Climate-Induced Disaster Resilience Planning Guidelines for Kakinada Municipal Corporation

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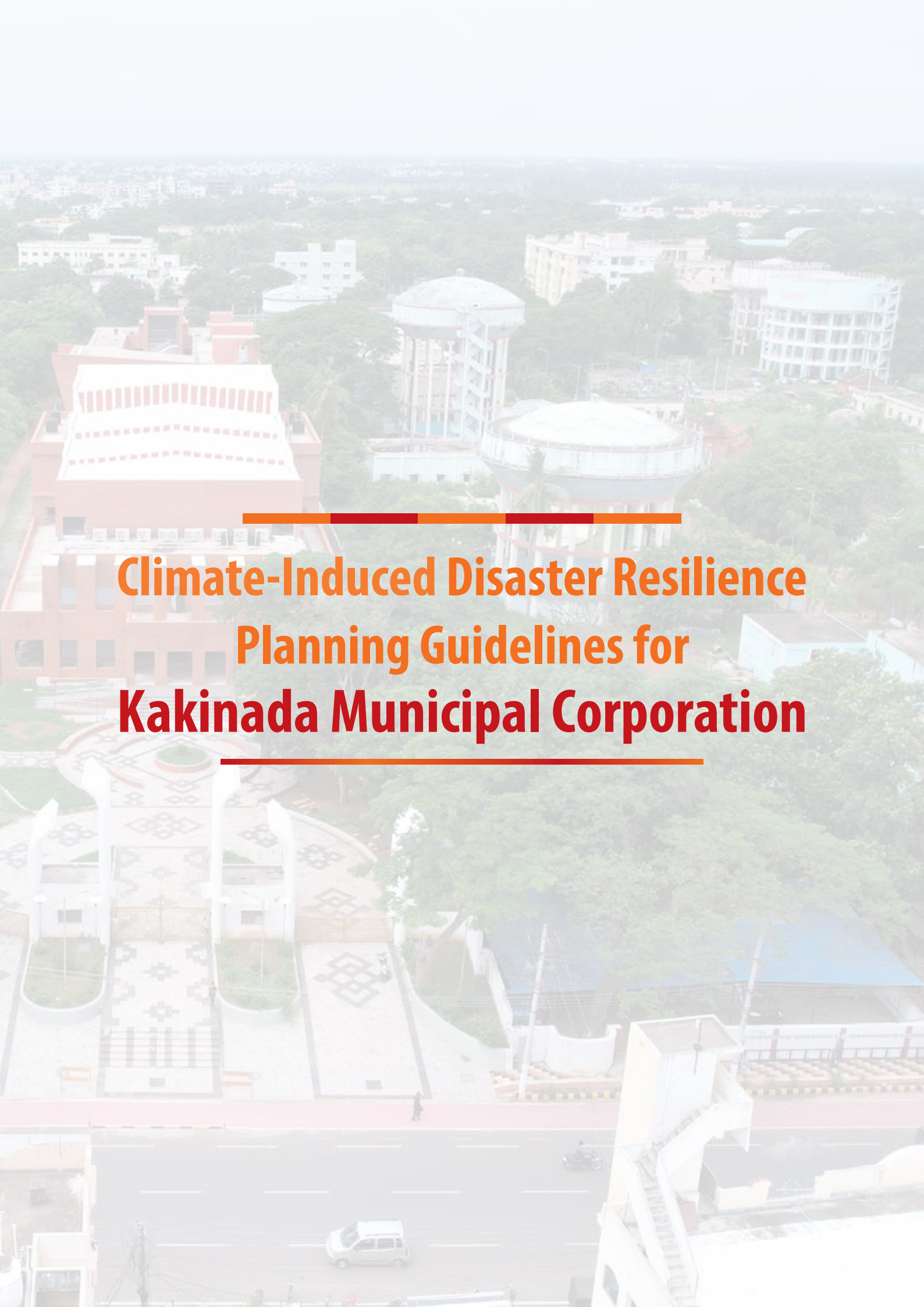
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About CDKN

The Climate and Development Knowledge Network (CDKN) is a Southern-led global programme, established in 2010 to enhance the well-being of those most affected by climate change – especially women, girls and marginalised groups – through transformative climate action. Its current five-year phase (2022–2027) supports equitable, locally-led, financed and ecosystem-based climate responses that mobilise the capacity and leadership of local actors, including community organisations, governments, researchers and civil society groups, across the Global South. CDKN is managed by SouthSouthNorth, in partnership with Fundación Futuro Latinoamericano (FFLA) and ICLEI South Asia, and co-funded by the Ministry of Foreign Affairs of the Netherlands and Canada's International Development Research Centre.



Climate-Induced Disaster Resilience Planning Guidelines for Kakinada Municipal Corporation



Message from Commissioner, Kakinada



Shri NVV Satyanarayana
Commissioner, Kakinada Municipal Corporation

Kakinada is a rapidly growing coastal city with a unique environmental and economic setting. Its location along the Bay of Bengal makes the city vulnerable to climate-induced hazards, particularly cyclones, urban flooding and heat stress, affecting infrastructure, livelihoods and essential urban services. With changing climate patterns likely to increase these risks, strengthening the city's preparedness and resilience is an important part of our development agenda.

Kakinada Municipal Corporation (KMC) has been taking progressive steps towards addressing climate change and building urban resilience. The Climate-Induced Disaster Resilience Planning Guidelines builds on Kakinada's Net-zero Climate Resilient City Action Plan (CRCAP), with a focus on strengthening disaster risk reduction at the city level, with greater emphasis on mitigation and preparedness.

The guidelines has been developed through a participatory process. The city's existing capacities and gaps were assessed using the UNDRR Disaster Resilience Scorecard for Cities, supported by consultations with the Kakinada District Disaster Management Authority, municipal departments, government agencies, communities and other stakeholders. It provides direction for strengthening risk assessment and planning, protecting natural features and their buffers, improving infrastructure resilience, enhancing preparedness and response, supporting post-disaster recovery, and strengthening institutional coordination. Gender equality, social inclusion, and ecosystem-based approaches have also been embedded into the planning process across the stages of disaster management.

Building a disaster-resilient Kakinada will require sustained coordination between KMC, the district administration, state government departments, technical institutions, civil society organizations, communities and the private sector. It will also require disaster risk reduction to become an integral part of our regular planning, infrastructure development, and service delivery, rather than being addressed only when a disaster occurs.

I appreciate the support of ICLEI South Asia, provided under the 'Climate and Development Knowledge Network (CDKN): Accelerating Inclusive Action' programme, in developing these guidelines. I also acknowledge the valuable contributions of all departments, agencies, community representatives, and stakeholders who participated in this process. I hope this document will serve as a practical reference for KMC and its partners in translating resilience priorities into coordinated and sustained action.

Our endeavour is to make Kakinada city better prepared for future climate risks, protect its people and natural ecosystems, and continue to develop in a safe, inclusive and resilient manner.

Commissioner
Kakinada Municipal Corporation

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Abbreviations and Acronyms

AMRUT	Atal Mission for Rejuvenation and Urban Transformation
APCZMA	Andhra Pradesh Coastal Zone Management Authority
APEPDCL	Andhra Pradesh Eastern Power Distribution Company Limited
APCPDCL	Andhra Pradesh Central Power Distribution Company Limited
APSDMA	Andhra Pradesh State Disaster Management Authority
APSDPS	Andhra Pradesh State Development Planning Society
APSHCL	Andhra Pradesh State Housing Corporation Limited
APUG&BC	Andhra Pradesh Urban Greening and Beautification Corporation
ASHA	Accredited Social Health Activist
BPL	Below Poverty Line
CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CAP	Common Alerting Protocol
CBDRM	Community-Based Disaster Risk Management
CDKN	Climate Development Knowledge Network
CDMP	City Disaster Management Plan
CITIIS	City Investments to Innovate, Integrate and Sustain
CRZ	Coastal Regulation Zone
CSR	Corporate Social Responsibility
CWC	Central Water Commission
DDMA	District Disaster Management Authority
DDMP	District Disaster Management Plan
DEM	Digital Elevation Model
DFO	District Fire Officer
DISCOM	Distribution Company
DPP	Draft Perspective Plan
DPR	Detailed Project Report
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
EGREE	East Godavari River Estuarine Ecosystem
EOC	Emergency Operations Centre
GESI	Gender Equality and Social Inclusion
GBV	Gender-Based Violence
GUDA	Godavari Urban Development Authority
HDPE	High-Density Polyethylene
ICCC	Integrated Command-and-Control Centre
IEC	Information, Education and Communication
IMD	India Meteorological Department
IRCS	Indian Red Cross Society
IVRS	Interactive Voice Response System
KMC	Kakinada Municipal Corporation
KPI / KPIs	Key Performance Indicator(s)

LST	Land Surface Temperature
LULC	Land Use / Land Cover
MCR2030	Making Cities Resilient 2030
MHA	Ministry of Home Affairs
MoEFCC	Ministry of Environment, Forest and Climate Change
MoHUA	Ministry of Housing and Urban Affairs
NDMA	National Disaster Management Authority
NDMP	National Disaster Management Plan
NDRF	National Disaster Response Force
NEOC	National Emergency Operations Centre
NGT	National Green Tribunal
NIUA	National Institute of Urban Affairs
NMSH	National Mission for Sustainable Habitat
NBC	National Building Code
NCAP	National Clean Air Programme
NCRMP	National Cyclone Risk Mitigation Project
NFCL	Nagarjuna Fertilisers and Chemicals Limited
NRDC	Natural Resources Defense Council
ODP	Outline Development Plan
ONGC	Oil and Natural Gas Corporation Limited
OSDMA	Odisha State Disaster Management Authority
PMAY-U	Pradhan Mantri Awas Yojana – Urban
RWA / RWAs	Resident Welfare Association(s)
SACHET	National Disaster Alert Portal
SDMA	State Disaster Management Authority
SDMF	State Disaster Mitigation Fund
SDRF	State Disaster Response Fund
SDRP	State Disaster Response Plan
SEOC	State Emergency Operations Centre
SFDRR	Sendai Framework for Disaster Risk Reduction
SHG / SHGs	Self-Help Group(s)
SOP / SOPs	Standard Operating Procedure(s)
ULB / ULBs	Urban Local Body / Bodies
UDMA	Urban Disaster Management Authority
UNDRR	United Nations Office for Disaster Risk Reduction
URDPFI	Urban and Regional Development Plans Formulation and Implementation
CPCB	Central Pollution Control Board

1. Introduction

India's complex and unique geography makes the country vulnerable to multiple climate-induced hazards such as floods, cyclones, landslides, avalanches and heat waves. The Climate Risk Index 2026 ranks India as the ninth most affected country in the world due to climate change-related impacts[1]. Despite occupying merely 3% of the country's land area, urban areas in India account for 75% of resource consumption[2]. The increasing frequency and intensity of extreme climate events, coupled with the inherent challenges of urban environments, increase the vulnerability of cities and pose serious threats to urban infrastructure, citizens, marginalised communities, and the environment. The need to integrate climate-induced disaster resilience into urban planning has never been more urgent, necessitating comprehensive resilience planning guidelines for Indian cities.

India is a signatory to the voluntary and non-binding global agreement Sendai Framework for Disaster Risk Reduction (SFDRR) and prepared the first ever National Disaster Management Plan in 2016. Further, a holistic resilience roadmap, called the Prime Minister's Ten-Point Agenda on Disaster Risk Reduction (DRR), was formulated in 2016, consistent with SFDRR, the SDGs, and the Paris Agreement, which led to the revision of the NDMP in 2019. Simultaneously, the National Mission for Sustainable Habitat (NMSH) 2.0, issued in 2021, fosters resilience to climate-related extreme events and disaster risks.

The Disaster Management (Amendment) Act, 2025 (DM Act), under the Ministry of Home Affairs (MHA), regulates disaster management in India. The amended DM Act advocates the decentralisation of disaster governance by empowering state governments to establish a separate Urban Disaster Management Authority (UDMA) for state capitals and cities with municipal corporations. The UDMA is responsible for preparing and implementing the urban disaster management plan. Moreover, the city contextualised the action plan under CITIIS 2.0[3].* The state-level component needs to integrate heat, urban flood and disaster management, amplifying the need for decentralisation and climate-risk-informed disaster-resilience planning.

This also signals a convergence of climate resilience and disaster-resilience administration, which different ministries (MHA, Ministry of Environment, Forest, and Climate Change (MoEFCC), and Ministry of Housing and Urban Affairs [MoHUA]) handle at the local level. However, in practice, routine disaster governance functions at the lower level still lie with the state and district administrations and are seldom mainstreamed for cities. District disaster management plans, currently among the lowest-level planning modalities, do not adequately account for typical urban challenges, such as high population densities, stressed infrastructure and socio-economic vulnerabilities. Moreover, 80% of central investment in disaster management focuses on disaster response and relief[4], even though disaster mitigation, especially for building infrastructure resilience, can significantly reduce reconstruction costs. These factors highlight the pressing need to address disaster resilience in a city's context, shifting the paradigm from a 'response and relief' approach to 'mitigation and preparedness'.

In this context, the Climate Development Knowledge Network (CDKN): Accelerating Inclusive Action Programme has partnered with the Kakinada Municipal Corporation (KMC) to develop a climate-induced disaster-resilience planning guideline for the city. Kakinada recently prepared a Climate Resilient City Action Plan (CRCAP) in 2025. Building on the valuable insights gained into the growing challenges of climate extremes during the CRCAP's preparation, the city has taken proactive measures to safeguard its infrastructure, environment and community against episodic climate hazards through a suitable combination of year-long, pre-, during- and post-disaster measures that mainstream gender responsiveness, social inclusion, and ecosystem-based approaches.

** CITIIS, or City Investments to Innovate, Integrate and Sustain, is a sub-component of the Government of India's Smart Cities Mission. It has been conceived by MoHUA, in collaboration with AFD, the German Development Bank (KfW), EU, and NIUA. The programme is providing financial and technical assistance for promoting a circular economy through integrated waste management projects at the city level, climate-oriented reform actions at the state level, and institutional strengthening and knowledge management at the national level.*

1.1. Vision and Objectives

'Kakinada envisions a resilient future built on ecosystem conservation, especially of coastal and wetland systems, community empowerment, and robust urban systems to reduce the risks posed by episodic climate-induced disasters.'

To achieve this vision, and as an addendum to the CRCAP, KMC is preparing a guideline document to accelerate planning and mainstreaming inclusive, ecosystem-based climate-induced disaster resilience at the city scale. The recommendations include both structural and non-structural interventions. The specific objectives of this activity are as follows:

1. To assess the city's existing capacities using the Disaster Resilience Scorecard for Cities by UNDRR and identify specific issues related to climate-induced disaster preparedness.
2. To foster a mitigation- and preparedness-centric disaster resilience approach, rather than a response- and relief-centric approach.
3. To enhance climate-induced disaster resilience at the city scale with a focus on gender equality and social inclusion (GESI) and ecosystem-based adaptation (EbA) aspects.
4. To create an enabling environment for the implementation of specific interventions related to climate-induced disaster resilience.
5. To raise awareness and empower KMC in planning, implementing, and monitoring climate-induced disaster resilience across all stages of the disaster management cycle.

1.2. Methodology of Disaster Resilience Guideline Preparation

The detailed scorecard assessment and resilience guideline preparation for Kakinada City followed a robust three-step approach. This structured methodology involves a participatory, realistic evaluation of the city's resilience status, followed by the formulation and prioritisation of recommendations. Each step supports a data-driven, evidence-based,

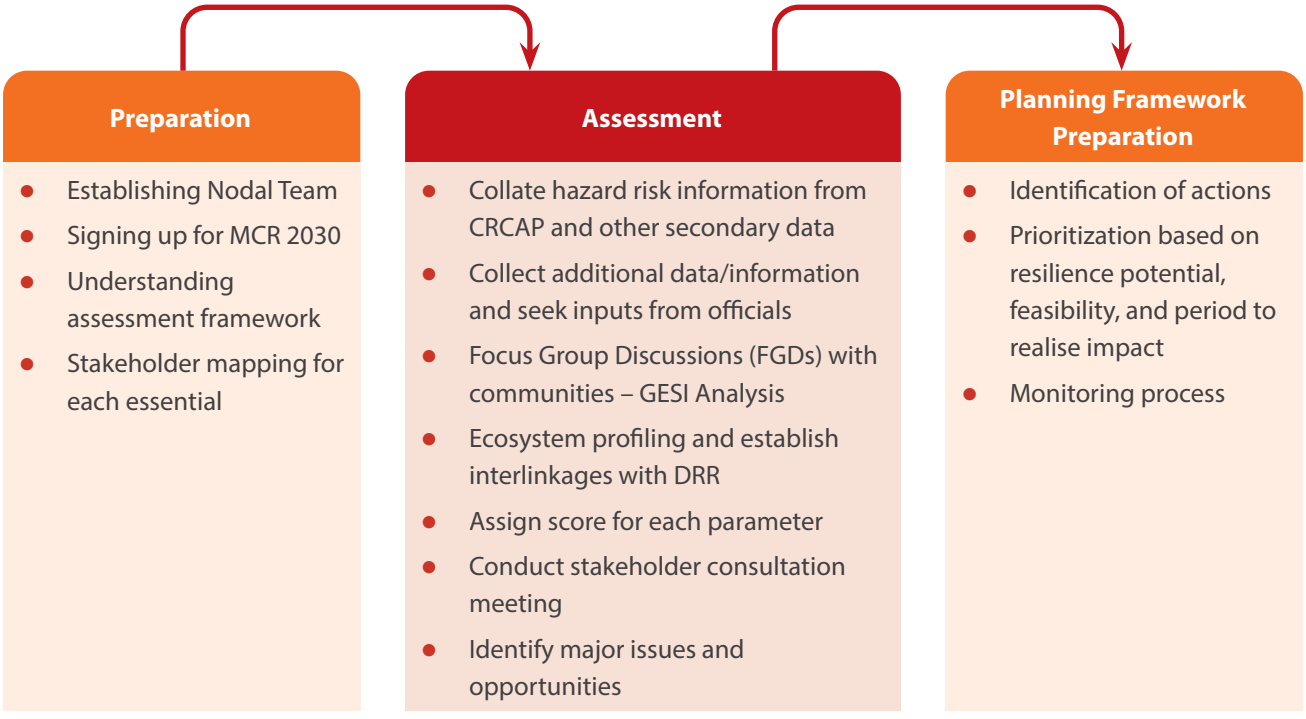


Figure 1: Methodology for Disaster Resilience Planning for Kakinada City

well-coordinated, and feedback-based approach for identifying key issues, challenges, and areas for improvement to achieve disaster resilience.

- Phase 1 (Preparation)
- Phase 2 (Assessment)
- Phase 3 (Post-Assessment)

Phase 1 (Preparation): At the onset, KMC constituted a Nodal Team to facilitate, oversee, and monitor activities related to assessing disaster resilience and supporting resilience planning. As disaster resilience in this case focuses on climate-induced disasters, some members of the Climate Core Team (CCT), established to prepare and implement the CRCAP, were entrusted with the extended responsibility of serving on the Nodal Team. Simultaneously, the city has signed up for MCR2030[5],** demonstrating its commitment to advancing disaster resilience and safeguarding its community, infrastructure and services from known and emerging climate extremes. Under MCR2030's 'resilience roadmap', KMC is currently at Stage A and is actively assessing disaster preparedness, increasing alignment among multiple institutions, and refining and enhancing early-stage strategies and actions.

To undertake the scorecard assessment, the thematic areas under each Essential, the assessment parameters, and the scoring framework were reviewed in detail. Stakeholders who could provide relevant information and insights to assign realistic scores to the parameters were identified. Key departments and stakeholders, including those from different tiers of administration (city, sub-district, district, and state), parastatal agencies, civil society organisations, and private entities, were identified for each Essential in consultation with the Nodal Team.

Phase 2 (Assessment): As KMC had already prepared the CRCAP, the information and knowledge obtained through this process were utilised effectively during scoring. For example, the CRCAP examined core hazards, their spatial distribution, and the impacts the city encounters (cyclones, floods, heat stress, etc.). This understanding formed the preliminary basis for scoring.

Additional information was collected through desktop research, secondary data such as the City Disaster Management Plan (CDMP), and the District Disaster Management Plan (DDMP) for Kakinada District, and key informant interviews (KII) with relevant officials. Focus group discussions (FGDs) with vulnerable groups such as fisherfolk, daily wage workers, residents near the dumpsite, and residents of low-lying areas, facilitated by KMC, helped understand disaster impacts and management through gender and social inclusion lenses. In parallel, different ecosystems, their conditions and their potential roles in hazard mitigation were mapped based on secondary data and stakeholder input.

Based on these inputs, a score was assigned to each indicator. The results of this assessment were used to identify major gaps and challenges in the disaster management system that need to be addressed to strengthen resilience. A joint stakeholder consultation meeting was then conducted to validate the draft. Based on their feedback, the assessment was finalised.

Phase 3 (Planning Guideline Preparation): Subsequently, a planning guideline was prepared that encompasses all four stages of the disaster management cycle, with an emphasis on year-long mitigation and prevention, and on planning during stable periods to enhance the city's capacity to respond to shocks.

Notably, the three phases lack a clear distinction or sequence; they often overlap and shift back and forth, allowing for reiteration. For example, while detailing the recommendations in Phase 3, a pre-existing community-based ecosystem conservation initiative might be identified that requires changes to the scores of Essentials 4 and 8, assigned in Phase 2.

*** MCR 2030 is a global partnership to strengthen local government and ensure that cities become inclusive, safe, resilient and sustainable by 2030. Its main objectives are to improve cities' understanding of risk and secure their commitment to local disaster risk reduction and resilience, to strengthen cities' capacity to develop local plans to enhance resilience, and to support cities implement local plans to enhance resilience.*

1.3. Scope and Limitations

Kakinada Municipal Corporation has advanced its climate resilience journey by preparing an ambitious CRCAP with technical assistance from ICLEI South Asia, supported by C40. Projected climate trends are likely to increase the intensity and frequency of these hazards, worsening disaster risk as exposure and heightened vulnerability increase. These trends warrant adopting city-specific mitigation- and preparedness-centric DRR actions. In this regard, the city-level climate-induced disaster resilience planning guidelines has been prepared as an addendum to the CRCAP under the CDKN program.

The climate-induced disaster resilience planning guideline for Kakinada covers the KMC jurisdiction and addresses its vulnerabilities to climate-induced disasters such as cyclones, floods, sea-level rise, and heatwaves. Building on insights from the CRCAP, the assessment of disaster resilience in the KMC area was conducted in a participatory manner following the UNDRR Scorecard to identify the city's resilience status and the additional measures needed to strengthen it. Because disaster management is a multi-stakeholder, cross-sectoral activity, the assessment examines the roles of line departments, community organisations, and other key stakeholders, and recommends institutional frameworks and inter-departmental coordination and collaboration to enhance resilience.

Although the Kakinada District Disaster Management Authority handles disaster management in Kakinada, the city-level planning guideline focuses on the KMC jurisdiction to capture the urban cause-and-effect dynamics of disaster risk. This approach fosters a deeper understanding of anthropogenic drivers, such as encroachment on wetlands and mangrove areas, unsustainable fishing, and reduced permeable surfaces, many of which are typical of urban settings and increase exposure. These, in turn, affect infrastructure, service delivery, lives and livelihoods, and compound disaster risk.

The assessment also recognises the challenges and marginalisation faced by different communities, especially traditionally excluded groups such as fisherfolk, daily wage labourers, construction workers, waste pickers, and residents of low-lying areas. Building on the ground-level understanding, it recommends interventions to accelerate inclusive and equitable DRR. Furthermore, the document treats ecosystems and biodiversity, along with their linkages to disaster risk, as integral parts. While the report acknowledges the important role of coastal ecosystems in disaster mitigation, KMC can adopt targeted ecosystem interventions only within its boundary and collaborate with state- or district-level departments for regional-scale conservation.

The disaster resilience assessment primarily evaluates the situation within the KMC area. Given KMC's limited mandate to spearhead disaster management, the plan also identifies sectors where KMC can demonstrate leadership through advocacy and collaboration with DDMA and line departments.



2. About the City

Kakinada, a port city in Andhra Pradesh, has evolved into a key industrial hub and is often called the "Fertiliser City" because of major fertiliser production facilities. Other important economic activities include maritime trade and the petrochemical industry. The city's population was 312,538 in 2011 (Census of India, 2011) and grew steadily to about 4.7 lakh by 2021. The city has a favourable sex ratio of 1048 females per 1000 males, significantly higher than the national average, and boasts a high literacy rate of over 81%.

Geographically, Kakinada lies on the coastal deltaic plain along the Bay of Bengal at an elevation of about 5 metres, with parts of the city lying near or even below sea level. The city's terrain slopes gently eastward, which supports a network of canals. These canals have an instrumental role in draining stormwater into the sea. The Coringa Wildlife Sanctuary, adjacent to the city boundary, is home to India's third-largest mangrove forest. These coastal ecosystems are vital to the regional ecological balance and provide a crucial natural buffer against cyclones and storm surges.



Figure 2: Location map of Kakinada

3. Brief Profile of Climate-induced Hazards in the City: Vulnerabilities and Risks

Kakinada is prone to several climate hazards, including cyclones, flooding and heat stress, with severe cyclonic storms being the most significant. The city also experiences surges of vector-borne and water-borne diseases during and after floods. However, city-specific data, reports, and research on hazard frequency, intensity, and impact are limited. An overview of the hazard occurrences is given below.

1. **Cyclones**: Due to its proximity to the sea, Kakinada is highly vulnerable to gusty winds and the impacts of cyclones. However, the seasonal pattern of cyclones has become less predictable over the past three decades, making it harder to prepare and respond to them. According to the Wind and Cyclone Hazard Map of India, Kakinada lies in the Very High Damage Risk Zone – B (Vb = 50 m/s), and heavy winds/gales and heavy rainfall are likely to affect the entire city. KMC has identified Wards 9, 10, 11, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25 and 26 as highly vulnerable and damage is expected to be higher in these wards than in other parts of the city.



2. **Floods:** Kakinada experiences flooding and related disruption annually. Wards 8, 9, 48 and 49 are the most vulnerable. Urban flooding worsens in the lower part of the city where rainwater from higher elevations converges but cannot drain effectively due to a sub-optimal stormwater network. Approximately 9.5% of the slum population resides in flood-prone areas, which impacts their livelihoods, health and well-being, deepening their poverty.



3. **Heatwaves:** KMC has identified 35 of 50 wards as the most vulnerable to heatwaves. Land surface temperature (LST) analysis conducted as part of the CRCAP preparation shows comparatively higher LST in areas with dumpsites, the anchorage port with heavy loading-unloading activities, industrial areas and salt farms. Approximately 50.8% of the city population and 38.9% of the slum population reside in the high-temperature zone and are likely to face challenges to their living conditions and overall well-being.



4. **Drought:** Drought affects the East Godavari district, including Kakinada, with a mild to moderate risk level. The city falls within the mild drought zone, as shown by the occasional scarcity of drinking water among its residents. Spot water sources have dried up, and the existing drinking water storage tanks, which rely on rainwater or canal systems, are insufficient to meet the demand during drought conditions.



The CRCAP identifies eight wards (10, 12-15, 26, 27, and 37) as highly vulnerable in terms of fragile urban systems. This indicates that water supply, wastewater, stormwater, solid waste management and transport systems in these wards are already impacted by intense rainfall events and heat stress. Impacts such as water contamination, reliance on water tankers, improper disposal of sewage, poor waste collection, disrupted connectivity, and accessibility are likely to be aggravated by intense climate-induced hazards. Consequently, the vulnerability of the 20% of the city's population residing in these eight wards is likely to intensify. Furthermore, about 24% of the city's slum population living in these wards is likely to face disproportionate impacts.

4. Existing Disaster Governance

Disaster management in the region is still governed under the old Disaster Management Act, 2005. Thus, the Kakinada DDMA serves as the lowest-level functionary responsible for disaster management, particularly response and recovery, in association with the concerned line departments. The DDMA has prepared the DDMP, outlining the roles and responsibilities of line departments. Reportedly, DRR planning, with a focus on mitigation and preparedness, is not yet mainstreamed in DDMA's operations, which face regular challenges due to inadequate human and financial resources. Disaster response and post-disaster operations are essentially contingency-based, with no prior planning, which reduces their efficacy and limits the dedicated support needed by some communities vulnerable to climate hazards.

Kakinada Municipal Corporation does not have any dedicated year-long operational institutional structure for disaster management and only takes initiative for disaster management initiative upon receiving a warning.

Pre-Disaster governance systems

The India Meteorological Department (IMD) initially issues weather alerts to the National Emergency Operations Centre (NEOC), MHA. NEOC acts as the central hub for disaster coordination and disseminates alerts to the National Disaster Management Authority (NDMA) and the National Disaster Response Force (NDRF) for national-level response. NDMA mobilises NDRF based on alerts and coordinates with APSDMA for preparedness and response. The National Disaster Alert Portal (SACHET) also operates on a Common Alerting Protocol (CAP) basis, integrating alerts from multiple agencies, including the IMD, Central Water Commission (CWC), and other alert-generating agencies, in an automated, round-the-clock system.

The State Emergency Operations Centre (SEOC), as part of APSDMA, subsequently forwards the alerts to the Principal Secretary, Home Department, DDMA, line departments, and Municipal Commissioners. Simultaneously, the AP Water Resource Department also shares real-time data with SEOC and district authorities, issues flood warnings and coordinates with local bodies for evacuation. APSDMA also circulates warning messages to all mobile numbers active in the region. As a result, everyone with a functional mobile phone receives an alert.

DDMA maintains an inventory of human, financial, and equipment resources for the line departments. Based on the roles and responsibilities defined in the DDMP and resource availability, DDMA deploys Revenue Divisional Officers, Mandal Development Officers and other line departments to support response efforts. Simultaneously, Kakinada Municipal Corporation conducts immediate intra- and inter-departmental coordination meetings and assigns responsibilities to Circle Special Officers (14 Circles), and Ward Level Nodal Officers (one for each ward), especially those from the Engineering, Public Health, Revenue, Town Planning and General Section departments.

During- and Post-Disaster governance systems

DDMA has initial funds to address immediate needs after a disaster. Subsequently, the relief and recovery funds are mobilised based on damage and loss assessment. The Andhra Pradesh State Revenue Department disburses both components from the National and/ or State Disaster Response Fund and channels them through DDMA to the affected parties.

5. Gender Equality and Social Inclusion Analysis

Kakinada city has a population of approximately 49% males and 51% females; however, the proportion of females is lower among slum dwellers. Approximately 0.118 million people (38% of the city population) reside in slum settlements where unsafe structures, lack of secure tenure, limited basic services, and high dependence on climate-sensitive livelihoods intensify vulnerability.

Ward Secretariats/Sachivalayams maintain disaggregated data on gender, disability, and chronic illness; however, these databases are not robust and are not consistently updated, impeding the ability to plan targeted interventions for marginalised groups. Women from the slums/below-poverty-line (BPL) communities are aggregated into Self-Help Group (SHG)-based microfinancing and livelihood collectives that provide vocational training in tailoring, stitching, small-scale entrepreneurship, loan access, repayment systems, and financial discipline. Women from BPL families and slum settlements mainly work in informal occupations such as domestic work, daily-paid construction work, and waste-picking. Some of the slum settlers along the canals are also traditionally engaged in fishing, with women supporting the processing and marketing of the catch. These occupations are highly vulnerable to climate risks and extreme events, inflicting disproportionate impacts on their livelihoods and recovery.

Of the 101 slums of Kakinada, 9.5% (~17,920)12 of the total slum population resides in flood-prone areas and is likely to face heightened vulnerability. Some slum settlements are also constructed on the canal buffer, while 68 slums lie below 3m MSL elevation, increasing exposure to inundation. While the existing impact is minimal, a severe cyclonic storm or a longer-return-period flood is likely to deepen their crisis. Constant hazard exposure, compounded by socio-economic marginalisation and inadequate basic services, leads to property damage, displacement, health concerns and loss of livelihood.

FGDs were conducted with the fisherfolk community, daily wage labourers, women-headed households, and waste pickers from slum settlements in flood-prone wards. These discussions provided insights into hazard impacts, the extent of their participation in pre-disaster planning and preparedness, and equity in disaster response and recovery.

- Discussion with representative fisherfolk communities from the Yeti Moga area explored the impacts of cyclonic storms and cascading heavy rainfall on livelihood losses. While a ban is imposed on fishing upon a cyclone warning, those already at sea face casualties or damage to their fishing gear. Beyond event-specific restrictions, fishing bans during the breeding season also affect their livelihoods. As most of the fisherfolk subsist on rented boats, they cannot avail themselves of the subsidy provided to boat owners in lieu of the seasonal ban. The community reported a 1/4th decrease in fish catch over time, and they need to sail into the deep sea to sustain this ancestral livelihood. Alternatively, they are adopting pond-based aquaculture and pisciculture, encroaching upon mangrove and coastal ecosystems. In addition to the direct risks associated with cyclones, fisherfolk are also at risk of heatstroke from prolonged exposure to heat and humidity. Thatched roofs have occasionally caught fire during extreme heat and been damaged during severe cyclonic storms.
- Discussions with slum dwellers, especially women-headed households and daily wage workers, noted the benefit of the ward Sachivalyam system, which has improved community-level early warning dissemination. Cyclone early warning messages are delivered via mobile alerts; fisherfolk receive dedicated cyclone warnings, and other communities are also informed about upstream water releases that can cause inundation. Evacuation and relief supplies depend on the hazard magnitude and do not reach all community members equally. Food distribution during floods often happens only along major roads, bypassing internal areas that are accessed through narrow lanes. While temporary relief camps were well equipped to meet the needs of critical groups such as pregnant women, children, and the elderly, financial assistance for recovery and reconstruction, such as funds for repairing damaged houses, is unavailable or inadequate. Mosquito breeding, wastewater, and hygiene issues remain major post-disaster health concerns.

- Focus group discussions conducted with marginalised slum women indicate a lack of inclusivity across pre-, during-, and post-disaster phases. Pre-disaster measures encompass early warning dissemination to fisherfolk, police notifications at beaches, and awareness campaigns on seasonal diseases by ASHA workers. During disaster events, vulnerabilities intensify, especially for informal livelihoods such as those of construction workers and waste pickers. Informal settlements adjacent to dumpsites also experience aggravated health hazards after cyclones and floods.

5.1. Key Gaps in Gender and Social Inclusion

Conversations with the fisherfolk community, daily wage labourers, women-headed households, and waste pickers reveal persistent gaps in ensuring equity and inclusion in disaster preparedness, response, and recovery. The key issues include:

Limited disaggregated Data: Ward Sachivalayams track gender, disability, and chronic illness, but the database is not updated periodically, limiting the institutional capacity to adopt targeted interventions for marginalised groups. Demographic data on slum dwellers show a lower proportion of females, especially among children, yet a robust gender-disaggregated database that captures their intersectionality is lacking. Inadequate data impedes equitable and inclusive planning for floods, cyclones, and heat stress.

Livelihood Vulnerabilities: Slum dwellers, especially women from slum communities who are engaged in informal livelihoods, experience high insecurity and delayed restoration of livelihoods post-disasters. This is further compounded by the decline in natural resources on which livelihoods are dependent, such as fish stocks. For example, fisherfolk reliant on rented boats cannot avail subsidies provided to boat owners in lieu of the seasonal ban and face a 25% decline in fish catch.

Participation Inequities: FGDs highlight uneven community involvement across the stages of disaster management. Although many women community members are organised through SHGs, their voices are absent in disaster risk assessment and planning. While early warnings are intended to be distributed universally, evacuation and relief often bypass locations that are hard to reach.

Response and Recovery Gaps: Relief distribution is not equitable; financial aid often does not cover house reconstruction aligned with the 'build back better' principle. Due to delayed restoration of municipal services and cleanliness in a few low-lying areas of the city, post-flood health risks related to water-borne or vector-borne diseases persist and disproportionately affect vulnerable groups. Without targeted interventions, certain groups such as pregnant and lactating women, the elderly, and persons with disabilities (PwD) bear the maximum burden.

Institutional Barriers: SHGs provide rudimentary microfinance and training (tailoring, entrepreneurship) that are not tailored to the requirements for upskilling or developing alternative livelihood options. These services do not address livelihood-specific concerns of groups such as fisherwomen and waste pickers, which amplifies their underlying socio-economic vulnerability because they are involved in climate-sensitive sectors. KMC, grassroots-level SHGs and NGOs do not work in a concerted manner to capture community-level information and feed it into to city-level planning, empower them with adequate skill sets and recognise their traditional knowledge. The lack of such measures amplifies the vulnerability of these communities.

6. Interlinkage of DRR with Ecosystems

6.1. Types of Ecosystems

Within the city, natural ecosystems primarily consist of urban green spaces, coastal ecosystems, wetlands, small mangrove patches, and canals. As per the Coastal Zone Management Plan of Andhra Pradesh prepared in accordance with the Coastal Regulation Zone Notification, 2019, 1.17 sq. km. of area in the southern part of the city is notified as a mangrove and mangrove buffer zone (CRZ IA)[6],* and an additional 0.94 sq. km. area is demarcated as intertidal areas (CRZ IB). No new constructions are permitted in CRZ IA except for critical facilities such as defence, trans-harbour links, atomic energy, pipeline and conveying systems, etc. However, certain activities related to natural gas, salt harvesting, desalination, non-hazardous cargo, etc. are permitted in CRZ IB**, subject to the necessary safety measures. AP Building Rules also mandate a 2 m-wide buffer for canals up to 10 m wide and a 9 m-wide buffer for canals more than 10 m wide. Kakinada has 73 parks, including four major parks and 69 colony parks. KMC maintains one major park and 24 colony parks, while the remaining 45 colony parks are maintained by Resident Welfare Associations (RWAs).

Significant ecosystems can be found beyond Kakinada city's limits. These include an estuarine ecosystem consisting of rivers and channels, floodplains, natural levees, mangrove forests, tidal channels, tidal flats, lagoons, bays, sand spits, mainland beaches, sand dunes, and paleo-sand ridges.

- East Godavari River Estuarine Ecosystem (EGREE), encompassing the Godavari mangroves, is the third largest mangrove forest in India. Part of the EGREE area is gazetted as the Coringa Wildlife Sanctuary (CWLS) because of its significant biodiversity. The CWLS spans 235.7 sq. km. and is home to 34 mangrove tree species. The Coringa Wildlife Sanctuary is home to many endangered species, including the fishing cat, otter, jackal, sea turtle, seagull, pelican, stork, heron, snipe, and flamingo. Around 269 bird species have been spotted here, with over 60,000 water birds visiting each year[7, 8]. , Coringa is also designated as a Critically Vulnerable Coastal Area (CVCA) under the CRZ Notification, 2011 and 2019, and will be managed with the involvement of coastal communities, including fisherfolk who depend on coastal resources for their sustainable livelihood[9].
- A 16 km-long sand spit (aptly named Hope Island) is strategically located around Kakinada Bay. Although about 18 km from the city, it provides significant natural protection to the Kakinada port, the city, and the mangrove reserve from ocean currents[10]. Hope Island and Sacramento Island are critical nesting sites for the endangered Olive Ridley turtles[11].

These areas play a pivotal role as a natural defence against storm surges, cyclones, and tsunamis, and help control coastal erosion, shoreline change, and saltwater intrusion. The District Forest Office, Kakinada District, under the AP Forest Department, is responsible for the protection, conservation, and management of these ecosystems beyond the city boundary, while the Andhra Pradesh Coastal Zone Management Authority (APCZMA) is implementing the Coastal Regulation Zone (CRZ) Notification, managing coastal development, and regulating projects within Andhra Pradesh's designated CRZs. The surrounding agricultural areas also support a range of plants, amphibians, and birds that thrive in human-altered environments. The rich marine biodiversity along the coast, featuring fish, dolphins, and other aquatic species, further underscores the region's ecological importance beyond Kakinada's urban footprint.

6.2. Ecosystem Services

The role of these mangroves as resource repositories and disaster regulators has been highlighted by several authors, including Raman (1995), Satyanarayana (1997), Chandra Mohan et al. (1997), Rönnbäck et al. (2003), Moberg and

** Ecologically sensitive areas are demarcated as CRZ IA (with the hope of protecting them from cyclones and storm surges).*

*** The area between the Low Tide Line and the High Tide Line (intertidal zone) is considered CRZ IB. Certain activities related to natural gas, salt harvesting, desalination, non-hazardous cargo, etc. are permitted following the necessary safety measures*

Rönnbäck (2003), Danielsen et al. (2005), and Guebas et al. (2006) . A 2020 study found that the Coringa mangrove provides 11 goods and services worth INR 549.6 crore per year. The direct recipients of these ecosystem services are primarily located beyond the city boundary.

Table 1: Ecosystem services in and around Kakinada city

Type of Ecosystem	Ecosystem Services	Stress on Ecosystems
Mangrove	• Flood and cyclone mitigation- reportedly protecting 75,000 people, with many lives and properties safeguarded[12]. • Livelihoods-- fisheries, aquaculture, agriculture, bee culture, salt production. During the seasonal ban, when fishing in the high seas is prohibited or during a phase of steady decline in the catch, mangroves work as an alternate fish-spawning ground[13]. • Eco-friendly tourism- local communities trained in mangrove interpretation act as nature guides, generating awareness. • Carbon sequestration. • Timber for fencing, housing materials, thatching materials and fishing poles, and firewood.	• Impacted by unsustainable fishing and aquaculture, encroachment, violations of conservation norms, waste, especially plastic dumping, discharge of effluents and pollutants from petrochemical refineries, aquaculture facilities, and other factories, and a decrease in freshwater flow, among other factors[14]. • Reduced fish stocks from pollution and overfishing of juvenile fish stocks, poor water quality, and loss of significant marine life, impacting the lives of local communities. • Non-adherence to environmental norms: The mangrove and its buffer located within wards 10 and 13 are allocated for port-based industries under the Outline Development Plan, 2035. Additionally, some of the low-cost housing apartments are constructed in the intertidal areas around this mangrove, depleting the ecosystem[15].
Canal bank	• Groundwater recharge, ensuring water availability for cultivation • Support for the municipal water supply • Fishing • Flood buffer • Species habitat • Recreational and cultural use	• Some parts of the canal buffer within city limits have been encroached upon by slum settlements.
Park	• Permeable space, supporting groundwater recharge and reduced run-off, contributing to flood control. • Microclimate regulation, mitigating the urban heat island impact. • Recreational use	• Some of the parks are not well-maintained.

7. Climate-induced disaster resilience assessment

The Disaster Resilience Scorecard for Cities by UNDRR is a tool that helps cities to assess their resilience, align their efforts with the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015–2030 and support the preparation of disaster resilience guidelines.

The Scorecard, especially the detailed assessment, aims to assess a city's ability to understand potential disaster risks and strengthen its capacity to mitigate and respond to them, minimising immediate and long-term losses of life, livelihoods, property, infrastructure, economic activity and the environment. The assessment covers all ten Essentials for Making Cities Resilient 2030, with 117 indicator criteria, each scored from 0 (lowest) to 5 (highest). The Scorecard has been used in over 200 cities worldwide to measure critical resilience.

- Essentials 1-3 cover governance and financial capacity.
- Essentials 4-8 cover many dimensions of planning and disaster preparedness.
- Essentials 9-10 cover disaster response and post-event recovery.

Kakinada experiences significant climate-induced hazards such as cyclones, urban flooding, and heat stress every year. This calls for mainstreaming climate-induced disaster resilience into its development process. Currently, the DDMA supervises and manages disasters within Kakinada city and across the Kakinada district. However, the city needs a proactive approach and a clear understanding of the technical, institutional, and financial capacities required to steer climate-induced disaster resilience in the urban landscape. Certain Essentials, such as Essentials 3, 9 and 10, which deal with financial capacity to build disaster resilience, disaster response, and post-disaster recovery, are spearheaded by DDMA at the local level. Thus, the scoring does not necessarily reflect the capacity or lack of it within KMC in these aspects. Instead, the scores show opportunities for KMC to strengthen collaboration with other stakeholders, remove bottlenecks in disaster response and recovery, access disaster finance structurally, and bolster resilience planning within its jurisdiction.

7.1. Assessing KMC's Disaster Preparedness Score

Essential 1: Organise for Disaster Resilience

Plan preparation

Kakinada city's overall development and growth are guided by the erstwhile Godavari Urban Development Authority's Draft Perspective Plan (DPP), 2050, while land use is guided by the Kakinada Zonal Development Plan (ZDP), 2040. The ZDP considers the city core of Kakinada as a resilient city and aims to reduce threats from natural hazards through regular and sustainable investment in programmes and plans. Insights from the ZDP have been integrated into the preparation of the Draft Perspective Plan. The DPP integrates the vulnerability of the entire area, including that of KMC, to natural hazards in vision development and recognises the need for strengthening the disaster management and relief system, and considers establishing a disaster management centre. Currently, the city has also prepared a CRCAP that recommends infrastructure projects with the potential to respond to current and anticipated climate risks. In addition to mainstreaming risk into planning, the plans are deemed participatory, incorporating feedback from diverse groups, including city services and departments, the health sector, utility providers, NGOs/CSOs, businesses, and local universities/scientific institutions. The city has also recommended reviewing and updating the CRCAP once every five years, in view of the pace of development, and the 'Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines' also recommend similar updates for perspective and strategic plans in response to fast-evolving social, economic, and technological scenarios[16]. Notably, the plans were only recently developed and have not yet had an opportunity for review and updating.

Although some of the city's vision and strategic plans consider risk factors, the City Sanitation Plan, the Low Carbon Mobility Plan, and, more broadly, project development, do not explicitly evaluate relevant risks and resilience benefits.

The implementation of the actions suggested under the CRCAP, such as setting up early warning systems for timely flood alerts and traffic redirection, and improving green cover in wards with high heat stress using native tree species, is likely to advance flood and heat resilience, respectively.

Organisation, Coordination, and Participation

The erstwhile East Godavari District was reorganised into three new districts: Kakinada, Konaseema, and East Godavari in 2022, with Kakinada Municipal Corporation being the district headquarters for the Kakinada district. Currently, the Kakinada DDMA is the nodal agency for planning, supervising, and managing disasters occurring in Kakinada district. DDMA has defined the roles, responsibilities, and coordination mechanisms among multiple stakeholders such as revenue, fire, police, fisheries, irrigation, power, finance, information, and broadcasting departments, private entities, and community representatives for pre-event planning, preparation, and response in the Kakinada DDMP. In addition to the DDMP, a City Disaster Management Plan (CDMP) briefly outlines the functions of the Incident Response System and the Emergency Support Function, which involve multiple departments.

DDMA, in association with line departments, plans and implements DRR measures, especially annual budgeting for immediate response and relief, and deploys human resources to tackle contingent situations. In contrast, disaster mitigation and preparedness efforts are minimal. Interdepartmental coordination is also evident. Discussions with the Kakinada District Fire Officer (DFO) revealed a gap between DDMA's disaster response planning and an inadequate understanding of the DFO's available resources to translate the plan into action on the ground.

On external assistance, the CDKN programme is supporting KMC in laying out climate-induced disaster resilience actions. The CRCAP has also outlined modalities of external (both public and private) assistance for the recommended actions, some of which, such as integration of green infrastructure to absorb and manage rainwater, ensuring flood-resilient urban planning and zoning policies, and enhancing green cover, directly influence flood and heat resilience. KMC has been receiving external assistance from the National Disaster Response Force, the Indian Coast Guard, NGOs like the Indian Red Cross Society, industries such as Oil and Natural Gas Corporation Ltd. (ONGC), Nagarjuna Fertilisers and Chemicals Limited (NFCL), etc., and other private organisations for responding to disasters effectively on a contingency basis. However, the outreach of disaster response and recovery mechanisms is limited and does not cover the entire city population. The City and DDMA clearly understand the existing inventory and additional support needed for effective DRR. However, they do not use this knowledge to plan and seek external assistance in advance; instead, they receive it on a contingent basis.

Data capture

DDMP provides overall district-level information, while CDMP captures city-level assessments without micro-level details. Most of these reports are not updated in real time and are not available in one place for easy access. The general public cannot access the preparedness and readiness status.

Table 2: Scores Achieved by Kakinada in Essential 1

1.1.1	Risk consideration in planning	**4**
1.1.2	Consultation in planning	**3**
1.1.3	Review of strategic plans.	**2**
1.2.1	Pre-event planning and preparation	**4**
1.2.2	Coordination of event response	**4**
1.2.3	City resources for managing organisation, coordination, and participation	**4**
1.2.4	Identification of physical contributions	**3**
1.3.1	Integration of disaster resilience with other initiatives	**2**
1.4.1	The extent to which data on the city's resilience position is shared with other organisations involved with the city's resilience	**2**

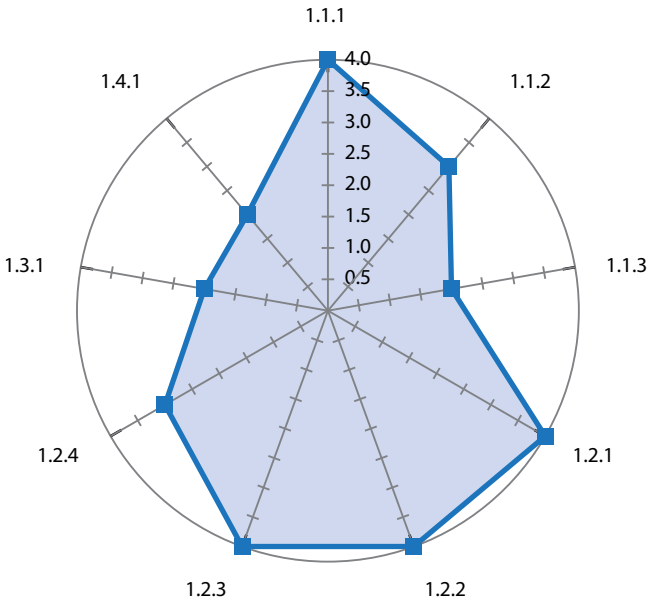


Figure 3: Radar Chart Showing Scores of Kakinada in Essential 1

Essential 2: Identify and Understand Risk Scenarios

Hazard Risk Assessment

DDMP and CDMP have identified cyclones, flooding, and heat stress as key climate-induced hazards for the city. The assessment includes spatial mapping and a seasonality calendar, especially for the frequency of severe cyclones. However, spatial risk assessment incorporating comprehensive probability and severity, and multifaceted exposure and vulnerability of populations, housing, ecosystems, and crops, is not available. The DDMP of the erstwhile East Godavari District, from which Kakinada District was bifurcated, broadly reflects only population exposure and the spatial distribution of disaster risk at the mandal level. Nonetheless, it does not provide a rational, evidence-based assessment of exposure and adaptive capacity, based on a robust loss- and-damage assessment.

To address these risks, the city has intensified efforts to mainstream climate resilience across urban systems by formulating the CRCAP, which aims to drive disaster resilience and other co-benefits. The National Building Code (NBC) promotes hazard-responsive building and construction, and the AP Building Rules mandate adherence to it.

Cascading Impact

While DDMP and CDMP acknowledge the importance of water supply, power and energy, and communication networks in disaster recovery, they do not determine the cascading impacts between these infrastructures. The CRCAP has identified the impacts of climate extremes, heat stress, and high-intensity rainfall on several urban infrastructure systems and services and their partial interlinkages. However, it does not delve into the impacts, especially the impacts of cascading or compounding hazards on other social infrastructure, such as health and education, energy distribution and communication systems,

Update Process

The Disaster Management Act, 2005, recommends updating the DDMP annually. Because Kakinada District was bifurcated from the erstwhile East Godavari District, Kakinada's DDMP was prepared in 2024 and reflects the severity and frequency of recent cyclonic events, such as Cyclone Phethai in 2018. Thus, this update is driven by an administrative requirement rather than a structured process. The 2018 CDMP has not yet been updated. Despite assessing infrastructure damage, casualties, population displacement, crop loss, etc., this information is not systematically integrated to

Table 3: Scores Achieved by Kakinada in Essential 2

2.1.1	Knowledge of hazards (also called perils, or shocks and stresses) that the city faces, and their likelihood.	**3**
2.2.1	Knowledge of exposure and vulnerability.	**1**
2.3.1	Understanding of critical assets and the linkages between them.	**1**
2.4.1	Hazard maps.	**4**
2.5.1	Update process.	**0**

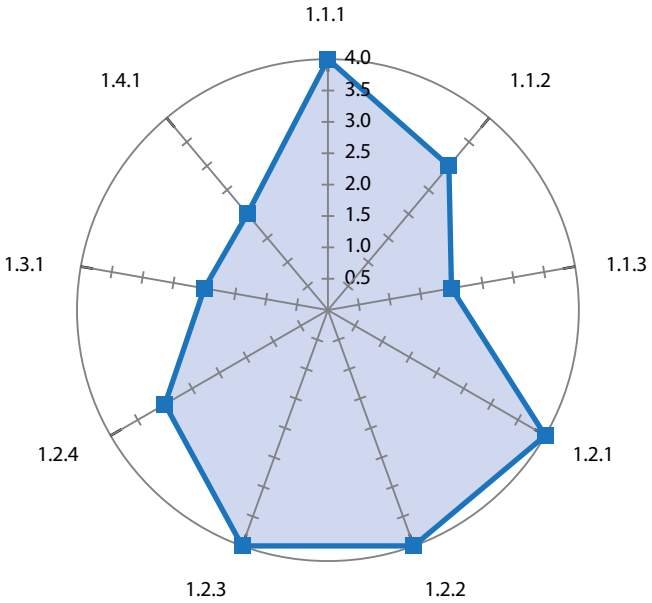


Figure 4: Radar Chart Showing Scores of Kakinada in Essential 2

Essential 3: Strengthen Financial Capacity for Resilience

Knowledge of Approaches for Attracting New Investment

Kakinada city primarily relies on DDMA for obtaining financial assistance for disaster relief and recovery. There is limited awareness of potential sources of resilience funding, including alternative financing methods. Neither the city nor DDMA has a dedicated entity responsible for financial planning for disaster resilience.

With support from the Andhra Pradesh Disaster Management Authority (APSDMA) and UNDP, KMC developed the CDMP, which includes Standard Operating Procedures (SOPs) created for various departments to address contingencies. A key component of the CDMP is the emphasis on staff training to clearly define roles and establish communication systems during emergencies.

The CRCAP has indicative financial implications and potential sources for some of the resilience needs, such as the installation of inundation sensors as early warning systems or the use of vegetated bioswales for neighbourhood-level stormwater management that would also have 'outbound resilience dividends,' including enhanced city aesthetics, and a reduced disease burden. Nevertheless, the CRCAP does not cover all aspects of disaster resilience, and KMC has not yet prioritised these needs*.

** Outbound resilience dividends, where an investment in resilience also provides an additional, non-resilience benefit- for example where a flood zone doubles as a park during times of normal weather. Outbound dividends serve to increase the visible benefits of resilience.*

Resilience Budget

KMC has a capital allocation in the annual budget to upgrade stormwater drains in areas prone to frequent inundation, sourced from the 14th FC and 15th FC. Although it is a sector-specific intervention, it significantly impacts flood and cyclone resilience in Kakinada. However, financial allocation for post-disaster recovery and reconstruction is generally limited. Focus Group Discussions (FGD) with some marginalised groups (e.g., fisherfolk) in the city voiced concerns about limited financial or non-monetary humanitarian assistance after cyclones.

KMC uses general funds for desilting drains, fogging, and anti-larval operations to mitigate vector-borne diseases as needed, and DDMA and line departments supply relief material and equipment depending on the intensity of the event. Notably, fund allocation is not guided by a comprehensive needs assessment; therefore, it cannot determine adequacy.

The city or DDMA has no exclusive contingency funds for disaster response and recovery. DDMA has funds to address immediate needs after a disaster is declared. Subsequently, the relief and recovery funds are mobilised based on damage and loss assessments. The AP State Revenue Department disburses both components from the National and/or State Disaster Response Fund and channels them through DDMA to the affected parties. However, these are not city-specific and may be used for notified disasters anywhere in the state or country, making it difficult to assess whether they meet Kakinada's needs. Notably, NDRF approved about INR 6.08 billion, in addition to the SDRF allocation (Rs. 13.81 billion), for Andhra Pradesh in FY 24-25, indicating that the state needed around 30% external assistance for disaster recovery[17].

Insurance and Incentives

Home insurance and insurance for non-domestic property, infrastructure or assets are not common practices in India. As home insurance is not mandatory for home loan applications, its penetration is negligible, at about 1-3%[18]. Consultations with the community or officials also indicate that home insurance is rarely adopted.

A few non-profit organisations (e.g., the Indian Red Cross Society) and businesses (e.g., Oil and Natural Gas Corporation Limited) have contributed to Kakinada's resilience. For example, the Indian Red Cross Society (IRCS) has conducted a training programme for capacitating ward secretaries as 'First Responders.' However, these initiatives are project-specific, rather than being incentive-driven. Homeowners receive only limited financial incentives to adopt resilience measures. State building rules mandate climate-resilient measures and disaster-sensitive (earthquake, cyclone) design in all applicable construction projects. Non-compliance with certain climate-resilient measures carries penalties. For instance, if applicants fail to install rainwater-harvesting structures or rooftop solar systems, the ULB may levy a penalty equal to an additional 10% of the property tax until the systems are installed and maintained. Also, the permit fee is recommended to be reduced for buildings constructed in accordance with the Andhra Pradesh Energy Conservation Building Code.

Table 4: Scores Achieved by Kakinada in Essential 3

3.1.1	Awareness and knowledge of all possible methods of financing and funding, as required. The city is actively pursuing required financing and funding.	**3**
3.2.1	Adequate financial planning for all actions necessary for disaster resilience.	**2**
3.2.2	Capital funding for long-run engineering and other works that address scenarios and critical assets identified in Essentials 2 and 8.	**4**
3.2.3	Operating funding to meet all operating costs of disaster resilience activities.	**1**
3.2.4	Contingency fund(s) for post-disaster recovery (may be referred to as a "rainy-day fund").	**3**
3.4.1	Incentives to business organisations to improve disaster resilience—disaster plans, premises, etc.	**0**
3.4.2	Incentives to nonprofit organisations to improve disaster resilience—disaster plans, premises, etc.	**0**
3.4.3	Incentives to homeowners to improve disaster resilience—disaster plans, premises, etc.	**2**

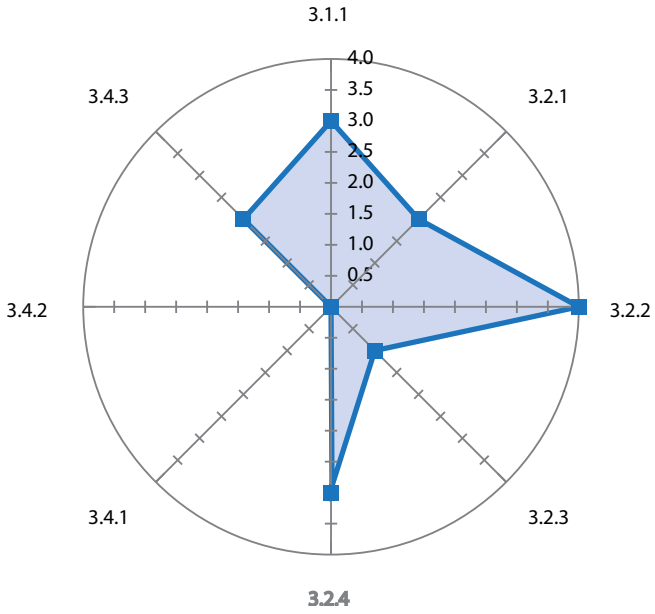


Figure 5: Radar Chart Showing Scores of Kakinada in Essential 3

Essential 4: Resilient Urban Development

Land Use Zoning

A robust assessment of population displacement, job loss, or business disruption due to disaster events has not been undertaken. Nonetheless, slum populations living along creeks or canals and in flood-prone areas (i.e., approximately 11,000 slum dwellers, about 2% of the city population) are temporarily relocated to safer areas like schools or community halls for 3-4 days in case of extreme inundation. Only in severe events, such as heat-induced fires and tsunamis, have a few slum houses been destroyed, and the settlers have been kept in temporary shelter for years. In all other cases, most probable scenarios have not resulted in months-long displacement.

In addition to the challenges of relocation, daily activities, especially informal livelihoods and businesses such as petty shops, street vending, waste picking, and scrap dealing along the creek or canal bank and flood-prone areas, are disrupted until the water recedes. Climate-sensitive livelihoods, such as fishing, are affected by severe cyclonic events. Despite widespread reporting and awareness of heat stress impacts on street vendors, construction workers, traffic police, and waste pickers, no specific assessment has been done. It is considered that most probable scenarios affect economic activities and businesses minimally, are concentrated in some areas, and last only a week.

Patches of agricultural land at the city periphery (Wards 2 and 48) are small compared with the food requirement for the city population. Moreover, no impact on agricultural activity is recorded. However, the impact on lives and livelihoods from the most severe scenario remains unknown or unassessed.

New Urban Development

Although the city currently has limited urban design solutions, such as community parks, rainwater harvesting, bicycle tracks, etc., it has advanced in exploring these interventions. CRCAP focuses on upgrading stormwater drainage, increasing permeability through neighbourhood-level intervention, urban greening, green and cool roofing, and rooftop solar PV for renewable energy generation, all aimed at augmenting city and community resilience.

Building Codes and Standards

The AP Building Rules, 2017, mandate adherence to relevant disaster-sensitive building codes as per the NBC and IS. They also integrate contemporary climate resilience provisions, such as on-site waste and wastewater processing,

and rainwater reuse and rainwater harvesting. The national-level mission AMRUT also recommends periodic review of building rules. However, enforcement and regular updating of the rules remain major challenges. Physical structures, including most households, have withstood hazards that have struck the city to date. Only a few households have been destroyed due to tsunami-induced storm surges and heat-induced fire accidents. The impact is usually limited to canal/ creek banks and flood-prone areas, which account for about 5% of the city's total households.

Application of Zoning and Building Codes

Current land use zoning for KMC and adjacent outgrowth areas, including eight adjacent gram panchayats, is guided by the Outline Development Plan (ODP). Given the 2035 time horizon, the ODP's application is an evolving process. However, the ODP is not fully environmentally sensitive, as it promotes industrial use within an area designated as mangrove in the 2019 CRZ Map. The AP Building Rules regulate building construction and ensure that structures are disaster- and climate-resilient. An occupancy certificate is issued after careful inspection and compliance with the submitted application and building rules. Most physical structures, including most of the households, have withstood hazards that have struck the city to date. However, this does not necessarily apply to informal settlements, which account for about 10% of total households. Satellite imagery shows encroachment on canal banks across the city, with a few examples indicated in Figure 5.

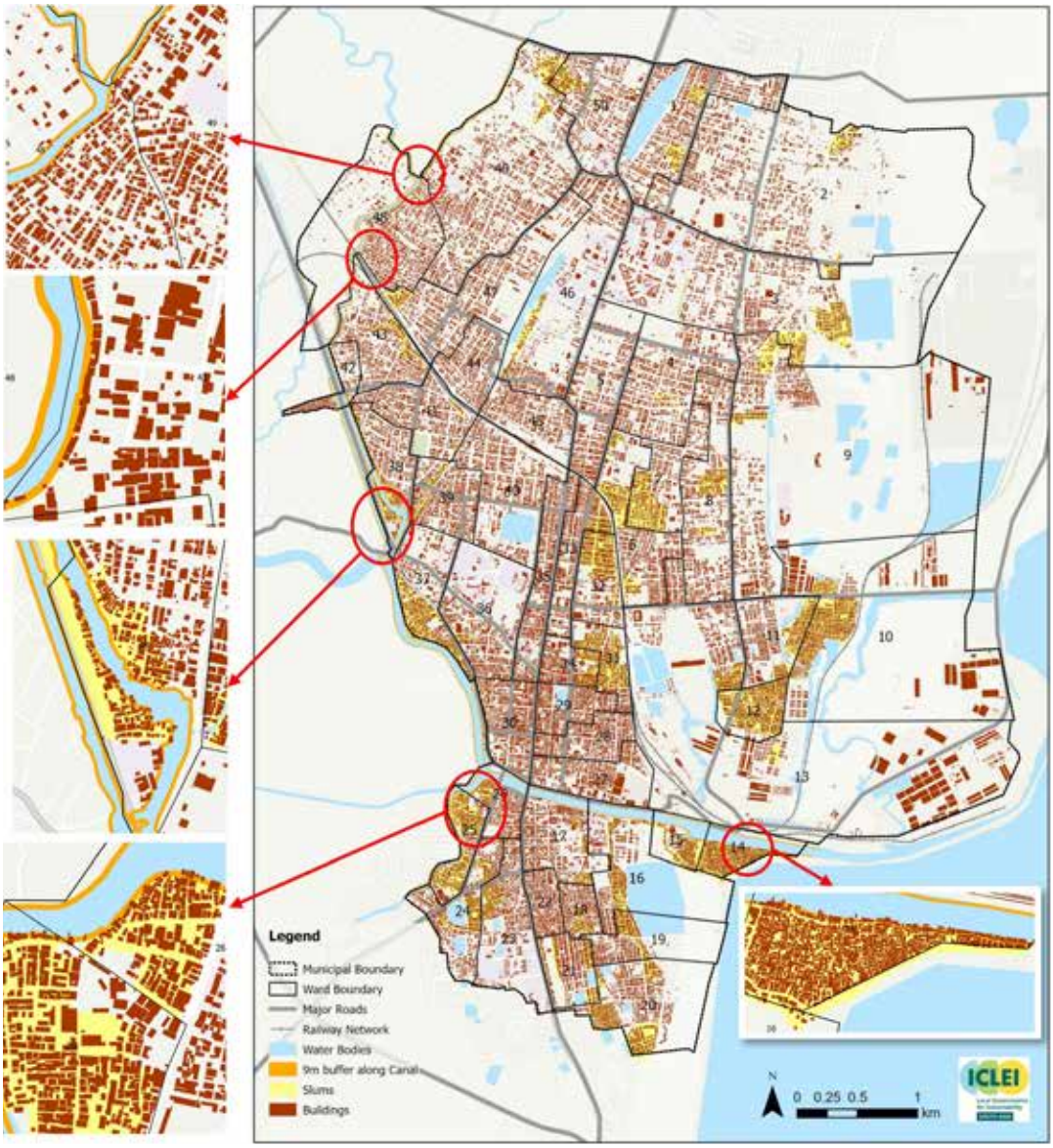


Figure 6: Encroachment on Canal Buffer

The AP Building Rules require the Structural Design Review Panel (SDRP), consisting of third-party experts, to verify structural design. In practice, there is no third-party verification prior to the issuance of building permission or occupancy certificate. Moreover, organisational multiplicity, such as KMC supervising construction up to 1000 sq. m. of built-up area and KAUDA supervising construction of >1000 sq. m. of built-up area, renders complexity in monitoring.

Evidently, Kakinada needs to proactively adopt sustainable building standards and green building while adhering to the existing regulatory framework. The Kakinada Beachfront Development, spearheaded by KAUDA, is underway, and includes developing coastal tourism infrastructure up to CWLS and Hope Island beachfront. This project should acknowledge the delicate balance of existing coastal ecosystems, mangroves, and creeks and duly incorporate conservation measures. While providing access to natural elements, especially beaches and creeks, the polluted and encroached stretches should be cleaned, restored, and rejuvenated to foster resilience and enhance socio-economic importance.

Table 5: Scores Achieved by Kakinada in Essential 4

4.1.1	Potential population displacement.	**4**
4.1.2	Economic activity (% of employment) at risk.	**4**
4.1.2.1	Economic activity (% of business output) at risk.	**4**
4.1.3	Agricultural land at risk.	**4**
4.2.1	New urban development.	**2**
4.3.1	Existence of building codes designed to address risks identified in Essential 2.	**4**
4.3.2	Updates to building codes.	**3**
4.3.3	Sustainable building design standards.	**0**
4.4.1	Application of land use zoning.	**3**
4.4.2	Application of building codes.	**3**

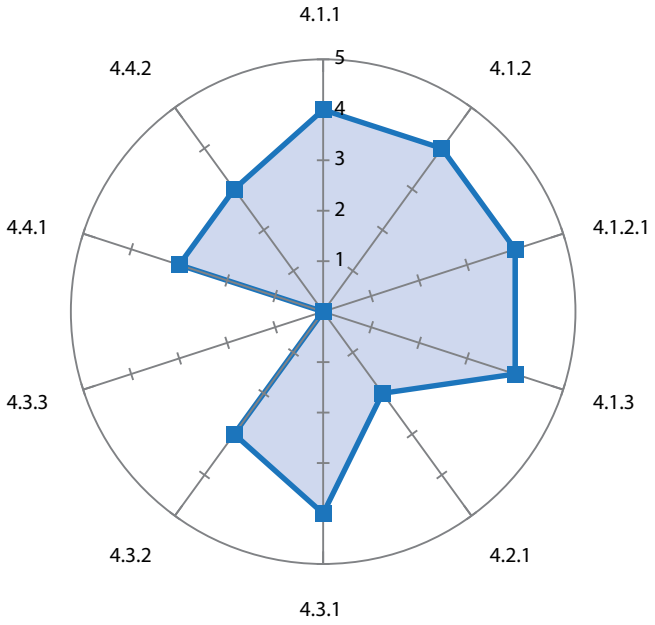


Figure 7: Radar Chart Showing Scores of Kakinada in Essential 4

Essential 5: Safeguard Natural Buffers to Enhance the Protective Functions Offered by Natural Ecosystems.

Existing Natural Environment and Ecosystem Health

The city's natural ecosystems primarily consist of urban green spaces, coastal ecosystems, wetlands, small mangrove patches, and canals. These, along with EGREE adjacent to the southern boundary of the city, hosting Coringa Wildlife Sanctuary (CWLS), add significant value to the region, especially as a natural hazard buffer. The District Forest Office, Kakinada, which oversees these ecosystems beyond the city boundary, has qualitatively assessed the ecosystem services of Coringa mangroves. Some studies have also assessed the monetary valuation of these ecosystem services. Despite identifying these services, the extent of damage to these ecosystems is neither assessed regularly nor monitored, particularly damage driven by rapid urbanisation and development.

Satellite imagery-based land use land cover (LULC) assessment indicates that the vegetation area within the city boundary decreased by about 20% from 2017 (6.42 sq. km.) to 2022 (5.12 sq. km.), primarily in Wards 9, 10, 13, and 48. Comparison of the land-use map with satellite imagery reveals that parts of the wetlands have been converted into godown areas. Reports suggest that the mangrove area in Kakinada (CRZ IB) has also been depleted for the construction of affordable housing schemes, 21 as evident from the building footprint captured in Figure 7. Kumbhabhisekham, a mudflat and nesting site for endangered bird species (e.g., the great knot and the Indian skimmer) within the city boundary, is not evaluated for its ecosystem services. Extensive fishing and anchoring of fishing boats have disturbed the ecological balance, thereby impacting bird nesting and inducing coastal erosion.

The GUDA Draft Perspective Plan indicates anthropogenic activities have inflicted irreversible damage to some of these ecosystems located within Kakinada or adjacent to the city boundary. In the Outline Development Plan 2035, wetlands and mangroves in Ward Nos. 10 and 13 are designated as a port-based industries zone which, if commissioned, is likely to inflict further damage to the sensitive ecosystems around the city.

Integration of Blue and Green Infrastructure (BGI) into City Policy and Projects

GUDA Draft Master Plan 2040 promotes an approach for a naturally resilient coastal city and mainstreamed protection of environmentally sensitive areas. However, translation of these pro-environment land-use policies into on-ground implementation is limited. The wetland and mangrove adjacent to the city boundary are designated as a port-based industrial zone in the Outline Development Plan 2035. Part of this area is eco-sensitive, and no construction is permitted as per the CRZ Map, 2019 (refer to Figure 8).

Kakinada city occasionally uses blue-green infrastructure, such as community parks, permeable footpaths, and urban green spaces, without any dedicated focus on canals, creeks, or wetlands within its jurisdiction. The city has committed to adopting blue-green infrastructure in the CRCAP to enhance infiltration, regulate the microclimate, and conserve local biodiversity, thereby driving climate resilience. However, these are not yet implemented on the ground.

Transboundary Environmental Issues

Major ecosystems in the region, such as EGREE, including CWLS and Hope Island, lie beyond the city boundary and are administered by the Kakinada District Forest Office, without any KMC involvement. Further, KMC and APCZMA do not collaborate in protecting and conserving the CRZ.

Table 6: Scores Achieved by Kakinada in Essential 5

5.1.1	Awareness of the role that ecosystem services may play in the city's disaster resilience.	**3**
5.1.2	Ecosystem health.	**2**
5.2.1	Impact of land use and other policies on ecosystem services.	**2**
5.2.2	Green and blue infrastructure is routinely embedded into city projects.	**1**
5.3.1	Identification of critical environmental assets.	**0**
5.3.2	Transboundary agreements.	**1**

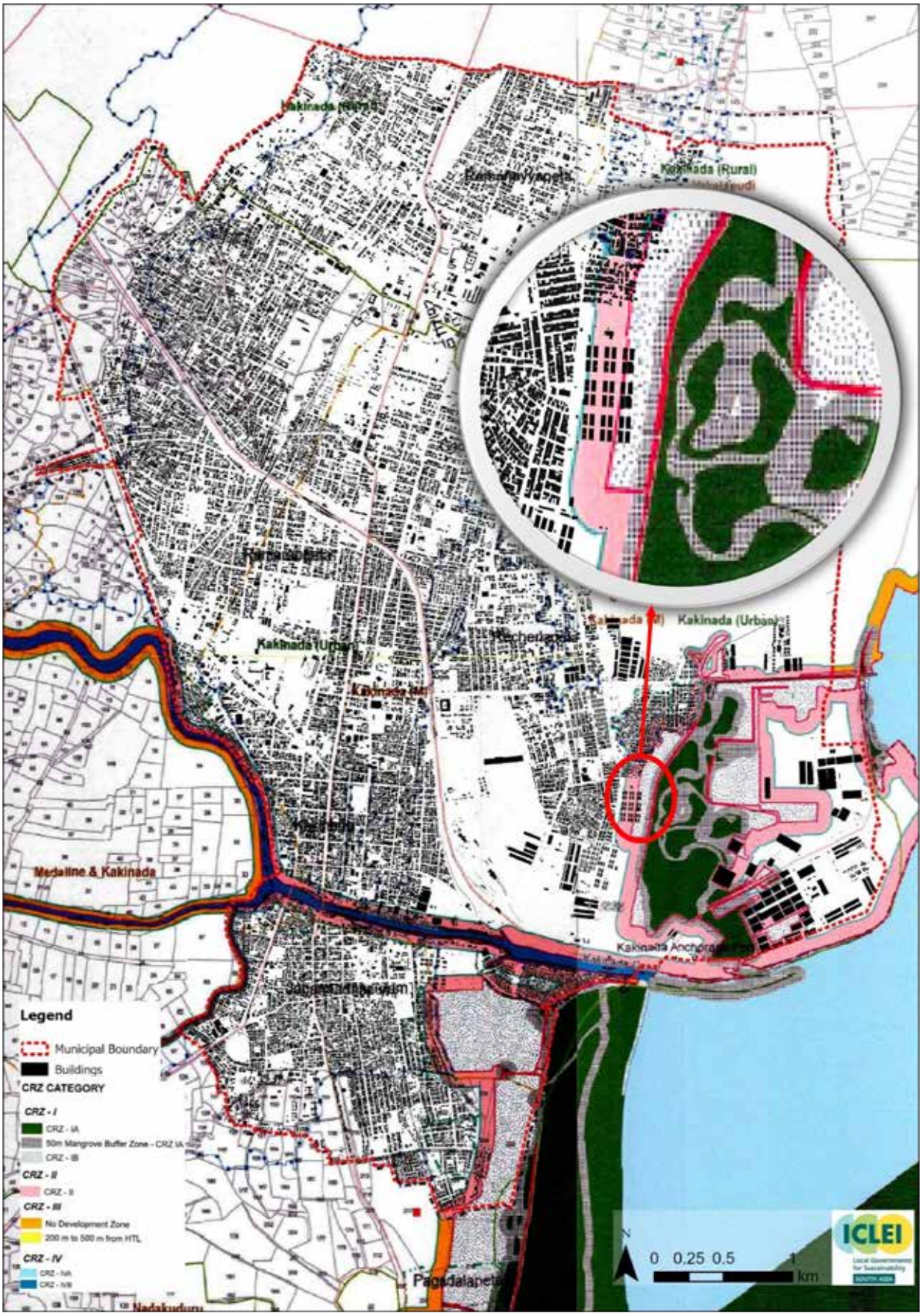


Figure 8: Encroachment on CRZ IB (Intertidal Areas)

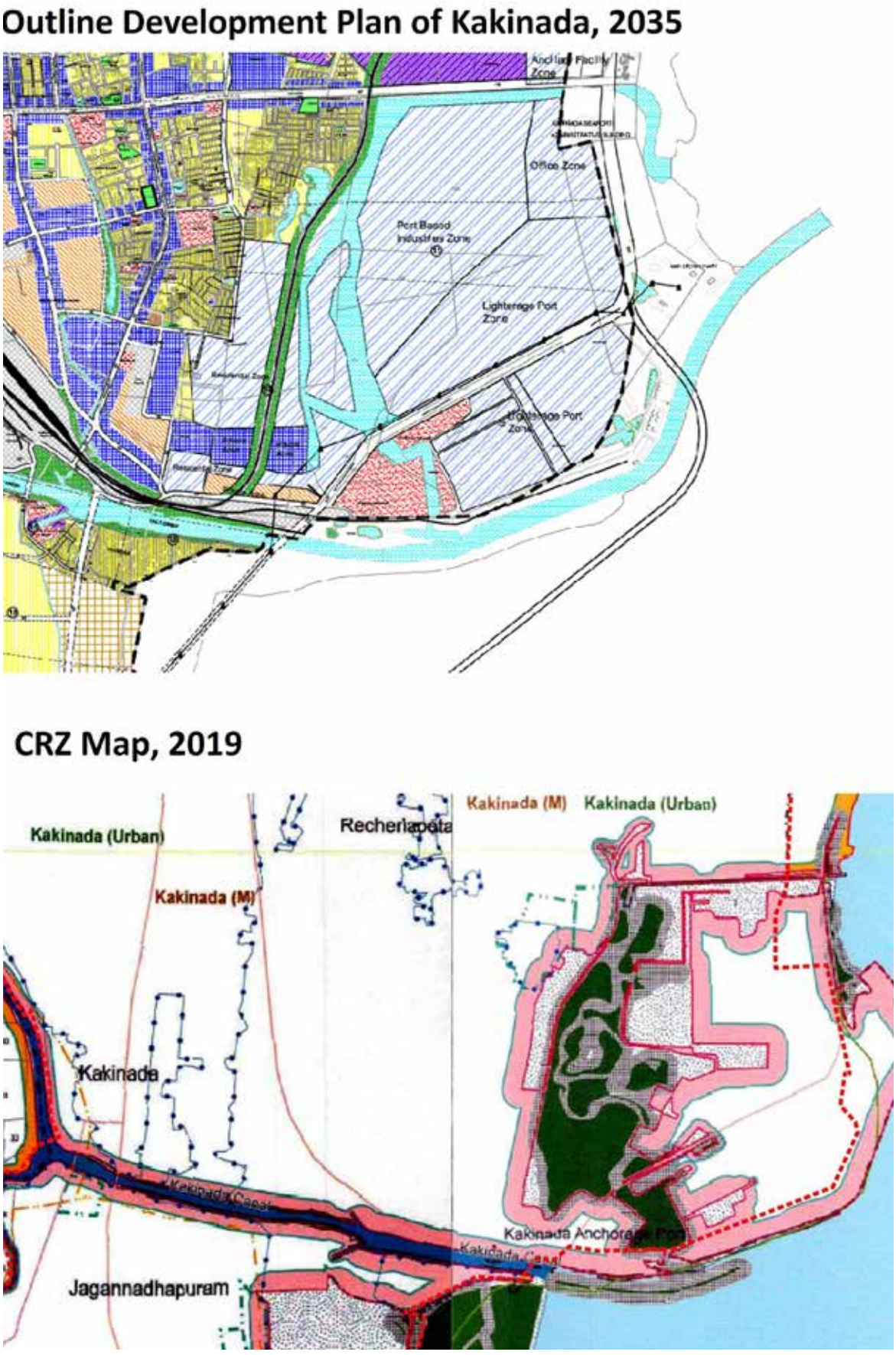


Figure 9: Visual Comparison between CRZ and ODP Shows Potential Encroachment on Designated CRZ IA

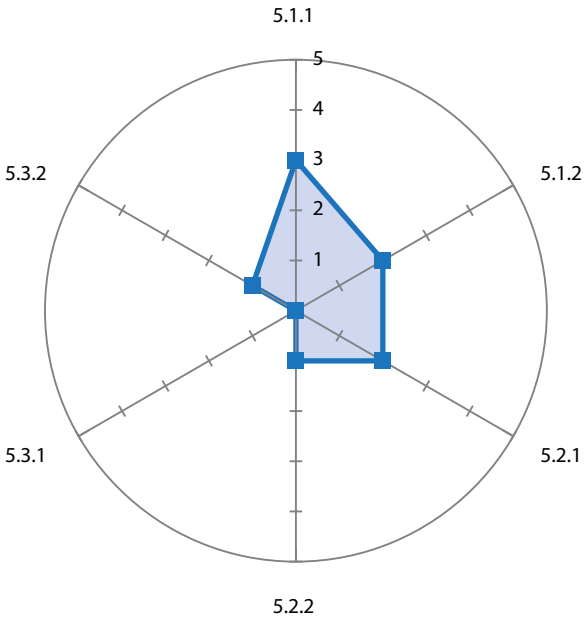


Figure 10: Radar Chart Showing Scores of Kakinada in Essential 5

Essential 6: Strengthen Institutional Capacity for Resilience

Skills and Experience

Currently, Kakinada does not have an inventory of available knowledge, skills, and experience related to disaster resilience. However, stakeholders have noted generally adequate knowledge and skills, especially for disaster response. The city is in the initial stage of stakeholder collaboration and professional training to build disaster resilience. Kakinada receives financial aid from private parties such as ONGC and NFCL for disaster response on a contingency basis. Civil Society Organisations (CSOs), such as the Indian Red Cross Society (IRCS), Kakinada District branch, supported by ONGC, have conducted disaster-resilience training and capacity-building programmes for ward secretaries of coastal mandals, including Kakinada Urban. Nevertheless, KMC has neither spearheaded nor covered this through any formal agreement with the concerned entities. Additionally, KMC is yet to explore the market opportunity to engage with the insurance sector to assess and transfer disaster risk.

Public Education and Awareness

APSDMA disseminates warnings about anticipated hazards through mobile messaging. KMC seldom uses public announcement systems and electronic display boards at traffic junctions and mobilises SHGs to generate awareness. Typically, citizens receive at least one hazard-specific warning message per quarter. Other public education and awareness campaigns on disaster preparedness are not conducted in a structured manner.

Data Capture, Publication and Sharing

DDMP provides overall district-level information, while CDMP has captured city-level assessments without micro-level details. The recently prepared DDMP of Kakinada district is not available on a public platform for any stakeholders to access. Most of these reports are not updated in real time, are seldom accessible, and require stakeholders to go through multiple documents across different sources for getting information. CSOs like IRCS, which is chaired by the Collector and District Magistrate, can easily access the DDMP and other relevant information from the DDMA, whereas other external stakeholders and the general public are likely to face challenges in obtaining disaster-related information.

Training Delivery

Professional training and capacity building on the adoption and implementation of DRR measures are conducted on an ad hoc basis. The NDRF, SDRF teams, and the District Fire Office focus on generating awareness and providing training on precautions to tackle natural calamities and fire incidents. Civil Society Organisations such as the Indian Red Cross Society (IRCS) have conducted training for Ward Secretaries to shoulder the responsibility of first responders. However, this is a one-off training programme conducted by IRCS, and is not a regular activity with a set curriculum.

Although these activities were originally conceived to reach citizens through trained ward secretaries, on-ground penetration has been limited. FGDs and Shared Learning Dialogues (SLDs) with some slum communities, e.g., fisherfolk and daily wage workers, highlight their critical role in spearheading community resilience when appropriate training is provided.

Language

As is common in India, professional or community-level training programmes are often multilingual, with training delivery conducted in the local language.

Learning from Others

The city has recently prepared and published the CRCAP in collaboration with ICLEI South Asia and C40. It is also collaborating with ICLEI South Asia to prepare these climate-induced disaster resilience planning guidelines under the CDKN project. City officials have participated in various workshops and peer-to-peer learning programmes related to climate and disaster resilience.

Table 7: Scores Achieved by Kakinada in Essential 6

6.1.1	Availability of skills and experience in disaster resilience—risk identification, mitigation, planning, response, and post-event response.	**0**
6.1.2	Private sector links.	**0**
6.1.3	Engagement of the insurance sector.	**0**
6.1.4	Civil society links.	**0**
6.2.1	Public exposure to education and awareness materials/messaging. (public relations, messaging, delivery)	**1**
6.2.1.1	Public exposure to education and awareness materials/messaging. (exposure per member of the public)	**2**
6.3.1	Extent to which data on the city's resilience position is shared with other organisations that work or support the city's resilience.	**2**
6.3.2	Extent to which data on the city's resilience position is shared with community organisations and the public.	**2**
6.4.1	Availability and take-up of training focused on risk and resilience (professional training) - (resilience professionals).	**2**
6.4.1.1	Availability and take-up of training focused on risk and resilience (professional training) - (city population).	**1**
6.4.2	System/process for updating relevant training.	**1**
6.5.1	Accessibility of education and training to all linguistic groups in the city.	**5**
6.6.1	Effort taken to learn from what other cities, states, and countries (and companies) do to increase resilience.	**2**

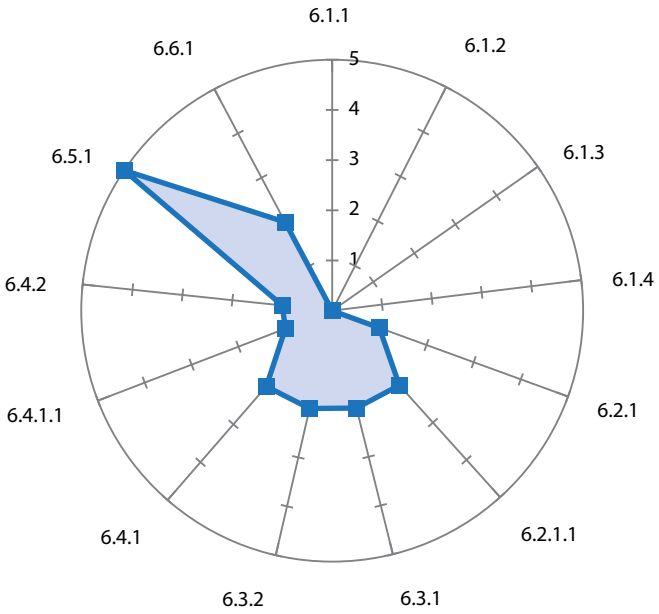


Figure 11: Radar Chart Showing Scores of Kakinada in Essential 6

Essential 7: Understand and Strengthen Societal Capacity for Resilience

Community or 'grassroots' organisations

The DDMP, Kakinada, has recognised the role of community organisations, and recommends setting up of a separate cell at the district or mandal revenue department to coordinate with NGOs. However, the cell is not yet established, and community organisations operate on an ad hoc basis and are usually limited to disaster response.

The Indian Red Cross Society, Kakinada District branch, has conducted training for ward secretaries of coastal mandals, including Kakinada Urban, in 2022-23 on disaster management, first aid, fire rescue operations, etc., to engage them as first responders. During 2016-18, training and capacity building were conducted in cyclone shelters. Although the activities were originally conceived to reach citizens through trained ward secretaries, on-ground community engagement has been limited. Notably, awareness-raising sessions are conducted with some slum communities, e.g., fisherfolk and daily wage earners, in collaboration with SHGs. The communities are sensitised about the importance of boiling water, vaccinating children, and seeking appropriate treatment at UPHCs if they fall ill. However, no structured approach is used to organise such community meetings.

Social Networks

Slum residents across the city, especially fisherfolk, daily wage workers, and construction workers are identified vulnerable. However, there is no dedicated process to enhance their preparedness and adaptive capacity. They primarily receive support in evacuation, response, and relief, as required.

Ward Secretariat offices support vulnerable groups and families during disasters, in accordance with government directives. One ward volunteer is assigned to 50-100 families and maintains their database. When a cyclone or flood warning is issued, these volunteers deliver warnings to their assigned families. For example, at the onset of Cyclone Montha in 2025, slum settlers, especially those with dilapidated structures and residents of more than 100-year-old buildings, were evacuated on a priority basis.

FGDs with slum residents highlighted community cohesion and solidarity, such as people from inundated properties finding shelter in unaffected households. However, not all affected slum dwellers receive relief and are evacuated in

a timely, consistent and equitable manner. While residents are evacuated from some areas (e.g., slums behind the TB hospital), slum dwellers in a few areas like Parlopeta are stranded amid the inundation.

Private Sector Engagement

About 144 small- and small-to-medium-scale industries dealing with cabinet manufacturing, food processing, oil milling, etc., are located within the city boundary. These are too small-scale to participate in resilience awareness initiatives or to prepare a business continuity plan. Large-scale climate-sensitive enterprises such as ONGC , which has offshore operations, are located close to KMC. ONGC and other companies, such as Indian Oil Corporation Limited and Coromandel Fertiliser Limited, actively engage in resilience communication, especially with employees, and volunteer for disaster rescue and relief operations. Entities such as ONGC also have dedicated Incident Response Teams (IRTs) that coordinate with the meteorological department.

Although the inventory of business continuity plans is not available, large businesses have established business continuity plans and standard operating procedures to address hazards, which are regularly updated in accordance with their company policies. However, such plans are largely absent among smaller businesses, especially concerning climate-induced disasters.

Citizen Engagement Techniques

APSDMA sends warning messages via mobile phones regarding cyclones, heavy rainfall, and heatwaves. Beyond these warnings, no other resilience messages are currently circulated. Citizens can lodge complaints about municipal service disruptions, water stagnation, leakage in water and sewer networks, drain siltation, or request mosquito fogging via phone calls, WhatsApp messages, app-based systems, etc. Although this is not a disaster-specific grievance redressal system, these complaints, partially linked with hazards, account for about 20% of the total registered complaints during 2021-22. However, this system does not include any provision to report gender-based violence or specific complaints from vulnerable populations when a disaster strikes.

For long-term citizen engagement and behaviour change, students could act as 'Agents of Change' by learning and subsequently promoting disaster resilience in daily life. However, disaster management has not yet been incorporated into the school curriculum to instil this awareness.

Table 8: Scores Achieved by Kakinada in Essential 7

7.1.1	Coverage of community or "grassroots" organisation(s) throughout the city.	**1**
7.1.2	Effectiveness of community network. (meeting frequency and attendance)	**1**
7.1.2.1	Effectiveness of community network. (agreement on roles)	**1**
7.2.1	Social connectedness and neighbourhood cohesion.	**3**
7.2.2	Engagement of vulnerable groups of the population.	**2**
7.3.1	Extent to which employers act as a channel with employees.	**5**
7.4.1	Frequency of engagement.	**2**
7.4.2	Use of mobile and e-mail "systems of engagement" to enable citizens to receive and give updates before and after a disaster.	**3**
7.4.3	Validation of effectiveness of education.	**0**

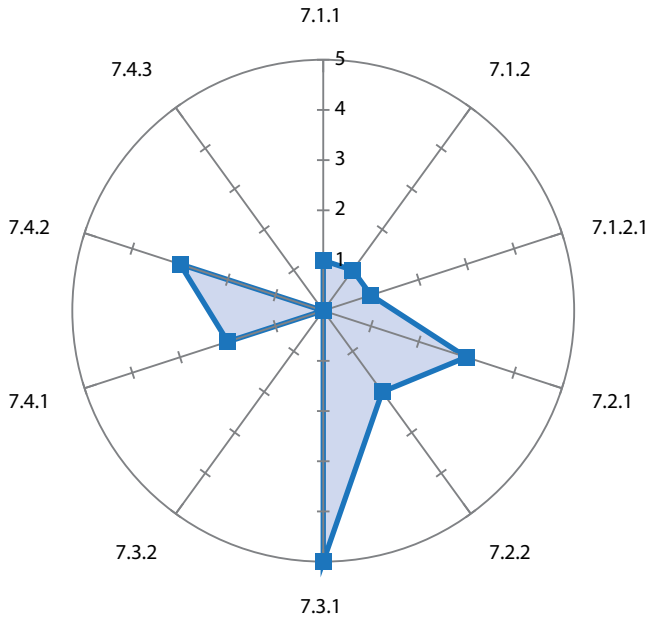


Figure 12: Radar Chart Showing Scores of Kakinada in Essential 7

Essential 8: Increase Infrastructure Resilience

Protective infrastructure

Kakinada is a low-lying coastal city on the Bay of Bengal and is exposed to cyclones, storm surges, and associated heavy rainfall, as seen during events like Cyclone Phethai, which made landfall near Kakinada and disrupted power, transport, and schooling in East Godavari district. An executive engineer described the city's topography as a "saucer", with urban areas at a lower level than some outfall points, which naturally increases stormwater retention and makes flood management critical.

Within the core municipal area, there are no major engineered coastal protection structures such as levees, sea dikes, or large flood walls. The Kakinada coast is characterised as having "moderate to high vulnerability," with very high vulnerability concentrated at erosion-prone sectors like Uppada and near Kakinada Port[19]. A 2.5-km geo-tube/seawall has been constructed near the Uppada Beach, outside the city, to mitigate coastal erosion and high-tide impacts on adjacent coastal stretches[20].

The city relies primarily on a network of eight outfall stormwater drains, with the major outfall at the Dummulupeta railway gate, historically receiving runoff from approximately wards 4 to 13 and serving as a key outlet for urban drainage. New stormwater drains have been constructed in recent years to decentralise drainage and reduce water retention time in chronic flooding locations such as Sambamurthy Nagar and Vikas Road. These additional drains act as outfalls, complementing the earlier limited network by creating catchment-based outlets rather than depending solely on the Dummulupeta outfall.

According to field observations by KMC staff over at least two monsoon seasons after construction, the new stormwater works have been effective in reducing inundation, improving flow, and shortening the duration of standing water in affected neighbourhoods. KMC notes roughly a 60% improvement in drainage performance in the Dummulupeta area and in areas with extended drainage networks, with residual waterlogging observed mainly where intermediate feeder connections or missing links have not yet been established.

Many permanent cyclone shelters in Kakinada are dilapidated, with some nearly collapsing. Because of this, officials

set up 110 relief centres in government schools and community halls to reduce loss of life when Cyclone Phethai made landfall[21].

No formal technical audit of the new stormwater drains has been carried out using a structured audit framework, but engineering staff undertake routine inspections during and after rainy seasons to verify functionality, identify issues, and carry out repairs and maintenance. Performance is tracked by ad hoc field visits instead of formalised audit checklists or third-party verification.

Water and sanitation

Under typical hazard events such as major floods or storms, the city's water supply and sewerage services are designed to remain operational with minimal disruption. In most cases, the water supply remains functional and is closely monitored by the concerned municipal authorities to ensure continuity of service. However, in severe scenarios where water supply pipelines are damaged, the issue is addressed on a priority basis. During repairs, temporary arrangements, such as water tankers, are provided to ensure residents continue to receive water. As a result, any service disruption is usually short-term and localised, affecting only a small percentage of users. Normal water supply is generally restored within a short period once the necessary repairs are completed.

KMC officials note that decentralised STPs have been proposed at about six locations (for example, around Vidyuth Nagar), and once operational, they will intercept wastewater and reduce the burden of sullage and contaminated standing water on the stormwater system, thereby indirectly reducing urban flooding and public health risks[22].

Energy - Electricity

During Cyclone Montha in October 2025, APEPDCL reported that 13,02,948 service connections across 11 circles were affected, with severe infrastructure damage, including 192 33kV feeders in the Kakinada district. Restoration efforts achieved 96% recovery within 24-36 hours, with full restoration completed in 48-72 hours for most areas, including 16,822 of 17,700 agricultural connections restored in 48 hours[23, 24].

Transportation

The engineer reported that roads, bridges, or tunnels have not been completely impassable or structurally unusable for multiple days; disruptions are typically limited to temporary tree falls or local waterlogging that are cleared by corporation staff.

Kakinada maintains multiple evacuation and access routes linking the city to inland areas, with important outbound corridors via Samarlakota and Pithapuram that can be used to move people away from the coast during severe cyclone warnings. During events such as Cyclone Phethai, the district administration prioritised selected rail and road services and positioned disaster response teams, reinforcing these corridors as critical lifelines for evacuation and post-event logistics.

Healthcare and education

A chronic shortage of beds, poor sanitation, and inadequate infrastructure are reported during monsoon season[25]. At the district level, government schools are often designated as relief centres and shelters during cyclones, and holidays have been declared in East Godavari's coastal areas (including Kakinada) during events like Cyclone Phethai to protect students and arrange potential shelter homes. Within Kakinada city, however, the executive engineer notes that community halls are the primary facilities used as cyclone and flood shelters, with many constructed in vulnerable localities at the request of corporators and communities.

Because major cyclones that affect Kakinada often coincide with periods when schools are already on holiday, educational disruption within the city has generally been limited to about two to three days per major event.

Table 9: Scores Achieved by Kakinada in Essential 8

8.1.1	Adequacy of protective infrastructure (ecosystems can offer a natural buffer – see Essential 5).	**3**
8.1.2	Effectiveness of maintenance.	**1**
8.2.1	Customer service days at risk of loss.	**4**
8.2.2	Designated critical asset service days (for example, services to hospitals or other critical assets) at risk of loss from water or sanitation failure.	**4**
8.3.1	Customer service days at risk of loss.	**3**
8.3.2	Designated critical asset service days at risk of loss from energy failure.	**4**
8.5.1	Road – service from the road system at risk of loss.	**4**
8.5.2	Road – survival of critical access and evacuation routes.	**4**
8.5.3	Rail/metro (if applicable) – service from the rail system at risk of loss.	**4**
8.5.5	River/Sea (if applicable).	**3**
8.6.1	Service days at risk of loss.	**4**
8.6.2	Designated critical asset service days at risk of loss from communications failure.	**4**
8.7.1	Structural safety and disaster resilience of health-care and emergency facilities (Staffing/ first responders – see Essential 9). (bed-days lost).	**4**
8.7.1.1	Structural safety and disaster resilience of health-care and emergency facilities (Staffing/first responders – see Essential 9). (critical bed-days lost).	**4**
8.7.2	Health records and data.	**4**
8.7.3	Availability of emergency healthcare including facilities and urgent medical supplies for acute needs.	**2**
8.8.1	Structural safety of education facilities.	**5**
8.8.2	Loss of teaching time.	**4**
8.8.3	Education data.	**4**
8.10.1	Assurance of continuity of all critical administration functions.	**4**

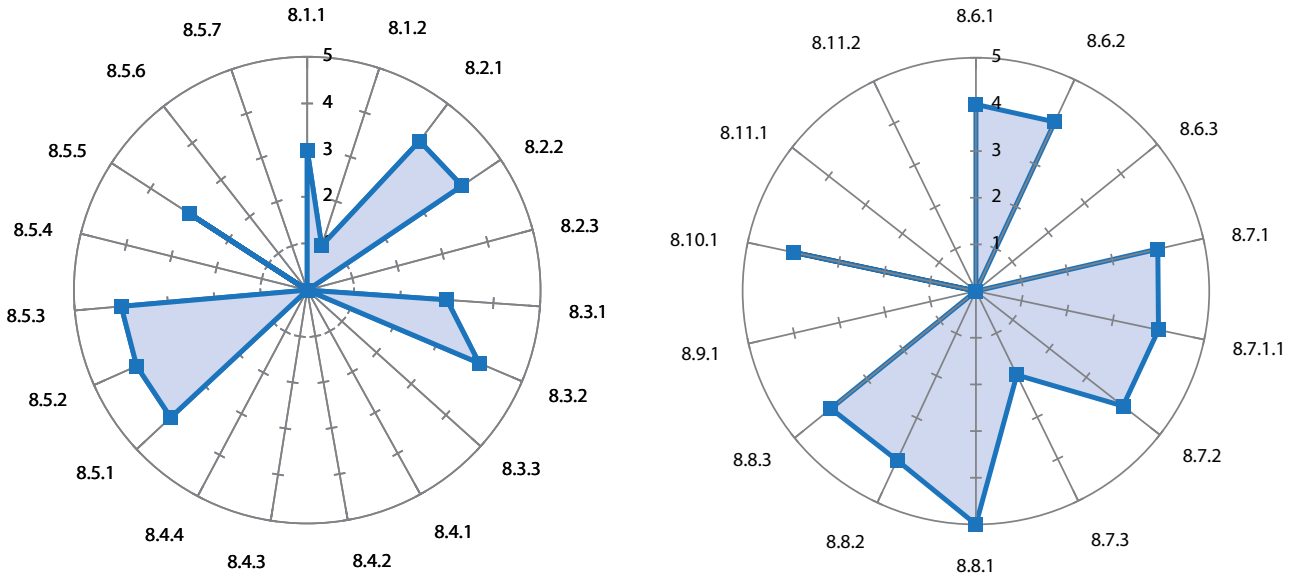


Figure 13: Radar Chart Showing Scores of Kakinada in Essential 8

Essential 9: Ensure Effective Disaster Response

Early Warning

The India Meteorological Department (IMD) initially issues weather alerts to the National Emergency Operations Centre (NEOC), MHA. NEOC acts as the central hub for disaster coordination and disseminates alerts to the NDMA and the NDRF for national-level response. NDMA mobilises NDRF based on alerts and coordinates with APSDMA for preparedness and response. Also, the National Disaster Alert Portal (SACHET), operates on a Common Alerting Protocol (CAP) basis, integrating all alerts from multiple agencies including the IMD, Central Water Commission (CWC), and other alert-generating agencies in an automated, round-the-clock system.

As part of APSDMA, the SEOC then forwards alerts to the Principal Secretary, Home Department, DDMA, line departments, and Municipal Commissioners. Simultaneously, the AP Water Resource Department also shares real-time data with SEOC and district authorities, issues flood warnings and coordinates with local bodies for evacuation. APSDMA also circulates warning messages to all mobile numbers active in the region. Thus, everyone with a functional mobile phone receives an alert.

DDMA maintains an inventory of human, financial, and equipment resources for the line departments. Based on the roles and responsibilities defined in DDMP and resource availability, DDMA deploys Revenue Divisional Officers, Mandal Development Officers and other line departments to support response efforts. Simultaneously, Kakinada Municipal Corporation conducts immediate intra- and inter-departmental coordination meetings and assigns responsibilities to Circle Special Officers (14 Circles), and Ward Level Nodal Officers (one per ward), especially from the Engineering, Public Health, Revenue, Town Planning and General Section departments.

Event Response Plans

As noted in Essential 2, Kakinada has not developed hazard risk scenarios. The existing emergency response plan under CDMP was developed without scenario-specific information. While it outlines preparatory and emergency support functions, the flow of information, and the roles and responsibilities of key stakeholders, it lacks detailed guidance on failure-chain identification among critical assets, citizen engagement, and triage policies.

Staffing/ Responder needs

DDMP, Kakinada District, has measured the availability of boat teams, wood-cutting teams, search-and-rescue operation teams, maintenance teams, logistics support teams, and food preparation teams, all of which primarily belong to the fire department. In the event of a shortfall in human resources, the District Collector can request additional forces from the State Government, adjacent districts, and municipalities. Discussions with the District Fire Officer, Kakinada, revealed a shortage of personnel in critical situations, especially when responding to rescue calls.

While the DDMP indicates the existing strength of police stations, it does not identify the surge capacity of the police to maintain law and order or the burden of first-responder duties. Stakeholder consultation highlights that law and order is maintained within the city in most likely scenarios. Despite recognising the critical role of sectors such as health, communications, and water and energy utilities in disaster response, staffing needs specifically for disaster situations are not assessed.

Equipment and Relief Supply Needs

Along with human resources, the DDMP enumerates firefighting and cyclone preparedness equipment such as floating pumps, life jackets, searchlights, and mobility vehicles. It also identifies equipment marine police stations need for rescue operations. Nevertheless, it does not reflect the actual on-the-ground requirements, especially for severe scenarios. The need for other resources such as medical supplies and debris-removal equipment is acknowledged but not measured. Although the adequacy of response and relief equipment and supplies is not measured, stakeholder dialogue suggests the equipment is sufficient. Equipment is outsourced from adjacent districts or municipalities,

sometimes from neighbouring states in the event of contingencies. Discussion with the District Fire Officer, Kakinada, reflects a shortfall in some protective equipment that disrupts effective response to rescue calls.

Supply of Essentials and Casualty Management

The disaster-affected population in Kakinada has not faced shortages of food, shelter, staples, or fuel during the response stage. Cyclone shelters are established in government schools on a contingency basis for temporary settlement, and are carefully selected in areas likely to remain unaffected during post-cyclone rainfall. Shelter homes usually cater to the different sanitation and privacy needs of men and women. However, the specific requirements of persons with disabilities are addressed after the initial emergency period subsides. Specific nutritional, medical, and hygiene requirements of pregnant and lactating mothers, children, or people with ailments are largely addressed. Women protection staff ensure the safety of women and protect them from gender-based violence. Notably, the database of critical groups is not updated, which prevents upfront prioritisation.

The District Collector and the Revenue Department manage human remains. A systematic process of identification, post-mortem, and handing over of remains is followed. Unclaimed/unidentified dead bodies are disposed of with the help of pre-identified voluntary agencies at the earliest after keeping their records. The Animal Husbandry Department provides medical aid to injured cattle and disposes of animal carcasses with the help of local bodies/health department.

Interoperability and Inter-agency Working

Interdepartmental communication and on-ground operations follow a defined structure, with DDMA as the single point of coordination for disaster response and recovery. District, mandal, and city-level officials participate in search-and-rescue operations, damage and loss assessment, and the disbursal of relief and recovery measures. Adjacent districts or cities also provide assistance based on the severity of the situation and resource shortfalls. However, DDMA planning and the on-ground response mechanism by DFO sometimes work in isolation. For example, the DFO's actual capacity to respond may be inadequate to meet the responsibilities defined by the DDMA. This warrants better coordination to ensure efficient ground-level management. Moreover, it usually takes up to 6 months for affected people to be resettled and restart their livelihoods after the funds are disbursed.

To streamline city-scale disaster response, CDMP has recommended establishing an Emergency Operations Centre (EOC). However, KMC currently has no dedicated EOC. Depending on the hazard's severity, KMC holds intra- and inter-departmental meetings along with the DDMA and assigns dedicated responsibilities to various departments. A dedicated control room with a 24x7 helpline number was established, as in the case of Cyclone Montha in 2025.

Drills

DDMP and CDMP consider mock drills as a key safety measure and recommend that the police and fire departments conduct regular drills to enhance preparedness. However, mock drill-related exercises are unstructured and primarily focus on fire accidents. Fire-related drills could help in the event of a fire caused by flooding, cyclone-related short circuits, equipment malfunction, or other related issues. Fire drills also revealed a shortage of personal protective equipment, cushioning for the rescuers and rescue equipment. However, these are sporadic, and no organisation follows a structured mock-drill calendar.

Table 10: Scores Achieved by Kakinada in Essential 9

9.1.1	Existence and effectiveness of early warning systems.	**4**
9.1.1.1	Reach of warning.	**5**
9.2.1	Existence of emergency response plans that integrate professional responders and community organisations (for post-event response, see Essential 10).	**3**
9.3.1	"Surge" capacity of police also to support first-responder duties.	**2**

9.3.2	Definition of other first responders and other staffing needs and availability.	**3**
9.4.1	Definition of equipment and supply needs and availability of equipment. (supply needs)	**4**
9.4.1.1	Definition of equipment and supply needs and availability of equipment. (estimated shortfall)	**3**
9.5.1	Likely ability to continue to feed the population.	**4**
9.5.2	Likely ability to meet needs for shelter/safe places. (shelter gap)	**4**
9.5.2.1	Likely ability to meet needs for shelter/safe places. (disaster resilience of shelters)	**5**
9.5.3	Ability to meet likely needs for staple goods.	**4**
9.5.4	Likely availability of fuel.	**4**
9.6.1	Interoperability of critical systems and procedures with neighbouring cities/states and other levels of government.	**3**
9.6.2	Emergency operations centre.	**0**
9.6.3	Coordination of post-event recovery.	**4**
9.7.1	Practices and rehearsals—involving both the public and professionals.	**1**

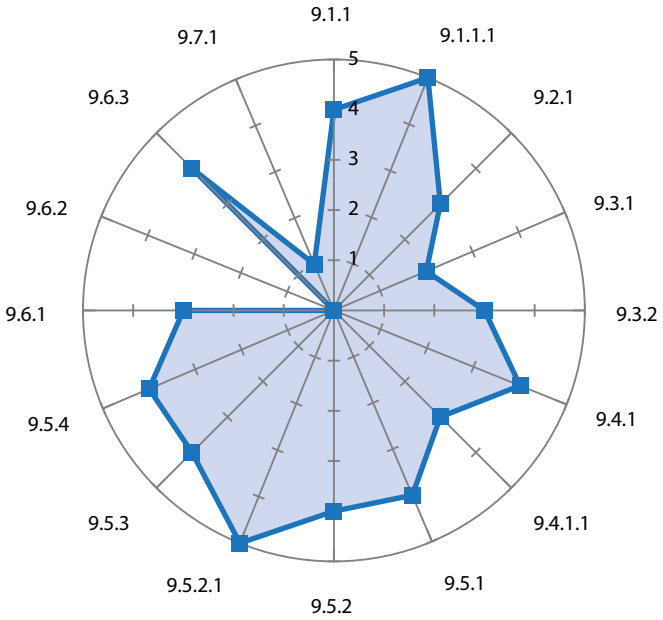


Figure 14: Radar Chart Showing Scores of Kakinada in Essential 9

Essential 10: Expedite Recovery and Build Back Better

DDMP, Kakinada, was prepared in consultation with multiple stakeholders, including Block Development Officers, members of Panchayati Raj Institutions (PRIs), utility providers, and NGOs, to define their roles and responsibilities in building back better. The plan outlines post-event recovery measures for relocating victims to safe shelters, counselling and personal support, and rebuilding homes; however, it is independent of risk scenarios and does not foster social inclusion. It usually takes 1 to 6 months to receive financial aid for recovery. FGDs with marginalised groups such as fisherfolk, daily wage workers, and construction workers reiterated that they receive negligible assistance even in case of extreme events.

Learning from the severe impacts of previous cyclones, KMC adopted a proactive approach ahead of Cyclone Montha in 2025 by allocating responsibilities, mobilising a ground team, and ensuring prior evacuation and shelter arrangements. However, long-term post-disaster recovery requires a more comprehensive approach, such as raising awareness of

resilient construction, understanding locational safety, and upskilling and skill-building for alternative livelihoods. Nonetheless, the efficacy of post-event recovery is not assessed, which could be incorporated to achieve a holistic 'build back better'.

Table 11: Scores Achieved by Kakinada in Essential 10

10.1.1	Planning for post-event recovery and economic reboot	**2**
10.1.2	Extent to which there has been stakeholder consultation around the 'event recovery and reboot' plans	**2**
10.1.3	Shadow financial arrangements for processing incoming aid and disbursing funds	**4**
10.2.1	Learning loops	**2**

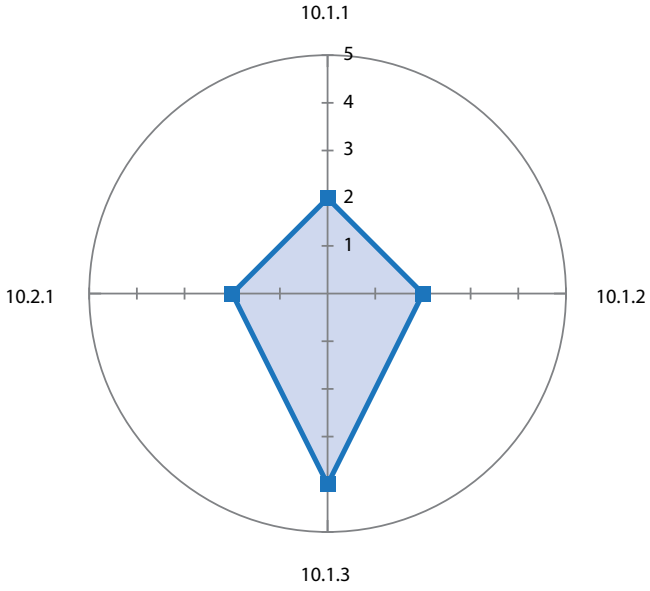


Figure 15: Radar Chart Showing Scores of Kakinada in Essential 10

Summary chart

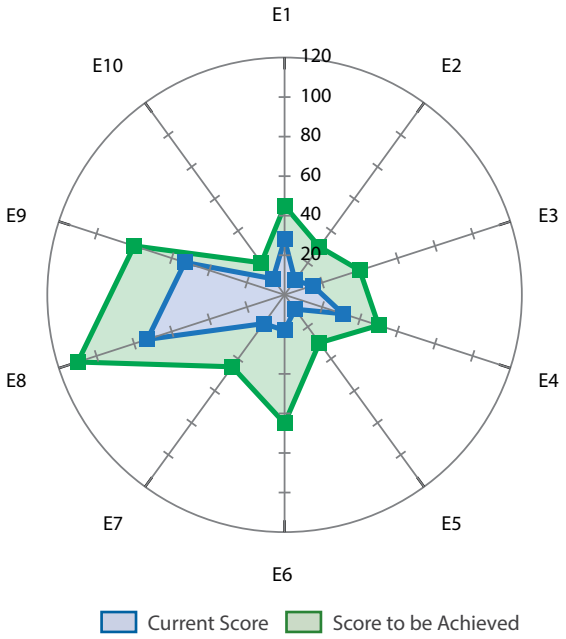


Figure 16: Radar Chart Showing Summarised Scores of Kakinada in Ten Essentials

Table 12: Brief Detail of Scores Achieved by Kakinada in Each Essential

No.	Essential	Indicators	Max. Score	Score Achieved	Percentage
E1	Organise for disaster resilience	9	45	28	62.22
E2	Identify, understand and use current and future risk scenarios	6	30	9	30
E3	Strengthen financial capacity for resilience	8	40	15	37.5
E4	Pursue resilient urban development design	10	50	31	62
E5	Safeguard natural buffers	6	30	9	30
E6	Strengthen institutional capacity for resilience	13	65	18	27.6
E7	Strengthen societal capacity for resilience	9	45	18	40
E8	Increase infrastructure resilience	22	110	73	66.36
E9	Ensure effective disaster response	16	80	53	66.25
E10	Expedite recovery and build back better	4	20	10	50

7.2. Key Issues

Governance

The city lacks permanent year-round governing bodies to manage disasters at all stages, especially for adopting adequate mitigation and preparedness measures tailored to the city's context. Moreover, disaster management planning emphasises response and recovery measures, while overlooking the changing climate trajectory that worsens disaster risk, a critical issue for a coastal city like Kakinada. Governance inadequacies are also evident in ecosystem conservation, particularly due to a lack of coordination among multi-level governance institutions. Because ecosystems serve as a protective buffer that cannot be delimited by city boundaries, seamless coordination between KMC and DFO is warranted for protection of eco-sensitive zones.

Risk Assessment and Planning

There is no comprehensive risk assessment that establishes various probability and intensity scenarios and encompasses diverse impacts on the economy, environment and demographic groups. Damage and loss assessment also does not include robust economic and non-economic losses, whose impacts stretch far beyond the post-disaster and recovery time frame. The city has not mainstreamed DRR concerns in the land use planning and project planning and implementation.

Finance

Financing for disasters primarily addresses response and recovery on a case-by-case basis, without any preemptive allocation. This is evident in the lack of robust disaster mitigation infrastructure, such as coastal protection structures or a well-coordinated network of feeder drains to increase the efficacy of the newly constructed stormwater management system.

Vulnerability of Marginalised Communities

Marginalised communities, including slum dwellers, especially those belonging to fisherfolk, waste pickers, daily wage workers, and communities in low-lying areas, do not receive response and recovery measures equitably. Although KMC targeted some of these groups for evacuation, response and relief during Cyclone Montha in 2025, a well-structured process is missing. It remains largely a traditional contingency-based process, lacking disaggregated information about these groups, recording their needs and priorities. Also, the existing community empowerment process through the SHG model is traditional and does not cater to the specific needs of these groups.

8. Climate-Induced Disaster Resilience Planning Guidelines for Kakinada

The planning guideline seeks to accelerate KMC's efforts to strengthen climate-induced disaster resilience at the city scale, with a focus on gender equality and social inclusion (GESI) and ecosystem-based adaptation (EbA). The guideline builds on insights from the UNDRR Scorecard and statutory disaster management plans, while proposing interventions that complement, and do not duplicate, existing recommendations in the CDMP and CRCAP.

The guideline adopts a holistic, cycle-based approach to disaster management, emphasizing mitigation and preparedness during non-disaster periods as the foundation for long-term resilience. It addresses all three phases of the disaster management cycle pre-disaster, during-disaster, and post-disaster and establishes a feedback loop whereby improved response and rehabilitation inform stronger future preparedness and planning. The interventions are provided for the three main phases of the disaster management cycle, under five categories (Figure 6). These are described in the diagram below (Figure 16).

Also, this is in coherence with the national and global targets and strategic roadmaps on disaster risk reduction. The recommended actions and related KPIs are mapped to the targets for achieving the outcome of disaster risk reduction. Notably, the guidelines as a whole aligns with Target E of SFDRR, conceptually, i.e. substantially increase the number of countries with national and local disaster risk reduction strategies by 2020, although differing from the timeline of the global target.

8.1. Structure of the Planning Guideline

Pre-disaster phase

Disaster mitigation measures: These prioritise disaster-specific structural risk mitigation measures that can be adopted immediately based on existing risk assessment. These measures target strengthening the city's resilience to floods, cyclones, and heatwaves. These mitigation measures need periodic updates, commensurate with updated risk scenarios.

Assessment and planning: The guideline advocates for robust planning during stable periods to make infrastructure, communities and the environment hazard-ready. Disaster risk assessment is essential for this planning process. A comprehensive risk assessment has several benefits. First, it improves preparedness and response by identifying high-risk zones and vulnerable infrastructure and communities. Second, it will help assess the need for mock drills, awareness, and training and skill building, especially for communities. Third, it will help define the parameters for conducting loss and damage assessments. Periodic risk assessments will also help identify opportunities for mainstreaming DRR into future plans and processes, along with adopting enhanced mitigation measures.

Stakeholder engagement and mobilisation: Structured stakeholder engagement and mobilisation will strengthen resilience planning, implementation, and response and recovery efforts. Engagement with NGOs, CSOs and SHGs is crucial to identify the specific needs of the most vulnerable and marginalised sections, and they can implement initiatives tailored to the needs of the communities. Extensive community engagement is needed to build awareness, skills, and capacity to respond effectively to disasters.

Disaster response phase

Preparedness and Response: These include interventions related to inclusive early warning dissemination and relief camps and supplies for disaster response, addressing the needs of women and marginalised communities such as the informal sector, the elderly and persons with disabilities (PwDs). A localised early warning system disseminates city-specific warnings that initiate a well-coordinated chain of preparedness and response activities. Evidence-based, structured preparedness and response measures stem from a comprehensive risk assessment. Further, year-round stakeholder engagement and mobilisation will help prepare the communities and expedite response efforts.

Post-disaster phase

Post-disaster recovery: This includes loss-and-damage assessment and specific actions for reconstruction and rehabilitation. Effective reconstruction and rehabilitation that account for risk assessment and aim at long-term support can mitigate future risk.

Implementation of resilience interventions requires a strong enabling environment. A well-defined governance structure, strong policy and legal support, sustained capacity development and smart use of technology are tenets of a robust enabling environment. However, the next section details governance mechanisms and proposes an institutional structure to streamline climate-induced disaster resilience initiatives in Kakinada.

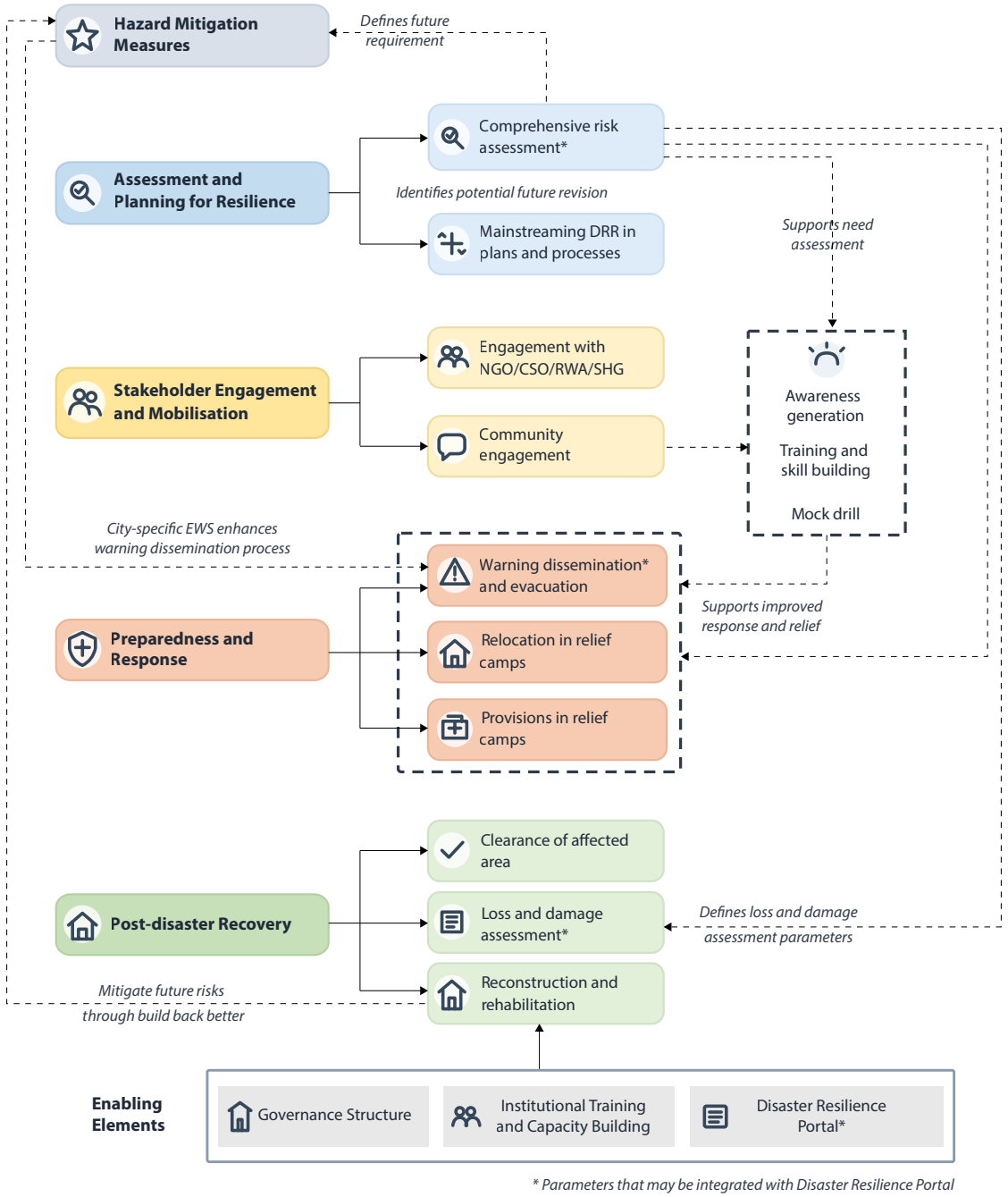


Figure 17: Structure for Climate-induced Disaster Resilience Planning Guideline of Kakinada

8.2. Basis for prioritisation

The interventions in this guideline were prioritised on the basis of their – i) potential to contribute to disaster resilience, ii) feasibility and iii) time taken to realise their impact(s). Prioritisation of interventions will help KMC invest in the most important or essential measures in the initial phase, and gradually move towards implementing other interventions that may be desirable for disaster resilience in the city. It will also ensure greater attention is given to strengthening the resilience of the most vulnerable groups and sectors through resource mobilisation. Further, it may help explore traditional/local knowledge to deal with a changing climate.

In this regard, the resilience potential of each intervention was evaluated against a set of resilience indicators. The evaluation assesses how an intervention enables the systems to function in the following ways.

- **Redundancy:** Whether the intervention enables the system to function through multiple paths or nodes when performance is critical. It means that a "single best solution" is less resilient than multiple options.
- **Flexibility:** Whether the system is designed to work under a variety of conditions; not rigid or designed only for one specific situation.
- **Responsiveness/ re-organisation:** The system responds and changes to meet unexpected shocks. This also means organisations can modify and re-organise to respond. It also includes access to resources (information, skills, equipment, knowledge and experience)
- **Access to Information:** Systems learn from and build on experience by not repeating past mistakes and integrating lessons from other cities. This also includes monitoring and evaluation mechanisms.
- **Social resilience:** The system has the potential to improve the social resilience of marginalised groups by providing them with the ability to cope.

Feasibility of the interventions was assessed on the basis of the following criteria -

- **Technical feasibility:** Whether the project is implementable, realistic and suitable to the local conditions of Kakinada. Whether KMC has the necessary expertise to implement the project, or can access the required skills.
- **Political feasibility:** Whether the intervention would be acceptable to city leaders and the community.
- **Financial feasibility:** Whether KMC can meet the cost, or can access the required funds from APSDMA or NDMA; and whether the anticipated benefits of the intervention will justify the cost.

Period for realisation of impact(s) was assessed using:

- **Timeframe:** Whether the interventions can be completed within a short or medium timeframe. Here, an indicative duration for the three timeframes is[26, *] –
    - **Short-term:** Within 5 years
    - **Medium-term:** 5 – 10 years
    - **Long-term:** 10 – 20 years
- **Priority:** Whether the proposed intervention will have a significant and measurable impact on the targeted disaster risk.

** Modified on the basis of Net-zero Climate Resilient City Action Plan for Kakinada City, ICLEI South Asia, 2025*

8.3. Hazard Risk Mitigation through Structural Measures

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Floods				
Nature-based Flood Mitigation and Sponge Infrastructure	**Very high**	**High**	**Short**	**High**
Develop and upgrade parks and open spaces with flood-resilient features such as detention lawns, recharge pits, bioswales, retention ponds, permeable surfaces, and sloping landscapes to absorb stormwater, enhance groundwater recharge, and reduce urban flooding in line with Sponge City principles. ***Example 1:*** A 16.6-acre wetland eco-park has been developed in Chennai as a solution to increase flood protection, enhance biodiversity, and provide an inclusive space for community engagement. The sponge park guides stormwater through a sequential ecological process starting with bioswales, a sedimentation pond, an aeration pond, a phytoremediation pond for pollution-load removal and finally a retention basin to recharge groundwater and reduce urban flood risk[27]. ***Example 1*** Greater Chennai Corporation (GCC) is developing a 1.8-acre sponge park with recreational facilities at Mathur MMDA Colony in Manali zone. The project cost is INR 8.06 crore[28].				
Lead Entity	KMC (UDMA)			
Supporting Entity	APUG&BC, DTCP, Town Planning Dept.			
Source of Fund	Municipal budget, Jal Jeevan Mission (Urban), AMRUT 2.0, NCAP, PPP, 15th FC, State budget, CSR funds			
Alignment with SFDRR	Target A, B, C, D			
Alignment with PM 10 Point Agenda	Element 1			
Community-based forest management approach	**Medium**	**Low**	**Long**	**Medium**
KMC can adopt a **community-based forest management approach** in alignment with the District Forest Office. It may engage SHGs in maintaining parks/forest patches, or in setting up and maintaining food gardens that not only conserve nature but also generate livelihoods through a viable business model. ***Example*** Warje Urban Forest is a model urban forestry initiative taken up by the Maharashtra Forest Department. It saw a collaborative model anchored by the Forest Department, with an NGO as implementation partner and leveraging CSR funds. A 16-hectare barren hilly area has been transformed by planting 9,500 plants from 23 indigenous species. The park also provides an opportunity for citizen engagement through the adoption of specific plants in your name. The park is frequented by 1000-1500 people per day[29].				
Lead Entity	KMC (UDMA)			
Supporting Entity	APUG&BC, District Forest Office			
Source of Fund	Municipal budget, Jal Jeevan Mission (Urban), AMRUT 2.0, NCAP, PPP, 15th FC, State budget, CSR funds			
Alignment with SFDRR	Target B, C			
Alignment with PM 10 Point Agenda	Element 1, 2, 3			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Integrating Rain City Elements	**Medium**	**Low**	**Long**	**Medium**
Integrate **'Rain City'** strategic elements while laying new roads, especially in flood-prone areas or while repairing damaged ones. This may include innovative inlet designs to capture runoff and promote sedimentation, weir walls to slow flow, and chambers for water collection and subsequent infiltration along bioswales with native plant species.				
Lead Entity	KMC (UDMA)			
Supporting Entity	Roads and Building Dept, APUG&BC, MAUD, DTCP, Town Planning Department, Architects and Builders Association			
Source of Fund	Municipal budget, CSR funds, NCAP, 15th FC			
Alignment with SFDRR	Target B, C, D			
Alignment with PM 10 Point Agenda	Element 1			
Protection of Waterbodies and Environmentally Sensitive Areas	**Very High**	**Medium**	**Medium**	**Medium**
Prohibit dumping of solid waste, debris, or construction material in canals, drains, wetlands, estuaries, coastal areas, and buffer zones, and enforce protection of environmentally sensitive areas to maintain natural drainage, flood storage capacity, and ecosystem functions. ***Good Practice*** **NDMA Guidelines on Urban Flooding**[30] **and Wetlands**[31] **(Conservation and Management) Rules, 2017** emphasise protecting natural drains, wetlands, and floodplains to reduce urban flooding and maintain ecological balance. Encroachment, dumping, and blockage of drainage channels are identified as major causes of urban flooding, and cities are advised to demarcate and protect these areas. ***Example*** ULBs that take up projects to rejuvenate water bodies will be incentivised based on the number of water bodies taken up for rejuvenation per city population, DPR preparation, contract award and work execution. INR 1-10 lakh for two water bodies (AMRUT guidelines)[32].				
Lead Entity	KMC (Engineering / Environment / Town Planning)			
Supporting Entity	Pollution Control Board, Revenue Department, APSDMA, Coastal Zone Authority, Water Resources Department.			
Source of Fund	AMRUT 2.0, 15th Finance Commission, Jal Jeevan Mission, State Government, Municipal budget, SDRF mitigation fund, External/ADB / World Bank projects			
Alignment with SFDRR	Target B, D			
Alignment with PM 10 Point Agenda	Element 1			
Desilting and Drain Capacity Restoration based on Hydraulic Assessment	**Very High**	**High**	**Short**	**High**
Undertake desilting and restoration of drains, canals, and outfalls based on hydraulic assessment and identified bottlenecks, in addition to pre-monsoon desilting. Prioritise low-lying wards, canal stretches, and outfalls connected to tidal or coastal systems. ***Good Practice*** **Delhi MCD Pre-Monsoon Drain Desilting Programme**[33] - Municipal Corporation of Delhi undertakes large-scale desilting of hundreds of drains before the monsoon season, based on flood-prone locations to improve carrying capacity and reduce urban flooding. ***Example*** MCD earmarked INR 36 crore to desilt around 800 drains.				

Action Areas		Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Lead Entity	KMC (Engineering / UDMA)				
Supporting Entity	Water Resources Department, Ward Secretariats				
Source of Fund	Municipal budget / SDRF / AMRUT / State funds				
Alignment with SFDRR	Target A, B, D				
Alignment with PM 10 Point Agenda	Element 1				
Inclusive Flood Warning and Response Systems		**Very High**	**High**	**Short**	**Very High**
Develop inclusive flood warning and response systems by integrating flood-prone area identification and hydrological modelling with local validation through consultations with ward secretariats, SHGs, and community organisations. Incorporate local knowledge on recurrent flooding locations, vulnerable households, evacuation routes, and safe shelters into response planning and link with the ICCC/Data Management Centre for real-time coordination. Disseminate early warning alerts in multiple accessible formats, including SMS, IVRS, sirens, mobile applications, and pictorial or multilingual messages, to ensure timely outreach to all population groups, including women, elderly persons, persons with disabilities, and informal settlements. ***Good Practice*** **Chennai Urban Flood Mitigation[34] and Stormwater Planning[35] (Greater Chennai Corporation / World Bank / ADB-supported projects)** - Chennai has undertaken GIS-based flood risk assessment, watershed-based stormwater planning, and flood mitigation works under multiple programmes, including World Bank and ADB-supported urban flood management projects. These projects involved drainage mapping, risk analysis, and integration with city-level planning and early warning systems.					
Lead Entity	KMC (UDMA / ICCC / IT / Town Planning)				
Supporting Entity	APSDMA, Smart City / IT Dept., NGOs, Technical agencies, Ward Secretariats				
Source of Fund	Smart City Mission, SDRF mitigation fund, State Government, AMRUT 2.0, External funding, CSR funds				
Alignment with SFDRR	Target A, B, C, D				
Alignment with PM 10 Point Agenda	Element 2, 7, 8				
Cyclone					
Mangrove Restoration and Estuary Buffer Protection		**Very High**	**High**	**Long**	**High**
Rehabilitate and conserve degraded mangroves along the Upputeru estuary and nearby coastal stretches to attenuate storm surge, reduce wave energy, and stabilise the shoreline. Mangrove restoration may be undertaken in coordination with the Forest Department and Coastal Zone authorities. Deploy floating bio-logs or bio-engineered barriers planted with mangrove or native vegetation at breach-prone creek mouths and canal edges to reduce erosion, stabilise banks, and act as natural buffers. ***Good Practice*** Mangrove Restoration in Odisha Coast[36] (Kendrapara/Bhitarkanika region) under the Integrated Coastal Zone Management Project supported by the World Bank. Mangrove plantation and protection activities along the Odisha coast have reduced the impacts of cyclones and storm surges. These mangroves acted as natural buffers during cyclones and are recognised as an effective nature-based DRR measure. Mangrove plantation[37] and restoration projects undertaken by the Mangrove Foundation of Maharashtra indicate restoration costs of INR 2–4 lakh per hectare, including plantation, fencing, hydrological improvement, and maintenance.					

Action Areas		Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Lead Entity	KMC (UDMA / Environment / Town Planning)				
Supporting Entity	Forest Department, Fisheries Department, AP Coastal Zone Authority				
Source of Fund	CAMPA, National Coastal Mission, State Government, CSR, external projects				
Alignment with SFDRR	Target A, B, C				
Alignment with PM 10 Point Agenda	Element 1				
Coastal Shelterbelt Plantation / Windbreak Green Belt		**Very High**	**High**	**Long**	**High**
Develop coastal shelterbelt plantations using species such as Casuarina, Palmyra, mangroves, and other native coastal vegetation along vulnerable stretches to reduce wind speed, protect settlements, stabilise soil, and reduce cyclone damage. Plantations may be established along coastal stretches, canal banks, estuary edges, and available government land in coordination with the Forest Department and Coastal Zone authorities. Undertake rapid breach management in coastal shelterbelts by using brushwood bundling, coir logs, and temporary bio-barriers to plug gaps in Casuarina or coastal vegetation belts and reduce wind and water ingress. This intervention may also align with the Great Green Wall[38] of Andhra Pradesh initiative to support large-scale coastal greening, ecological restoration, carbon sequestration, and long-term climate resilience across vulnerable coastal landscapes. **Coastal Shelterbelt Plantation under the National Cyclone Risk Mitigation / Forestry Programmes[39] in coastal states (Gujarat, Odisha, Tamil Nadu)** – Shelterbelt plantations and coastal vegetation belts have been recommended in cyclone-prone coastal zones to reduce wind velocity, protect infrastructure, and reduce storm surge impacts.					
Lead Entity	KMC / Forest Department				
Supporting Entity	UDMA, Fisheries Department, AP Coastal Zone Authority, Panchayati Raj Department, NGOs				
Source of Fund	CAMPA, Green India Mission, SDRF mitigation fund, State Forest Scheme, NCRMP, CSR, external projects				
Alignment with SFDRR	Target A, B, C, D				
Alignment with PM 10 Point Agenda	Element 1				

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Heat				
Construct public housing with suitable heat-resilient measures	**High**	**High**	**Medium**	**High**

Encourage the adoption of low-cost, heat-resilient measures for existing building stock, such as painting rooftops white, using jute mats, and installing vetiver curtains, especially in the hottest areas.

Similarly, Anganwadis, libraries, and community halls may also be equipped with heat-resilient features.

Good Practice
Ahmedabad Municipal Corporation, in partnership with NRDC, IIPH-G, and MHT, piloted cool roofing in 3,000 low-income households using reflective white lime painting, which helped reduce indoor temperatures by 2-3 degree Celsius. Community awareness and engagement with real estate developers complemented this by encouraging voluntary adoption of cool roofing solutions.

Example
The unit cost of white lime paint is around INR 1/sq. ft., and that of HDPE cool roof coating membrane is INR 13/sq. ft[40].

Lead Entity	KMC (UDMA)
Supporting Entity	Andhra Pradesh Township and Infrastructure Development Corporation (APTIDCO), APCPDCL, Andhra Pradesh State Energy Conservation Mission, A.P. State Housing Corporation Limited (APSHCL), architects and builders associations
Source of Fund	
Alignment with SFDRR	Target A, B
Alignment with PM 10 Point Agenda	Element 1, 2

Upgrade street vending zones and traffic islands with adequate shading	**Very high**	**High**	**Short**	**High**

Ensure shaded resting areas at construction sites and transfer stations. Incorporate native plant species into shaded areas.

Misting stations, solar-powered air coolers and water coolers, ice packs, and ORS should be mandatory in these occupational environments to provide an immediate response.

Good Practice
Smart Street Vending Zone – Kakinada Municipal Corporation (Andhra Pradesh)
Under the DAY-NULM / Smart Street initiative, Kakinada Municipal Corporation developed organised vending zones with:

- shaded vending structures
- container-based shops
- pedestrian-friendly layout
- basic infrastructure (lighting, paving, amenities)

The project demonstrates how structured vending zones with shading and public-realm improvements can formalise informal markets and improve livelihoods.

The total cost of Project Smart Street is around INR 5 crore, including the beneficiaries' contribution for setting up their shops in the containers.

Action Areas		Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Lead Entity	KMC (UDMA)				
Supporting Entity	Roads and Building Department, DTCP, Town Planning Department, Traffic Police				
Source of Fund	Municipal Budget, CSR Funds				
Alignment with SFDRR	Target A, B, C				
Alignment with PM 10 Point Agenda	Element 1, 2				
Raise Health Awareness and Build Community Capacity for addressing Heat Stress		**High**	**High**	**Short**	**High**
Raise awareness of heatwave impacts and build community capacity to take preventive action, with special focus on vulnerable populations such as the elderly, children, outdoor workers, and low-income households. Activities may include inclusive IEC campaigns, training frontline workers (ASHA, Anganwadi), disseminating early warnings, and community-level preparedness sessions. ***Good Practice*** **Ahmedabad Heat Action Plan (India's first Heat Action Plan)**[41] – The Ahmedabad Municipal Corporation implemented awareness campaigns, early warning systems, and training of community workers to reduce heat-related illness and mortality. IEC materials, public advisories, and community outreach were key parts of the intervention.					
Lead Entity	KMC (Health Department/UDMA/Engineering/Town Planning)				
Supporting Entity	APSDMA, Health Department, Women and Child Development Department, NGOs, Ward Secretariats				
Source of Fund	SDRF mitigation fund, State Government, National Health Mission, AMRUT 2.0, CSR funds, external/development partners				
Alignment with SFDRR	Target A, B				
Alignment with PM 10 Point Agenda	Element 1, 2, 8				
Restore Tree Cover and Expand Shaded Areas in Dense Zones		**High**	**Medium**	**Medium**	**Medium**
Restore tree cover and expand shaded areas in crowded public spaces, markets, and dense residential areas. Promote plantation drives and incentivise shade trees and green roofs for households, especially for vulnerable populations. ***Good Practice*** **Cool Roof and Urban Greening Initiatives - Ahmedabad –** Cities have implemented cool roofs, tree plantation, and passive cooling strategies to reduce heat exposure and improve thermal comfort, especially in low-income areas.					
Lead Entity	KMC (Health Department/UDMA/Engineering/Town Planning)				
Supporting Entity	APSDMA, Health Department, Women and Child Development Department, NGOs, Ward Secretariats				
Source of Fund	SDRF mitigation fund, State Government, National Health Mission, AMRUT 2.0, CSR funds, external/development partners				
Alignment with SFDRR	Target A, B				
Alignment with PM 10 Point Agenda	Element 1				

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Multi-Hazard Mitigation				
Flood- and Cyclone-Resilient Housing Upgradation in Vulnerable Wards	**Very High**	**Medium**	**Medium**	**Medium**

Promote flood- and cyclone-resilient housing in vulnerable wards by retrofitting existing houses and adopting resilient design features in new construction, especially in low-lying, coastal, and high-wind-risk areas.
Retrofitting support may be prioritised for houses in slums, coastal settlements, low-lying wards, and informal housing areas, where structural weakness increases risk. Incremental upgrading methods may be promoted so that households can adopt resilience features without full reconstruction.

Typical retrofitting measures may include:

- raising plinth level using compacted fill or concrete blocks along with the placement of a ramp
- providing RCC lintel and roof bands for wind resistance
- anchoring roof sheets/tiles to the structural frame
- using fly-ash bricks concrete blocks instead of mud walls in flood-prone areas
- providing proper slope and drainage around the house
- using corrosion-resistant fittings in coastal areas
- shifting electrical panels above flood level

Resilient housing design needs to adopt universal design principles. For example, housing should ensure accessibility for persons with disabilities, older persons, and others with mobility or functional limitations.

Good Practice
Odisha Disaster Recovery Project supported by the World Bank – Cyclone-Resilient Housing Reconstruction after Cyclones Phailin and Fani - Under the Odisha Disaster Recovery Project and NCRMP, thousands of houses were reconstructed with raised plinths, RCC bands, wind-resistant roofs, and improved foundations to withstand cyclones and flooding. These standards are now widely used in coastal hazard-prone regions of India.

Example
INR 60,000 – INR 1.5 lakh per house for retrofitting support;
INR 1.5 – INR 2.5 lakh per house for resilient reconstruction (PMAY / disaster housing scale[42])

Good Practice
Odisha Disaster-Resilient Housing under NCRMP / ODRP[43] – Raised plinth housing and cyclone-resistant construction were initiated to reduce future risk. A policy guideline and ToR have been adopted for Owner Driven Construction of Houses (ODCH) @ INR 3,00,000/- (Rupees Three Lakh only) per house. This amount would be provided to each beneficiary for construction of about 300 sq. ft of housing (one bedroom, one drawing-cum-bed room, kitchen and toilet) having other facilities like electricity and water supply. (Disaster-Resilient Housing, OSDMA)

Lead Entity	KMC (Town Planning/Housing/UDMA/Engineering)
Supporting Entity	MAUD, APSDMA, Housing Department, NGOs, Technical institutes
Source of Fund	PMAY-U, State Housing Scheme, SDRF mitigation fund, 15th Finance Commission, World Bank/External projects/CSR funds
Alignment with SFDRR	Target A, B, D
Alignment with PM 10 Point Agenda	Element 1, 9

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Promotion of Climate-Resilient and Resource-Efficient Local Construction Techniques	**High**	**Medium**	**Medium**	**Medium**

Encourage the use of locally suitable, climate-responsive, and resource-efficient construction practices that reduce heat stress, improve structural performance during floods and cyclones, and lower reconstruction costs after disasters. Suitable techniques may include filler slab roofing, rat-trap bond masonry, glass-bottle filler slabs, fly-ash bricks, recycled plastic blocks, and other locally available materials that reduce dead load, improve thermal comfort, and allow easier repair after damage. Such methods may be promoted especially for low-rise housing, incremental construction, and retrofitting in vulnerable wards.

Good Practice

Laurie Baker / COSTFORD Low-Cost and Climate-Responsive Construction Techniques, Kerala[44] - Techniques such as rat-trap bond masonry, filler slab roofing, exposed brick walls, and the use of local materials were widely used in government housing and institutional buildings in Kerala through COSTFORD projects. These methods reduce material consumption, improve thermal comfort, and lower costs while maintaining structural stability, making them suitable for affordable, climate-responsive construction.

Example

Each unit will cost INR 21 lakh, with a total of 105 units planned[45].

Lead Entity	KMC (Town Planning/Engineering/Housing)
Supporting Entity	MAUD, Housing Department, Technical institutes, NGOs
Source of Fund	PMAY-U, State Housing Schemes, CSR funds, SDRF mitigation fund, external aid
Alignment with SFDRR	Target A, B, D
Alignment with PM 10 Point Agenda	Element 9

Safety Audit of Housing in Risk-Prone Areas	High	High	Short	High

Conduct a structural safety audit of existing and proposed housing in flood-prone, coastal, and high-density areas to assess vulnerability to flooding, high winds, and waterlogging. Use audit findings to guide retrofitting, strengthening, or relocation measures.

Lead Entity	KMC (UDMA/Town Planning/Engineering)
Supporting Entity	APSDMA, Technical institutes
Source of Fund	SDMF / SDRF / State Government
Alignment with SFDRR	Target A, B, D
Alignment with PM 10 Point Agenda	Element 1, 9

8.4. Assessment and Planning for Disaster Resilience

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Comprehensive risk assessment				
Flood-prone Area Mapping and Flood Zoning Enforcement	**Very High**	**Medium**	**Short**	**High**

Identify flood-prone areas using hydrological modelling, depth-based flood mapping, DEM / LiDAR surveys, and coastal inundation scenarios, and enforce flood-zoning regulations to restrict unsafe construction in high-risk zones. Mapping should cover both urban flooding and coastal / storm surge flooding and be integrated with the Master Plan, building permissions, and infrastructure planning.

Good Practice

Punjab Floodplain Mapping Project (Sutlej Basin)[46] - The Punjab Government undertook DEM-based floodplain mapping along the Sutlej River to identify high-risk zones after repeated floods. The floodplain maps are being used to guide land-use regulation, flood protection works, and disaster preparedness planning.

Example

A project to undertake floodplain zoning of the River Sutlej over a 145-km stretch, covering 98 km as required by the CWC and 47 km under consideration by the NGT, is proposed under the state disaster mitigation fund. The project amounts to INR 5.83 crore for the "provision of services for acquisition, processing, and delivery of digital elevation model and digital ortho image for flood risk mitigation and mapping of the area along the river Sutlej".

Lead Entity	KMC (Town Planning / UDMA / Engineering)
Supporting Entity	APSDMA, MAUD, Water Resources Department, Survey agencies
Source of Fund	SDMF / SDRF / State Government / External project
Alignment with SFDRR	Target A, B, D
Alignment with PM 10 Point Agenda	Element 4, 9

Multi Hazard Risk Assessment (MHRA)	**Very High**	**High**	**Short**	**High**

KMC may undertake a climate risk-informed comprehensive Multi Hazard Risk and Vulnerability Assessment (MHRVA). The assessment may support risk-informed planning, preparedness, infrastructure prioritisation, and investment decision-making for climate-induced and other disasters by integrating current hazard conditions with future climate risks, compounding hazards, and cascading impacts.

The MHRVA may include preparation of city-scale climate projections for Kakinada to understand future trends in rainfall intensity, cyclones, storm surge, flooding, heat stress, waterlogging, and sea-level rise. The assessment may be undertaken in coordination with the Indian Meteorological Department, APSDMA, Andhra Pradesh State Development Planning Society, and relevant technical institutions.

Actions may include:

- Conduct a city-wide Multi-Hazard Risk and Vulnerability Assessment covering cyclone, flood, storm surge, extreme rainfall, heat stress, waterlogging, coastal flooding, and other relevant hazards affecting Kakinada. The assessment may consider compounding hazards (for example, cyclone combined with flooding) and cascading impacts (for example, flooding leading to disease outbreaks, infrastructure failure, service disruption, and livelihood loss).
- Strengthen the MHRVA by incorporating future climate projections, demographic trends, land-use change, urban growth, and economic development scenarios to simulate different risk conditions and identify priority intervention areas.

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level

- Assess the exposure and vulnerability of critical infrastructure, including water treatment plants, pump houses, sewage treatment plants, drainage systems, roads, bridges, power supply, communication networks, health facilities, schools, shelters, and emergency response infrastructure to support contingency planning and rapid response strategies.
- Conduct structural vulnerability assessments of buildings and infrastructure, especially in old settlements, slums, coastal habitations, low-lying wards, informal housing areas, and high-density neighbourhoods, to assess their capacity to withstand cyclones, flooding, high winds, storm surge, and extreme rainfall.
- Map the number, location, and spatial distribution of vulnerable population groups including women-headed households, the elderly, persons with disabilities, children, persons with critical health conditions, migrant and temporary workers, fishermen, street vendors, informal workers, and gig workers. The information may be used to prepare GESI-sensitive risk profiles and targeted evacuation, relief, and recovery plans.
- Include ecosystem-based risk assessment as part of the MHRVA by preparing an inventory of ecosystems within and around the city, including wetlands, canals, mangroves, estuaries, coastal buffers, water bodies, and green spaces. The assessment may include:
  - current condition of ecosystems
  - ecosystem services relevant to disaster risk reduction
  - areas under degradation
  - role of ecosystems as flood buffers, storm barriers, erosion-control systems, and heat regulators
- Collaborate with the District Forest Department, Water Resources Department, Fisheries Department, Revenue Department, and other relevant agencies to understand the relationship between hazard risk and ecosystems beyond municipal boundaries, recognising that ecosystem functions influencing urban resilience may extend outside KMC jurisdiction.
- Adopt a bottom-up approach for MHRVA preparation by mobilising Ward Secretariats / Sachivalayam system, SHGs, RWAs, NGOs, and community organisations to collect ward-level information on vulnerable households, evacuation needs, infrastructure gaps, local flooding conditions, and service deficiencies. The information may be aggregated at zonal and city levels to support inclusive planning and prioritisation.
- Ensure that the MHRVA includes ward-level risk profiles to support ward-level disaster preparedness plans, evacuation planning, infrastructure prioritisation, awareness generation, and IEC activities based on local needs, capacities, and risk conditions.

Additional Thematic and Area-Specific Risk Assessments

The MHRVA may be supplemented with detailed thematic and sector-specific studies where required. These may include:

- hydrological and drainage assessments of canals, natural drains, outfalls, and surrounding catchments to identify bottlenecks, encroachments, siltation, tidal influences, and pollution-related flood risks
- assessment of coastal and tidal influences affecting flooding and storm surge vulnerability
- neighbourhood-level heat stress mapping to identify high-temperature zones and areas lacking green cover
- use of GIS, remote sensing, LiDAR, and advanced analytics for building-level or neighbourhood-level risk mapping where feasible
- assessment of service delivery vulnerabilities including water supply, sanitation, drainage, transport, health, education, communication systems, and emergency access infrastructure

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
The MHRVA may be treated as a living database and periodically updated as new climate projections, infrastructure, land-use changes, or vulnerable groups emerge. Outputs of the assessment may be integrated with the Master Plan, CRCAP, stormwater management planning, infrastructure projects, and ward-level disaster preparedness plans. All maps, databases, and knowledge products may be stored and managed through the ICCC / Disaster Resilience Data Portal to support early warning dissemination, evacuation planning, infrastructure prioritisation, relief and recovery planning, and long-term resilience monitoring. **Data Management and Integration with ICCC** All MHRVA outputs, maps, databases, and related knowledge products may be stored and managed through the ICCC/Disaster Resilience Data Portal/Data Management Centre, which may function as a central repository for risk information. The database may support: • early warning dissemination • evacuation planning • infrastructure planning • relief and recovery planning • ward-level decision making • monitoring of resilience actions				
Lead Entity	KMC (UDMA/Planning/ICCC)			
Supporting Entity	APSDMA, APSDPS, IMD, Water Resources Department, Fisheries Department, Forest Department, Revenue Department, Panchayati Raj Department, Research Institutions, Technical Agencies			
Source of Fund	State Government/SDRF/National schemes/International projects/ Development partners			
Alignment with SFDRR	Target A, B, C, D, G			
Alignment with PM 10 Point Agenda	Element 2, 4			
Mainstreaming DRR in Plan and Processes	**Very High**	**Medium**	**Long**	**Medium**
KMC may mainstream disaster risk reduction and climate resilience considerations into city planning, infrastructure design, building regulations, and municipal processes to ensure that future development does not increase risk and that investments contribute to long-term resilience. Actions may include: • Integrate findings from the MHRVA and climate projections into the Master Plan, zonal plans, ward-level plans, and sectoral infrastructure projects to guide risk-informed development. • In coordination with the Municipal Administration and Urban Development Department (MAUD), incorporate spatial risk information into land-use planning to demarcate flood-prone areas, low-lying zones, coastal buffers, canal corridors, and environmentally sensitive areas, and regulate development in such locations. • Promote incorporation of sponge city / water-sensitive urban design principles in planning regulations and project design to improve infiltration, reduce runoff, recharge groundwater, and mitigate urban heat stress. Measures may include permeable surfaces, recharge pits, bioswales, green roofs, urban greening, and protection of natural drains, in line with CRCAP and stormwater management plans. • Ensure that building regulations and development permissions reflect city-level risk assessment findings, including provisions for flood-safe plinth levels, wind-resistant construction, drainage connectivity, and safe access for emergency vehicles.				

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
• In coordination with MAUD, strengthen enforcement of building codes and development control regulations, and ensure compliance during building permission, layout approval, and occupancy certification. • Integrate disaster resilience considerations in design and location of municipal infrastructure across sectors. For example: o locating critical facilities such as transfer stations, pumping stations, and control rooms in safe and elevated locations o providing shade, ventilation, and heat mitigation features in public infrastructure such as bus stops and markets o ensuring hoardings, poles, and temporary structures comply with wind safety norms o ensuring stormwater drainage is included in all road and layout projects				
• Require preparation of basic emergency preparedness or business continuity measures for large commercial establishments, industries, and critical service providers as part of the trade licence or approval process, so that essential services can continue during disasters. • Ensure that disaster risk considerations are incorporated in DPR preparation, tender documents, and project approvals for municipal works. • Use ICCC / Data Management Centre to maintain risk maps, hazard zones, infrastructure exposure data, and planning layers so that all departments use the same risk information while preparing plans and projects.				
Lead Entity	KMC (Town Planning/UDMA/Engineering/ICCC)			
Supporting Entity	MAUD, APSDMA, APSDPS, IMD, Water Resources Department, Fisheries Department, Forest Department, Revenue Department, Technical Institutions			
Source of Fund	State Government/Municipal funds/SDRF/National schemes/External funding/ Development partners			
Alignment with SFDRR	Target A, B, D			
Alignment with PM 10 Point Agenda	Element 1			

8.5. Stakeholder Engagement and Mobilisation for Streamlining Disaster Resilience Planning and Implementation

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Updating Hazard Map with Community Consultation	**Very High**	**High**	**Short**	**High**
Update hazard maps using ward-level consultation with community members, including fishermen, women's groups, youth, and local organisations (especially those focusing on gender equality, disability rights and community development), to identify flood-prone areas, safe routes, and no-build buffer zones. The maps may be integrated with the ICCC / disaster data portal. ***Good Practice*** **Community-Based Disaster Risk Management (CBDRM) / Community involvement in Shelter Management and Disaster Preparedness**[47] – Odisha (UNDP Programme) Community inputs and involvement are used to improve local disaster risk maps, evacuation planning, shelter management and disaster preparedness.				
Lead Entity	KMC (UDMA/ICCC/Ward Secretariats)			
Supporting Entity	APSDMA, NGOs, SHGs			
Source of Fund	SDRF mitigation, State Government, UNDP			
Alignment with SFDRR	Target B			
Alignment with PM 10 Point Agenda	Element 3, 8			
Stakeholder mapping	**Very High**	**High**	**Short**	**High**
KMC may map RWAs, NGOs, CSOs, SHGs, youth groups, and community-based organisations across all wards and assess their capacity to support disaster resilience activities. Their engagement may be structured in coordination with the Ward Secretariat/Sachivalayam system for ward-level planning, awareness generation, training, evacuation support, relief distribution, recovery, and monitoring. Ensure effective mobilisation by: • Maintaining a ward-wise stakeholder database • Assigning clear roles to each organisation during disasters • Conducting periodic coordination meetings at ward and city levels, along with engagement of the police, health, fisheries, and revenue departments • Ensuring participation of women, elderly, persons with disabilities, and vulnerable occupational groups in ward-level meetings				
Lead Entity	KMC (UDMA)			
Supporting Entity				
Source of Fund				
Alignment with SFDRR	Target B			
Alignment with PM 10 Point Agenda	Element 8			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Community-level IEC and awareness generation	**High**	**Medium**	**Medium**	**High**

KMC may formally prepare an annual calendar for organising **community-level IEC and awareness generation programmes,** especially targeting women, youth, schoolchildren, slum residents, fishermen, and migrant workers to promote more meaningful participation in community decision-making processes.

Topics may include:

- Compliance with zoning and building regulations to remain eligible for response and recovery support
- Proper registration of businesses to ensure inclusion in loss and damage assessment
- Understanding early warning messages and alert systems
- Recognising natural indicators of extreme events
- Ward-wise evacuation routes and shelter locations
- Safeguarding elderly, pregnant women, children, and persons with disabilities during evacuation
- Responding to and reporting gender-based violence during disasters
- Awareness of government welfare, livelihood, and employment schemes
- Awareness of financial literacy and leadership development
- Procedures for accessing relief, insurance, and compensation
- Role of ecosystems such as mangroves, water bodies and green areas in reducing disaster risk

Ensure maximum participation in IEC programmes by:

- Organising sessions in schools and colleges
- Conducting programmes in slums, fishing settlements, and vulnerable wards
- Arranging sessions near workplaces when targeting occupational groups (for example, near construction sites, markets, fishing harbours)
- Scheduling sessions after working hours where required
- Maintaining local customs and decorum, including deploying women coordinators for women's groups
- Conducting sessions in safe spaces to facilitate their meaningful participation and ensure that diverse perspectives are captured in the process.
- Mobilising participants through Ward Secretariats, SHGs, and Anganwadi networks

KMC may also create **public awareness displays** at parks, coastal areas, riverbanks, religious places, and public buildings to highlight the role of ecosystems as natural buffers against floods, cyclones, storm surge, and heat.

KMC may encourage homeowners, fishermen, vendors, and small businesses to adopt insurance and financial protection mechanisms to reduce disaster losses.

Awareness may be created on insurance coverage, claim procedures, and compensation schemes by engaging the Roads and Buildings Department, AP Chambers of Commerce, insurance agencies, and private sector institutions.

Alignment with SFDRR	Target A, B, C, G
Alignment with PM 10 Point Agenda	Element 2, 3, 7, 8

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Training for vulnerable communities	**High**	**Medium**	**Medium**	**Medium**
KMC may conduct training and capacity-building sessions for vulnerable communities by engaging NGOs, CBOs, SHGs, and ward secretariats. Training may include: • Alternative livelihoods (for example, training of fisherfolk on the preparation of fish-based food products) • First-aid and basic rescue techniques • Paperwork for insurance and compensation • Safe evacuation practices • Food preservation techniques such as pickling and drying • Climate-adaptive livelihoods such as sustainable fisheries, ecotourism, and small enterprises Ensure maximum participation by: • Conducting handholding sessions at ward level • Arranging sessions near workplaces for targeted groups and accounting for physical accessibility • Scheduling sessions outside working hours and core caregiving responsibilities where required • Selecting the communication medium while maintaining local customs and decorum • Deploying women coordinators for women participants • Mobilising participants through the Sachivalayam system Identify dedicated community members, especially women, and empower them as **local champions** who may: • Support early warning dissemination • Assist in evacuation • Help vulnerable households • Anchor training sessions • Act as contact persons between the community and KMC				
Mock drills with special focus on vulnerable populations	**Very High**	**High**	**Short**	**High**
KMC may conduct periodic mock drills at ward and city levels to test preparedness for climate-induced disasters, with special focus on vulnerable populations such as women, persons with disabilities, elderly, children, slum residents, and coastal communities. Mock drills may be used to: • Assess evacuation time • Identify gaps in transport and shelter capacity • Estimate resource requirements • Improve coordination between KMC, ward secretariats, and community organisations • Strengthen community confidence in disaster response systems.				
Alignment with SFDRR	Target A, B, C, G			
Alignment with PM 10 Point Agenda	Element 2, 3, 7, 8, 9			

8.6. Preparedness and Response

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Climate-Responsive Retrofitting of Cyclone Shelters	**High**	**High**	**Short**	**High**
Retrofit existing cyclone shelters with wind-resistant features that are also heat-resilient, such as green roofs, shaded facades, improved ventilation, rainwater harvesting, and solar backup to improve usability. ***Good Practice*** **Multi-Purpose Cyclone Shelters under NCRMP (India)**[48] - Cyclone shelters constructed under NCRMP are designed for multi-hazard use and are upgraded with improved ventilation, sanitation, and climate-responsive features. ***Example*** Under NCRMP, full cyclone shelter construction costs generally ranged between approximately INR 1.5–3 crore per shelter depending on size, access roads, water supply, sanitation, and associated infrastructure. Retrofitting typically constitutes approximately 10–25% of full construction cost, depending on scope (solar, roof treatment, ventilation, sanitation upgrades, accessibility, etc.).				
Lead Entity	KMC (UDMA/Engineering)			
Supporting Entity	APSDMA, NDMA, MAUD			
Source of Fund	SDRF, NDMA, State Government, World Bank, CSR			
Alignment with SFDRR	Target B			
Alignment with PM 10 Point Agenda	Element 9			
Inclusive Signage and Tactile Markers for Evacuation and Safe Zones	**High**	**High**	**Short**	**High**
Install tactile boundary markers, pictogram signage, and multilingual warning boards in vulnerable wards, evacuation routes, and shelters to support persons with disabilities, elderly, and low-literacy residents during emergencies. ***Good Practice*** **Accessible Disaster Risk Reduction Guidelines, NDMA/UNDRR** **Disability-Inclusive Disaster Risk Reduction – Odisha Cyclone Shelters (ODRAP/NCRMP)** Inclusive signage and accessible evacuation systems are recommended for disaster preparedness. These measures were particularly strengthened after Cyclones Phailin and Fani, when inclusive evacuation planning helped achieve near-zero casualties despite large-scale evacuation (more than 1 million people). ***Example*** 300–800 signage locations (wards + evacuation routes + shelters) INR 20,000–40,000 per location (including tactile features +signage + installation) INR 20–40 lakh for citywide signage and markers				
Lead Entity	KMC (UDMA / Engineering / Social Welfare)			
Supporting Entity	APSDMA, NGOs, Disability Dept.			
Source of Fund	SDRF, Smart City, Municipal budget, CSR			
Alignment with SFDRR	Target A, B, C			
Alignment with PM 10 Point Agenda	Element 2			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Warning Dissemination and Targeted Evacuation	**Very High**	**High**	**Short**	**High**

KMC may ensure timely dissemination of early warnings through the City Emergency Operations system, ward secretariats, and community networks to enable safe and inclusive evacuation.

Actions may include:

- Alert pre-identified NGOs, CSOs, SHGs, RWAs, and trained community resource persons experienced in gender-sensitive warning and relief activities
- Use a ward-wise disaggregated risk-assessment database for targeted communication
- Issue special advisories, in accessible formats and local languages, using multiple channels, for elderly persons, pregnant women, persons with disabilities, fishermen, construction workers, migrant labour, and gig workers ahead of hazards. These channels can include community radio, mobile phone alerts, loudspeakers, and door-to-door communication by community volunteers.
- Conduct targeted evacuation based on the vulnerability database, prioritising pregnant women, senior citizens, PwDs, children, and chronically ill persons
- Establish inclusive and accessible evacuation routes with clear signage
- Prepare evacuation route plans at ward and city levels and integrate them with ICCC/Data Management Centre/ CEOC for real-time monitoring and decision support
- Arrange accessible transportation for persons with disabilities, elderly, women with children, and injured persons
- Coordinate with NGOs and community organisations to support evacuation and crowd management
- Identify specific organisations, CSOs, SHGs, and community volunteers for evacuation support and prepare a pre-defined engagement and implementation plan for different wards
- Issue threshold-based warnings in Telugu/English/visual cards, with sign language appropriate for persons with disabilities.

Lead Entity	KMC (UDMA)
Supporting Entity	APSDMA, APSDPS, IMD, Water Resources Department, Police, Fire Department, Health Department, NGOs/CSOs, Ward Secretariats
Source of Fund	UDMA Contingency Fund/SDRF/NDRF
Alignment with SFDRR	Target A, B, C
Alignment with PM 10 Point Agenda	Element 2, 7

Warning Dissemination and Targeted Evacuation	**Very High**	**High**	**Short**	**High**

KMC may ensure timely dissemination of early warnings through the City Emergency Operations system, ward secretariats, and community networks to enable safe and inclusive evacuation.

Actions may include:

- Alert pre-identified NGOs, CSOs, SHGs, RWAs, and trained community resource persons experienced in gender-sensitive warning and relief activities
- Use a ward-wise disaggregated risk-assessment database for targeted communication
- Issue special advisories, in accessible formats and local languages, using multiple channels, for elderly persons, pregnant women, persons with disabilities, fishermen, construction workers, migrant labour, and gig workers ahead of hazards. These channels can include community radio, mobile phone alerts, loudspeakers, and door-to-door communication by community volunteers.

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
• Conduct targeted evacuation based on the vulnerability database, prioritising pregnant women, senior citizens, PwDs, children, and chronically ill persons • Establish inclusive and accessible evacuation routes with clear signage • Prepare evacuation route plans at ward and city levels and integrate them with ICCC/Data Management Centre/ CEOC for real-time monitoring and decision support • Arrange accessible transportation for persons with disabilities, elderly, women with children, and injured persons • Coordinate with NGOs and community organisations to support evacuation and crowd management • Identify specific organisations, CSOs, SHGs, and community volunteers for evacuation support and prepare a pre-defined engagement and implementation plan for different wards • Issue threshold-based warnings in Telugu/English/visual cards, with sign language appropriate for persons with disabilities.				
Lead Entity	KMC (UDMA)			
Supporting Entity	APSDMA, APSDPS, IMD, Water Resources Department, Police, Fire Department, Health Department, NGOs/CSOs, Ward Secretariats			
Source of Fund	UDMA Contingency Fund/SDRF/NDRF			
Alignment with SFDRR	Target A, B, C			
Alignment with PM 10 Point Agenda	Element 2, 7			
Emergency Coordination and Field Response	**Very High**	**High**	**Short**	**Very High**
KMC may activate inclusive emergency coordination mechanisms to ensure timely response and support for vulnerable populations. Actions may include: • Deploy mobile medical units with trained staff, including female healthcare workers • Activate ward secretariat functionaries for field-level coordination and beneficiary identification • Maintain a real-time database of evacuated persons and affected households • Ensure communication between CEOC, ward secretariats, police, health services, and relief teams • Provide emergency transport for injured, elderly, pregnant women, and PwDs • Coordinate with NGOs, CSOs, SHGs, and volunteers for inclusive response • Pre-identify organisations for medical support, evacuation, relief management, and camp management and prepare an engagement plan for their deployment during emergencies • Ensure uninterrupted power, communication, and water supply in the relief centres • Conduct regular health check-ups and emergency health screenings for vulnerable groups to detect early signs of heat stress and prevent severe health impacts during extreme temperature events. • Provide emergency water delivery through tankers to vulnerable areas during extreme heat stress • Set up public hydration points to prevent dehydration and heat-related illnesses. • Erect temporary shade sails over markets and transit stops, anchored to potted native trees relocated from city nurseries during heat stress				
Lead Entity	KMC (UDMA)			
Supporting Entity	Health Department, Police, Fire Department, Revenue Department, NGOs/CSOs, Ward Secretariats			
Source of Fund	SDRF/NDRF/UDMA contingency fund			
Alignment with SFDRR	Target A, B, C, D			
Alignment with PM 10 Point Agenda	Element 7			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Relocation to Relief Camps	**Very High**	**High**	**Short**	**High**

KMC may ensure inclusive relocation of affected populations to designated safe shelters during disasters.

Actions may include:

- Identify cyclone and flood shelters to avoid overburdening existing shelters in severe scenarios
- Maintain a ward-wise shelter allocation plan
- Arrange accessible transport for vulnerable groups
- Train rapid response teams in gender-sensitive rescue, triage, and emergency health support
- Prepare inclusive relief kits based on GEDSI-sensitive risk assessments
- Include newborn care supplies, hygiene products, medicines, and assistive items for PwDs
- Link shelter database, evacuation plans, and camp capacity details with ICCC/CEOC/data management system for real-time monitoring

Lead Entity	KMC (UDMA)
Supporting Entity	Revenue Department, Education Department, Police, Fire Department, Health Department, NGOs/CSO
Source of Fund	SDRF / NDRF
Alignment with SFDRR	Target A, B
Alignment with PM 10 Point Agenda	Element 2

Provisions in Relief Camps	High	High	Short	High

KMC may ensure that relief camps provide safe, inclusive, and dignified living conditions for all affected persons.

Actions may include:

- Ensure relief camps have separate and safe spaces for women, children, the elderly, and PwDs
- Provide safe spaces for lactating and menstruating women
- Provide safe drinking water, sanitation, lighting, and separate toilets for women
- Provide medical assistance and deploy trained staff for psychological support
- Ensure special care for pregnant women, the elderly, PwDs, children, and persons with chronic illness
- Deploy female health workers and counsellors
- Coordinate with police to deploy security personnel in relief camps
- Establish reporting systems to prevent gender-based violence and harassment
- Set up help desks for complaints related to relief, food, shelter, or services
- Provide a toll-free number and ward-level contact persons
- Address dietary needs and medical care of elderly, pregnant women, children, patients, and disabled
- Provide labour-saving cooking equipment such as gas stoves, pressure cookers, and fuel
- Provide support or compensation for community cooking and relief work
- Assign identified NGOs/CSOs/SHGs for camp management support based on a pre-approved engagement plan
- Install small solar-powered refrigerators at health-camp sites for cold storage of medicines and hydration packs.

Lead Entity	KMC (UDMA)
Supporting Entity	Health Department, Police Department, Fire Department, Education Department, NGOs/CSOs, APSDMA, IMD, Water Resources Department

Action Areas		Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Source of Fund	SDRF/NDRF				
Alignment with SFDRR	Target A, B				
Alignment with PM 10 Point Agenda	Element 2				
Flood Preparedness and Immediate Response Measures		**Very High**	**High**	**Short**	**Very High**
KMC may undertake targeted infrastructural and nature-based interventions to equip systems and communities to address flooding. Actions may include: • Deploy inclusive buoyant platforms in flood-prone areas, equipped with ramps, handrails, and non-slip surfaces to ensure accessibility for persons with disabilities, the elderly, pregnant women, and children • Provide backup power systems (such as generators or solar backup) for sewage treatment plants (STPs), pumping stations, and critical water infrastructure to ensure uninterrupted operation during floods • Install anti-backflow valves and mechanisms in sewerage systems to prevent reverse flow of sewage into households during flooding or power outages • Pre-position materials and response kits (coir rolls, sandbags, bamboo supports, pumps) in vulnerable locations for quick deployment during extreme events Integrate these interventions with ward-level response plans and ensure coordination between engineering teams, ward secretariats, and community volunteers for rapid execution					
Lead Entity	KMC (UDMA/Engineering)				
Supporting Entity	Water Resources Department, Forest Department, APSDMA, Fisheries Department, NGOs/CSOs, Ward Secretariats				
Source of Fund	SDRF/NDRF / State Disaster Mitigation Fund/Municipal Budget/External Projects				
Alignment with SFDRR	Target A, B, C, D				
Alignment with PM 10 Point Agenda	Element 1, 8				

8.7. Post-disaster Recovery

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Clearance of Affected Areas and Environmental Safety	**Medium**	**Medium**	**Short**	**Medium**
KMC may undertake safe and environmentally responsible clearance of affected areas immediately after disasters. Actions may include: • Remove and dispose of disaster debris through scientific methods such as authorised C&D waste processing, composting of organic waste, safe disposal of hazardous materials as per CPCB norms, recycling and reuse of debris, and GIS-based tracking of disposal sites. • Prohibit dumping of debris in water bodies, canals, drains, coastal areas, and environmentally sensitive zones • Segregate hazardous waste, construction debris, and organic waste • Assess the possibility of replanting uprooted trees and replant where feasible using proper soil treatment and depth				

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
• Convert damaged roadside wetlands into sediment-capture basins to remove flood-borne debris and pollutants. • Restore damaged green areas, wetlands, and natural drainage channels to reduce future risk • Ensure that debris removal and restoration works do not disturb ecologically sensitive areas • Reconstruct foredune barriers using native sand-binding grasses and Casuarina saplings. • Replant cleared mangrove stands along the Upputeru estuary to restore a surge buffer and fish habitat. • Reinstate native riparian vegetation (e.g., vetiver, native grasses) along drains to stabilise banks and filter runoff.				
Lead Entity	KMC (UDMA)			
Supporting Entity	Forest Department, Pollution Control Board, NGOs/CSOs, Revenue Department			
Source of Fund	SDRF/NDRF/DMA			
Alignment with SFDRR	Target B, D			
Alignment with PM 10 Point Agenda	Element 9			
Loss and Damage Assessment (Inclusive and Ecosystem-Sensitive)	**High**	**Medium**	**Short**	**High**
KMC may conduct rapid and comprehensive loss and damage assessments to guide recovery planning and ensure that vulnerable groups and ecosystems are adequately covered. Actions may include: • Conduct rapid assessment using drone surveys, GIS mapping, and ward-level field verification • Use the ward secretariat / Sachivalayam database for identifying affected households • Collect gender-, age-, disability-, and socially disaggregated data • Record casualties, injuries, disabilities, displacement, and damage to houses and infrastructure • Include losses in the informal sector, fisheries, street vending, gig workers, and daily wage labour • Assess damage to public utilities, pipelines, drainage, water supply, sanitation, roads, and power infrastructure • Assess livelihood interruption and income loss • Identify damage to service delivery infrastructure affecting vulnerable populations • Ensure participation of ward secretariats, NGOs, SHGs, and community representatives in verification • Include a biodiversity assessment to record damage to wetlands, mangroves, coastal areas, urban green spaces, and water bodies • Assess impacts on local ecosystems that may increase future disaster risk • Share the assessment with district and state authorities for funding support				
Lead Entity	KMC (UDMA)			
Supporting Entity	Revenue Department, APSDMA, Ward Secretariats, Forest Department, NGOs/CSOs, Planning Department			
Source of Fund	SDRF/NDRF			
Alignment with SFDRR	Target A, B, C, D			
Alignment with PM 10 Point Agenda	Element 2, 9			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Recovery Planning and Build Back Better	**Very High**	**High**	**Medium**	**High**
KMC may prepare post-disaster recovery plans in consultation with government agencies, financial institutions, NGOs, and community groups to ensure resilient reconstruction. Actions may include: • Convene coordination meetings with line departments, banks, insurance agencies, NGOs, and community representatives • Prepare a recovery plan based on the extent of damage and vulnerability • Follow Build Back Better principles and principles of universal accessibility in all reconstruction • Retrofit damaged buildings to withstand floods, cyclones, and extreme weather • Relocate highly vulnerable structures where required • Ensure relocation does not occur in eco-sensitive areas such as canal banks, floodplains, and coastal buffers • Provide technical guidance to households and small businesses for safe rebuilding				
Lead Entity	KMC (UDMA)			
Supporting Entity	Roads & Buildings Dept., Town Planning, Revenue Dept., Banks, Insurance agencies, NGOs/CSOs			
Source of Fund	SDRF/NDRF /State Government/External assistance			
Alignment with SFDRR	Target A, B, C, D			
Alignment with PM 10 Point Agenda	Element 2, 9			
Livelihood Restoration	**High**	**Medium**	**Medium**	**Medium**
KMC may support livelihood restoration for affected populations, especially informal workers and vulnerable households. Actions may include: • Identify affected workers in the informal sector, fisheries, vending, gig work, and daily wage labour • Provide access to compensation, insurance, and government livelihood schemes • Organise vocational training camps for alternative and climate-resilient livelihoods • Promote skills introduced during pre-disaster training programmes • Facilitate credit support through banks, SHGs, and cooperative groups • Support reopening of small businesses and markets • Provide temporary employment through public works programmes				
Lead Entity	KMC			
Supporting Entity	Labour Department, Fisheries Department, Banks, SHGs, NGOs/CSOs			
Source of Fund	State schemes/SDRF/NDRF/Livelihood missions			
Alignment with SFDRR	Target B, C			
Alignment with PM 10 Point Agenda	Element 8, 9			

Action Areas	Disaster Resilience Potential	Feasibility of Interventions	Period to Realise Impact	Priority Level
Physical and Mental Health Sustenance	**High**	**Medium**	**Medium**	**Medium**
KMC may ensure continued health and psychosocial support for affected populations after disasters. Actions may include: • Provide rehabilitation services for injuries and disabilities • Provide mental health and psychosocial support through PHCs, NGOs, and counsellors. This must include awareness programmes on recognising and addressing trauma and stress, reducing stigma associated with mental health challenges, and facilitating access to appropriate support services. • Conduct regular counselling for women, children, and the elderly				
Lead Entity	Health Department/KMC			
Supporting Entity	PHCs, NGOs/CSOs, Women and Child Department, Ward Secretariats			
Source of Fund	Health Department/SDRF/NDRF			
Alignment with SFDRR	Target B, D			
Alignment with PM 10 Point Agenda	Element 9, 8			
Education Continuity Support	**Medium**	**High**	**Medium**	**Medium**
KMC may ensure continuity of education and social services after disasters. Actions may include: • Deploy temporary or mobile education facilities where schools are damaged. These temporary facilities should also cater to learners with special needs. • Use community halls or shelters as temporary learning spaces • Provide learning materials for affected children • Engage teachers, NGOs, and volunteers for support classes • Use SHGs and ward secretariats to monitor vulnerable families				
Lead Entity	Education Department/KMC			
Supporting Entity	NGOs/CSOs, Ward Secretariats, Women and Child Department			
Source of Fund	State Government/SDRF/Education Department			
Alignment with SFDRR	Target B, D			
Alignment with PM 10 Point Agenda	Element 9, 8			

8.8. Key Performance Indicators

KMC, along with other implementing partners, is encouraged to evaluate the progress and impact of the initiatives through a robust list of KPIs. The recommendations that target the vulnerable groups directly should be examined in a disaggregated manner, where feasible. The disaggregated monitoring and evaluation (e.g., by gender, age, disability status, caste, and other relevant characteristics) could help address existing GESI data gaps and provide a more nuanced understanding of differential vulnerabilities, capacities, and resilience across population groups.

Recommendation	KPI	Frequency
Nature-based Flood Mitigation and Sponge Infrastructure Develop and upgrade parks and open spaces with flood-resilient features such as detention lawns, recharge pits, bioswales, retention ponds, permeable surfaces, and sloping landscapes to absorb stormwater, enhance groundwater recharge, and reduce urban flooding in line with Sponge City principles.	Number of new parks designed with flood-resilient features	2—3 years
	Stormwater storage capacity created through parks and retention features (KL or cubic metres)	Annual monitoring with pre- and post-monsoon assessment
	Reduction in localised flooding incidents near upgraded parks	Post-monsoon review and annual assessment
	Percentage of existing parks retrofitted with detention/ retention features	Annual
	Number of sponge infrastructure projects implemented	Annual
	Area converted to permeable surface (sq. .m.)	Annual
	Stormwater retention/ infiltration capacity created (ML or cubic metres) through sponge infrastructure interventions	Annual monitoring with pre- and post-monsoon assessment
	Reduction in waterlogging incidents (%)	Annual
	Percentage increase in permeable/semi-permeable area	Annual
KMC can adopt a **community-based forest management** approach in alignment with the District Forest Office. They may engage SHGs in maintaining parks/ forest patches, or in setting up and maintaining food gardens that not only conserve nature but also generate livelihoods through a viable business model.	Number of parks/forest patches under SHG management	Annual
	Number of food gardens established by SHGs	Monthly (post-initiation)
	Number of SHG women generating livelihoods	Annual
Integrate '**Rain City'** strategic elements while laying new roads, especially in flood-prone areas or while repairing damaged ones. This may include innovative inlet designs to capture run-off and induce sedimentation, weir walls to slow down flow, GI chambers for water collection and subsequent infiltration along bioswales with native plant species.	Km. of roads with rainwater capture and infiltration systems	Annual
	Reduction in waterlogging points along roads	Post-monsoon
Risk-based Desilting and Drain Capacity Restoration Undertake desilting and restoration of drains, canals, and outfalls based on hydraulic assessment and identified bottlenecks instead of routine desilting. Prioritise low-lying wards, canal stretches, and outfalls connected to tidal or coastal systems.	Number of drains restored based on hydraulic assessment	Annual (pre - monsoon)
	Number of outfalls maintained and cleared for uninterrupted flow	Pre-monsoon annual review with monsoon-season monitoring
	Reduction in drainage and waterlogging complaints during monsoon (%)	Monsoon season monitoring and annual review
	Reduction in flood-prone locations	Post-monsoon

Recommendation	KPI	Frequency
Flood- and Cyclone-Resilient Housing Upgradation in Vulnerable Wards Promote flood- and cyclone-resilient housing in vulnerable wards through retrofitting existing houses and adopting resilient design features in new construction, especially in low-lying, coastal, and high-wind-risk areas. Measures may include raising the plinth level above the identified flood depth, providing RCC bands at the lintel and roof level, strengthening roof anchoring to withstand high wind speeds, using water-resistant and saline-resistant materials, elevating electrical fittings above flood level, and ensuring proper drainage connectivity around buildings.	Number of houses retrofitted	Quarterly
	Percentage of vulnerable households receiving retrofitting support	Annual
	Number of houses constructed with raised plinths	Annual
	Percentage of compliant new buildings	Annual
	Number of new compliant constructions	Annual
Promotion of Climate-Resilient and Resource-Efficient Local Construction Techniques Encourage locally suitable, climate-responsive, and resource-efficient construction practices that reduce heat stress, improve structural performance during floods and cyclones, and lower post-disaster reconstruction costs. Suitable techniques may include filler slab roofing, rat-trap bond masonry, glass-bottle filler slabs, fly-ash bricks, recycled plastic blocks, cob walls, and other locally available materials that reduce dead load, improve thermal comfort, and allow easier repair after damage. Such methods may be promoted especially for low-rise housing, incremental construction, and retrofitting in vulnerable wards.	Number of buildings using resilient materials/techniques	Annual
	Number of awareness and training sessions conducted for masons, contractors, engineers, and communities on resilient local construction techniques	Quarterly with annual consolidated review
	Number of trained masons/ contractors disaggregated by gender, age, caste, location/ dwelling as relevant	Annual
Safety Audit of Housing in Risk-Prone Areas Conduct structural safety audit of existing and proposed housing in flood-prone, coastal, and high-density areas to assess vulnerability to flooding, high winds, and waterlogging. Audit findings should guide retrofitting, strengthening, or relocation measures.	Percentage of buildings audited in risk zones	Annual
	Number of unsafe buildings identified	Annual
	Percentage of unsafe buildings retrofitted	Annual
	Percentage of housing meeting universal accessibility standards	Annual
Ward-level Flood Risk Mapping and Inclusive Warning Systems Prepare ward-level flood risk maps and evacuation plans through consultation with ward secretariats, SHGs, and local organisations, incorporating local knowledge of flooding locations, safe routes, and vulnerable households. Integrate maps with the ICCC/Data Management Centre to disseminate warnings and coordinate response. Issue alerts in multiple formats, such as SMS, IVRS, sirens, mobile apps, and pictorial messages, to ensure accessibility for all population groups.	Number of wards with evacuation plans	Annual
	Percentage of vulnerable households mapped	Annual
	Number of evacuation routes validated	Annual

Recommendation	KPI	Frequency
Mangrove Restoration and Estuary Buffer Protection Rehabilitate and conserve degraded mangroves along the Upputeru estuary and nearby coastal stretches to attenuate storm surge, reduce wave energy, and stabilise the shoreline. Mangrove restoration may be undertaken in coordination with the Forest Department and Coastal Zone authorities and integrated with CRZ regulations and coastal risk management plans.	Area restored (hectares)	Annual
	Survival rate of mangroves (%)	Biannual
Coastal Shelterbelt Plantation / Windbreak Green Belt Develop coastal shelterbelt plantations using species such as Casuarina, Palmyra, mangroves, and other native coastal vegetation along vulnerable stretches to reduce wind speed, protect settlements, stabilise soil, and reduce cyclone damage. Plantations may be established along coastal stretches, canal banks, estuary edges, and available government land in coordination with the Forest Department and Coastal Zone authorities. Shelterbelt plantations may also be integrated with coastal zone management plans and disaster risk reduction strategies.	Length of plantation developed (km)	Annual
	Survival rate of plantation (%)	Biannual
Protection of Waterbodies and Environmentally Sensitive Areas Prohibit dumping of solid waste, debris, or construction material in canals, drains, wetlands, estuaries, coastal areas, and buffer zones, and enforce protection of environmentally sensitive areas to maintain natural drainage, flood storage capacity, and ecosystem functions. Integrate buffer zone demarcation and protection of natural drainage channels, wetlands, and coastal regulation areas with the Master Plan, CRZ regulations, stormwater management plans, and Multi-Hazard Risk Assessment to reduce flood risk and prevent blockage of natural flow paths.	Number of waterbodies demarcated and protected	Annual
	Number of encroachments removed	Quarterly
	Length of canal/drain/wetland buffer restored and protected (km)	Annual monitoring with pre- and post-monsoon review
	Percentage reduction in dumping incidents	Quarterly
Rain Gardens/Bio-Retention Areas for Local Flood Management Develop rain gardens, bio-retention pits, and small infiltration areas in parks, public spaces, and institutional campuses to temporarily store and filter stormwater, reduce runoff, and support local flood management. These spaces may also serve as temporary aid points during disasters with support from youth groups and volunteers.	Number of systems installed	Annual
	Area under infiltration systems	Annual
	Number of shelters with accessibility features	Annual

Recommendation	KPI	Frequency
Construct public housing with suitable heat-resilient measures. Encourage the adoption of low-cost, heat-resilient measures for existing building stock, such as painting rooftops white, using jute mats, and installing vetiver curtains, especially in the hottest areas.	Number of houses adopting cooling measures	Annual
	Percentage of buildings retrofitted with cool roof/low-cost solutions	Seasonal
	Reduction in heat-related illness cases	Seasonal
Upgrade street vending zones and traffic islands with adequate shading. Ensure shaded resting areas at construction sites and transfer stations. Native plant species can be anchored in the shades Provide misting stations, solar-powered air coolers and water coolers, ice packs, and ORS should be mandatory in these occupational environments to enable immediate response.	Number of vending zones upgraded with shading	Annual
	Number of workplaces with shaded rest areas	Seasonal
	Number of cooling systems installed	Seasonal
	Reduction in heat stress cases	Seasonal
	Number of frontline workers trained disaggregated by gender, age, caste, etc. as relevant to track equity and inclusion	Annual
	Percentage of vulnerable population reached	Annual
Restore Tree Cover and Expand Shaded Areas in Dense Zones Restore tree cover and expand shaded areas in crowded public spaces, markets, and dense residential areas. Promote plantation drives and incentivise shade trees and green roofs for households, especially for vulnerable populations.	Number of trees planted	Annual
	Increase in shaded public area (%)	Annual
	Increase in canopy cover (%) in public spaces, markets, roads, and dense residential areas	Annual monitoring with seasonal pre- and post-summer assessment
	Survival rate of plantation (%)	Biannual
Multi Hazard Risk and Vulnerability Assessment (MHRVA) KMC may undertake a comprehensive **Multi -Hazard Risk and Vulnerability Assessment (MHRVA)** to support risk-informed planning, preparedness, and investment prioritisation for climate-induced and other disasters. The assessment may consider current hazards, future climate risks, compounding hazards, and cascading impacts to guide spatial and sectoral actions across the city.	MHRA prepared and uploaded	2–3 years
	Number of wards covered	Annual update
	Number of risk scenarios modelled under the MHRVA (including future climate and cascading hazard scenarios)	Every 3–5 years with periodic updates after major disaster events or new climate projections.

Recommendation	KPI	Frequency
Flood-prone Area Mapping and Flood Zoning Enforcement Identify flood-prone areas using hydrological modelling, depth-based flood mapping, DEM / LiDAR surveys, and coastal inundation scenarios, and enforce flood zoning regulations to restrict unsafe construction in high-risk zones. Mapping should cover both urban flooding and coastal/ storm surge flooding and be integrated with the Master Plan, building permissions, and infrastructure planning.	Percentage of the city covered under LiDAR/DEM flood mapping	3–5 years
	Number of development/ building approvals modified based on disaster risk and climate risk assessment	Quarterly review and annual consolidated assessment
	Number of building rules updated	5 years
	Percentage of plans integrating DRR	Annual
Updating Hazard Map, shelter management with Community Consultation Update hazard maps through ward-level consultations with community members, including fishermen, women's groups, youth, and local organisations, to identify flood-prone areas, safe routes, and no-build buffer zones. The maps may be integrated with ICCC/ disaster data portal.	Number of hazard maps updated with community inputs	Annual
KMC may **map RWAs, NGOs, CSOs, SHGs, youth groups, and community-based organisations** across all wards and assess their capacity to support disaster resilience activities.	Number and type of organisations identified	2–3 years
	Number and type of organisations actively engaged	Annual
KMC may formally prepare an annual calendar for organising **community-level IEC and awareness generation programmes**, especially targeting women, youth, schoolchildren, slum residents, fishermen, and migrant workers.	Number of sessions conducted	Annual
	Percentage participation of women, PwDs, and vulnerable groups in IEC and awareness programmes	Quarterly and annual consolidated review
	Number of participants (disaggregated)	Annual
KMC may **conduct training and capacity-building sessions** for vulnerable communities by engaging NGOs, CBOs, SHGs, and ward secretariats.	Number of training and capacity-building sessions conducted	Quarterly
	Number of participants trained (gender and social group disaggregated)	Quarterly
	Number of NGOs/CBOs/ SHGs engaged in training programmes	Annual
	Number of ward secretariat staff and volunteers trained	Annual
	Number of vulnerable communities covered through outreach programmes	Annual
	Number of participants trained in first aid, evacuation, and rescue techniques. disaggregated by gender, age, caste, etc., as relevant to track equity and inclusion	Annual

Recommendation	KPI	Frequency
	Number of participants trained in climate-adaptive livelihoods disaggregated by gender, age, and other relevant social identifiers	Annual
	Number of local champions/ community resource persons identified and trained, disaggregated by gender and other relevant social identifiers	Annual
KMC may conduct **periodic mock drills** at ward and city levels to test preparedness for climate-induced disasters, with special focus on vulnerable populations such as women, persons with disabilities, elderly, children, slum residents, and coastal communities.	Number of mock drills conducted	Biannual
	Number of people reached (disaggregated by gender, age, disability, location/dwelling)	Biannual
Climate-Responsive Retrofitting of Cyclone Shelters Retrofit existing cyclone shelters with heat-reducing and wind-resistant features such as green roofs, shaded facades, improved ventilation, rainwater harvesting, and solar backup to improve usability during disasters and reduce heat stress during normal periods.	Number of shelters upgraded with heat-reducing and wind-resistant features	Annual
	Percentage of shelters with solar/ventilation upgrades	Annual
	Number of consultations conducted (Disaggregated by respondent category)	Quarterly
Inclusive Signage and Tactile Markers for Evacuation and Safe Zones Install tactile boundary markers, pictogram signage, and multilingual warning boards in vulnerable wards, evacuation routes, and shelters to support persons with disabilities, the elderly, and low-literacy residents during emergencies.	Number of evacuation routes with inclusive signage	Annual
Warning Dissemination and Targeted Evacuation KMC may ensure timely dissemination of early warnings through the City Emergency Operations system, ward secretariats, and community networks to enable safe and inclusive evacuation.	Percentage of the population receiving warning messages	Event-based
	Time taken for warning dissemination	Event-based
	Percentage of vulnerable groups safely evacuated	Event-based
Emergency Coordination and Field Response KMC may activate inclusive emergency coordination mechanisms to ensure timely response and support for vulnerable populations.	Average response time	Event-based
	Number of emergency response teams trained in inclusive disaster response and emergency coordination	Annual with refresher training before monsoon/cyclone season
	Number of responders deployed, disaggregated by gender and other relevant social identifiers	Annual
	Percentage of staff trained on SOPs	Annual

Recommendation	KPI	Frequency
Relocation to Relief Camps KMC may ensure safe and inclusive relocation of affected populations to designated shelters during disasters.	Number of shelters mapped	2—3 years
	Percentage of adequacy of shelters relative to displaced population	Post-disaster
	Percentage of vulnerable groups receiving relief kits	Post-disaster
Provisions in Relief Camps KMC may ensure that relief camps provide safe, inclusive, and dignified living conditions for all affected persons.	Percentage of shelters with inclusive facilities	2—3 years
	Percentage of camps with safe cooking systems	During operation
	Number of gender-based violence (GBV) complaints reported/resolved	Real-time
	Percentage of affected persons receiving psychosocial support	Post-disaster
Flood Preparedness and Immediate Response Measures KMC may undertake targeted infrastructure and nature-based interventions to reduce flood risk, protect vulnerable populations, and ensure critical services continue during flood events.	Percentage of drains cleaned before monsoon	Annual
	Number of pumping stations equipped with functional backup power systems	Annual pre-monsoon assessment and post-disaster review
	Number of response kits pre-positioned	Annual
Clearance of Affected Areas and Environmental Safety KMC may undertake safe and environmentally responsible clearance of affected areas immediately after disasters.	Percentage of debris disposed at authorised sites	Post-disaster
	Number of illegal dumping incidents	Post-disaster
	Survival rate of replanted trees	3/6/12 months
	Time taken for the clearance of affected areas and debris removal after disaster events	Post-disaster (daily monitoring until completion)
Loss and Damage Assessment (Inclusive and Ecosystem-Sensitive) KMC may conduct rapid, comprehensive loss and damage assessments to guide recovery planning and ensure vulnerable groups and ecosystems are adequately covered.	Time taken to complete the assessment	Post-disaster
	Percentage of the affected area covered	Post-disaster
	Percentage of records with disaggregated data	Post-disaster
Recovery Planning and Build Back Better KMC may prepare post-disaster recovery plans in consultation with government agencies, financial institutions, NGOs, and community groups to ensure resilient reconstruction.	Percentage of properties retrofitted/relocated	Biannual (2 - 3 yrs)
	Percentage of safe relocations outside risk zones	Biannual
	Number of people trained in livelihoods	Annual
	Percentage of livelihoods restored	Annual
	Percentage of infrastructure restored within target time	Post-disaster

Recommendation	KPI	Frequency
Physical and Mental Health and Social Protection KMC may ensure continued health and psychosocial support for affected populations after disasters.	Number of people receiving medical support	Post-disaster
	Number of mental health sessions	Monthly (post-disaster)
	Percentage of vulnerable population covered under schemes	Annual
Education Continuity and Community Support KMC may ensure continuity of education and social services after disasters.	Time taken to resume schooling	Post-disaster
	Number of children supported	Monthly
Livelihood Restoration and Social Recovery KMC may support livelihood restoration for affected populations, especially informal workers and vulnerable households.	Number of affected households receiving livelihood assistance, disaggregated by gender and other relevant identifiers	Quarterly (post-disaster phase)
	Percentage of informal workers covered under recovery support programmes, disaggregated by type of work	Quarterly
	Number of beneficiaries linked to government welfare/ employment schemes	Quarterly
	Number of livelihood restoration programmes initiated	Annual
	Percentage of disrupted livelihoods restored within the defined timeline	Biannual
	Number of women-led/ self-help group enterprises supported	Annual
	Number of vulnerable households receiving financial assistance/insurance compensation	Quarterly

9. Enabling Governance Structure

Disaster resilience is a multi-stakeholder subject that entails extensive vertical and horizontal coordination. Until recently, the district was the lowest tier of disaster governance in India, steering district-level disaster management plan preparation, response, and recovery in coordination with line departments. However, the DM Act, 2025, further decentralises disaster management by recommending that states constitute Urban Disaster Management Authorities for state capitals and municipal corporations.

In this context, a structured institutional and governance mechanism is proposed to implement mitigation- and preparedness-centric, inclusive, and evidence-based disaster management tailored to address Kakinada's challenges. The proposed structure includes the Urban Disaster Management Authority as an administrative unit and the SDMA and DDMA as coordinating and guiding institutions. A robust data portal, along with adequate awareness-raising, training, and capacity-building measures, can support the proposed institutional structure.

Urban Disaster Management Authority (UDMA)

The State Government may constitute an UDMA for the KMC. The existing Climate Core Team (CCT) of KMC may also be entrusted with the responsibility of UDMA, with the required modifications. Under the DM Act, 2025, the UDMA, chaired by the city's Municipal Commissioner, will plan, implement, and monitor disaster resilience actions.

UDMA will act as a single point of contact for all issues related to city-level disaster resilience, with representation from internal and external departments, including stormwater management, engineering, roads and buildings, urban community development, horticulture, the IT/GIS cell, town planning, electricity distribution corporation, endowments, education and health, forests, and the fire department. It may have an exclusive nodal officer on long-term deputation for institutional coordination and effective functioning.

The State Government may review UDMA's composition periodically and adjust it. Depending on the need for additional expertise, it may be amended accordingly to reflect a broad range of skills and knowledge.

Department of Climate Action

A Department of Climate Action, as recommended under 'Cities 2.0' by Swachh Andhra Corporation, may be formed under KMC[49]. As a coastal city vulnerable to cyclones, flooding, storm surge, and heat stress, the Department of Climate Action will support climate research and development, embed future climate trajectories into disaster-resilience decision-making, and mainstream climate concerns into municipal planning and service delivery. KMC may engage a multidisciplinary team of experts, including climatologists, hydrologists, development scientists, GIS specialists, urban planners, and disaster risk professionals, either in-house or through empanelled technical agencies, as required. The Department of Climate Action may coordinate with IMD and APSDPS to collect and analyse real-time weather data and future climate patterns relevant to the city's context, as well as microclimates in different parts of the city.

The department may also strengthen multi-hazard risk assessment by incorporating climate change aspects and cascading hazards. It may use ICCC for modelling and analysis, and ensure that the evaluation results are collated and stored there, streamlining climate and disaster data management through a single platform. The department may train sectoral departments to maintain climate considerations in their regular operations.

Thus, the two institutional structure recommended for the KMC have two distinct functionalities: while UDMA is for planning, implementation and monitoring and evaluation, Department of Climate Action is for evidence based climate and disaster risk assessment. However, the assessment by Department of Climate Action is the evidence basis for

UDMA to take on-ground action. Although both units are critical for a concerted and comprehensive disaster resilience planning, KMC may adopt a phased approach to streamline the implementation of mitigation measures for the already known risks and gradually move to constituting a dedicated disaster governance mechanism.

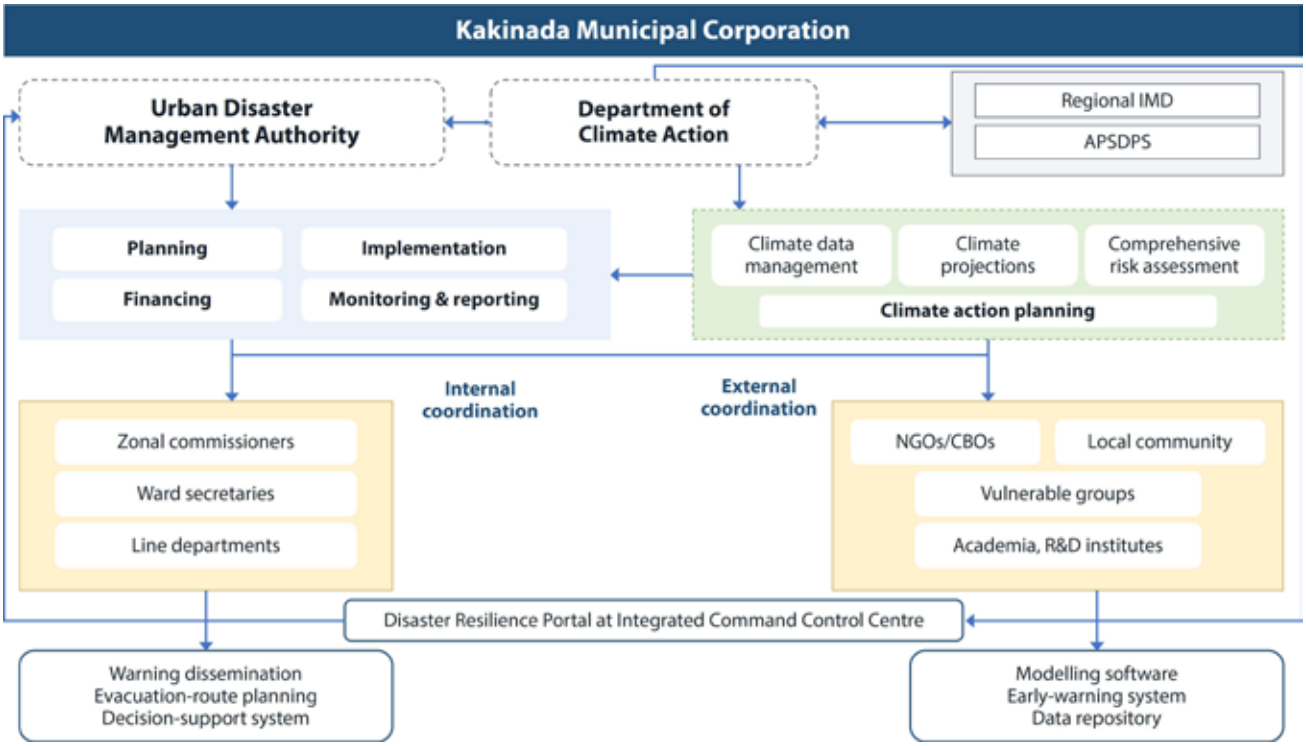


Figure 18: Recommended Governance Structure for Driving Climate-induced Disaster Resilience in Kakinada

9.1. Roles and Responsibilities of UDMA

Planning: UDMA needs to steer multi-hazard risk assessment through the Department of Climate Action; seek technical assistance from multilateral and donor agencies, SDMA, and DDMA; formulate a comprehensive plan; and prioritise actions based on this climate-induced disaster resilience planning framework. It needs to ensure gender equality and social inclusion in risk assessment and planning involves a co-creation process that gives different societal groups genuine influence on decisions that affect their lives, including opportunities to shape priorities, contribute to decision-making processes, and hold stakeholders accountable. UDMA may ensure that sectoral departments mainstream disaster risk into physical plan preparation and sectoral project planning and design. UDMA may provide input into the design of the ICCC's disaster resilience data management system (refer below) and ensure its effective utilisation for monitoring, reporting, and decision support.

Implementation: UDMA needs to oversee, guide, and coordinate the implementation of the disaster resilience plan. It can engage with the Department of Climate Action (refer above), internal and external departments, and local communities to implement proposed interventions in a concerted, participatory manner. It needs to ensure that inclusivity and ecosystem concerns are prioritised in implementing the plan. Implementation in the context of UDMA also entails conducting a holistic loss and damage assessment, facilitating equitable relief and response, and ensuring sustainable rehabilitation and reconstruction to safeguard communities from future risks.

Financing- UDMA may explore the feasibility of allocating a dedicated municipal budget or securing external funding sources to support the efficient implementation of prioritised disaster mitigation actions. Further, UDMA may establish a contingency budget based on the risk assessment to enable timely action during the critical period before a disaster

strikes. To this end, UDMA shall utilise and disburse the response and recovery funds in a well-coordinated and transparent manner.

Monitoring and Reporting- UDMA will monitor the progress of recommended interventions and review and update the plan at regular intervals, taking into account evolving ground conditions.

9.2. Functioning of UDMA

The Commissioner and District Magistrate, in coordination with the State Government, can jointly define UDMA's composition and responsibilities, based on past disaster management experience and inputs from the existing Climate Core Team. Terms of Reference (ToR) should be developed to specify its roles and responsibilities. UDMA may carry out its essential functions through the following approaches:

Departmental Coordination

UDMA needs two levels of departmental coordination: within KMC administration and across state- and district-level multi-departmental representatives, to mainstream city-specific contexts into resilience planning and expedite disaster response and recovery.

- UDMA may convene quarterly coordination meetings with the Commissioner, ADC, Zonal Commissioners and Ward Secretariats to understand on-the-ground challenges, resource needs, and departmental buy-in before updating plans or developing project proposals. The Urban Community Development Department, which anchors the ward secretaries and the Self-Help Group (SHG) network in Kakinada, will play a key role in mobilising SHGs. These groups can support training and skill development initiatives, lead awareness campaigns, and participate in ward-level planning, helping ensure a genuinely consultative and participatory process.
- Sectoral departments within KMC can bring technical insights to strengthen disaster-resilience measures. For example, the Horticulture Department may promote coastal green belts, urban tree cover, and buffer plantations to reduce heat stress and enhance microclimate regulation. Over time, municipal officials are expected to better harmonise DRR strategies with routine planning processes. For instance, sanitation teams can proactively identify elevated or well-drained locations for solid-waste transfer stations to avoid waterlogging and service disruption during heavy rainfall or storm events.
- UDMA can play an important role in resolving operational bottlenecks arising from overlapping mandates or multiple agencies working in silos. In Kakinada, UDMA can serve as a coordinating platform among entities such as the Forest Department, Fisheries Department, Irrigation Department and Coastal Zone authorities to jointly plan and implement measures to strengthen coastal green buffers and restore degraded mangrove belts. UDMA can also strengthen city-level response and recovery by bringing together all relevant line departments, including Urban Community Development, Police, Fire Services, Traffic Police, DISCOM, Revenue, Health, and Education, ensuring that preparedness and action on the ground are unified, timely, and city-specific.
- UDMA may prepare an inventory of tangible resources (JCBs, cranes, ladders, boats, etc.) and intangible resources (skills and knowledge), to assess their adequacy, and explore the feasibility of obtaining external resources during an emergency.

External Coordination

UDMA will also map non-governmental stakeholders, such as NGOs/CBOs, community representatives, the private sector, research institutions, and academia, that can influence disaster resilience planning and implementation. UDMA may collaborate with international and national organisations for their technical assistance in preparing a resilience plan, supporting loss and damage assessment, and designing reconstruction and rehabilitation.

UDMA may convene an annual consultation with NGOs/CBOs and R&D institutes on implementing the proposed actions, achieving the intended impacts, and any required course corrections. It may also arrange Key Informant Interviews (KIIs) with relevant stakeholders to integrate their suggestions into the implementation and updating process. UDMA may also plan structured engagement with communities during peaceful periods, especially with vulnerable communities, to sensitise them to disaster risks and co-create micro-level interventions. This exercise helps integrate gender perspectives and other intersectional factors, such as income level, marital status, physical and psychological disabilities, and age, into decision-making.

UDMA may coordinate community training and capacity building, especially for women, schoolchildren, and informal workers, by engaging with NGOs and CBOs. It may provide training in alternative livelihoods, first aid, and food preservation techniques, among others. Notably, UDMA may reach out to communities before, during, and after a disaster.

Financing Disaster Mitigation

The following process is proposed to mainstream disaster resilience in the municipal budget.

- **Needs Assessment and Prioritisation:** UDMA may conduct comprehensive needs assessments to identify and prioritise interventions from the disaster resilience plan that require financial support. The prioritisation must ensure that the differentiated needs of women, persons with disabilities, the elderly and other vulnerable groups are explicitly considered and included.
- **Financial Evaluation:** Estimate the financial requirements for each identified intervention, considering all relevant costs, including capital, operational, and maintenance expenses.
- **Engagement with Relevant Departments:** The lead department for each of the identified interventions shall prepare a detailed technical and financial proposal highlighting its alignment with the disaster resilience targets and submit it for council approval.
- **Budget Allocation:** Once the municipal council approves the proposals, funds may be allocated from the annual budget, with an earmarked percentage of the budget for GESI-related activities to support effective implementation and accountability for GESI.
- **Periodic Evaluation:** Conduct periodic evaluations to assess the impact and effectiveness of the funded projects. The evaluation process may include tracking budget allocations and expenditure on GESI priorities. Adjustments can be made in the subsequent budget cycle based on performance.
- **Convergence with national and state schemes:** Convergence with existing national and state-level urban development, disaster resilience, and infrastructure programmes such as AMRUT, Smart Cities Mission, 15th Finance Commission grants, State Disaster Response Fund (SDRF), National Cyclone Risk Mitigation Project (NCRMP), and other sectoral schemes to support the implementation of prioritised resilience interventions.

Apart from the municipal budget, UDMA may also seek external funds from national and international sources such as the National and State Disaster Mitigation Fund, Public-Private Partnership projects, Corporate Social Responsibility (CSR) grants, bilateral partners (Japan International Cooperation Agency, GIZ, KfW, AFD), and multilateral agencies (European Union, Asian Development Bank, World Bank).

UDMA shall also track international calls for proposals and grant opportunities, explore financing opportunities through the Making Cities Resilient 2030 portal, and submit project proposals through private climate financing mechanisms such as the C40 Cities Finance Facility and the Transformative Actions Programme.

Monitoring, Evaluation, and Reporting Process:

A structured monitoring, evaluation, and reporting system is essential for effective planning and implementation. The monitoring system has three pillars: formulating Key Performance Indicators (KPIs); establishing a structured mechanism for receiving and reporting information through an automated system; and collating, integrating, and interpreting data to enable decision-making, identify opportunities, assess progress, and facilitate course correction to achieve targets effectively.

All monitoring responsibilities, including defining KPIs, frequency, and targets, preparing a reporting template, and establishing regular reporting arrangements, should be determined at the start of the implementation period. UDMA will supervise and monitor the progress, strive to resolve any inter-departmental coordination challenges, and stay apprised of the transition. If CCT is restructured into UDMA with additional disaster resilience responsibilities, it will also need to monitor, review, and update the CRCAP.

Robust, periodic monitoring of a disaster resilience plan can effectively cover mitigation and preparedness actions. Relief and response can be monitored on a case-by-case basis. A structured monitoring system can be introduced for the recovery and reconstruction phase, rooted in inclusivity, equality, safeguarding eco-sensitive areas, and 'build back better' principles. The M&E process should enable reporting of gender- and social-group-disaggregated impacts to measure progress towards inclusivity and equality. For effective and transparent monitoring and reporting, UDMA can adopt the following approach:

- **Formulating Sectoral Key Performance Indicators (KPIs):** A list of KPIs for the selected actions has been added to help develop periodic reports. The UDMA may decide the action-specific monitoring frequency, and the KPIs may be restructured if needed.
- **Ensure Frequent Data Collection:** It is essential to collect transparent data and information to develop the KPI reports. The Ward Secretariates should support the collection of local-level data and report it to the Commissioner and the ADC.
- **Internal and External Reporting:** It is anticipated that the progress of the climate-induced disaster resilience plan implementation will be reported to APSDMA. UDMA can also report to the MCR 2030 portal to advance from the current Stage A to Stage B. This may raise Kakinada's international recognition for mainstreaming city-level disaster resilience and potentially attract resilience finance.

Review, Evaluation, and Update: The UDMA may review the city's disaster risk at least every five years, with support from the Department of Climate Action. However, regardless of the suggested frequency, a city should conduct a review after any severe climate-induced disaster, such as a 50-year return period flood. This helps assess the impact of the earlier mitigation and preparedness measures. This event-specific review also supports evidence-based decision-making and may reduce future risks. The review and update process may also incorporate new spatial risks and emerging vulnerable communities, based on-the-ground conditions.

UDMA may also assess broader benefits and alignment with international frameworks, such as the SDGs and SFDRR, to reflect how the disaster resilience plan contributes to achieving these overarching global goals. To this end, UDMA, with help from ICCC, can maintain a repository of knowledge products (assessments, plans, impact reports) that stakeholders can access for learning, assimilation, and utilisation. Thus, UDMA contributes to broader knowledge dissemination.

9.3. Embedding DRR with Integrated Command-and-Control Centre (ICCC)

Efficient planning and implementation of city-level climate-induced disaster resilience should be supported by a scientific and realistic database management system. The ICCC can serve as a platform to integrate a climate-induced DRR module. While preparing the climate-induced disaster resilience plan for Kakinada, several discrepancies in disaster data and information were observed. Gaps exist in the capture and management of information on disaster risk,

including data disaggregated by social groups, and information on infrastructure, the economy, and environmental assets. City-contextualised geo-hydrological data, as well as a holistic and accurate account of loss and damage, are also unavailable, preventing scientific decision-making. The disaster-related database is fragmented, sporadic, and not available on a single platform.

KMC may develop a disaster-resilience portal, taking input from UDMA. It may include features to aggregate weather data from IMD and APSDPS stations, as well as hydro-climatic modelling software for simulation and risk assessment. It may include an early warning module to issue flood, and cyclone alerts specific to Kakinada, in coordination with the IMD, the AP State Water Resources Department, and the APSDMA.

The system can also rationalise evacuation routes through GIS-enabled network analysis, enabling quicker responses. This portal can also store and manage city-specific future climate trajectories and disaster risk assessment databases and serve as a decision-support system for UDMA. It can host the disaster resilience monitoring framework for automated recording and reporting through Ward Secretariats and Zonal Commissioners. UDMA can utilise this system as a disaster resilience data repository to support data-driven disaster risk reduction in Kakinada.

9.4. Enhancing Institutional Readiness through Training and Awareness Generation

UDMA officials should be sensitised to disaster mitigation and preparedness measures to drive a major shift in disaster management. Another important aspect is promoting rehabilitation and reconstruction that can withstand future disaster risks. Further, officials need to systematically integrate gender equity and social inclusion principles while planning and implementing resilient interventions across the disaster management cycle. They should understand how to leverage and conserve local ecosystems as disaster buffers.

To enhance UDMA's capacity, KMC, in consultation with the state government, may engage local resilience professionals for short-term skill development. KMC may develop a training calendar and proactively conduct a range of training programmes, workshops, and mentoring sessions to support long-term adoption and practice of disaster-resilient measures.

Core UDMA members could be trained in areas such as disaster-resilience finance, loss and damage assessment, rehabilitation and reconstruction following 'build back better' principles, and GESI-responsive resilience planning. Ground-level officials also need training in planning, implementation, enumeration, and monitoring. These initiatives should extend to the ward level, enabling ward-level administrations to conduct ward-level resilience planning, build social group-disaggregated databases, understand and prioritise the needs of vulnerable groups, and empower local communities to participate actively in disaster resilience planning and implementation.

In the spirit of knowledge exchange, participants in national and international workshops and training sessions can share learnings through internal seminars facilitated by KMC.

Officials, especially ward-level functionaries, will also share this knowledge with local NGOs, SHGs, and other community-level organisations, who, in turn, can raise awareness and build community capacity. This 'training of trainers' approach will accelerate knowledge transfer and potentially strengthen communities' adaptive capacities and skills, and empower them as 'agents of change'.

10. Way forward

Kakinada Municipal Corporation needs to take a proactive approach to translate this climate-induced disaster resilience guideline into a phased, time-bound implementation pathway that consolidates structural measures, institutional reforms, and equitable, inclusive, and ecosystem-sensitive approaches. Initially, KMC should collaborate with the State Government to constitute the Urban Disaster Management Authority (UDMA), formalise its roles and responsibilities, and operationalise the Department of Climate Action as a technical unit co-located with the Integrated Command and Control Centre. Once constituted, KMC needs to roll out the first cycle of capacity building for UDMA, ward secretariats, and line departments on disaster risk reduction, gender and social inclusion, ecosystem-based adaptation, and Build-Back-Better principles using a training-of-trainers model to subsequently reach out to self-help groups, NGOs, and community leaders. A dedicated budget line for the immediately required disaster mitigation and preparedness measures needs to be created, alongside internalising a contingency budget. During this phase, KMC should also develop a prototype disaster resilience portal within the ICCC, starting with basic integration of the IMD and TSDPS database, incorporating KPIs, and setting the foundation for regular tracking and decision support.

Once the governance structure is set up, the plan is to carry out phase-wise planning, implementation, and monitoring. With collaborative and participatory planning, steadfast implementation, periodic review, monitoring and updating and reporting, Kakinada can position itself as a state and national learning hub on urban climate-induced disaster resilience.

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Glossary

Term	Definition
Adaptive Capacity	The ability of people, communities, institutions, and systems to adjust to climate-related risks and changing conditions.
Blue-Green Infrastructure (BGI)	The integration of natural and water-based features, such as parks, wetlands, canals, vegetation, and permeable surfaces, to manage water, improve urban environments, and strengthen resilience.
Capacity Building	Activities such as training, awareness programmes, and skills development that improve the ability of individuals and institutions to plan for and manage disasters.
Compounding Hazards	Two or more hazards that occur together or in sequence and may produce greater impacts than a single hazard alone.
Ecosystem-Based Adaptation (EbA)	The use of biodiversity and ecosystem services to help people adapt to climate change and reduce climate-related risks. Examples relevant to the report include conserving wetlands and mangroves and protecting coastal ecosystems.
Ecosystem Services	The benefits people receive from ecosystems, including water regulation, biodiversity support, and natural protection against some disaster impacts.
Exposure	The presence of people, infrastructure, livelihoods, and environmental assets in places where they may be affected by a hazard.
Gender Equality and Social Inclusion (GESI)	An approach that considers the different needs, barriers, and vulnerabilities of people across genders and social groups, ensuring that disaster planning and resilience measures are equitable and inclusive.
Inclusive Disaster Resilience	An approach to disaster planning that considers the needs and participation of all groups, particularly those who are marginalised or more vulnerable to disaster impacts.
Climate Resilience	Integrating climate risks and resilience measures into routine urban planning, infrastructure development, policies, and public service delivery.
Mitigation	Actions that reduce the likelihood or severity of disaster impacts, including structural measures and ecosystem protection.
Resilience Dividend	Additional benefits generated by an investment in resilience beyond reducing disaster losses, such as improved public spaces, environmental quality, or health.
Cascading impacts	Effects that spread from disruption in one system or service to other connected systems, such as power, water, transport, health, or communications.
Climate-induced hazard	A potentially damaging climate-related event or condition, including cyclones, floods, heatwaves, drought, and sea-level rise.
Climate resilience	The capacity of urban systems, communities, infrastructure, and ecosystems to withstand, adapt to, and recover from climate-related shocks and stresses.
Disaster risk	The potential loss or damage arising from the interaction of hazards with exposure and vulnerability.
Disaster Risk Reduction (DRR)	Measures that prevent new disaster risk, reduce existing risk, and manage residual risk to strengthen resilience.
Preparedness	Advance planning, capacity-building, warning, coordination, and readiness measures that enable effective response.
Risk assessment	The process of analysing hazards, exposure, vulnerability, and potential consequences to understand and prioritise risk.

Term	Definition
Structural Measures	Physical construction or engineering interventions designed to reduce disaster impacts, such as drainage improvements or protective infrastructure.
Non-Structural Measures	Policies, plans, regulations, training, awareness, and institutional arrangements that reduce disaster risk without relying primarily on physical construction.
Vulnerability Assessment	The process of identifying the conditions that make people, infrastructure, ecosystems, or services susceptible to harm from hazards.
Stakeholder Engagement	The involvement of government departments, communities, civil society, businesses, and other relevant groups in planning and implementing resilience measures.
Urban Flooding	The accumulation or overflow of water in urban areas, often associated with intense rainfall, inadequate drainage, or the loss of surfaces that absorb rainwater.
Early Warning Dissemination	The communication of timely, understandable hazard alerts to at-risk people and institutions so they can take protective action.
Build Back Better	Rebuilding and recovering after a disaster in ways that reduce future risk and improve the resilience of infrastructure and communities.
Loss and damage assessment	A systematic assessment of disaster impacts, including damage to assets and losses to lives, livelihoods, services, and economic activity.
Disaster Risk Governance	The institutions, policies, responsibilities, and coordination arrangements through which disaster risks are assessed and managed.
Disaster Risk Financing	The planning and mobilisation of financial resources to support risk reduction, preparedness, emergency response, and post-disaster recovery.
Cascading Impacts	Consequences that spread from one affected system to other connected systems—for example, flooding disrupting roads, electricity, water supply, and health services.

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