cooling and increasing energy efficiency.

- **Increasing Urban Green Spaces:** Protecting existing vineyards and gardens and converting abandoned streets and plots into temporary or permanent small "pocket parks" or community gardens, will break the UHI effect on a local scale and protect public health by creating shaded, cool recreational areas.

Priority 3: Long-Term Strategic Framework (Holistic Governance and Legal Integration)

The success and sustainability of physical interventions depend on a strong governance and legal framework.

- **Disaster Risk Management Plans and Early Warning Systems:** A Disaster Risk Management Plan that integrates the interventions mentioned above should be prepared, including detailed flood, drought, and rockfall risk maps specific to Sille. Establishing an early warning system, particularly for flash floods, is a critical long-term investment to prevent the loss of life and property.
- **Participatory Planning and Awareness-Raising:** The success of all implemented strategies depends on the participation and knowledge of the local community. Education and awareness programmes should be organised in collaboration with the public, NGOs, and local authorities on topics such as water conservation, the maintenance of traditional buildings, and the protection of green spaces.
- **Legislative Integration:** Updating cultural heritage conservation legislation (e.g., the Conservation-Oriented Development Plan) to include climate change adaptation goals will ensure that all these efforts are legally grounded. Incentivising or mandatory clauses should be added to planning regulations concerning the use of permeable surfaces, the requirement for local materials, and rainwater harvesting systems.

Table 3 Prioritised Climate Adaptation Strategies for Sille

Priority Level	Strategic Area	Implementation Proposals	Targeted Benefit / Associated Vulnerability
Priority 1: Urgent and Foundational	Water Management and Flood Risk Reduction	• Expansion of permeable surfaces (car parks, stream banks). • Integration of rainwater harvesting and greywater systems. • Ecological restoration of Sille Stream	• Benefit: Water efficiency, reduced flood risk, groundwater replenishment. • Vulnerability: Flash floods and flooding, drought and water scarcity.
Priority 2: Medium-Term	Combating the Urban Heat Island (UHI) Effect and Architectural Adaptation	• Promoting green roofs and vertical gardens. • Preserving traditional materials (Sille Stone) and passive design principles. • Increasing urban green spaces (pocket parks, gardens).	• Benefit: Reduced UHI effect, energy savings, improved quality of life. • Vulnerability: Urban Heat Island, extreme temperatures.
Priority 3: Long-Term	Holistic Governance and Legal Integration	• Preparation of detailed disaster (flood, drought, rockfall) risk plans. • Establishment of early warning systems. • Participatory planning and awareness programmes. • Updating conservation legislation with climate objectives.	• Benefit: Disaster preparedness, community participation, sustainable conservation. • Vulnerability: Institutional and legal unpreparedness for all risks.

6. Conclusion

Konya Sille, with its rich 5000-year heritage, now stands at a critical crossroads in the face of threats from climate change, such as drought, floods, and extreme heat. The fundamental dilemma in this process is twofold: on one hand, the inadequacy of static conservation approaches, which aim to preserve the cultural fabric as if frozen in time, against dynamic climate threats; and on the other, the risk that modern adaptation solutions, which disregard historical identity, could irreversibly damage this heritage. At this delicate balance point, this study centers on the understanding that conservation must not only preserve the past but also be able to adapt to the conditions of the future.

The core argument of this article and its original contribution to the literature is its reinterpretation of Sille's traditional architectural fabric not merely as a passive heritage to be preserved, but as an active and living set of strategies for climate resilience. High thermal mass local materials, terraced settlements adapted to the terrain, and architectural elements providing passive climate control embody a time-tested experience offering low-carbon, energy-efficient solutions to modern challenges. Accordingly, the study presents a concrete planning framework that integrates this local knowledge with innovative solutions like green and blue infrastructure, prioritized according to Sille's specific vulnerabilities.

In conclusion, the case of Konya Sille transcends the limits of a local case study to offer a paradigm for other historic cities worldwide facing similar climatic and cultural pressures. This study demonstrates that the sustainable future of historic cities is profoundly linked to our capacity to use the architectural heritage of the past as a laboratory to design and conserve the resilient and identity-rich spaces of the future. Placing cultural heritage at the centre of climate action is to protect not only structures, but also our collective memory and a liveable future.

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CRediT Authorship Contribution Statement

Murat KİTİR: Conceptualization, Methodology, Investigation, Data Curation, Writing – Original Draft, Writing – Review & Editing.

Declaration of Competing Interest

The author declares no known competing financial or personal interests that could have appeared to influence the work reported in this paper.

Data Availability

Data will be made available on request.

Ethics Committee Approval

An ethics committee decision is not required.

Resume

Murat Kitir received his Bachelor's degree in City and Regional Planning from Dokuz Eylül University (2008), his Master's degree from Selçuk University (2016), and his Ph.D. from Konya Technical University (2024). He works as an urban planner at the Turkish Ministry of Culture and Tourism's Konya Regional Directorate for the Protection of Cultural Heritage. His primary research areas include cultural heritage, Zoning Law No. 3194, and zoning applications.