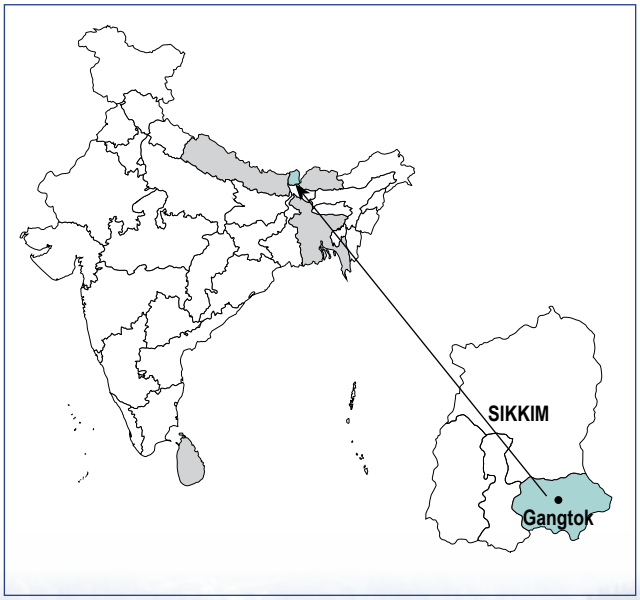
City Resilience Strategy: Gangtok

Gangtok is the capital and the largest city of the state of Sikkim in India. It acts as the headquarters of the East Sikkim district. Located in the Eastern Himalayan range between the elevations of 1,300 m and 1,600 m, the city is topographically undulating. It lies at 27° 21" N and 88° 37" E. According to the Census of India (2011) the population of Gangtok city is 100,286 and is made up of different ethnicities such as Nepali, Lepchas and Bhutias. The hospitality industry is the largest industry as the city is the main base for Sikkim's tourism.

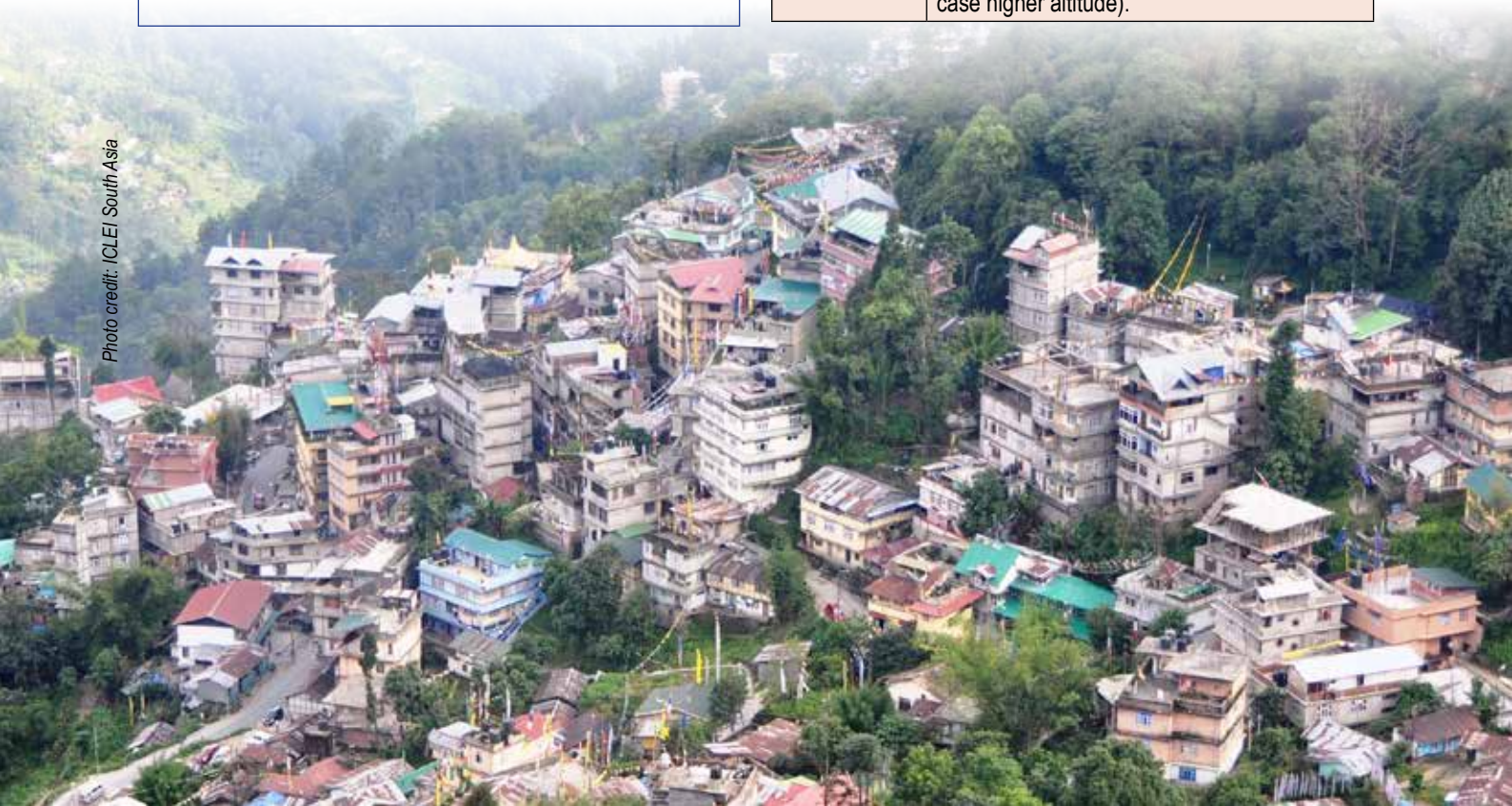


Temperatures range from an average maximum of 22°C in summer to an average minimum of 4°C in winter. Snowfall is rare. The monsoon season from June to September is characterized by intense torrential rains often causing landslides that block Gangtok's land access to the rest of the country. Annual rainfall varies from about 1,300 mm to 5,000 mm. Gangtok falls under seismic Zone-IV and is subject to frequent earthquakes.

Climate Risks

The two major future climate risks identified through the ICLEI ACCCRN Process (IAP) for Gangtok are:

Changing Climate Conditions	Climate Scenario Summary Statements
Short duration, high intensity rainfall	With respect to the 2050s, in Oct-Dec there might be marginal increase in rainfall, but in Jan-Feb, the southern part of Sikkim (where Gangtok is located) is likely to experience reduced rainfall with respect to the 1970s by about 25 percent.
Increased temperature	The average maximum temperature in Sikkim is likely to increase by 1.8-2.6°C in 2050s, with temperature change gradually increasing from lower to the higher latitudes (also in this case higher altitude).



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Vulnerability Assessment

The fragile urban systems and their corresponding climate fragility statements for Gangtok are:

Fragile Urban Systems	Climate Fragility Statements
	• Can lead to melting of glaciers at an increasing rate which can cause receding of catchment areas, consequently, posing stress on water sources for the city.
	• Can cause more landslides which can destroy the water supply infrastructure and pose additional stress on the water supply system of the city.
	• Coupled with clogged natural drains can lead to more landslides which will cause infrastructure, financial and human losses.
	• Can pose additional stress on the road infrastructure.

Through the vulnerability assessment, the adaptive capacity of the key actors identified in the IAP was scored based on three parameters: capacity to organize and respond, availability of resources, and access to information. Actors who receive a low adaptive capacity score are classified as vulnerable while those who receive medium and high scores are classified as supporting and can aid the local government in resilience building activities. The table below presents an overall analysis of actors across the different fragile urban systems.

Actor Analysis for Gangtok City

Vulnerable Actors	Supporting Actors
• Local Residents • Shopkeepers • Tenants • Slum Population • Hospital • Rural Management and Development Department	• Hotels • Border Roads Organisation • Sikkim State Disaster Management Authority/District Disaster Management Authority • Roads and Bridges Department • Fire and Emergency Services • Indian Army

Gangtok Municipal Corporation (GMC), the primary stakeholder demonstrates medium to low adaptive capacity across all the fragile urban systems. This is because it is not active in all sectors of the city and cannot take action on climate change with available resources.

The adaptive capacities of the fragile urban systems are assessed on the basis of five broad categories – economic, technology/ infrastructure, governance, social, and ecosystem services. Each of these five categories was rated as high/medium/low and averaged across all the urban systems to generate an overall score for each parameter in the city as detailed in the following table.

Overall Adaptive Capacity of Systems in Gangtok City

Adaptive Capacity Parameters	Adaptive Capacity Score		
	Low	Medium	High
Technological/ Infrastructural			
Economic			
Governance			
Societal			
Ecosystem services			

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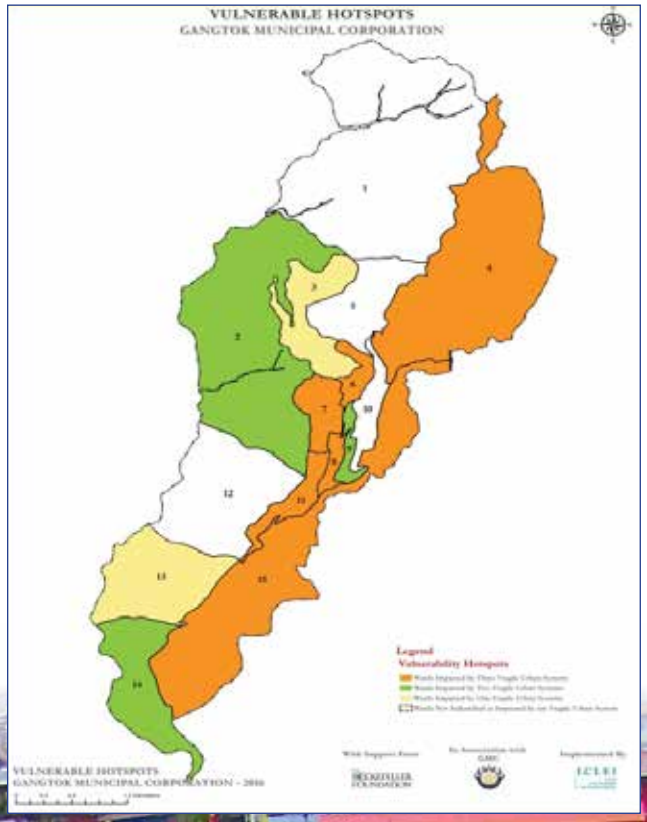
In Gangtok, ward nos. 4, 6, 7, 9, 11 and 15 are the vulnerability hotspots impacted by all three fragile urban systems (refer map).

Among soft measures identified through the IAP, better inter departmental coordination among different government agencies responsible for various urban services and awareness generation activities to promote water conservation, prevent littering and improve sanitation was stressed upon.

Community engagement should be enhanced and early warning systems should be in place to prepare for possible landslides. Better zoning regulations can also help prevent disasters. In case of infrastructural measures, protection of *jhoras* (natural drains), cleaning and maintenance of water sources, and better parking and public transit was identified as the main measures that should be undertaken on priority basis.



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Key Interventions Identified for Gangtok City

Infrastructural Measures	Non-Infrastructural/ Policy Measures
Water Supply	
• Catchment area restoration and treatment by engineering measures such as step drain, angle iron barbed wire fencing, stone masonry, check dams or biological measures such as development of nurseries, plantation/afforestation, pasture development, social forestry. **Costs associated:** INR 15 lakhs per site. **Co-benefits:** Can help protect soil, reduce impacts of landslides.	• Development of a database of the water distribution system and connections, which will help in identification of pipelines, leaks, and so on. **Costs associated** (Service cost of consultant): INR 5 lakhs. **Co-benefits:** Can help in long term monitoring and developmental planning.
Storm Water Drainage	
• Climate resilient solid waste management infrastructure for through the installation of a bio composting plant for composting vegetable waste at vegetable market (at *Kanchenjunga* shopping complex). **Costs associated** (construction and labour costs, costs of meetings, training of staff): INR 31.5 lakhs. **Co-benefits:** Prevent water logging because of waste dumping in *jhoras* and drains.	• Community engagement in the operation and maintenance of drains through some form of a reward system. **Costs associated** (Costs for meetings and trainings): INR 1 lakh per community. **Co-benefits:** Better governance.
Transportation	
• Increase the number of buses within the city to improve public transport options. **Costs associated** (Cost of buses): INR 50 crores. **Co-benefits:** Promote eco-mobility to reduce pollution and Green House Gas emissions.	• Integrate a directive that new buildings must have parking space included into building by-laws. **Costs associated** (Cost of meetings, trainings): INR 5 lakhs.

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