

February, 2018

RAPID CLIMATE VULNERABILITY ASSESSMENT OF GANGTOK, SIKKIM

Developing Disaster Resilience Action Plan Through GIS &
Prioritising Actions for Natural Disaster Risk Reduction in Urban
Agglomerations of Shillong & Gangtok



Gangtok City, Sikkim

Gangtok, the capital city of Sikkim, is located in the eastern Himalayan range. The city is flanked on east and west by two streams, namely Roro Chu and Ranikhola, respectively, comprising 17 municipal wards. These two rivers divide the natural drainage into two parts, the eastern and western parts.

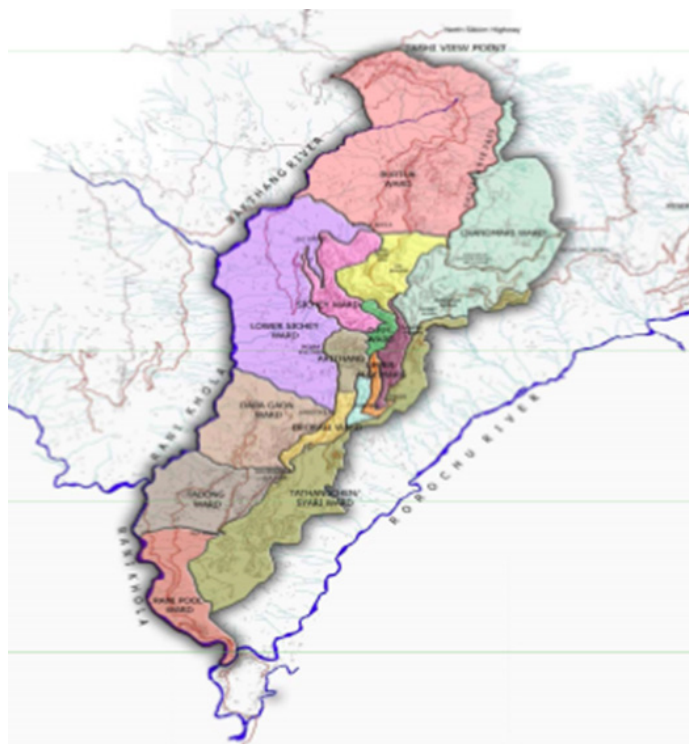


Fig 1: Gangtok City map

Gangtok City Characteristics

Indicators	Characteristics
Classification of the city	Hill
Location	27°20'N 88°37'E
Area	19.016 sq.km
Climate Type	Subtropical highland climate
Temperature	Average Annual Maximum Temperature - 27°C
	Average Annual Minimum Temperature - 19°C
Rainfall	Average annual : 3494 mm
Height above Mean Sea Level	1,676 m above MSL



Fig2: The main road connecting Gangtok to other cities and towns

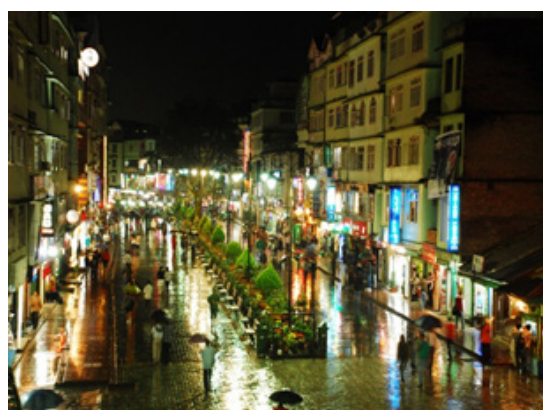


Fig3: Gangtok M G Marg

Steep slopes, vulnerability to landslides, large forest cover and inadequate access to most areas characterize Gangtok. Unplanned urbanization and rapid construction on the hill slopes has increased the risk of environmental degradation in Gangtok.

Hazard Exposure

Sl. No	Hazard Type	Exposure
1	Flash Flood	Y
2	Drought/ Heat Wave	N
3	Earthquakes	Y
4	Landslides	Y
5	Forest Fires	Y
6	Heavy Rainfall	Y
7	Hailstorms/thundering	Y

Hazard Timeline

Index	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Landslides												
Flash Flood												
Hailstorm/thundering												
Forest Fire												
Earthquake												



Fig4: Landslide occurrences in Gangtok

Gangtok City Rapid Vulnerability Assessment

DESCRIPTION	
SOCIO-ECONOMIC CHARACTERISTICS	
Population	<ul style="list-style-type: none"> 100,286 (as per 2011 Census)
Density	<ul style="list-style-type: none"> 5,223 persons per sq.km
Slum Population	<ul style="list-style-type: none"> 20,504 (6,085 HHs) Notified & Non-notified slums¹
HAZARD AND EXTREME EVENTS	
Temperature observed and projection	<ul style="list-style-type: none"> Due to its elevation and sheltered environment, Gangtok has a mild, temperate climate all year round Average Maximum Temperature (2016) ranged between 27°C & 19°C respectively
Temperature Projections	<ul style="list-style-type: none"> By 2030s, the average annual temperature of Sikkim is projected to rise by 1.8 to 2.1°C with respect to 1970s (State Action Plan on Climate Change for Sikkim, 2011).
Rainfall observed trend and projections	<ul style="list-style-type: none"> Rainfall rises from pre-monsoon in May, and peaks during the monsoon, with July recording the highest monthly average of (Meteorological Center, Gangtok, 2008). Snowfall recorded in year 1990, 2004, 2005, & 2011
Rainfall Projections	<ul style="list-style-type: none"> Sikkim is likely to experience a fall of about 3% in precipitation by 2030 with respect to 1970 (INCCA, 2010; State Action Plan on Climate Change for Sikkim, 2011).

¹ RAY Socio-economic HH survey (SFCCoA, Gangtok, 2013)

Extreme events : Landslides	<ul style="list-style-type: none"> • In 2016, landslide hit Sikkim-Bengal border, resulting in loss of lives (data NA) • In 2015, landslides near Rambhi, on the outskirts of Siliguri on the way to hills had disrupted the road traffic between Gangtok and the North Bengal hub
Earthquakes	<ul style="list-style-type: none"> • Sikkim is placed in Zone IV/V of seismic vulnerability indicating high risk zone • 6.9-magnitude earthquake hit Sikkim in September 2011. It killed 70 people and destroyed villages. Its epicenter was located at Chungthang, Sikkim.
Urban Floods/ Flash Floods	<ul style="list-style-type: none"> • In 2012, flash floods triggered by a series of landslides killed 22 people and washed away nearly 30km of highway in north Sikkim.
INFRASTRUCTURE STATUS ^{2,3}	
Water Supply	<ul style="list-style-type: none"> • Per capita water supply is low at 60-70 lpcd • 75% of the households (HHs) have water supply connections • River Rateychu is the primary source of water supply • The city has one water treatment plant of 41MLD at Selep (capacity 41 MLD)
Sewerage	<ul style="list-style-type: none"> • The city has 42% coverage of sewerage network services, with 96% coverage of individual & community toilets • The sewer system and storm water drainage systems are separate in Gangtok, with no treatment facility for the drains which are presently being discharged into the natural streams
Solid Waste Management	<ul style="list-style-type: none"> • The city generates about 50MT of solid waste daily • Only about 40% of municipal solid waste is collected in Gangtok area. A significant amount of waste is dumped into the nearest water course (Jhora), streets and valley. • There is also no provision for collection & disposal of hazardous toxic wastes generated from industries. • Declared the best among the top 10 cleanest city in India, 2015, Gangtok Municipal Corporation (GMC) has developed a programme called "Engage 14 Programme" to engage schoolchildren in the process of understanding SWM. • Gangtok Municipal Corporation (GMC) has already initiated work to improve the situation at Martam landfill site.
Storm Water Drainage	<ul style="list-style-type: none"> • Only 24% of the city area has storm water drainage network • Roadside drains cover 3774 km, out of which 28.09% are still earthen or below the required capacity. • Incidence rate of sewerage and storm water mixing is 25-30 % • Incidence of water logging days is 4.72%.
Transportation	<ul style="list-style-type: none"> • The share of personal vehicles and taxis combined is 98% of Gangtok's total vehicles, a high percentage when compared to other Indian cities. • The 1 km (0.6 mi) long cable car with three stops connects lower Gangtok suburbs with Sikkim Legislative assembly in central Gangtok and the upper suburbs.
Power	<ul style="list-style-type: none"> • Gangtok has a nearly uninterrupted electricity supply due to Sikkim's numerous hydroelectric power stations.
Housing	<ul style="list-style-type: none"> • Urban Development and Housing Department are the nodal agencies for providing individual urban housing in the state. • High demand for rental housing in the urban areas, nearly 79%, (CDP, 2011)
GOVERNANCE	
Administrative Units assigned to address climate change	<ul style="list-style-type: none"> • Sikkim State Disaster Management Authority • Gangtok Municipal Corporation: Municipal Disaster Management Committee, Ward Disaster Management Committee etc.
Willingness of the city to address Climate Change	<ul style="list-style-type: none"> • City Disaster Management Plan, Multi hazard Vulnerability Assessment, SSDMA, Comprehensive mobility Plan, re-frame - ' City Development Plan (CDP) Gangtok has been developed

² SLIPS (Service Level Improvement Plans) data, AMRUT, NIUA, 2016-17

³ City Development Plan Gangtok, 2011