

The contribution of traditional knowledge systems to sustainable urban development: The case of the historic settlement of *Sille*

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Traditional Knowledge Systems (TKS) encompass the indigenous knowledge, techniques, values, customs, and ethics developed and preserved by native inhabitants over centuries. Analyzing these systems helps transmit them to future generations while enhancing their adaptability to contemporary designs. This research focuses on TKS in Sille, a historical settlement in Konya, Türkiye, aiming to increase awareness and establish their connection with sustainable development. Through archival and literature research, field observations, and interviews, the study identifies Sille's traditional construction techniques, cultural practices, and methods of food production and preservation. Findings reveal that these practices are deeply tied to the region's natural environment, including its climate, topography, and ecology. They also align harmoniously with ancestral customs, traditions, and rituals. Despite their richness, Sille's TKS face threats from modernization and the pressures of increased tourism. With each passing day, unique elements of this heritage are being lost, underscoring the urgent need for protection through qualified area management planning. This study highlights the importance of documenting and preserving Sille's TKS to safeguard its original values. By integrating this knowledge into sustainable urban development strategies, the research also explores practical solutions compatible with the historic urban fabric of the region. Overall, it emphasizes the potential of blending traditional wisdom with contemporary approaches to address ecological and cultural challenges.

Keywords: Architectural conservation, Historic settlement, Sille, Sustainable urban development, Traditional knowledge systems

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Traditional Knowledge Systems (TKS) and their contribution to sustainable development and resilience for cultural heritage are closely linked. This was first highlighted at the Earth Summit in Rio de Janeiro in 1992, and is currently a hot topic mentioned in many media including UNESCO^{1,2} and ICCROM^{3,4}. The adaptation and mitigation strategies of TKS are closely related to the conservation and management of cultural heritage and include the preservation of cultural landscapes, historic environments/settlements, traditional skills and practices, as well as their sustainability, resiliency, documentation, applicability, adaptability and rediscovery³. TKS from ancient times to the present have largely shaped and influenced a society's way of life and vice versa. However, technological, economic, digital, and cultural changes have greatly affected the use of TKS and even caused them to be forgotten. Therefore, the main aim of this

research is to investigate the primary TKS in Sille, Konya, focusing on cultural traditions, values, beliefs, and technical knowledge, to understand how they influence sustainable development in the region through oral interviews and fieldwork. The study addresses the changes in the consideration and use of these traditional systems due to tourism pressures, changing lifestyles, changes in users, environmental and developmental changes, etc. Several studies have already been carried out on the traditional houses and architecture of the historic settlement in Sille⁵⁻¹⁰ and on geography¹¹, history, area management/ development/ sustainability¹²⁻¹⁵. However, there is still no detailed study of TKS, their importance and their contribution to the sustainability, authenticity, and architectural conservation of the area. Therefore, this study engages in a series of critical reviews of the relevant literature on TKS and establishes a link between them and sustainability to illustrate their mutual contributions to urban development.

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Materials and Methods

The study area

The historical settlement of Sille was chosen as a case study area in view of its well-preserved condition, its deep-rooted history, and the tangible/intangible values that have survived to this day. The settlement has served as a refuge for various societies throughout history, fostering cultural richness through their interactions. This legacy remains visible today, warranting detailed study. TKS, including technical knowledge, values, and ecological systems, were studied in depth using data, photographs, and maps obtained from field and literature studies, both through field observations and oral narratives and interviews with local people. Their relationship to the environmental, economic, and social impacts of the Sustainable Development Goals was then identified. Sille lies on both sides of a deep and narrow valley 7 km northwest of Konya, Türkiye (Fig. 1). The region, inhabited since the Phrygians, has a history spanning thousands of years. It became significant during the Byzantine period as an early Christian center and a key stop on the pilgrimage route between Istanbul and Jerusalem¹⁶. Greeks, Orthodox Turks, Seljuks, and Ottoman Muslims lived in this region¹¹. The land abandoned by the Greeks after the population exchange was used by the Turks, who continued to live in the area. The Sille region has a hot and humid continental climate. There is much more rainfall precipitation in winter than in summer. Summers in the region are dry and hot, and winters are cold and snowy. The average annual temperature is 11.2°C and the amount of precipitation is 406 mm¹⁷.

Research methodology

This research focuses on two main aspects: uncovering TKS in the historical settlement of Sille and explaining their contribution to the area's architectural sustainability, as well as demonstrating

their role in preserving the settlement's traditions and customs.

The methodology of this study comprises four main steps (Fig. 2). These steps are given and explained below:

1- Data collection: Data collection involves literature and archive research, focusing on TKS, their types, sustainability, and prior studies on Sille. The goal is to highlight TKS's role in sustainable urban development and identify previous work on Sille.

2- Sampling, case study selection: The case studies of historic buildings in Sille were selected on the basis of literature research^{6-8,10,11,14} and preliminary site observations, with priority given to those buildings that still retain their characteristic features in relation to TKS. In total 3 historical houses were examined in detail because they had authentic building elements and can be entered, as well as the entire settlement of Sille in general with regard to its TKS.

3- Interviews: The interviews were conducted with the locals who use and own the buildings in the case studies. The aim is to uncover their customs and traditions and to learn more about the technical details of the TKS in Sille. In April 2022, interviews were conducted with 5 residents of Sille vernacular houses. Participants were first asked about their knowledge of TKS, which was then explained to them. They shared insights on food storage, pest protection, climate-sensitive design, and construction in traditional houses. Additionally, they discussed areas and practices of traditional lifestyles. These interviews also helped identify key issues in Sille's sustainable urban development.

4- Field research: The site visits to Sille and selected case study buildings were carried out in three different periods, one for the photography (November 2021- April 2022), one for the interviews



Fig. 1 — Location of Sille and its aerial views (Source: Google Earth (left and center) [43] and photo archives of the authors (right), 2022).

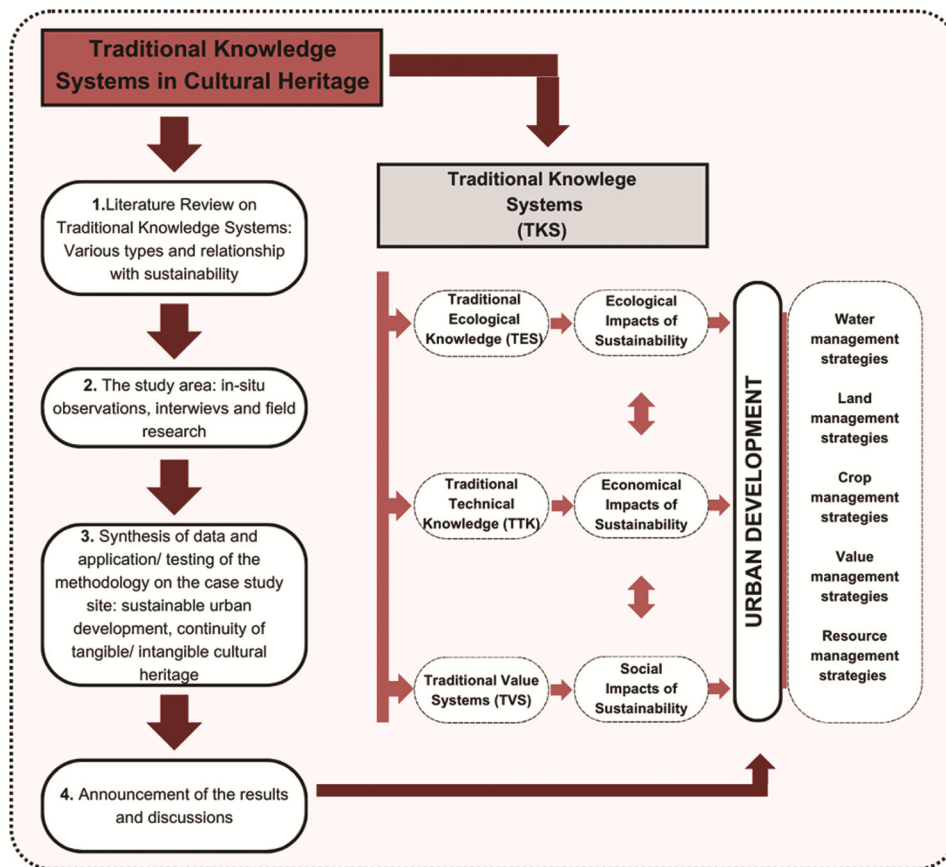


Fig. 2 — Conceptual framework of the research methodology

(April 2022) and one for the detailed analyses (November 2021- May 2022).

After the introduction, the first part of the study is devoted to a brief description of the case study area. This is followed by the definition of TKS, which can take the form of either traditional ecological systems (TES), technical knowledge (TTK), or value systems (TVE). This part also includes their relationship to tangible and intangible cultural heritage and sustainable urban development. The study continues with site selection, field observations, and interviews with Sille residents about sustainable living practices. It defines different types of TKS observed in the area, identifies existing problems related to sustainable urban development, and explains their contribution to the site's sustainability and traditional continuity. The role of TKS in addressing development issues, conserving biodiversity, and preserving intrinsic values in Sille is also explored, followed by general assessments and conclusions. (Fig. 2).

TKS for sustainable urban development: Definitions and recent discussions

Traditional knowledge is closely related to the long-standing traditions, rules, rituals, beliefs, customs, practices, innovations, techniques, and skills of a local community and can shape and manage both intangible knowledge and the tangible-built environment¹⁸⁻²⁰. Achieving sustainability goals is crucial for the longevity of urban and rural areas, and revitalizing TKS can be a key strategy for developing sustainable habitats. Given the rapid changes in places, buildings, and architecture, the sustainability of TKS, vital for architectural conservation, has gained increased importance³, could play a key role in the balanced development of social, economic, and environmental quality of life in the future. Therefore, it is necessary to explore the long-term dynamics of the built environment through a sustainable approach linked to the deep-rooted traditional technical knowledge, ecological knowledge, and value systems of traditional historical areas for centuries.

According to ASTEC (2018)¹⁹ TKS are mainly divided into three basic categories: traditional technical knowledge (TTK), traditional ethical and value systems (TVS), and traditional ecological knowledge systems (TES). TTK refers to knowledge about the construction and development of tools, implements, and equipment for various purposes related to the management of natural resources by local people. These practices are mostly related to agriculture, fishing, livestock, forestry, hand weaving, and handicrafts. TTK includes knowledge and skills related to design and construction, such as vernacular houses, water harvesting systems, roads, and bridges. TES refers to ancient knowledge developed through interaction with the environment, unique to each region, focusing on sustainable practices like resource gathering from forestry, hunting, fishing, farming, and livestock. TVS involves local customs, rules, rituals, beliefs, and cultural practices to manage the built and natural environment.

TKS are essential for "cultural survival," as they contribute significantly to solving development challenges faced by indigenous communities. They help preserve biodiversity and protect intrinsic cultural values, playing a crucial role in the sustainable development of the area²¹. For example, thanks to the sustainable use of land, plants, and animals by local people for thousands of years, it has been possible to combat climate change, desertification, and water scarcity²⁰, an example of which is the Tay communities in Vietnam²². TKS are closely linked to land and the environment, as the earth provides food for indigenous peoples, who in turn respect it. For instance, a study on traditional food practices in Tamil Nadu's Kolli Hills, Pachamalai Hills, and Pechiparai highlights how these communities adapt and preserve local knowledge through traditional food use²³. The use of TKS in organic farming is very important for crop health and productivity²⁴. Similarly, cultural heritage contributes to sustainable development thanks to the choice of durable materials, the construction system, the wise use of topography, and climate-resilient designs adapted to local conditions¹⁸. The study of green architecture, which emphasizes sustainable energy, material reuse, safety, and environmental impact²⁵, exemplifies how sustainable development has been achieved through ancient Vastu principles in Hindu ideology²⁶. TKS have shaped urban development through construction materials, techniques, decoration, and craftsmanship³, integrating closely

with the culture and society of the local population, thus contributing to sustainable use over time²¹.

Results and Discussions

In this part, three aspects of the research problem have been discussed rigorously;

- TKS still existent in historic settlement of Sille: ecological knowledge, technical knowledge, and traditional value systems.
- Primary urban problems of Sille.
- Contribution of TKS to the sustainable urban development of Sille.

Interviews with locals and field studies were the main sources of information used in this section, as well as the literature review.

TKS in the historic settlement of Sille

Traditional ecological knowledge (TES)

Traditional ecological knowledge forms the ecological foundation of the techniques observed in Sille. This section outlines the region's ecological features, focusing on how the local people's dwelling culture and traditions respond to these conditions. It also covers food production, as well as methods of obtaining and preserving food.

Sille's rugged terrain influenced its dwelling culture and construction, requiring buildings and streets to be built in terraces. The settlement rises gradually from the south side of the Sille Stream, which flows through the valley. This geography also shaped land use, with vegetable gardens, orchards, vineyards, urban and archaeological conservation areas surrounding the settlement. In this context, the Sille valley and its immediate surroundings (Sille dam, Sille vineyards and gardens) were used as an open green space and make an ecological contribution to both Sille and the city of Konya²⁷. The Sille valley is a narrow alluvial land formed by the flooding of the Sille Stream. Despite its continental climate, it has highland characteristics due to surrounding mountains (Takkeli, Gevenli, Büyük Gevele), low population density, and rural nature. This results in milder winters and cooler summers compared to Konya. The mountains also protect the vineyards and gardens in the eastern and western parts of Sille from cold damage^{27,28}.

Due to the above-mentioned ecological features, Sille is one of the most important wine-growing areas of Konya. The vineyards are widespread in the south and west of the old settlement. In the vineyards, grape varieties are cultivated for both wine and molasses

production, some of which have been cultivated since Phrygian times¹¹. Almost every family in Sille owned a small vineyard house, typically made of stone, earth, or wood, with a single room¹⁴. Many traditional houses also featured stone hearths in courtyards or vineyards, used for making molasses or cooking. In some other cases, there are also special rooms called *caraş/sandıkevi*, where grapes are pressed and molasses is cooked, or which were used in earlier times by non-Muslims to make wine^{6,13,29}.

There are various ways to protect food, e.g. under the saddle, in the well, in the cellar/*basdırık*, and in wire mesh cupboards^{29,30}. *Basdırık* is a small, enclosed space for food storage, typically located on

the ground floor or underground, with small windows for light. Accessed by steps or a ladder from the kitchen (*aşevi*), it features compacted earth floors. Sea buckthorn (*cehri*), once grown extensively in Sille for use in carpet dyeing, is now found in limited quantities^{14,31}. In Sille, the tradition of drying fish, known as *gavinna*, involves cleaning and stringing the fish on a rope to dry in the sun on balconies or terraces. This process allows the fish to be stored for long periods without spoiling (Table 1)¹⁴.

Traditional technical knowledge (TTK)

The tangible and intangible heritage of Sille represents a significant part of the cultural heritage of

Table 1 — Compilation of data on Traditional Ecological Knowledge (TEK) in Sille (Source: Field Survey, 2021- 2022).

Food production	Wine, grapes, molasses Viticulture
Agriculture	Sea buckthorn (<i>cehri</i>) Vineyards Grape cultivation Sea buckthorn cultivation
Vernacular details: food storage, protection, production	Vineyard houses Hearths for molasses (1) <i>Caraş/sandık evi</i> Food protection/storage under the saddle Food protection/storage in the well Cellar/ <i>basdırık</i> (2) with small embrasure windows tandoor room/ <i>tandırevi</i> (3), tandoor (4), <i>Aşevi</i> /kitchen room (5)
Fishery	<i>Gavinna</i> - drying fish Sille Stream.



the Konya region: three churches carved into the rock from the 9th century, the Aya Eleni Church (4th century), historic mosques, masjids (*Kurtuluş, Subaşı, Mezarkayası, Ak, Karataş, Orta, Çay*), baths, bridges, and numerous fountains in the area¹¹⁻¹³. The settlement reflects a unique blend of Christian and Muslim architecture. The valley's shape has influenced the layout, with narrow, stone-paved streets featuring central gutters to prevent flooding by collecting rainwater for irrigation¹⁴. In addition, the Sille stream divides the settlement into two parts and then extends into the Konya plain.

The main TKS in Sille's building craft focus on masonry and stonework. The capillary water absorption of andesitic tuffs, known as Sille stone, is similar to concrete and higher than that of travertine, limestone, and granite³². The Sille stone mined in the nearby quarries is called *ken*. It is used in brick and tile factories and in the production of lime kilns as it can withstand heat of 2000 degrees Celsius¹⁴. As its moisture resistance is low, Sille stone is commonly used for walls supported by wooden beams and as a cladding material, but not for foundation walls⁵. In Sille, where most of the hills are made of tufa, stone is the main building material because of its easy workability and availability¹². Special Sille lime mortar and craft are used for the masonry of traditional Sille houses. The joints between the stones are curved so that the rainwater that hits the surface of the wall with the wind does not remain on the surface but drains away quickly¹³. In traditional houses, wood from tar, pine, oak, poplar, and juniper is commonly used. Large beams are placed at small intervals for ceilings and floors, often protruding beyond the walls. The walls are constructed using the *bağdadi* technique, where wooden laths are nailed between a wooden frame with 1-2 cm gaps and plastered on both sides. This construction method results in walls that are no thicker than 25-30 cm, providing both stability and insulation⁵. This technique is used in *cumba* (cantilever) to reduce the structural load¹³. Cupboards and chests are made of tar wood because of the essential oils of the tree, which indicates the local experience of the woodworkers⁵. Traditional houses are small and compact, and mostly in the cubic form to avoid heat loss. Their entrance faces south/southeast. Above the entrance, there is usually a balcony (*tahtaboş*), which is mostly covered with grapes that provide cooling in summer, and it is also used for drying food¹³.

The drying process can also be carried out on earth roofs. Dried fruit and vegetables are called *kak* in the

local language³¹. In the traditional houses of the Sille, the roofs are flat, covered with earth and clay kneaded with straw on a mat supported by wooden beams. Flat roofs covered with earth consist of *boyra* (wattle and daub) on wooden beams, *kevek* stone, *bişirik* (thick layer of earth), *çorak* (salty and clayey layer of earth), and *çelen* stone as eaves⁷. Earth roofs consist of snow and rain-proof earth with a final layer of earth called *çorak* mixed with salt and ash. The earth on the roof, which swells due to seasonal and temperature differences, is compacted with a stone cylinder called *yuvak/loğ* before the autumn rains¹¹. In addition, *pardı*, *boyra*, *bişirik*, and *çorak* were used as covering materia on wooden beams. *Pardı* is a thin tree branch that is straightened and brought to certain dimensions. *Bişirik* (*makat/ pahaz*) is mud made from the earth that has been sifted with a fine sieve³³. *Çörten* (waterspout) is a rainwater drainage system on roofs, consisting of a wooden or stone gutter that directs water away from the walls. Rainwater chains are attached to the waterspouts to further divert excess water from the building⁷. Long, overhanging eaves protect walls from rain and provide shade. Zinc eaves above windows prevent water entry and offer shade in summer. In addition, a wire mesh in front of ground floor or basement windows protects against insects, while allowing controlled lighting and ventilation to keep food and drinks fresh³⁰. In traditional Sille houses, the *buhari* is a terracotta pot with holes, used as a chimney on the roof to release excess smoke from fireplaces. It serves both for ventilation and lighting when the fireplaces are not in use for heating.

In some houses, there is a tandoor house/*tandirevi*, which can be seen as a kind of kitchen in the courtyard that covers the tandoor to better protect and enclose it²⁹. The tandoor is made from a mixture of sand, earth, mud, and straw, shaped into a cone that tapers from bottom to top. An air hole is created at the base, and the structure is dried. The tandoor is then buried in the ground, and pipes are inserted into the air hole. These pipes direct the airflow to the courtyard, and a chimney is built to control the fire. When the air hole is closed, the fire burns slowly for 10-12 hour, a process known as "sleeping off the tandoor"²⁹. Clay, pottery, and ceramics have been produced in Sille since the Byzantine period. The clay is made by mixing materials from pits in the south of Sille with fine sand. In the 18th and 19th centuries, Sille's ceramics, including pots, jars, bricks, tiles, tandoors, glasses, and jugs, were widely distributed in Konya and beyond (Table 2)¹¹.

Table 2 — Compilation of data on Traditional Technical Knowledge (TTK) in Sille (Source: Field Survey, 2021- 2022).

Traditional Houses	Construction techniques: Stonemasonry (6), earth roofs (7, 8) Building material selection: Wood- tar, pine, oak, poplar and juniper for beams (9), Sille stone/tuff for the walls (10), ceilings, floors, bağdadi construction, cupboards and chests, Sille lime mortar (11) Special architectural details/elements: <i>Bağdadi</i> (12), <i>tahtaboş</i> (13), waterspouts (<i>çörten</i>), <i>Buhari</i> (14), <i>hanay</i> , <i>geysievi</i> , <i>pardi</i> (15)
Water management	Building material extraction: Ken: Sille quarries (1-2 km distance) In the courtyard: Wells, pools, fountains Inside the house: gusülhane (16) In the neighborhood: fountains, hammams (17), geysievi, collection of rainwater to be used for irrigation, Sille Stream, wise location of the settlement to the topography, aqueducts, waterways, fountains
Ancient HVAC practices	Heating/cooking: <i>Buhari</i> (14), hearth, fireplace, tandoor (18), <i>tandurevi</i> (19) Cooling: <i>Tahtaboş</i> , cantilever (<i>cumba</i>) (13), <i>basdırık</i> /cellars (20), kitchen (21) Rainwater discharge: Waterspouts (<i>çörten</i>) with rainwater chains, Long, overhanging eaves, zinc covers above the windows (22) Ventilation/lighting: wire mesh covers (23) Windows, doors, <i>buhari</i> (14)
Handicrafts	In construction practices: Woodworker, Sille building craft: masonry, stone works, Sille mortar joints (11) In daily life: Clay, pottery, and ceramic art
Site selection/location	Valley: Location in compliance with the topography Sille Stream: Divides the settlement into two sides Roads: Narrow, steep slopes



(Contd.)



Traditional value and ethics (TVE)

Sille is unique with its history, architecture, and traditions, but also with its spectacular arts and crafts. Wealthy people's clothing, world-famous carpets, candle making, jug making, stonework, and artisans are proof of the wealth of craftsmanship in Sille³¹. The locals of Sille still try to keep their culture alive, whether at weddings, soldiers' farewells or greetings, *Gereği* (harvest time) ceremonies, monthly gatherings, or at the Sille Day events in the last week of September³¹. In the past, they used *gusülhanes* (showers) in their homes and public baths such as the Subaşı Bath and the Hacı Ali Ağa Bath to cleanse their bodies. The baths, which could only be used outdoors to a limited extent became a means for women to go out and enjoy themselves.

Baths were primarily for religious purification but also served as places for beauty, relaxation, and socializing. In addition, the baths were places where mothers chose wives for their sons. Women used the baths to care for their bodies, hair, and feet, and some applied henna or braided their hair. Entire days were spent here for these treatments³⁴. *Gusülhanes*, which serve as showers, are placed in bedrooms to wash the whole body. They are usually part of a deep cabinet called *yüklük*, which completely covers

one wall of the room. Another unique feature of Sille is the *geysi evi*, traditional laundries built near wells. These structures were surrounded by low walls and had capstone-covered floors. Several hearths were placed beside washbasins to heat water. While there was once a geysi house in every neighborhood, today only one remains in front of the Subaşı Bath¹³. In the past, the toilets in Sille were located near the entrance to the courtyards due to the Islamic religion's understanding of cleanliness. In the settlement, the buildings do not block each other's air, light, and view due to the slope of the terrain¹⁴. Due to limited land, houses in Sille are closely packed, and streets are narrow. When a house becomes too small, two families often close the street between their homes with wooden beams, creating a space known as a *hanay*. This room, typically used as a bedroom for a new bride, was also used for storing light goods when not in use (Table 3)¹³.

Primary urban problems of Sille

The Sille dam, built between 1953 and 1960 for flood protection and irrigation purposes, also provides some of Konya's drinking water. Since the dam stores water from the Sille Stream and the amount of rainfall

Table 3 — Compilation of data on Traditional Value Sytems (TVS) in Sille (Source: Field Survey, 2018-2022).

	Traditional clothes (24)
	Carpets (25)
Handicrafts/Artisanship	Jug manufacturers (26)
	Stonework/decorations
	Candle making
	Traditional wedding ceremonies
Farewells/Greetings	Soldiers' farewells/greetings
	<i>Gereği</i> gatherings (harvest time)
	Sille Day events
Customs/Traditions and their reflections in vernacular architecture	Religious purification: <i>gusülhane</i> (16), <i>hammams</i> /public baths (17)
	Choosing a bride in public baths
	<i>Yüklük</i>
	<i>Geysi evi</i> (clothes washing house)
	<i>Hanay</i>



has decreased, this stream has dried up along with several small streams in the region^{27,35}.

Population decline and changes in the socio-economic structure have led to the disappearance of viticulture and old vineyards. With technological advancements, carpets once woven in most homes are now made only for personal use, and many quarries have closed. These changes have impacted the survival of Sille's urban, socio-economic, and cultural heritage³⁶.

Tourism is currently the biggest threat to the sustainability of TKS in Sille. Other challenges include a lack of policy and management planning, poor restoration efforts, and the abandonment of ancient traditions. Development and natural hazards exacerbate these issues. Both local communities and the metropolitan city promote tourism to boost income, leading to rapid, unqualified restorations and new, inappropriate additions to historic buildings. Tourism also threatens the urban fabric, leaving ancient rock-cut areas vulnerable to erosion despite climbing being prohibited. Although the area has an approved conservation plan and was declared as a 1st Degree Archaeological and Urban Site in 1995³⁷ it does not have an area management plan yet including visitor, administration, education, transportation, conservation,

awareness, and financial measures. Nor is there a strategic government policy to protect local handicrafts such as Sille stone carvings, clay jars, and traditional carpet weaving. Special room arrangements in traditional Sille houses such as *caraş/sandık evi* have been converted into stables for animals or rooms for storage functions. If remaining traditional knowledge is lost, indigenous peoples will become more vulnerable to threats, risking damage to their property, traditions, and customs. Therefore, participatory approaches and community awareness are essential for sustainable development. However, awareness efforts must be supported by all segments of society³⁸.

Interviews and site visits confirm the tourism-related problems. Parking is scarce, especially on weekends, cafés are overcrowded, and the main street is congested. Locals who still live in their homes complain about a lack of privacy due to the influx of tourists.

Contribution of TKS to the sustainable urban development of Sille

Sille remains an important historical settlement due to its geographical, ecological, socio-cultural, and historical characteristics. To preserve its unique

heritage, its sustainability must be ensured³⁶. In this part, the TKS observed in Sille and their contribution to sustainable urban development were explained, focusing on the importance of TKS in solving the development problems, biodiversity conservation, and protecting and preservation of intrinsic values in Sille.

As outlined in the 2030 Agenda³⁸, “people, planet, prosperity, partnership, and peace” are key dimensions of sustainable development, in which “social inclusion, economic growth, and environmental protection” are the core elements. This research shows that Sille’s locals have developed various indigenous strategies, including resource management practices related to water, land, and crops, all contributing to sustainable urban development. For centuries, they have adapted techniques that are environmentally friendly, cost-effective, and compatible with their land. Environmental factors, historical events, and socio-cultural influences have shaped Sille’s traditional way of life³⁹.

Traditional technical details in Sille’s houses, such as *bağdadi*, *buhari*, *cumba*, earthen roofs, and woodwork, have allowed locals to live in healthy dwellings while protecting nature through reuse. These techniques have supported sustainable urban development by aligning with the region’s natural and environmental conditions. For example, Sille stone is used for masonry and decoration due to its ease of use and high quality, thanks to skilled stonemasons. The combination of local materials and knowledge supports urban development. The region’s alluvial soil, enriched by the Sille Stream’s flooding, fostered strong pottery production. Natural dyes from sea buckthorn enabled carpet making, which became a key craft, used for both flooring and wall insulation^{40,41}.

The region’s ecological conditions have fostered diverse handicrafts, contributing to its socio-economic development. Traditional house design and construction are based on user needs, without formal planning. Some places are carved into rocks, taking advantage of the terrain’s slope. The careful use of topography preserves nature and ensures access to sunlight for neighbors³⁹. The locals have used the region’s rugged topography to build eco-friendly dwellings, integrating nature into sustainable urban development. Practices like using *basdırık*/cellars, clay jars, wells, and saddles preserve food for long periods. Thanks to the favorable climate and knowledge of sustainable agriculture, viticulture, grape harvesting, molasses production, and sea buckthorn cultivation thrive. Courtyards and surrounding land are utilized for food production, supporting sustainable land use.



Fig. 3 — Examples of fountains (top left and right, bottom left) and an aqueduct/*Şeytan Köprüsü*-Devil’s Bridge (bottom right) in Sille (Source: Photo archives of the authors, 2021- 2022)

The locals of Sille use traditional and spiritual practices to preserve crafts, customs, and traditions important for ecological balance and biodiversity. The community has developed collective practices for sustainable land and resource management, with women playing a key role in food production and conservation.

Geysi evi, the tandoor house, extensive vineyards, as well as courtyards and earthen roofs of traditional houses are just a few examples of places where community activities take place. The activities carried out help to impart to the locals about traditional washing, cleaning, cooking, and even growing local seeds, plants, and crops.

Local construction practices protect residents from climate impacts and damage. Techniques include proper stone extraction, reinforcement with wooden beams, lightweight *bağdadi* structures, plastering walls against prevailing winds, special drainage details on earthen roofs, zinc covering over windows/doors, and effective use of topography—all contributing to sustainable urban development. Traditional water management has been crucial to the settlement’s sustainability. As the settlement located in a valley, rain and snowwater from the mountains are collected in the Sille Stream. The settlement features wells, fountains, baths, and washing places/*geysi evi*, all connected to the stream. Also an aqueduct called *Şeytan Köprüsü* (Devil’s Bridge) once carried water to the main settlement through deep valleys⁴² (Fig. 3).

Table 4 — Strategies used in water, land, crop, and value management in Sille

Water management strategies	Wells, fountains, Sille Stream, Sille dam, rainwater collection strategies
Land management strategies	Vernacular building techniques, multiple reuse of buildings, respect to topography in dwelling construction
Crop management strategies	Use of courtyards or nearby areas for food production, use of native varieties, respect to climate in timing
Value management strategies	Collective practices and spaces
Resource management strategies	Use of local and ecological materials in buildings

By summarizing the above data, the strategies for sustainable urban development using TKS are presented in Table 4.

Conclusions

The aim of this research was to recognize the importance of indigenous knowledge and its contribution to sustainable urban development in the historical settlement of Sille. This study highlights how traditional knowledge can complement contemporary strategies and scientific knowledge. The findings from Sille demonstrate that;

- The know-how practices of the indigenous people of Sille are deeply rooted in the nature, environment, climate, topography, and ecology of the region. The cultivation of water, land and crops in Sille proved to be very diverse. Based on local knowledge and know-how strategies, it supports the preservation of the natural ecosystem. This in turn reduces vulnerability to climate impacts.

- The study documented key ecological, technical traditional knowledge and value systems in Sille, highlighting the locals' expertise in building techniques suited to the region's topography, ecology, and resources. These practices, in harmony with ancestral customs, have helped the community adapt to climate and environmental challenges over centuries.

- These TKS contributed in various ways to the sustainable urban development of the region, allowing the area to reach its current state, at least to a certain extent, with its preserved condition.

However, the survival of TKS in Sille is threatened, particularly by tourism pressure. Locals face privacy issues due to increased visitors and lack of management strategies. Tourism and growing commercial areas also lead to poor, rapid restorations, eroding local craftsmanship and building details. This study finds that TKS alone cannot ensure sustainable urban development; it must be supported by comprehensive management plans involving locals, communities, municipalities, and area users.

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Conflict of Interest

The authors declare that there is no competing or conflict of interest.

Author Contributions

GD and ENA conceptualized and conducted the research and collected the data. GD formulated the conceptual framework of the research. ENA conducted most of the field surveys and applied the conceptual framework under the supervision of GD. ENA prepared the draft manuscript and GD refined, revised, and finalized the research manuscript.

Data Availability

The authors confirm that the data supporting the findings of this study are available within the article.

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