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Indigenous Sustainability and Post-Earthquake Vulnerabilities: A Case Study of the Traditional City Khokana

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Keywords

Accessibility, Compact city, Heritage, Resource management, Urbanization

ABSTRACT

Traditional cities have quietly operationalized localized resource management and self-sufficiency for centuries. However, in the Nepalese context, traditional cities are generally studied through a heritage and conservation lens, though to a lesser extent through a sustainability lens. This study addresses this knowledge gap by examining the sustainability of Khokana, a traditional city also affected by rapid urbanization and post-Gorkha earthquake reconstruction. The objective of the study is to investigate a traditional citys inherent capacity for self-sufficient resource management and its response to rapid urbanization and sudden disasters. The study applies the concept of sustainability across the six dimensions: land use, built forms, accessibility, open spaces, water management, and waste management, which are identified through a literature review. The study adopts a descriptive case study methodology and collects qualitative data through field observations, interviews, and a literature review of journals, articles, and governmental and institutional reports. Findings show that Khokana demonstrates sustainable characteristics through mixed land use, compact built form, pedestrian accessibility, multifunctional open spaces and efficient water and waste management. However, the study also identifies city congestion, vehicular intrusion, and wanton conversion of traditional built forms due to rapid urbanization and the post-Gorkha earthquake. The study concludes that while traditional cities like Khokana offer highly valuable lessons for modern sustainable cities, this city is currently at risk of losing its inherent sustainability characteristics. Immediate planning and policies are required to balance rapid urbanization and disaster resilience with sustainability characteristics.

Introduction

While contemporary urban planning uses strategies such as circular urban models (Longo et al., 2026) and the zero-carbon concept (Duan & Kim, 2023), traditional cities have quietly operationalized these concepts for centuries. Therefore, this study addresses this critical knowledge gap through an empirical examination of indigenous sustainability in the traditional city of Khokana, while also focusing on vulnerabilities arising from the post-Gorkha earthquake and rapid urbanization.

The main characteristics of a sustainable city are the overall quality of life, continuing access to natural and built resources, and avoiding environmental damage (Direc-

torate General for Environment, Nuclear Safety and Civil Protection., 1997). The place where people live for a long period of time in the harmony of an ecologically clean environment, good health, and constant improvement of the quality of life of the population is also a sustainable city (Shalbolova et al., 2020). Many studies have explored traditional cities through heritage conservation (Rokka & Singh, 2020; Yamada & Furukawa, 2016); cultural compatibility (Rapoport, 1969), ecological wisdom (Akbar et al., 2020; Wei et al., 2025), materials and technologies (Zheng et al., 2024). In contrast, Bibri and Krogstie (2017) have emphasized that integration of advanced ICT and data-driven solutions bridges the gap between technological innovation and ecological sustainability. Moreover, sustainable cities are increasingly conceptualized within global frameworks such as the Sustainable Development Goals (SDGs), particularly SDG 11, the New Urban Agenda, and international climate commitments, all of which emphasize inclusivity, resilience, environmental sustainability, and an improved quality of life (Chen et al., 2024). There are potential directions for research in the Nepalese context, as the sustainability of traditional cities like Khokana remains largely underexplored.

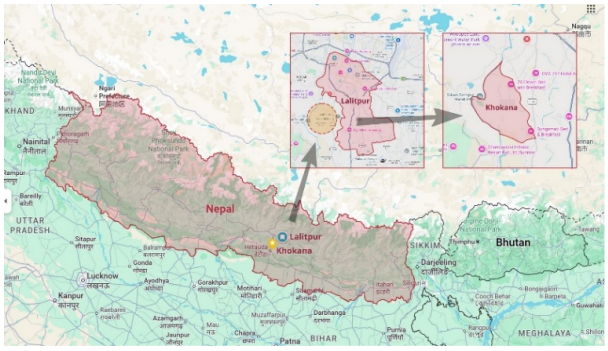
Within this vast discourse of sustainability, this study explicitly rejects the concept of sustainability that relies on modern technologies and solutions. Also, the study moves beyond the traditional framework of heritage conservation and cultural compatibility. Instead, this study conceptualizes sustainability explicitly through the lens of indigenous resource management and self-sufficiency. Traditional cities, rich in historical architecture and indigenous urban planning, reflect the principles of sustainability (Cao et al., 2024; Matar et al., 2023; Oers & Pereira Roders, 2012). For self-sufficiency, proper access to basic services is important.

The UN-Habitat (2018) and World Bank (2018) define basic urban services as safe drinking water, adequate sanitation facilities, solid waste management, reliable electricity, affordable and inclusive transportation, drainage, and stormwater management. This literature clearly shows that sustainable cities have local access to basic services without relying on other cities. To achieve this without relying on non-contextual planning models, cities should adopt an ecologically responsive, sustainable development approach that fosters a multidimensional connectedness between the population and their land (Akbar et al., 2020).ăIn this paper, the conceptualization of indigenous resource management has also been examined in terms of spatial efficiency. Traditional cities integrate residential, commercial, religious, and social functions in close proximity, minimizing travel distances, reducing dependence on mechanized transport, and promoting walkability. Therefore, accessibility is a core principle of sustainable city structure (Lynch, 1960). Generally, a 300-meter distance is equated with a five-minute walk and is commonly used as an indicator of sufficient access (Richards et al., 2025). Empirical evidence from compact built environments shows that compactness, density, diversity, mixed land use, sustainable transportation, and green space are the core strategies of the compact city for achieving sustainability (Bibri et al., 2020). To achieve this, land-use distribution follows natural topography, solar orientation, and prevailing winds, thereby supporting environmental sustainability through ecological planning (Meng, 2024).ăBy embedding ecological planning into the spatial fabric, traditional cities naturally lower ecological risks, prevent urban sprawl, and improve the quality of life (Mersal, 2016). Thus, the ecological embeddedness of traditional settlements can provide lessons for contemporary cities as they envision more sustainable built environments for present and future generations (Akbar et al., 2020). However, when traditional indigenous cities face a sudden natural disaster, their resilience is severely challenged. In Nepal, the 2015 Gorkha Earthquake revealed that traditional settlements are heritage-compatible and sustainable but lack disaster resilience (Daly et al., 2023; Yenny et al., 2023).

In this study, sustainability is conceptualized as the ability of a traditional city to manage resources efficiently through an integrated, self-sufficient harmony between the built environment and local natural resources. In the context of Khokana, the study applies to this concept of sustainability across the six dimensions: land use, built forms, accessibility, open spaces, water management, and waste management, which have been identified through a literature review. The study further encompasses the impact of modern urbanization and post-Gorkha earthquake reconstruction practices on these six dimensions.

Figure 1

Location Map of Khokana



Source. Google Map

Khokana, located approximately 8 kilometers south of Kathmandu, is an ancient Newari settlement in Ward 21

of the south-west part of Lalitpur Sub-metropolitan City (Figure 1).

The civilization of Khokanas residents is believed to have originated in the historically significant Ku:desh area (locally known as Ku:de), situated in the lowland near the renowned Shikali Temple to the west of the ward, along the Bagmati river bank and todays Khokana settlement was expanded with the migration of the Jyapu from this Ku:desh area (Poudel et al., 2024). According to residents, it was difficult for a single caste to perform all societal functions, which led to the inclusion of Shahi (as butchers), Kusle (as musicians), Kapali (as cleaners) and Napit (as nail trimmers and barbers). They also stated that migrants from other caste groups currently live there. As stated by a local resident, Khokana preserves distinctive cultural traditions like strict prohibition of raising chickens or serving chicken meat during communal feasts. Khokana has a typical form of a clustered traditional Newari settlement (Rokka & Singh, 2020). The place was nominated as a UNESCO World Heritage Site in 1996, recognized for its unique cultural and mustard oil industrial heritage (UNESCO, 1996). The historic urban planning, use of local resources, and community-based development of Khokana offer valuable lessons for sustainable city development by emphasizing the integration of cultural heritage with modern needs (Rokka & Singh, 2020).

Khokana is renowned for its traditional mustard oil production, with many mills that have operated for centuries using traditional techniques. In one of the mills, the furnace and oil press, over 300 years old, are believed to have been gifted by the Patan royalty, predating the Shah dynasty. These mills were distributed throughout the settlement and were largely community owned. At present, the use of alternative products and manpower shortages has led to the closure of many traditional mills, affecting the local economy. However, Khokana remains historically significant as one of the first areas in Nepal to gain access to electricity.

The article examines the sustainability characteristics of Khokana, raising two specific research questions: How does the traditional city of Khokana, across the six dimensions of land use, built forms, accessibility, open spaces, water management and waste management, leverage indigenous resources and achieve self-sufficiency? What is the impact of rapid urbanization and post-Gorkha earthquake reconstruction on these indigenous resources and self-sufficiency?

Materials and Methods

The study adopts a descriptive case study methodology based on a qualitative study. Rather than seeking statistical generalization across a vast population, this research focuses on gaining a deep context-specific understanding from the indigenous people of the traditional city of Khokana. The study utilized purposive selection alongside snowball sampling to identify key informants for interviews. The selection of informants was based on three criteria:

- Long-term residency in the traditional city of Khokana to provide historical context and practices.
- Direct involvement in indigenous resource management.
- Institutional expertise in local administration and post-Gorkha earthquake reconstruction, e.g. ward officials.

The study employed three interconnected qualitative methods to collect primary data.

- Semi-structured interviews using an open-ended questionnaire engaged residents, community elders and Ward 21 officials to understand indigenous sustainability wisdom and daily experiences.
- Observation of architectural and spatial aspects like land use, compactness, built forms, street hierarchies, open spaces, and accessibility further validated the information obtained through interviews.
- The field observations of architectural and spatial aspects were further validated by imagery from cadastral maps and Google Earth.

The study conducted open-ended qualitative interviews for primary data, which secondary sources - journals, governmental, and institutional reports subsequently complemented. By integrating field-based observations, community perspectives, and documented references, the study has developed a comprehensive analysis.

Results

Land Use

Khokana occupies a land area of 3.47 square kilometers, where the ancient settlement covers only about 0.20 square kilometers, and more than 90% of the total land is covered by agricultural fields (ICOMOS Nepal., 2015). This high-density footprint (Figure 2) represents Khokana as an example of compact city as defined by the literature on compact city planning and development (Bibri et al., 2020; Katuri., 2025). The land-use pattern of Khokana is characterized by a mixed-use system that integrates built structures, such as residences

and temples, with various open spaces, including chowks (street junctions) and courtyards (Figure 2). It also encompasses water bodies such as ponds and hitis (community waterspouts), community forests, and extensive agricultural land (Figure 2). These elements are interconnected through a network of streets that link chowks to residential courtyards and surrounding farmlands, creating a cohesive, functional, and accessible spatial structure. During the interview, when asked about their idea of Khokana as a sustainable city, most of the residents explained Khokana as A unique and well-managed historic settlement with rich cultural heritage, efficient resource management and surrounded by greenery outside the settlement. This localized spatial efficiency creates a profound academic dialogue with the urban sustainability frameworks (Akbar et al., 2020; Huang et al., 2025; Shalbolova et al., 2020), which identify compact density, pedestrian-centric mixed-use development and local resource management as prerequisites for achieving urban sustainability. Local narratives further validate the spatial mapping, as a 40-year-old resident who is a service holder at Ward 21 stated, Everything I need for my daily life is very near to my house. The groceries, health clinic, my sons school, my office and the temple are all within five minutes walk. We rarely have to leave the core or use a vehicle for our daily routines.

Figure 2

Land Use Map of Khokana

Source. Cadastral Map of Khokana

As shown in Table 1, while comparing the population data from three census periods- 2001, 2011 and 2021, it is known that the population and population density have been gradually increasing, resulting in dense built forms with vertical expansion, addition of rentable spaces and compact living.

Table 1

Household and Population Data of the Traditional City of Khokana

Year	Number of Households	Population	Population Density	Source
2001	818	4542	1433 per sq. km.	(CBS., 2001)
2011	1056	4927	1554 per sq. km.	(LMC, 2011/12)
2021	1235	5274	1664 per sq. km.	(LMC, 2025/26)

Population growth, especially due to migration, has affected not only the traditional city area but also the surrounding farmlands. Many farmlands have been subdivided and sold to migrants, resulting in the replacement of agricultural areas with concrete housing. As stated by a local resident, Major development projects such as the Kathmandu-Terai Fast Track (KTFT), Smart City, 132 KV High Voltage transmission line, and Outer Ring Road have further intensified migration and land use pressures in Khokana. This expanding new settlement on the outskirts of the traditional city of Khokana and unmanaged development activities, coupled with high agricultural production costs, lack of irrigation facilities, and growing apathy among youths towards agriculture, align with the contextual problem identified in Khokana Visioning Booklet: "Prosperous and equitable Khokana with glorious Newari cultural identity" (Poudel et al., 2024).

Built Forms and Settlement Pattern

The swastik-shaped settlement pattern of Khokana (Figure 2) reflects traditional Newari planning, characterized by temples, courtyards and narrow streets, and it is believed that during the reign of King Amara Malla around 1530 AD, the Rudrayani Temple was established to control a cholera outbreak, after which Khokana also came to be known as Jitapur (Poudel et al., 2024). The residential clusters are organized around a communal courtyard and interconnected pedestrian lanes, forming a compact settlement (Figure 3). Building typologies feature traditional symmetrical façades with finely carved wooden windows, walls made of sun-dried bricks on the inside and burnt bricks on the outside, bonded with mud mortar, timber structural elements, and clay jhingati roof tiles that provide thermal insulation (Figures 5 and 6).

Khokanas compact, thick-walled houses stay warm in winter and cool in summer through solar geometry and traditional design. The narrow streets and closely spaced houses allow buildings to shade one another, creating a cooler pedestrian environment and reducing indoor heat

gain during the hot summer season (Figure 4). During the cold winter season, the lower sun angles permit solar penetration into both streets and indoor spaces.

Figure 3
Courtyard Planning

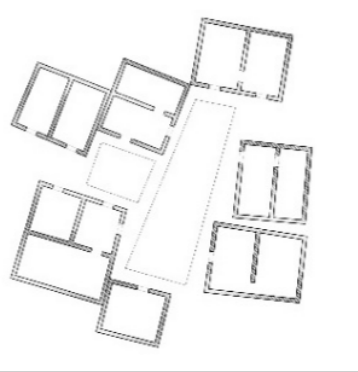


Figure 4
Solar Radiation through Streets

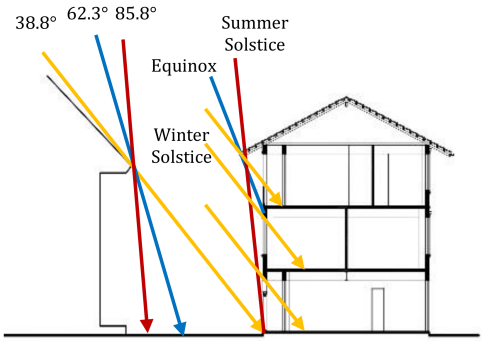


Figure 5
External Wall Detail

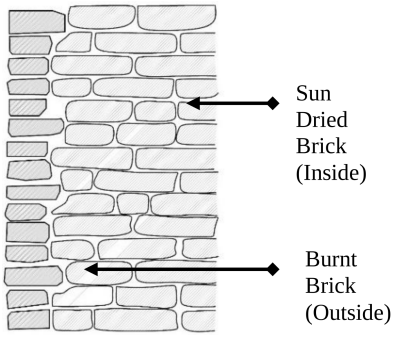


Figure 6
Symmetrical Traditional Houses along the Street

Originally, the traditional houses were limited to three stories (Figure 6). The Gorkha earthquake caused extensive damage, destroying nearly 80% of the houses at Khokana (Poudel et al., 2023). Temporary shelters tahara were constructed after the earthquake, often encroaching upon nearby agricultural land and open spaces, and have poor thermal comfort.

At present, residential buildings in Khokana can be categorized into three types: traditional low-rise brick houses up to three stories, reinforced concrete houses of four or more stories, and hybrid structures that combine both (Figure 7). The breakdown of joint families has led to the subdivision of houses, and rising housing demand has driven vertical expansions. Unplanned reconstruction practices have used baked bricks instead of sun-dried bricks, cement mortar instead of mud mortar, cement-plastered walls instead of exposed brick walls, and CGI sheets or RCC slabs instead of traditional clay-tiled roofs (Figure 7). Local administrative representatives emphasize the policy challenges driving this transformation. As noted by a Ward 21 official, We want to preserve the traditional façade, but the traditional materials, especially timber, are too expensive and building bylaws are difficult to enforce because engineers hesitate to provide safety assurance with a load-bearing brick wall structural system. This impact on spatial harmony reflects the vulnerabilities identified in the case study along Nyala Dan Street in Khokana (Yamada & Furukawa, 2016) regarding spatial transformation resulting from post-disaster reconstruction.

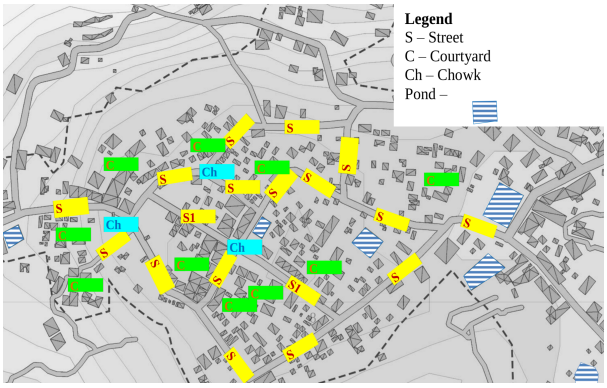
Figure 7
View from a Street of Khokana

Accessibility

Based on the land use map (Figure 2), Khokana is characterized by dense housing, mixed land use, and narrow streets 2.5 to 3.75 meters wide, which favor pedestrian movement. Street widths less than 20 feet (6 meters) are considered narrow (Millard-Ball, 2022). The street network follows the hierarchy of function, scale, and variation. The main street, S1, serves socio-cultural activities such as jatras (religious processions) (Figure 8). Rudrayani Devi Temple, a significant 3-storey temple of Khokana, essential for hosting the 9-day Sikali Jatra is situated along the main street S. The main street connects the central chowk to other community squares. Secondary streets link these chowks to residential courtyards and extend to surrounding agricultural lands.

Figure 8

Street and Open Space Network Map of Khokana

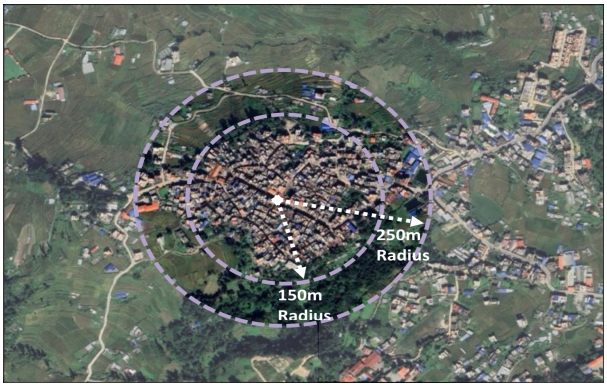


Source. Cadastral Map of Khokana

The width of the streets, 2.5 to 3.75 meters, was determined by the wheelbase of religious chariots for procession during jatras. The Khokana bus park (Figure 2), located along Khokana Karyabinayak Marg, functions as the main node for public transportation. Public transportation runs at regular intervals to Ratnapark. Public transportation and four-wheeled private vehicles are restricted within the traditional settlement. Basic services such as educational institutions, healthcare facilities, banks, and shopping markets are located within 250 meters of the city center (Figures 2 and 9). The funeral procession begins in the residential core, following a specific pathway to the cremation site along the Bagmati River.

Figure 9

Proximity of Basic Services



However, rapid urbanization following the Gorkha earthquake and infrastructure developments, such as the Kathmandu-Terai Fast Track (KTFT), have increased vehicular traffic within the traditional settlement. During the discussion about accessibility, a 75-year-old local shopkeeper said, Private cars and motorbikes are now entering the narrow streets of Khokana. We dont feel safe as pedestrians; children feel unsafe to play, and the brick pavements on the streets are being damaged. This statement aligns with the study of traffic congestion due to the KTFT project on the Khokana-Nakkhu Road (Shrestha et al., 2024). Also, observations have shown a lack of essential infrastructure, such as proper drainage and street lighting, which poses challenges to safe mobility.

Open Space

The settlement pattern is characterized by two primary elements: compact residential clusters organized around courtyards and public squares linked by streets, which is further validated by the study of Khokana by Rokka and Singh (2020). The nodal points created at street junctions in the form of chowks, indicated as Ch (Figure 8), have social significance as community and market gathering spaces. These chowks also incorporate religious structures: temples, ponds, and waterspouts. Courtyards serve multiple functions: recreational areas for the elderly (Figure 11), play areas for children, spaces for religious and cultural practices, spaces for economic activities such as straw weaving (Figure 10), and spaces for household activities such as washing, drying, and bathing. In the communal lifestyle of the Newars, the house is primarily used for cooking, sleeping, and storage, while most daily activities occur outside the house in open spaces (Figure 10). Daily rituals like bathing in sacred ponds and worshipping deities further enhance the cultural significance of these open spaces. The open spaces in the form of chowks and courtyards, water bodies in the form of pukhu (ponds) and hitis (waterspouts), and greenery in the form of forests and agricultural land help to create a natural ecosystem. Courtyards and streets enhance natural lighting and ventilation within the built environment.

However, reconstruction after the Gorkha earthquake and rapid urbanization have led to a decline in open spaces, agricultural land, and forests. The decline of open spaces and their use is further validated by local narratives, as a 75-year-old resident living near the chowk aside Rudrayani Devi Temple explained, The chowks are our communal living room where we sit together, sundry our grains and weave straw mats. But they are being turned into parking lots. This narrative highlights the profound spatial problem occurring at Khokanas street nodes.

Figure 10

The Multifunctional Courtyards

Figure 11

The Chowks as Social Gathering Spaces

Water Management

Water management at Khokana was traditionally based on the interconnected systems of wells, springs, ponds, and waterspouts that supply water for drinking, cooking, and washing. The settlements slope topography, with the settlement area on a higher elevation and agricultural land on a lower elevation (Figure 12), enabled a gravity-based water distribution system. Open drains also provided water to livestock such as ducks, goats, and cattle.

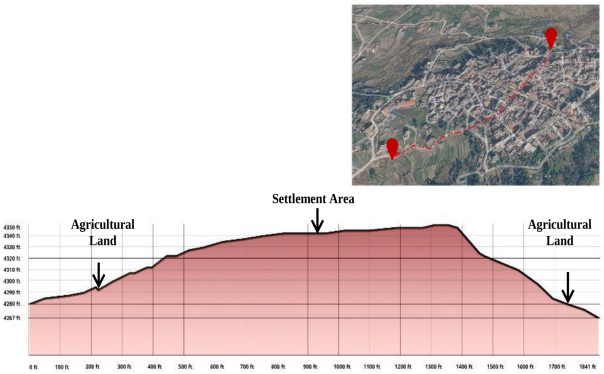
Raj Kulo, a large irrigation network approximately 1.3 meters deep and 1.5 meters wide, channels water from nearby rivers and streams, particularly from Tikabhairav, to agricultural fields. At present, due to encroachment resulting from urban expansion, the natural flow of water through wells, springs, ponds, and waterspouts is interrupted. Many ponds have dried up and require refilling from water tanks during festivals. Shallow wells in most households are dry during the dry season due to declining groundwater levels. Consequently, Khokana today relies largely on modern water supply for domestic use, which provides water for a limited duration each week. Despite the evident water scarcity, sustainable practices such as rainwater harvesting and grey water recycling are absent.

Waste Management

Solid waste management in Khokana is done through composting. Biodegradable waste is processed through an anaerobic pit, locally known as saga, to produce compost used as fertilizer in agricultural fields. In modern waste management, planning experts talk about zero waste cities (Makan et al., 2025) and closed loop systems (Zhang et al., 2024), but the inhabitants of Khokana have used these principles for centuries through the network of sagas. Saga is a pit in the ground, lined with traditional clay bricks laid in mud mortar, with an unpaved bottom, allowing organic fluids to naturally seep and filter into the deeper soil matrix without contaminating the shallow groundwater tables used for drinking water. As per an 80-year-old resident, sagas are strategically placed at the perimeter of neighborhoods or chowks or along the periphery where built core transitioned into the sloping agricultural lands, where households deposit organic waste from the kitchen, agricultural residues, livestock manure and even human waste. Layers of organic waste are periodically covered with ash, which neutralizes odors and regulates moisture levels. Once or twice a year, the sago is excavated, and the resulting material is highly concentrated, nutrient-rich organic fertilizer Saa. Since the traditional city of Khokana is elevated, with farmland sloping downward, gravity conveniently facilitates the transport of heavy fertilizer from the urban core to the farmland below (Figure 12).

Figure 12

Topography of Khokana



Source. Google Earth

At present, though the practice of saga is decreasing, this indigenous knowledge is integrated with modern technologies such as biogas digesters, which convert organic waste into biogas for cooking, and the by-product slurry is used as fertilizer. Other non-biodegradable waste, such as plastics, rubber, and fibers, is disposed of by burning in pits. This process is managed at the community level, rather than only at the household level.

Regarding wastewater management, Khokana has historically relied on the ecological ponds and wetlands for wastewater treatment. This process functioned through natural processes, including sedimentation, plant uptake, and soil infiltration. The purified water used to be directed into irrigation channels, linking household waste with agricultural production. At present, due to rapid urbanization, greywater recycling is largely absent,

and wastewater overflow is contaminating ponds. Moreover, the sewer network channels untreated wastewater directly into the Bagmati River, affecting both the environment and community well-being.

Discussion

The findings demonstrate that Khokana possesses characteristics of a sustainable city, such as mixed land use, compact built form, pedestrian accessibility, multifunctional open spaces, and efficient water and waste management.

Regarding mixed land use, the high-density footprint (Figure 2) represents Khokana as an example of compact city as defined by the literature on compact city planning and development (Bibri et al., 2020; Katuri., 2025). The localized spatial efficiency creates a profound academic dialogue with the urban sustainability frameworks (Akbar et al., 2020; Huang et al., 2025; Shalbolova et al., 2020), which identify compact density, pedestrian-centric mixed-use development and local resource management as prerequisites for achieving urban sustainability. Regarding built forms and settlement patterns, the traditional built forms and local materials at Khokana align with global studies that demonstrate how climate-responsive architecture inherently reduces carbon footprints (Oers & Pereira Roders, 2012; Rokka & Singh, 2020). The findings indicate that the compact built form and settlement pattern of Khokana align with the literature on the compact city paradigm (Bibri et al., 2020), which positions compactness, density, diversity, mixed land use, sustainable transportation, and green space as the core strategies of the compact city for achieving sustainability. However, while global studies view compactness as an engineered goal, Khokana demonstrates this as an organic, indigenous reality. However, the post-Gorkha earthquake transformations of traditional settlements at Khokana, as observed by other studies (Daly et al., 2023; Yenny et al., 2023), lack disaster resilience. Regarding accessibility, availability of basic services such as educational institutions, healthcare facilities, banks, and shopping markets within 250 meters of the city center (Figures 2 and 9), proves the existence of pedestrian accessibility within the traditional city of Khokana, as this aligns with the 300-meter distance equated to a five-minute walk, as an indicator of sufficient pedestrian access proposed by Richards et al. (2025). The high degree of walkability also reflects Lynch (1960)'s core principle of a sustainable city: accessibility. Regarding open spaces, the compact residential clusters organized around courtyards and public squares linked by streets, align with the study of Khokana by Rokka and Singh (2020), which acknowledged Khokana as a clustered traditional Newari settlement whose historic urban planning, use of local materials and community-based development provide important lessons for a sustainable city. Courtyards support recreational, social, cultural, economic, and domestic activities, while chowks function as community gathering and market spaces. Similarly, the findings on water and waste management provide critical insight into Khokanas gravity-based water conduits and waste management, reflecting a closed-loop, self-sufficient harmony with local natural resources. This aligns with the circular economy model proposed in contemporary sustainability theories (Duan & Kim, 2023; Longo et al., 2026).

Unlike modern sustainability, which often relies on advanced technologies, Khokana illustrates how indigenous city planning has long relied on locally available resources and self-sufficiency. Despite its strong indigenous sustainability characteristics, Khokana currently faces challenges stemming from rapid urbanization and post-Gorkha earthquake reconstruction, leading to non-contextual modern construction practices, increased population density and vehicular intrusion into the traditional settlement. Nevertheless, preserving these indigenous sustainability practices requires planning and development approaches that balance heritage conservation, disaster resilience, modernization and contextual community needs.

Conclusion

The study concludes that the traditional city of Khokana has the inherent capacity for self-sufficient resource management through mixed land use, compact built form, pedestrian accessibility, multifunctional open spaces, and efficient water and waste management. Traditional planning elements such as courtyards, chowks, ponds, waterspouts, and agricultural land support sustainability. The use of local materials, climate-responsive built forms, gravity-based water systems, composting practices, and pedestrian streets further represent sustainability embedded in the traditional city. However, the study also reveals that inherent sustainability is deteriorating under the dual pressures of rapid urbanization and the aftermath of the Gorkha earthquake. City congestion, vehicular intrusion and the wanton replacement of traditional built forms with concrete structures and modern facades are the distinct forms of degradation observed. Ultimately, while traditional cities like Khokana offer invaluable lessons for contemporary sustainable cities, these inherent characteristics are at risk and require immediate policy response.

However, the unmanaged response of the traditional city of Khokana to rapid urbanization and the post-Gorkha earthquake shows that the planning policies should transition from generic zoning laws to context-based planning and building norms. Policies should mandate the integration of traditional building materials, building height, and building form with modern earthquake-resilient techniques. Policies should be formulated to avoid encroachment of open spaces and agricultural lands in response to sudden disasters. Instead, the open spaces should be recognized as critical spatial buffers and community spaces. To mitigate vehicular intrusion, local planning policies should implement strict pedestrian-only zones within the traditional cities, route vehicular traffic along peripheral roads and establish strategic public parking zones outside the traditional boundary. Instead of replacing ancient gravity-based water systems (hitis) and waste disposal systems with carbon-intensive modern alternatives, municipalities should work to restore these indigenous systems to function alongside modern utilities.

Implications

This study has important theoretical, policy, planning, and practical implications for sustainable city development. Theoretically, this study shifts the dominant research discourse in the Nepalese context, which has long favored the study of traditional cities through the lens of heritage preservation. Instead, this study focuses on studying traditional cities through the lens of sustainability. This contributes to urban sustainability theory by showing that traditional cities have quietly operationalized localized resource management and self-sufficiency for centuries. The indigenous self-sufficient sustainability characteristics also include a closed-loop resource system, as discussed in many contemporary theories.

From a planning and policy perspective, the findings suggest a shift from standardized, modern planning approaches to context-sensitive policies that recognize the spatial, cultural, and environmental characteristics that support sustainability in traditional settlements. By studying the inherent sustainability characteristics of Khokana, this study provides lessons for developing contemporary sustainable cities and preserving traditional cities, integrating self-sufficient resource management and preventing the one-size-fits-all standard. The findings provide practical lessons for development practitioners and authorities, showing that the preservation and revitalization of indigenous water systems, composting practices, pedestrian-oriented streets, multifunctional open spaces, and sustainable resource management reduce dependence on resource-intensive infrastructure and strengthen local self-sufficiency. The study further implies that post-disaster reconstruction policies should adopt context-sensitive approaches that integrate traditional built forms, local materials, and indigenous resource management with modern technologies.

The study, therefore, highlights the need to recognize traditional cities like Khokana not only as heritage cities but also as examples of sustainable urban practices that can inform contemporary city planning and development strategies.

Artificial Intelligence (AI) Use and Disclosure

Statement: In the preparation of this manuscript, AI tools were used for some sections, with minimal or no editing.

Similarity and Originality Confirmation

The manuscript is original, not under review elsewhere, and complies with TUJ publication ethics.

Conflict of Interest

The authors declare no conflict of interest.

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Data Availability

Data available from the corresponding author on request.

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