



# Kathmandu Impact Story

## Bridging Tradition with Disaster Preparedness



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**Tomorrow's  
CITIES**  
Urban Risk in Transition

# Summary

## **Building resilience in Kathmandu means empowering communities to face future disasters while preserving their cultural heritage.**

Since Nepal's transition to a federal republic in 2008, the governance landscape in the country has shifted considerably, promoting rapid urban growth across the country. As part of this trend, plans for 4 new smart cities in the Kathmandu Valley have been introduced. Khokana, a historic Newari settlement in the southern Kathmandu Valley, is one of such places. However, its location in a region highly vulnerable to natural hazards presents significant challenges to current and future populations. Additionally, unplanned urbanisation and fragmented governance have exacerbated the risks faced by vulnerable populations.

In Khokana, Tomorrow's Cities sought to address the town's compounded risks, with a particular focus on flood hazards from the Bagmati and Nakhu rivers. Key actions included flood risk modelling to aid in forecasting under present and future climate scenarios, as well as seismic studies that integrated field data with historical earthquake records to improve knowledge of ground shaking in the region.

The project engaged a broad spectrum of stakeholders, including the Ward Disaster Management Committee (WDMC), the

Ministry of Urban Development, Lalitpur Metropolitan City, and the National Disaster Risk Reduction and Management Authority, alongside various community actors.

Through partnerships with national and local bodies, such as the Ministry of Urban Development, the initiative strengthened the capacity of local governance structures, promoting inclusive, equity-oriented urban planning methods. This strategy increased community risk awareness and empowered local authorities to adopt a 7-step participatory planning process, inspired by the Tomorrow's Cities approach. This process aims to ensure that future development in Khokana is both resilient and inclusive. The Tomorrow's Cities strategies are now being considered for wider adoption across other wards in the Kathmandu Valley, demonstrating their potential impact beyond Khokana.

Ultimately, the Tomorrow's Cities project has laid the foundation for long-term disaster risk reduction (DRR) in Khokana. Local governance structures are now better prepared to address future risks while preserving the town's cultural heritage. In doing so, the project not only strengthens disaster preparedness but also fosters a more inclusive and sustainable model for urban development in Khokana.

Next page: Kathmandu, Nepal





# Introduction

**Amid rapid urbanisation and rising disaster risks, Khokana must navigate the tension between preserving its heritage and safeguarding its most vulnerable communities.**

Nestled in a wide valley at the heart of the Himalayas, Kathmandu faces a range of hazards, including earthquakes, landslides, and monsoon floods. Recovery from the devastating 2015 Gorkha earthquake is still ongoing, while rapid and often haphazard urban expansion continues. This growth is reducing open spaces and agricultural land, increasing the vulnerability of low-income communities to multiple hazards, and exacerbating social, economic, and environmental challenges.

One such case is Khokana, a medieval Newari settlement located in the southern part of the Kathmandu Valley. Once a predominantly farming community, Khokana now faces rapid urbanisation driven by centrally imposed development projects, migration, commercial expansion, and unplanned development. As pressures spread from nearby urban areas, Khokana's narrow alleys, historic architecture, and densely clustered homes make it particularly vulnerable to natural hazards.


Against this backdrop, Kathmandu's political and governance landscape is also evolving. In 2008, Nepal transitioned from a Hindu monarchy to a federal republic, bringing changes to governance structures and institutions. The new government is promoting rapid urbanisation across the country, including plans for four new 'smart satellite cities' in the Kathmandu Valley.

Tomorrow's Cities work in Khokana focused on identifying vulnerabilities - particularly in relation to flood risks from the Bagmati and Nakhu rivers - through flood inundation mapping, highlighting the need for better urban flood risk management. By addressing structural vulnerabilities exposed by the 2015 Gorkha earthquake and other hazard events, the Tomorrow's Cities initiative sought to build a resilient, socially equitable future for Khokana, while preserving the town's cultural heritage and ensuring that development does not further endanger vulnerable populations.




▲ Khokana


# Kathmandu

 395 km<sup>2</sup>  
urban area

 6.5% / year  
urban growth since 2000


 Over 160% increase in  
informal settlements since  
1970

 1.51% annual  
population growth

 2,041,587  
population (2021 census)

 18% of urban pop.  
below poverty line




 Kathmandu



***Tomorrow's Cities has laid the foundation for long-term disaster resilience in Khokana. Local governance structures are now better prepared to address future risks while preserving the town's cultural heritage.***

Ramesh Guragain  
Deputy Executive Director at National  
Society for Earthquake Technology

 Kathmandu



# Challenges

## 1

### Multi-Hazard Profile

Khokana's dense layout, historical architecture, and increasing urbanisation pressures exacerbate its exposure and vulnerability to multiple hazards, underscoring the need for improved disaster resilience measures.

- **Earthquakes:** The region is highly vulnerable to earthquakes, having been severely impacted by the 1934 Nepal-India earthquake and the 2015 Gorkha earthquake, which damaged 80% of the town's structures.



▲ The 2015 Gorkha earthquake was the single deadliest disaster of Nepal's history



▲ 2024 Nepal floods. Photo: AP Photo/Gopen Rai

- **Floods:** During the monsoon season, flooding in the lowland agricultural fields is becoming more frequent. This issue is exacerbated by the rapid and haphazard increase in new construction in flood-prone zones, including residential, developmental, and commercial projects.
- **Landslides:** Although the main settlements in Khokana are located on a hilltop, minor landslides have occurred along the banks of the Bagmati River in the past. Several new constructions, particularly those positioned on the ridge's edges and near the riverbank, are especially vulnerable to landslides.
- **Fire:** Fires have been a recurring issue, with major incidents in 1990, 1993, and 2009, where the town's densely packed buildings allowed flames to spread rapidly.

## 2

### Rapid Urbanisation and Unplanned Development

Khokana is experiencing rapid urban growth driven by centrally-imposed development projects. However, much of this urbanisation is unplanned, leading to haphazard expansion that worsens vulnerability to hazards and disrupts the town's traditional layout and social structure. Khokana's traditional Newari architecture and cultural practices are vital to its identity, but they are under threat from both urbanisation and disaster damage.



▲ Dense urbanisation in Kathmandu

## 3

### Social and Demographic Changes

The influx of new residents and businesses is leading to demographic shifts, disrupting Khokana's traditional Newari community and contributing to a growing migrant population and the rise of 'temporary shelters'. These changes are introducing social tensions, as long-standing cultural practices and the town's social cohesion are increasingly challenged by new economic and social dynamics.

## 5

### Governance and Institutional Coordination

Fragmented governance structures and overlapping responsibilities between local, municipal, and national authorities create challenges in ensuring cohesive decision-making and policy implementation. This is hindering effective urban planning and hazard management.

## 4

### Loss of Agricultural Land and Open Spaces

As urbanisation spreads, agricultural land and open spaces are being reduced, which has long-term consequences for food security, the environment, and community livelihoods.

## 6

### Data Availability and Quality

Comprehensive hazard assessments are hindered by limited availability and quality of crucial data, which limits the development of targeted and effective DRR policy.

# Opportunities

Empowering local leaders through collaboration offers a pathway to adopting risk-informed strategies and building stronger institutional capacity to manage urban hazards.

## 1

### Collaboration and Stakeholder Empowerment

The involvement of diverse institutions and stakeholders—including local communities, governmental bodies, NGOs, and academic institutions—created a platform for collaborative decision-making. This presents an opportunity to empower city and community leaders to adopt integrated, risk-informed strategies for development.

## 2

### Strengthening Institutional Capacity

The collaboration between entities like the Ministry of Urban Development, Lalitpur Metropolitan City, and National Disaster Risk Reduction and Management Authority highlights an opportunity to strengthen institutional capacity to manage urban hazards.



*Keeping intact the cultural glory of historic Khokana while adopting new practices and technologies. Through the promotion of modern Khokana we aim to develop a safe, equitable, inclusive, and prosperous community with eco-friendly and risk-sensitive infrastructures and urban development.*

Khokana inhabitant



▲ Traditional Newari constructions

Next page: Ancient hindu temple at Khokana traditional Newari village, Kathmandu, Nepal





ममनाय चैर

# Khokana

**Khokana's rich cultural heritage is at risk as its historic infrastructure faces the recurring threats of earthquakes, floods, and landslides, leaving vulnerable communities in need of stronger disaster resilience.**

Khokana is a historic Newari settlement located in the southern part of the Kathmandu Valley, Nepal, known for its rich cultural heritage and traditional architecture. Covering an area of 3.2 square kilometres, it is home to over 5,000 people. The town is famous for its mustard oil production and its medieval layout, featuring narrow alleys, densely clustered houses, and community shrines.

Like much of Nepal, Khokana is highly exposed to earthquakes. In fact, the 2015 Gorkha earthquake severely damaged 80% of its buildings, revealing the need for stronger disaster preparedness and resilient infrastructure. Khokana's proximity to the Bagmati River also makes it prone to monsoon-induced floods and landslides, further endangering low-income and migrant communities.



***A prosperous and equitable Khokana with a glorious Newa cultural identity.***

Community-produced Visioning Statement for Khokana



▲ Khokana

The Newar community in Khokana has maintained a distinct way of life, centred around closely-knit families, religious festivals, and communal work. Social interactions are often governed by customs, rituals, and caste-based hierarchies, which play a role in shaping community relations.

Despite urbanisation pressures, Khokana has managed to preserve its traditional values, but it also faces challenges such as modernisation, youth migration, and threats to its cultural heritage due to infrastructure development and tourism.

# 40

local community members  
and leaders engaged

# 10

municipal and national  
institutions engaged

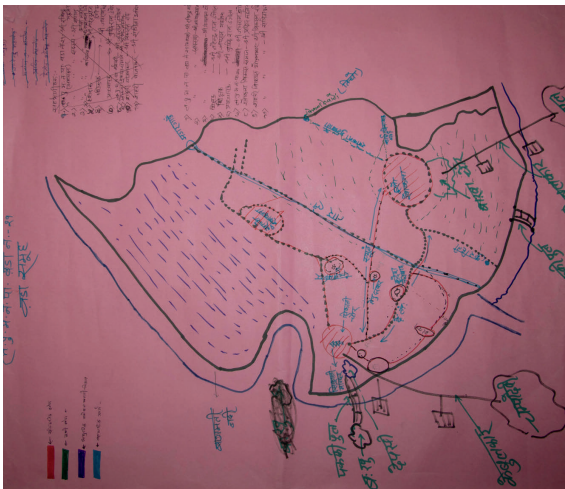


◀ Tomorrow's Cities workshops

# 10

# TCDSE Implementation

The implementation of the Tomorrow's Cities Decision Support Environment (TCDSE) in Khokana led to the development of four distinct future urban scenarios, each designed to address potential natural hazards, such as earthquakes and floods. These scenarios were supported by detailed scientific models, incorporating exposure data, hazard impact assessments, and demographic trends to ensure risk-informed urban planning. One scenario directly reflected and incorporated diverse community aspirations. The process also carefully integrated Khokana's cultural heritage by promoting the use of traditional architecture and local materials.



▲ Example of urban scenario designed by one of the groups in Khokana

## 40

local community members and leaderships engaged in co-production workshops

## 1500

visitors in Tomorrow's Cities exhibition for the Earthquake Safety Day

## 10

Public servants from various municipal and national institutions engaged in Action Planning workshop

# Challenges in deploying the TCDSE

In the early stages of the project, challenges included identifying distinct groups for future planning while remaining somewhat neutral between those opposing or supporting large-scale development, and the need to foster unity between local and migrant communities. Additionally, it was important to ensure marginalised voices were given space. Over time, deployment challenges evolved, and community expectations of the researchers increased, particularly regarding the implementation of measures based on findings. Transparent communication and equitable partnerships were key to advancing the project through these challenges.



▲ Engaging the local community of Khokana

## Stakeholders

The key disaggregated groups engaged were:

### **Ward Disaster Management Committee (WDMC) Group**

Local leaders involved in disaster preparedness and response, representing the community's formal DRR efforts.

### **Ward Representatives Group**

Elected representatives responsible for local governance and decision-making in the Khokana area, providing insight into governance structures and community needs.

### **Women, Marginalised, and Migrant Group**

A critical group representing women, economically disadvantaged, minority

communities, and migrant laborers, who are often overlooked in urban planning and disaster risk management processes.

### **Sano Khokana Group**

A group focused on residents from specific localities within Khokana, providing a more localised perspective on the challenges and opportunities facing their community.



# Impact

**Harnessing real-world data on rainfall and seismic activity, Tomorrow's Cities delivered precise forecasts of climate and earthquake risks, empowering vulnerable communities to develop tailored strategies for disaster resilience.**

## 1

### **Hazard/Risk Modelling Data**

During the Tomorrow's Cities project, hazard models were improved using data collected throughout the research stages, combined with extensive hazard and impact analysis. For flood risk, data on rainfall patterns, land conditions, and climate projections were used to refine predictions of extreme rainfall events. Earthquake risk assessments incorporated ambient noise measurements and data from past seismic events.

### **Flood Risk**

In the Tomorrow's Cities project, the HAIL-CAESAR hydrological model (that simulates how rainfall turns into surface runoff, leading to flooding, erosion, and sediment movement) was calibrated using historical flood events from 2002 and 2021. Researchers also integrated precipitation and discharge data from local weather stations in the Kathmandu Valley, future rainfall projections from General Circulation Models, and historical sub-daily rainfall data from the Global Precipitation Measurement. This provided detailed insight into the impact of extreme rainfall under both

current and future climate scenarios.

By using real-world data on rainfall patterns, land elevation, and soil types, this work helps to forecast how water will flow during storms, providing a detailed spatial and temporal breakdown of future extreme rainfall events, identifying when and where intense rainfall might occur. This is crucial for understanding how climate change will affect flood risks, particularly in vulnerable areas like Khokana, and for developing long-term strategies for flood risk mitigation and urban planning.



▲ Flood modelling

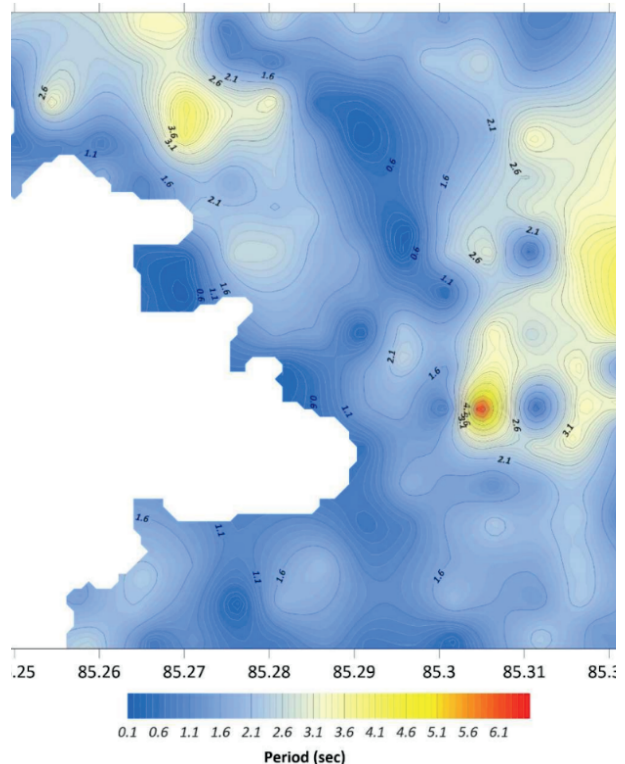
In addition, researchers developed a flood fragility function using data from 100 households affected by flooding. This tool helps predict how vulnerable different types of buildings are to flood damage based on factors such as construction materials, location, and flood severity. It enables planners to map flood-prone areas and identify structures at high risk, allowing them to prioritise flood protection measures and design strategies to reduce flood risks, especially for vulnerable communities.

### Earthquake Risk

A comprehensive earthquake hazard analysis was conducted by measuring ambient noise at 210 locations across the southwestern Kathmandu Valley. These ambient noise measurements were used in conjunction with the HVSr (Horizontal-to-Vertical Spectral Ratio) method to assess seismic risks. The HVSr technique helps identify the fundamental frequencies of the ground, which reveal how local soils and rock layers will behave during an earthquake, particularly in terms of amplifying seismic waves. Additionally, the collected data helped estimate the depth to bedrock and map the underlying subsurface basin structures.

To further enhance the analysis, information from the Gorkha earthquake's ground acceleration was integrated. This data captures the intensity and speed of seismic waves during the earthquake helping to model the expected ground motion in future earthquakes, particularly how the shaking intensity varies across different areas due to factors like soil type and depth to bedrock. Combining this with the HVSr results allows for a clearer understanding of how seismic energy will be amplified or dampened in

certain areas, providing a more accurate picture of seismic risks and helping inform targeted risk reduction measures and safer building designs.



▲ Earthquake modelling



◀ Tomorrow's Cities engagements



**Khokana became a focal point for development, with several major multi-billion rupees urban projects that trigger processes like land fragmentation, speculation, and the influx of migrants, primarily comprising laborers and low-income communities, for whom there's no formal housing response. As a result, the urbanisation takes on a haphazard nature, perpetuating the production and reproduction of risks within the region.**

Dilli P. Poudel  
Southasia Institute of Advanced Studies



▲ Tomorrow's Cities workshops

## 2

### Improved Risk Awareness

The Tomorrow's Cities workshops and methodology played a crucial role in enhancing community risk awareness by actively involving local stakeholders in identifying and understanding the risks their communities face. These workshops used participatory approaches, bringing together residents, local authorities, and experts to collaboratively map out potential hazards, such as floods, landslides, and earthquakes, while also assessing vulnerabilities unique to each area. The methodology encouraged the use of local knowledge and experience, fostering a sense of ownership over risk mitigation strategies.

Through hands-on activities, interactive discussions, and real-life scenario planning, communities gained a clearer understanding of the risks, empowering them to take proactive steps toward disaster preparedness and resilience building. This bottom-up approach not only improved awareness but also led to more sustainable, community-driven solutions.

## 2

### Municipal Confidence and Commitment

The ward has developed the capacity to address disaster risks and build a more resilient city, with an emphasis on equity, participation, and stakeholder engagement in urban planning. This marks a significant shift in local governance capabilities, serving as a tangible outcome of the project.

Additionally, local governments have committed to integrating the Tomorrow's Cities approach into their annual planning processes. Specifically, they intend to adopt a 7-step participatory planning model, ensuring future plans are both more equitable and responsive to risks. This demonstrates the project's clear influence on policy and planning practices at the local government level.

## 3

### Encouragement for Broader Adoption

The municipal authority has recognised the success of the initiative in Khokana and has encouraged other wards to adopt a similar approach. This demonstrates that the project's influence is extending beyond Khokana, with the potential to impact a broader area by promoting visioning processes in urban planning across the municipality.



**Our future vision for Khokana prioritised disaster resilience and equity, culminating in a productive workshop in Nagarkot. I believe this has established a solid foundation for future initiatives, as these discussions offered clear guidance on developing more effective and resilient plans for a better Khokana.**

Ms. Helen Shova Maharjan,  
Elected Representative  
Lalitpur Municipal Council (LMC), Ward 21



▲ Tomorrow's Cities workshops

# In Short

**Empowering a city to tackle disaster risks through inclusive planning, Khokana's model is setting a new standard for resilience and equity in urban development.**

Tomorrow's Cities tackled critical disaster risks in Khokana, including floods and earthquakes, exacerbated by rapid urbanisation. The project employed advanced flood risk modelling, incorporating local data to enhance the prediction and management of future flood risks. Additionally, earthquake hazard assessments were carried out to improve understanding of seismic risks and inform safer building practices.

A key success was the collaboration with the Ward Disaster Management Committee. Through this partnership, the ward developed the capacity to address disaster risks and build a more resilient city, with a strong emphasis on equity, participation, and stakeholder engagement. The project's inclusive approach also ensured that marginalised groups were actively engaged, so that the most vulnerable voices considered in risk-sensitive urban planning.

Notable achievements include increased community awareness of disaster risks, the adoption of a 7-step participatory planning process by local authorities, and the integration of risk-sensitive development strategies into the city's governance framework. Furthermore, the Khokana experience influenced municipal planning broadly, with methods now being promoted across other wards in the Kathmandu Valley.



**I can assure you that we will take concrete steps towards implementing this project. Our next priority is to engage with all relevant authorities and stakeholders to ensure its integration into the budget planning process.**

Mr. Rabindra Maharjan,  
Ward Chairman LMC Ward 21



▲ Tomorrow's Cities workshops

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UK Research  
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GCRF  
Global Challenges  
Research Fund

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