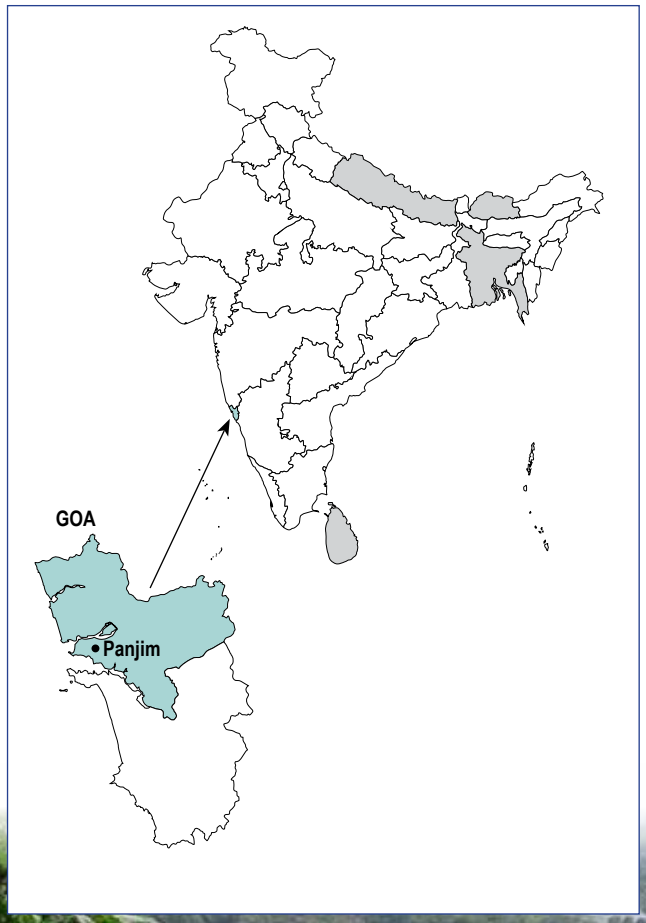
City Resilience Strategy: Panjim

Panjim city is located along the West Coast of India by the Arabian Sea and is a part of the Tiswadi Taluka in the northern part of the State of Goa. The city is bound by the Arabian Sea along the South West, Mandovi River along the North and West and Zuari River towards the South East. It also has two Creeks: Querem Creek on the east and St. Inez Creek along the west. The total population that falls within the jurisdiction of the corporation of Panaji is 40,017 as per Census 2011 while the population for the entire metropolitan region is 114, 759. The city also deals with a high influx of tourist population throughout the year. As per the tourist statistics for 2011, Tiswadi taluka received 1,136,861 tourists which comprised of 690,926 domestic tourists and 445,935 foreign tourists. The main occupation in the city is based on tourism and agriculture. The state is famous nationally and internationally for coastal tourism.



During summers in Panjim, temperatures reach up to 32°C and in winter it ranges from 20°C to 28°C. Panjim receives an average annual rainfall of 2,774 mm, largely spread over the monsoon months. Goa, especially North Goa where Panjim is located is prone to natural disasters like Earthquake, Floods/ Heavy rains, Cyclones, Landslides, Tsunami.

Climate Risks

The three climate risks identified through the ICLEI ACCCRN Process (IAP) for Panjim are:

Changing Climate Conditions	Climate Scenario Summary Statements
Increased rainfall	The annual rainfall in the Western coastal region is likely to vary between 935± 185.33 mm to 1794±247.1 mm. The projected precipitation is likely to increase by 6% to 8% in 2030s with respect to 1970s.
Increased temperature	The mean annual temperature is projected to increase by 1.5°C to 2.2°C in the 2030s. The net increase in temperature ranges from 1.7°C to 1.8°C with respect to the 1970s. Temperatures also show a rise in all seasons.

Photo credit: ICLEI South Asia

Vulnerability Assessment

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

Fragile Urban Systems	Climate Fragility Statements
 	• Leads to unhygienic conditions and health hazards due to increased incidences of water borne diseases.
 	• Leads to increased demand for water thereby posing additional stress on the supply system.
	• Leads to increased flooding situation resulting in contamination of potable water.
 	• Impacts the fundamental functioning of the ecosystem by bringing about changes in pollinators, migratory species and seed dispersers' behaviour and can affect mangrove survival.
 	• Water logging and flooding situation in low-lying areas would only get worse, thereby reducing access to usable land.
 	• Leads to heat stress and increased morbidity and illness.
	• Leads to water logging/flooding which will increase chances of water/vector borne communicable diseases.
 	• Leads to increased instances of flooding and also increases the chances of greater 'knock-on' impacts on human health and wellbeing.
 	• Leads to flooding situation leading to congestion and in extreme cases loss of connectivity/ access.

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.

The Corporation of the City of Panaji (CCP), the primary stakeholder, is a vulnerable actor across all the fragile urban systems except in the case of sanitation where it emerged as a supporting actor with a medium score. CCP and other departments may be able to address present issues, however, in terms of disaster preparedness, planning needs to be initiated. Furthermore capacities will also need to be developed.

Actor Analysis for Panjim City

Vulnerable Actors	Supporting Actors
• Residents/ household • Unorganized societies/ Slum Population • Department of Science and Technology • Fisher folk • Coastal Regulatory Zoning Authority • Health Department • Transport Department • Forest Department • Goa state Biodiversity Board • Town and Country Planning • North Goa Planning and Development Authority	• Traffic police cell • Private Hospitals

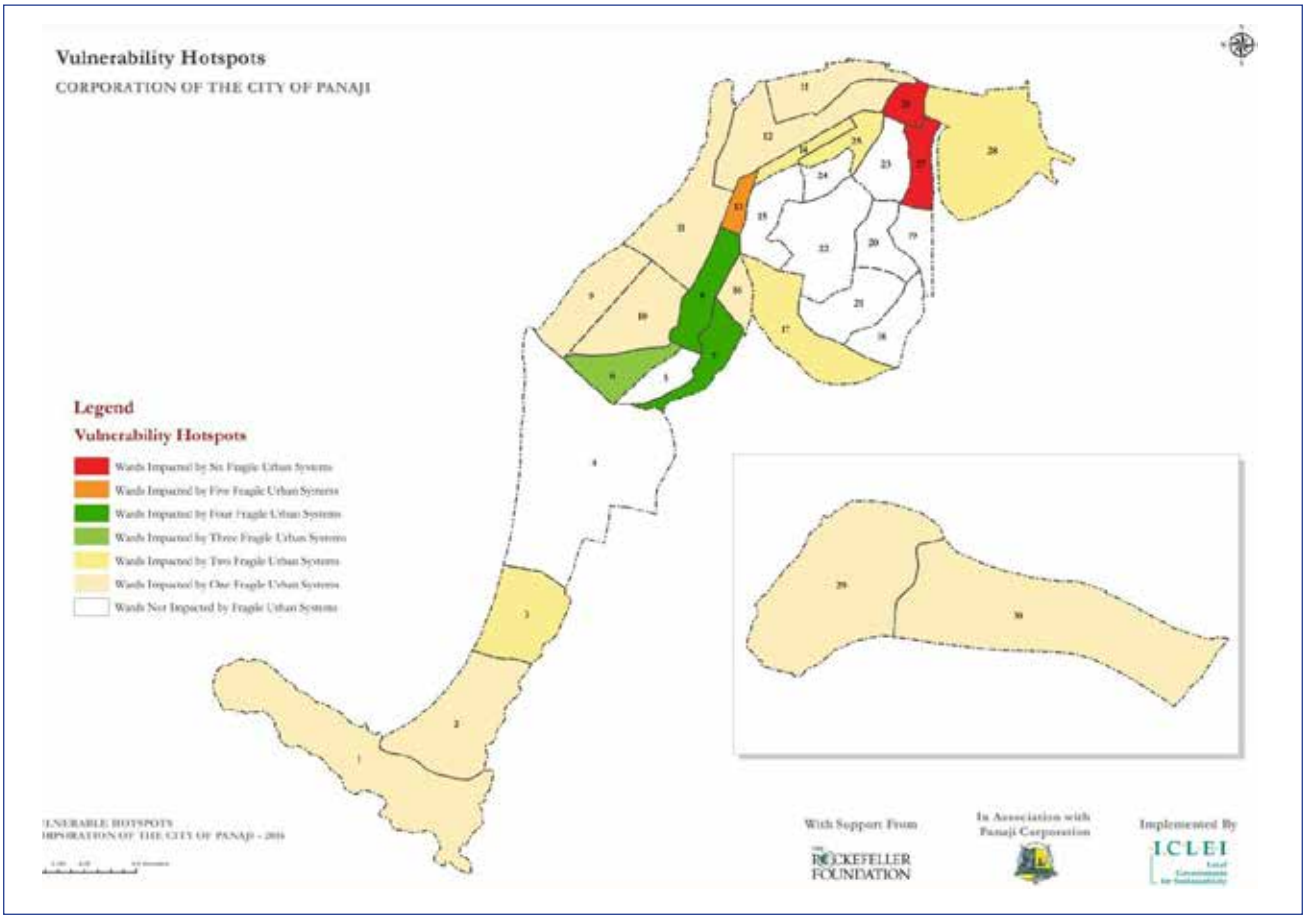
The adaptive capacities of the fragile urban systems are assessed on the basis of five broad categories – economic, technology/ infrastructure, governance, social, and ecosystem services. Each of these five categories was rated as high/medium/low and averaged across all the urban systems to generate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

Overall Adaptive Capacity of Systems in Panjim City

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

The areas in Panjim that were found to be most vulnerable are wards 26 and 27 which are vulnerable to six fragile urban systems, while ward 13 is vulnerable to five fragile urban systems (refer map). Wards 26 and 27 have very poor levels of infrastructure, a substantial slum population and are inundated annually following heavy rainfall. Ward 13 also has a large slum population on private land and due to issues with ownership of the land, is extremely poor in basic services.

For each urban system, hard and soft measures were identified. The most important measures include awareness generation activities for better sanitation, conservation of water and improved waste management; capacity building for better locally available healthcare; planning and policy measures for better land use, protection of khazan lands, and non-motorised transportation in the soft measures. Improvements in water supply systems, sanitation and drainage systems, decentralised management systems for waste and waste water, plantation and dune management for protection of ecosystems, provision of non-motorised infrastructure for public transit were identified among infrastructural measures.



Key Interventions Identified for Panjim City

Infrastructural Measures	Non-Infrastructural/ Policy Measures
Water Supply	
• Rain water harvesting as an alternative source as well as for ground water recharge. **Costs associated:** Per unit cost can range from INR 3-5 lakhs. **Co-benefits:** Reduction of cost of using tankers or poor health from consuming low quality water.	• Introducing a cap on commercial extraction of water and an increase in the rate for the same. **Costs associated** (Introduction of Policy at local level, cost of meetings): INR 2 lakhs. **Co-benefits:** Can help generate revenue for municipal corporation.
Sanitation	
• Decentralized Sewage Treatment Plants in new colonies that are not linked to the sewerage system. **Costs associated** (Civil construction, system costs): INR 80 lakhs per MLD sewage. **Co-benefits:** Reduce health risks.	• Awareness generation on segregation at source. **Costs associated** (Cost of meetings, hoardings, leaflets, and other IEC materials): INR 5 lakhs. **Co-benefits:** Can be used for multiple issues together.
Ecosystem	
• Tree plantation including replanting of mangroves. **Costs associated** (Cost of trees, plantation, maintenance): INR 10 lakhs per annum. **Co-benefits:** Can support better drainage in the city.	• Legal protection of Khazan lands. **Costs associated** (Cost of meetings, cost of making the policy): INR 5 lakhs.
Storm Water Drainage	
• Revamp of storm water drainage system. **Costs associated** (Cost depends on materials, type of land, etc.): INR 200 lakhs per km. **Co-benefits:** Can reduce health risks.	• Planning drainage infrastructure considering future sea level rise especially around vulnerable areas. **Costs associated** (Cost of consultants): INR 10 lakhs.
Land Use	
• Increased green cover, especially mangroves. **Costs associated** (Cost of trees, plantation, maintenance): INR 10 lakhs per annum. **Co-benefits:** Can prevent water pollution from sewerage, and act as sinks for drainage.	• Policy of no-construction on steep slopes and near water bodies. **Costs associated** (Cost of meetings, cost of making policy): INR 5 lakhs. **Co-benefits:** Reduce life risks.
Health	
• Health department to be reinforced and equipped to handle epidemics through training and capacity building. **Costs associated** (Per training costs, materials, logistics): INR 2 lakhs per training. **Co-benefits:** Improved healthcare for citizens.	
Transportation	
• Provision of smaller/eco-friendly public transport (bus service) options with increased frequency. **Costs associated** (Cost of vehicles, registration policy): INR 100 Crores. **Co-benefits:** Supplementary income generating opportunities.	• Restriction of commercial/tourist vehicles during peak hours. **Costs associated** (Cost of meetings, cost of policy): INR 5 lakhs. **Co-benefits:** Cleaner air, less congested roads.

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