CITY WATER RESILIENCE ASSESSMENT

VISAKHAPATNAM

WATER RESILIENCE PROFILE

SIWI

GREATER VISAKHAPATNAM MUNICIPAL CORPORATION GVMC City of Destiny

National Institute of Urban Affairs

Acknowledgements

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Tenneti Beach, Visakhapatnam. © Uday agastya07/shutterstock.com

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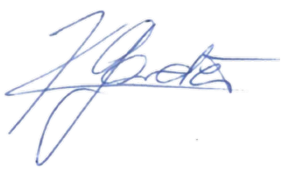
Forewords

Water systems are the lifeblood of a city and constitute a complex ecosystem whose health and balance are critical in making cities inclusive, safe, resilient, and sustainable. To safeguard this, we need a holistic approach to water governance, where water is at the heart of policies, planning, and investments, and where the entire water cycle is taken into account. In the face of a rapidly growing urban population and increasing impacts of water-related shocks and stresses, cities must prioritize resilience actions through four critical elements: understand their system at a wider basin scale; better leadership and strategies; promote a healthy natural environment; and protect health and well-being of the people, all enabled by improved water governance.

Water is a connector across sectors and stakeholders, and water governance is the catalyst and ultimate driver for improved resilience capacity. Where there are governance deficiencies, water interventions will fail, further exacerbating the effects of water challenges. Therefore, understanding a city's current governance capacity is critical, i.e., who makes the decisions, how are those decisions made, who gets to participate in decision-making, and who benefits or is affected?

SIWI believes that only by improving water governance on all levels, from national to local, can we achieve the 2030 Agenda on Sustainable Development, address climate change, and reverse environmental degradation. Governance-based approaches and tools, such as the City Water Resilience Approach (CWRA), can influence cities to prioritize water resilience. CWRA enables city stakeholders to address water related shocks and stresses at policy, financial, regulatory, and capacity levels, leading to improved local governance and decision-making. This approach helps improve coordination within urban water stakeholders and with other critical urban systems, such as energy, food supply, forest, land, and transportation. And it helps understand where new connections are needed. The application of CWRA has informed water resilience strategies for many cities like Visakhapatnam. There is great potential to upscale the tool in other cities of India to achieve resilient and sustainable water outcomes.



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Message

In recent decades, the concept of resilience has gained traction as a strategic planning model for the effective management of urban resources and the mitigation of diverse urban crises. Despite its comprehensive coverage in theoretical studies, practical applications of resilience are very few, especially in the water sector.

The City Water Resilience Approach (CWRA) is an innovative tool for urban water management. It has immense potential to build the water resilience of cities and help them address local water challenges through improved water governance. Since it is a consultative process which involves all relevant stakeholders, it considers all aspects to make city water resilient.

Vishakhapatnam is the first city in India to implement the CWRA tool and I am hopeful that the lessons learnt from this pilot project will inspire a larger cohort of cities in India to use it to improve city's water resilience as well as to contribute in achieving targets set under UN Sustainable Development Goals and LiFe Mission of Government of India.

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New Delhi
6th December, 2023

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Executive summary

The city of Visakhapatnam, commonly known as Vizag, is a coastal industrial port in southeast India, covering around 682 square kilometres (Town Planning Section, GVMC). It was once a small fishing village and, in 1858, it became one of the earliest municipalities. It is now one of five major harbours in the state of Andhra Pradesh.

Kailasagiri Park Vishakhapatnam.
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The city has always been threatened by rising sea-levels, cyclones and flooding. Cyclone Hudhud in 2014 affected the water supply for at least week as water treatment plants (WTPs) were disrupted, and groundwater could not be extracted without power. The power supply lines were broken due to uprooted trees, which took time to repair. Neighbouring states did help with tanker supplies. Water scarcity has also been a major concern for a city trying to meet increasing demand from a growing population, which has impacted its economic development. For instance, according to the Niti Ayog, the Vizag steel plant was forced to operate at reduced capacity in 2016, due to lower water availability.

The city has learnt from past experience and has prioritized improving the sustainability and resilience of its water sector. The municipality has established a sustainability and resilience unit (SRU) under a sustainability and resilience programme (SRP). The SRU will build capacity to enable the water system to adapt

and cope with climate shocks and other water-related stresses, guided by the city water resilience approach (CWRA) with technical support from the National Institute of Urban Affairs (NIUA) and the Stockholm International Water Institute (SIWI). CWRA enables a holistic view of a city's water systems to build urban water resilience.

Key city stakeholders got together in a multi-stakeholder workshop to diagnose the strengths and weaknesses of municipal water system, using quantitative and qualitative indicators. This assessment identified key action areas, as outlined in this water resilience profile. The *Visakhapatnam Water Resilience Profile* illustrates the critical areas in which to build a water resilience capacity to adapt to and cope with the challenges faced. The actions thus identified will guide city stakeholders in their ongoing work on Smart Cities.

Resilience assessment

Leadership and strategy

Under this dimension, the city assessed the goals of 'empowered communities', 'strategic vision' and 'coordinated basin governance'.

The city initiated several programmes to improve community engagement. One such is the *Sachivalayam*, which, through its ward secretariat, helped GVMC facilitate resident participation and strengthen community networks. During Covid-19, authorities were able to reach citizens and provide better services in the city through such established networks. Public authorities regularly share information on existing programmes and policies related to water use with residents through these networks. The municipality has also established a grievance mechanism, the *Spandana* programme, which has helped them improve community engagement. This platform enables municipality officials to share information about government programmes, and residents to raise concerns and issues with decision makers.

The city's leadership is committed to building a safe and smart city that is climate resilient. To this end the municipality has initiated several programmes through the national Smart Cities mission for climate adaptation, water body protection, and green infrastructure.

However, increased funding and political commitment are needed to address critical long-term needs and to promote water resilience as a key principle of the city's water strategies and programmes. Public policy encapsulates various combinations of government intentions, actions, processes, policies, and outcomes,

therefore acknowledgment and advocacy at a political level will be crucial. Despite several ongoing community engagement programmes, considerable effort is still needed to ensure that the local knowledge and cultural values of all population groups is integrated in water policies and strategies.

Planning and finance

Under this dimension, the city assessed the goals of 'effective regulation and accountability, 'adaptive and integrated planning', and 'sustainable funding and finance'.

The roles and responsibilities on regulating the water sector are spread across multiple organizations, whereas the Andhra Pradesh Pollution Control Board, which is at state level, is responsible for environmental regulation. Tariffs and health regulations for water are managed by GVMC. The city needs to improve regulation enforcement in interdependent urban systems, such as land regulation and the Coastal Regulation Zone (CRZ) norms and act. Lack of enforcement has put water and sanitation service providers under immense pressure, given rapid urban expansion and illegal housing developments.

GVMC has made considerable progress by improving their planning through financial support from national schemes and programmes, such as AMRUT and the Swachh Bharat Mission.

Infrastructure and ecosystems

Under this dimension, the city assessed the goals of 'effective disaster response and recovery, 'effective asset management', and 'protected natural environments'.

Multi-hazard early warning systems and effective coordination of disaster management is a priority for the city. The capacity building for disaster response and recovery has been improved. There is now effective coordination between the collector officer's disaster section, GVMC and the City Operation Centre, who collaborate on disaster mitigation and involve the National Disaster Response Force (NDRF), the State DRF, the fire department and officials of the factory department. There are adequate technical and managerial skills to operate key infrastructure and to implement projects. However, improvement is needed in capacity development to ensure effective and successful implementation, both to protect the ecosystem and to build an infrastructure resilient to floods and other hazards. Supply chains are not well managed and water infrastructure system mapping is needed to deploy and maintain adequate resources well in advance of possible disruptions.

The key aspects raised on protected natural environment areas included the need to improve environmental monitoring, restoring water bodies in the city, protecting groundwater from over-abstraction and promoting the use of alternatives sources (such as rainwater harvesting with a tax rebate), not only to meet water supply demand but also to improve the overall water potential.

Health and wellbeing

Under this dimension, the city assessed the goals of 'equitable provision of essential services, 'healthy urban spaces', and 'prosperous communities'.

The long-term sustainability of the city's water resources will depend on efforts to protect its water sources. A major concern is waste disposal impacting natural streams and polluting the sea.

Land use planning is another critical area. To prepare for urban development projects, existing city maps need updating through geospatial mapping using the latest technologies. The city's master plans must be reviewed and updated through an integrated approach that protects and conserves water bodies, such as wetlands.

Another priority area is to generate awareness among residents about efficient water use and ecosystem protection.

Opportunity areas

During assessment workshops, participants prioritized nine critical challenges confronting the city of Visakhapatnam and through multi-stakeholder design exercises they identified opportunities that respond directly to those challenges, as shown in table 1.

Table 1 List of prioritised challenges and opportunities

	The challenge	The opportunities
1	Job opportunities around coastal resources	Innovative marketing system for promotion of tourism and recreational activities, skill development, and business models
2	Spaces and institutionalizing community engagement	Community secretariat
3	Capacity for water resilience at different levels (political to community)	Advocating and building awareness around best practice in urban water resilience
4	Land regulation in water-poor areas (informal settlements)	Guidelines to protect water bodies and to improve monitoring of encroachment around water bodies
5	Access to disaster recovery funds	Develop a proper assessment framework to improve access to disaster funds
6	Early warning dissemination in a timely manner	AI technology and community-based risk management
7	Water quality information dissemination to relevant stakeholders	Interactive web-based GIS portal with real-time monitoring of water data
8	Protection and promotion of green infrastructure	Training modules on green infrastructure and nature-based solutions
9	Monitoring the health of environmental ecosystems	Developing guidelines and capacity development in ecosystem conservation

Abbreviations

AMRUT – Atal Mission for Rejuvenation and Urban Transformation

CAA – Constitutional Amendment Act

CDMA – Commissioner & Director of Municipal Administration

CLAP – Clean Andhra Pradesh

CRZ – coastal regulatory zone

CSCAF - Climate Smart Cities Assessment Framework

CSR – corporate social responsibility

CT & PT – community toilets & public toilets

CWRA – City Water Resilience Approach

CWRF –City Water Resilience Framework

GIS – Geographical Information System

GoI – Government of India

GVMC – Greater Vishakhapatnam Municipal Corporation

IPCC – Intergovernmental Panel on Climate Change

ISO – International Organization for Standardization

MoHUA – Ministry of Housing and Urban Development

MT – metric ton

MW – megawatt

NATCOM – National Communication

NBS – nature-based solutions

NDRF – National Disaster Response Force

NGO – non-governmental organisation

NIUA – National Institute of Urban Affairs

ODF – open defecation free

PPP – public–private partnership

RWA – residential welfare association

SBM – Swachh Bharat Mission

SCADA - supervisory control and data acquisition

SIWI – Stockholm International Water Institute

SRU – sustainability resilience unit

STP – sewage treatment plant

TERI – The Energy Research Institute

ULB – urban local body

UNDP – United Nations Development Programme

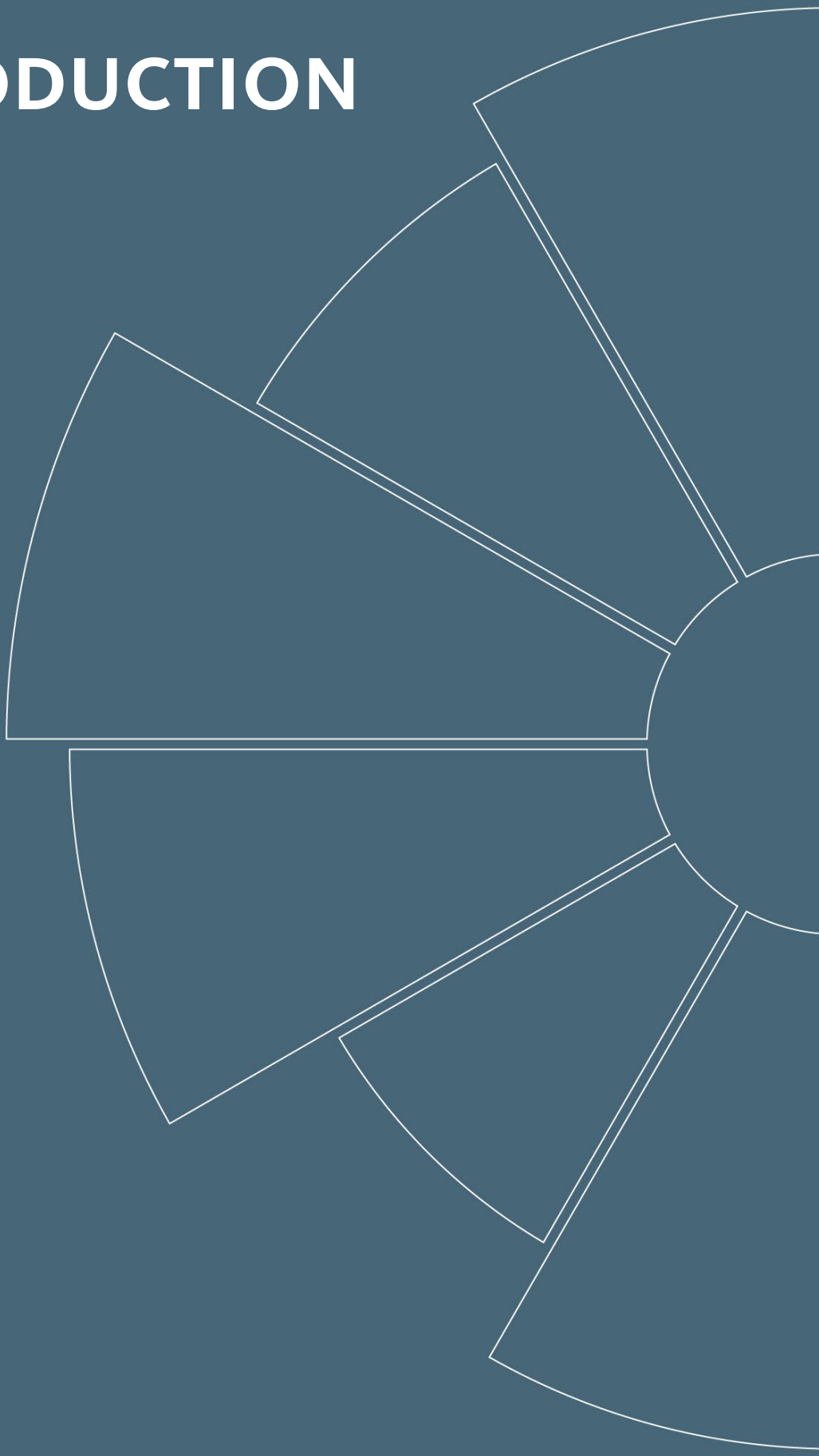
USAID – United States Agency for International Development

VMRDA - Vishakhapatnam Metropolitan Regional Development Authority

VUDA – Vishakhapatnam Urban Development Authority

WTP – water treatment plant

1. INTRODUCTION



Geographical map location of Vishakhapatnam.

Context

The coastal city of Visakhapatnam is one of the largest urban centres in the state of Andhra Pradesh. It is in a small basin surrounded by Yarada hill, popularly known as the Dolphin's Nose (358 m), on the side of the Kailasgiri hills on the north, with the Bay of Bengal to the east. The Kailasa hill range stretches from Simhachalam to Muvvala Vani Palem (MVP) Colony on the north flank of the city. The coast runs northeast to southwest for six kilometres. On the west is the extensive Upputeru tidal basin, which is being reclaimed. Beyond Yarada is a valley then another range of hills.

The climate is generally tropical and humid, with an average annual rainfall of 1,260 mm. September is the wettest month of monsoon season. Every year at least one cyclone from the Bay of Bengal passes through this region, which is a major threat to the city.

Demography

Census 2011 estimates the city's population as 1.73 million (17.28 lakh). shows how the population escalated during 2001–11, as a result of the municipal area being extended to include Gajuwaka municipality and 32 villages within the former VMC – renamed GVMC in 2005. After Bheemili and Anakapalli municipalities and five villages were merged with GVMC, the population increased from 9.82 lakhs to 17.28 lakhs, a growth rate of 91 percent.

Table 1 Vishakhapatnam's population growth (Source: Census of India, 2011)

Year	Population (in lakh)	Decadal growth rate (percent)	Area (sq.km.)
1991	8.24		111.3
2001	9.83	19.2	111.3
2011	17.28	75.8	515

The city's high population growth rate is expected to continue to the 2040s. Most growth will be peri-urban, away from the core city, in vast tidal flats that are prone to such natural hazards as storm surges and tidal inundation from cyclones and tsunami. Vishakhapatnam has witnessed the urban flooding that is one of the emerging challenges for Indian cities due to unplanned growth.

Projections have used various methods (incremental, geometric, exponential, etc.) which showed that 2.4 million people were expected in the GVMC area by 2021, growing to about 5 million by 2041. The slum population of 0.56 million is approximately 30 percent of the total, which is the highest in India. Of the 741 slums in the city, 286 are notified and 455 are non-notified. Water and sanitation infrastructure is very poor in slum pockets. This growth has serious implications for service delivery mechanisms in both core and peripheral areas and requires planning for the infrastructure and sustainability of its operations and maintenance.

Institutional arrangements

The city is divided into 27 wards. In 2005, the government of Andhra Pradesh reconstituted the municipal corporation into the GVMC by extending the jurisdiction and merging Visakhapatnam Municipal Corporation (VMC), Gajuwaka Municipality and 32 other villages. The state government transferred all 18 functions of schedule 12 of the 74th CAA to GVMC.

GVMC operates under a commissioner as head with subheads for 11 departments covering an area of 540 square kilometres.

As GVMC's jurisdiction has been extended its area of service provision has significantly increased, putting pressure on existing staff to monitor and implement the work. Therefore, its human resources and institutional capacities need to be strengthened. GVMC is responsible for water supply, sanitation and storm water drainage management. Within GVMC the roles and responsibilities are divided across departments.

The engineering department is responsible for the planning, design, implementation, operation and maintenance of infrastructure projects and for water supply and sanitation. This is reflected in the projects implemented and the services delivered.

There are 1,400 sanctioned posts in the engineering department, but in 2013 only 1,095 (78 percent) of the posts were filled (CRISIL report, 2013). No numbers are available for how many were in water supply and sanitation (technical and non-technical). Moreover, the awareness of roles and responsibilities is limited, which affects services. One important institutional issue for GVMC is that state government plays a key role in the recruitment and deployment of technical staff and project implementation suffers when staff are transferred.

Responsibility for sanitation is split between engineering, for sewerage, and Visakhapatnam Public Health for sustainable water management, with various wings allotted specific functions. Contact numbers of officers accountable for sustainable water management are publicly available.

Srisailam Dam Border of Telangana and Andhra Pradesh states India.

GVMC has implemented an IT system for lodging complaints via SMS. Its accounts department prepares the municipal budget, and the human resources department looks after staff training and capacity building.

One of the most important issues for GVMC is that the state has not conducted elections in the city and therefore there is no council, no mayor, and no elected ward members. Therefore, the people are unable to participate in city development projects.

Beach at Visakhapatnam, India.
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Water supply and sanitation services

The city relies mostly on surface water for its raw water supply and serves 54.9 percent of the city's 439,335 households through household-level piped connections. There is a supply gap of almost 66 million litres per day and the infrastructure is in need of repair. Evaluated on the basis of service level benchmarks recommended by the Ministry of Urban Development, Vizag's piped water supply scored well on financial parameters (cost recovery and collection efficiency), and all piped water samples tested for quality internally by GVMC and contractors complied with national standards. However, Vizag's piped water supply lagged far behind benchmarks for service availability, coverage, non-revenue water, and metering. Moreover, the high-cost of recovery is attributable to the industrial connections that provide the majority (83.68 percent) of revenues. Since 2005, GVMC has been assessing the feasibility of a continuous piped water supply, but this goal has only recently gained traction under the Smart Cities programme. The city has piloted several related projects, but none have succeeded, as the current infrastructure cannot support 24/7 supply.

GVMC's distribution network supplies water daily for 45 minutes in 70 wards, while two wards (51 and 62) receive water on alternate days. The access to water in slum areas is not adequate, with more than two-thirds of households without a connection and reliant on community taps.

The GVMC's vast Public Health Department, headed by the Chief Medical Officer of Health, is responsible for water and sanitation services, comprising such major activities as sanitation, solid waste management, maintenance of CTs and PTs, the National Urban Health Mission, urban primary health centres (UPHCs), vital statistics, veterinary services, and urban malaria activities. The municipality is taken new

initiatives and approaches to improve their capacity and services to the city. There are nearly 5,750 regular and outsourced sanitation workers and drivers in the department. To improve services, GVMC is implementing 100 percent door to door waste collection in all 98 wards by deploying 628 CLAP (Clean Andhra Pradesh) auto rickshaw vehicles or pushcarts (depending on road width) from 6.30 a.m. to 10.00 a.m. every day, and is carrying out road sweeping and drain cleaning activities.

To increase segregated waste to 100 percent, GVMC has implemented such activities as: i) distributing bins in three colours (to date, 11.5 lakh bins have been distributed to slum households); ii) conducting information, education and communication (IEC) activities to increase awareness in each household, such as using microphones, street plays, hoardings, conducting Residential Welfare Association (RWA) meetings, rallies and so on.

GVMC and JITF Urban Infrastructure Limited are operating a 15 MW per hour waste to energy plant (PPP mode) with a capacity of 1,200 MTs per day.

GVMC maintains 15 processing and recycling units of wet and dry waste for waste to compost and material recovery centres and has initiated several waste management projects: Vyzag Bio Energy Fuel Pvt. Ltd.'s bio-gas and power plant with a capacity of 30 tons per day at an existing dumpsite in Kapuluppada; land reclamation/remediation of 20 acres at an existing dumpsite, with 2.5 lakh MTs of legacy waste processed by Zigma International Ltd.; Pro Enviro Engineers Pvt. Ltd. construction and demolition waste processing plant at Kapuluppada with 200 tons per day capacity. To control plastic pollution, GVMC adopted PWM Rules 2016 vide CR.No 1772/2019 and 773/17 and banned single use plastic and thermocal derived plastic items within municipal limits.

To eradicate open defecation and urination, GVMC has constructed 328 community and public toilets and 14,120 individual household latrines for slum households, with the support of state and central government. To sustain open defecation free (ODF) areas, GVMC is conducting IEC activities (rallies, miking, street plays, displaying hoardings, meetings) in slum areas and has actively participated in Swachh Survekshan since 2015 – achieving 205, 5, 3, 7, 23 and 9 rankings – and a 9 ranking in 2021. The city also achieved ODF certification in 2019, ODF + certification in 2020, and ODF ++ and Water ++ certifications in 2021. The Garbage Free Cities challenge was initiated in 2019, when GVMC achieved two stars, followed by three stars in 2020 and 2021.

Suburbs of Vishakhapatnam.
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Climate change impacts

Climatic shocks come mainly from cyclones, heavy rain, coastal erosion, and floods, exacerbated by local conditions and human activity. Non-climatic shocks, such as pollution of waterbodies, depletion of groundwater, saltwater intrusion, and waterborne diseases are due to human activity.

Both NATCOM in 2012 and a later assessment by the Ministry of Earth Sciences on the climate change prognosis for India indicated that, by the end of this century, extreme weather conditions (such as heatwaves, drought, frequent flooding, severe cyclones and so on) are going to impact different parts of the country. Therefore, robust and long-term mitigation measures need to be put in place to prepare for the worst climate change impacts.

Vishakhapatnam frequently experiences severe cyclones that have devasted it in the past. The IPCC's latest assessment mentioned that the city is at high risk from a rising sea level, especially the impact of coastal erosion.

Heatwaves, flood, drought, cyclonic winds and surges, rising sea levels, are typical meteorological hazards that can affect the city's normal functions and cause loss of life, resulting in direct and indirect economic loss. Physical damage to treatment plants and storm water drains, and power supply failures affecting the functioning of WTPs, STPs and groundwater extraction are typical risks associated with extreme weather conditions and Vishakhapatnam's urban infrastructure is vulnerable. Therefore, city officials need to clearly understand the risks to better prepare for resilience.

Sustainability and Resilience Programme (SRP)

The SRP was started by establishing a sustainability and resilience unit (SRU) in 2021 as an autonomous entity under the GVMC Commissioner, to carry out UNDP-GoI project activities and long-term city initiatives. The SRP, through the SRU will support both city and state in achieving sustainable development and improving resilience.

The main components of the programme are planning, mainstreaming, environment management, disaster management, climate risk management, human resource development, knowledge management, research and innovation, partnerships, collaborations, and convergence. The SRU prepares work plans encompassing all the above components on an annual basis and/or according to need, working in close association with the relevant sections of the city administration, as well as state and central governments, under the supervision of the GVMC Commissioner.

Smart Cities programme

Objectives:

- Achieve a comprehensive, sustainable, and resilient development of Visakhapatnam city
- Support the government of Andhra Pradesh in achieving its sustainable development goals by 2030 and ensuring their long-term sustainability
- Strengthen institutions through planning, mainstreaming, capacity building, knowledge management, technological mechanisms, collaborations, networking, stakeholder engagement, research and innovation and so on
- Promote better governance by adopting citizen-centric approaches in planning and development
- Develop and/or implement policies, frameworks and best practice, as laid out by local, state, and central governments.

The programme supports the GVMC in public health, engineering, city planning, urban community development (UCD), zones, and education for its mission targets of 'health and resilience' and 'liveability'.

It also supports state government and central ministries, along the lines of SRU objectives. The SRU has specialist environment, climate, disaster management, and human resource development cells, each with defined objectives.

Site of destruction after Hudhud cyclonic storm in Visakhapatnam district of Andhra Pradesh, India.
© IMAGO/Xinhua/alamy.com

ClimateSmart Cities Assessment Framework

Urban India has been impacted by climate change for the past two decades, from unprecedented and erratic rainfall, flash floods of high intensity, super cyclonic storms, droughts, and waves of heat and cold. In 2014, the city of Visakhapatnam was ravaged by cyclone Hudhud, 40 people lost their lives and infrastructure damage of over Rs. 21,000 crores was caused. Thousands of trees were uprooted, causing habitat loss and damage to its only biodiversity park.

To understand the current scenario and the need for sustainable urban planning and climate informed development across Indian cities, the ClimateSmart Cities Assessment Framework (CSCAF) was applied by the National Institute of Urban Affairs (NIUA), under the national government's Ministry of Housing and Urban Affairs. NIUA supports centre, state and city level governments in various thematic areas, including climate change and resilience. It uses the CSCAF to guide cities to mainstream climate actions within current and future policies, programmes and projects.

The CSCAF uses 28 progressive and aspirational indicators under the five themes of: i) urban planning, green cover and biodiversity; ii) energy and green buildings; iii) mobility and air quality; iv) water management; and v) waste management. Each indicator not only assesses but also provides guidance.

A total of 126 cities (including 100 Smart cities and some capital cities) undertook the assessment in 2020. Not only was Visakhapatnam one of them, but it was also one of only nine cities to secure four stars in all the indicators. Nevertheless, it did not perform well in terms of water management, for which it only secured three stars.

Water resilience

To meet climate-smart city's objectives and address its water challenges, the city must focus on building its capacity for water resilience. Water resilience describes a capacity to survive and thrive in the face of water-related shocks and stresses – including sudden shocks such as floods, storms and human-caused disruptions, and slow onset events such as drought and rising sea levels, and persistent stresses such as poor water quality, water scarcity or inadequate infrastructure.

Resilience allows cities to anticipate, adapt and respond to disruptions, thus protecting the health, wellbeing and prosperity of the people living and working there. A water resilient city provides high-quality water and sanitation services to its residents during normal conditions and in the face of shock events related to water, exhibiting the capacity to:

- Provide access to high-quality water-related services for all residents, including water supply, sanitation services, and access to water amenities
- Protect residents from water-related hazards, such as drought, flooding, and contaminated water.

To achieve these objectives, all relevant stakeholders involved in the water cycle should be considered, and the relationships between water and other critical urban systems must be well understood.

Evaluating urban water resilience means understanding a city's natural and hydrological setting, its built infrastructure and its unique human, social, political, and economic settings. The water sector operates interdependently with energy, transport, waste management, public health, housing, and a host of other systems. A systems approach also helps account for the important ways governance influences decisions around assets, how socio-cultural systems determine human behaviour, and how these phenomena ultimately impact how physical systems are designed and used in the urban environment. Therefore, a broad, holistic perspective is key to building resilience.

Visakhapatnam's CWRA

The City Water Resilience Approach (CWRA) responds to a demand for new approaches and tools that help cities grow their capacity to provide high-quality water resources for all residents, and to protect them from water-related hazards (provide and protect). The CWRA process outlines a path for developing urban water resilience and provides a suite of tools to help cities survive and thrive in the face of water-related shocks and stresses.

The CWRA is based on fieldwork and desk research, collaborative partnerships with subject matter experts, and direct engagement with city partners. The approach was developed through investigations in eight cities, and consultation with over 700 individual stakeholders. Arup worked with the Stockholm International Water Institute (SIWI), 100 Resilient Cities, and the Organization for Economic Co- Operation and

Development. The city partners were Cape Town, Amman, Mexico City, Greater Miami and the Beaches, Hull, Rotterdam, Thessaloniki, and Greater Manchester. The cities represented diverse geographies and socio-political contexts, and each confronted persistent water-related shocks or suffered chronic water-related stresses, and each is committed to co-creating water resilience approaches.

The CWRA outlines five steps (see Figure 1) to guide partners through an initial stakeholder engagement and baseline assessment, action planning, implementation and monitoring of new initiatives that build water resilience.

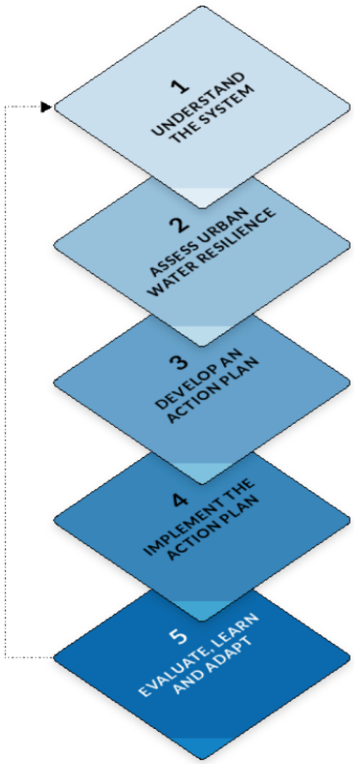


Figure 1 CWRA five steps

Step 1. Understand the system – the city's unique context is appraised to understand shocks and stresses, identify system interdependencies, convene local stakeholders, and map key infrastructure and governance processes. This first step results in city characterization reports that summarize the results.

Step 2. Assess urban water resilience – the city's current practices are assessed using the City Water Resilience Framework (CWRF) to identify existing strengths and weaknesses and establish a baseline against which progress is measured. This second step results in a city water resilience profile, which summarizes the assessment process and outlines potential actions to build resilience.

Step 3. Develop an action plan – to realize interventions that develop water resilience, based on an holistic evaluation of anticipated benefits and costs, and prioritization of projects identified in the second step.

Step 4. Implement the action plan – according to best practice. The CWRA provides best practice guidance for monitoring ongoing actions to ensure that objectives are met and resources are used appropriately.

Step 5. Evaluate, learn and adapt – implementation is evaluated and the plan is adjusted to account for new developments or changing circumstances, and to align with updated objectives for the next period.

The CWRA offers a suite of resources to guide cities through this process that target specific challenges identified by cities in their efforts to build water resilience.

OurWater

OurWater is a digital tool that helps cities better understand the types of shocks and stresses they confront, their impact on natural and manmade infrastructures, and the interaction between key stakeholders involved in urban water management. The OurWater tool is used in Step 1 of the CWRA to map the infrastructure and governance arrangements that define the urban water system.

City Water Resilience Framework (CWRF)

The CWRF assesses the resilience of a city to water-based shocks and stresses, allowing it to identify the strengths and weaknesses of its urban water system and to prioritize future action. Understanding their resilience helps cities formulate a clear vision of what urban water resilience means to them, including: what specific conditions must be in place to achieve this vision; what efforts will be required to build resilience; and what actors are involved. It is the primary tool used in Step 2 and is the focal point for workshops conducted in the city.

Workshops in Visakhapatnam assessed the metropolitan area against a model of water resilience – comprising dimensions, goals, sub-goals, and indicators – as described in the CWRF. The innermost ring of the CWRF consists of four dimensions, critical areas for building resilience.

Within each dimension are the resilience goals that cities should work towards to build resilience in that area. Hybrid goals, which are marked in a different colour, refer to goals that can be placed in more than one dimension.

Resilience sub-goals identify the critical elements for realizing each goal. They provide additional detail and help guide the concrete actions that help realize each goal. Finally, the outermost layer of the CWRF wheel consists of indicators, which measure how the city performs according to each area.

The City Water Resilience Framework (CWRF)

The CWRF, represented in the form of a wheel (see Figure 2) has been developed as a holistic, comprehensive, and technically robust tool to assess urban water resilience and inform decision-making and investments to address urban water challenges. It integrates human, societal, environmental, and infrastructural factors, and the governance elements that are necessary for building urban water resilience.

The water resilience indicators help measure complexity when direct measurement is either difficult or impossible. Responses to indicator questions help identify strengths and weaknesses, and measure progress over time.

The CWRF takes a pioneering approach to measuring resilience through collaborative workshops dedicated to discussing qualitative indicators, supplemented by quantitative indicators that provide additional detail and help validate qualitative results. This mixed approach has been adopted because elements of resilience – especially those related to water governance – can be difficult to measure quantitatively. For example, a

quantitative indicator might suggest whether a long-term strategy exists, but not whether the strategy is a good one or if it has been properly implemented.

The workshop approach allows for a diversity of views on the same subject, gauges general perceptions of system performance, and creates an opportunity for capacity building and dialogue between stakeholders. This approach also reveals how much consensus exists between different stakeholders on any given topic. The assessment can be conducted over a single week (with additional quantitative indicators gathered later), which reduces time and costs.

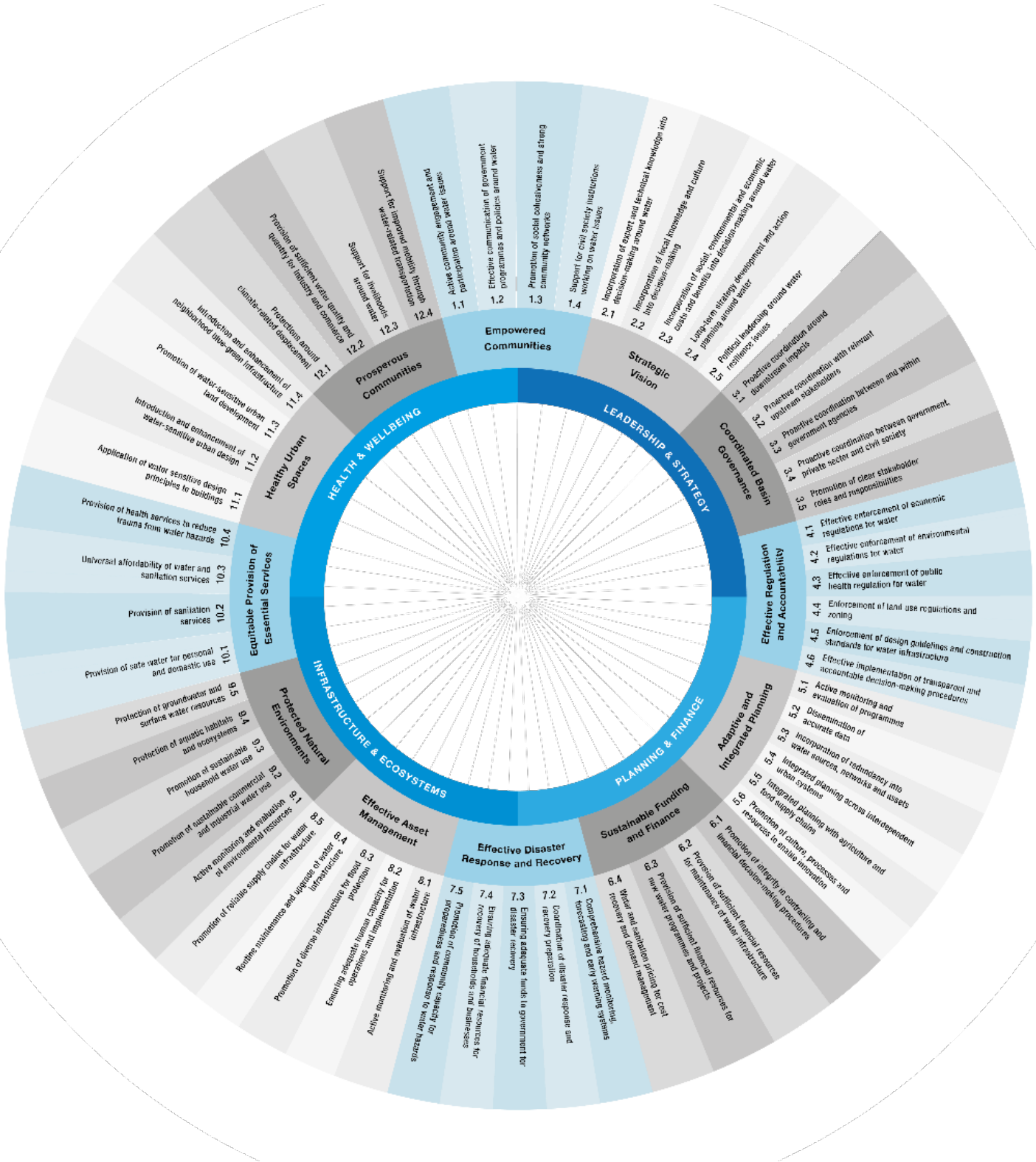


Figure 2 The City Water Resilience Framework (CWRF) wheel outlining the water resilience dimensions, goals and sub-goals

Workshop methodology

This section describes the approach taken to assess water resilience in Visakhapatnam. Three day workshops were held with stakeholders to assess the city's current water resilience and to identify actions that will promote resilience-building activities.

The workshops were held in person in the city, keeping the official protocols around Covid-19 restrictions. Each group had an in-person facilitator and a rapporteur to take notes. They were supported by plenary facilitators from NIUA and virtual facilitators from SIWI. The plenary sessions were held in English. The group discussions were held in both Telegu and English, depending on the preference of the attendees.

The workshops were:

- Day 1: Water resilience assessment workshop
- Day 2: Expert consultation workshop
- Day 3: Visioning workshop

Stakeholders

The water resilience assessment workshops gathered subject matter experts from government, academia, civil society, and the private sector to participate in round-table discussions focusing on the city's resilience to water challenges. This included representatives from the Greater Visakhapatnam Municipal Corporation (water supply section), Andhra University, Visakhapatnam district's irrigation department, National Institute of Oceanography (NIO), the Indian Meteorological Department's (IMD) cyclone warning centre, Visakhapatnam Port Trust (VPT), Groundwater Board, Andhra Pradesh Pollution Control Board (APPCB).

Water resilience assessment workshop

The objective of the assessment workshops was to evaluate the resilience of the Visakhapatnam's water system by analysing its strengths and weaknesses using the CWRF. Results from this workshop informed action planning in the visioning workshop.

Participants in this multistakeholder workshop had diverse backgrounds and expertise. They scored a set of qualitative water resilience indicators in the CWRF through an in-depth discussion to assess and evaluate Vizag's current performance around water resilience. After this assessment workshop, the city could see which areas and dimensions it needed to improve to build water resilience.

Workshop programme

Introduction to the CWRA – The session began in plenary with keynote remarks from the GVMC Commissioner followed by an introductory presentation by NIUA on the climate assessment of Visakhapatnam, Smart City Mission. SIWI joined the workshop

virtually to introduce CWRA and the day's agenda. An Arup CWRA expert also joined virtually to share examples of CWRA implementation in African cities.

Indicator Assessment – Attendees were split into six groups based on their area of expertise and to reflect a range of perspectives in each group. Each group was given two goals to assess, based on the background and expertise within the group.

Table 2 Allocation of goal assessments

Table No.	Goals assessed
Table 1	Empowered communities Prosperous communities
Table 2	Strategic vision Effective regulations and accountability
Table 3	Coordinated basin governance Sustainable funding and finance
Table 4	Adaptive and integrated planning Healthy urban spaces
Table 5	Effective disaster response and recovery Effective assets management
Table 6	Protected natural environments Equitable provisions of essential services

- At each table a facilitator introduced each new indicator by reading its name out loud, then allowing time for participants to read guiding criteria and to take notes
- The facilitator asked each participant to provide an initial score, with a minimal explanation.
- Once all participants had reported, the facilitator encouraged them to explain their scores and share their views with the group.
- The facilitator then asked participants to discuss the indicator and provide a final score.
- The guiding criteria asked participants to understand each indicator and score.
- Scores were marked on the indicator sheet.
- Discussion of each indicator lasted approximately 10-15 minutes.

Expert consultation

The expert consultation was held on day two to reflect on the discussion notes and assessment results and to compile the scores for a preliminary analysis by the SIWI, NIUA and SRU team, along with the group rapporteurs and facilitators.

This resulted in the project team then framing 15 challenge statements that reflected the critical challenges identified by the city stakeholders.

Visioning workshop

A combined visioning workshop was held on day 3, during which participants from the assessment workshop reconvened to identify specific opportunity areas that could be incorporated in future strategies to improve the resilience of the city's water systems based on initial findings of the resilience assessment.

Workshop programme

Presentation – The project team presented preliminary results from the assessment workshop and highlighted the key challenges facing Vishakhapatnam, which participants were asked to discuss.

The fifteen challenges statements identified in the expert consultation workshop were presented, followed by an open discussion in the plenary. Additional inputs from participants were noted and integrated.

Identification of opportunities – From the fifteen challenge statements, participants selected nine to work on throughout the day to identify opportunities for building resilience and to outline specific actions that advance these opportunities.

- Attendees were split back into their assessment workshop groups, with the same facilitator and rapporteur
- Each group worked on the challenge statements that related to the dimensions and goals they had assessed.

Participants were given two worksheets to fill in which helped them to discuss through to identify and draft the actions.

- Root cause analysis – each table identified underlying root causes for the problem addressed by each challenge statement. Worksheet A (see Figure 3) offered a fish-bone analysis that covered social and environmental, governance (financial, policy, capacity, monitoring and evaluation, regulations), infrastructure and technology and other underlying contributory causes.
- Ideation and proposed intervention – on worksheet B (see Figure 4), participants developed concrete interventions, based on the identified root causes. The ideation phase was broken down into key questions that were addressed by the group to frame a implementable intervention, including: need assessment of the challenge; ideation on how to address the need; and defining an intervention idea. Participants also identified the beneficiaries and the enablers, that is: available assets and resources; critical next steps in the short and long terms; key decision makers and responsible stakeholders to design and implement the intervention; and the shocks and stresses the action might respond to.

The workshop concluded with a short feedback and reflections session that identified ways to improve CWRA workshops and for additional comments that might guide the development of the Vishakhapatnam Water Resilience Profile and integrate the identified interventions into existing GVMC programmes and projects.

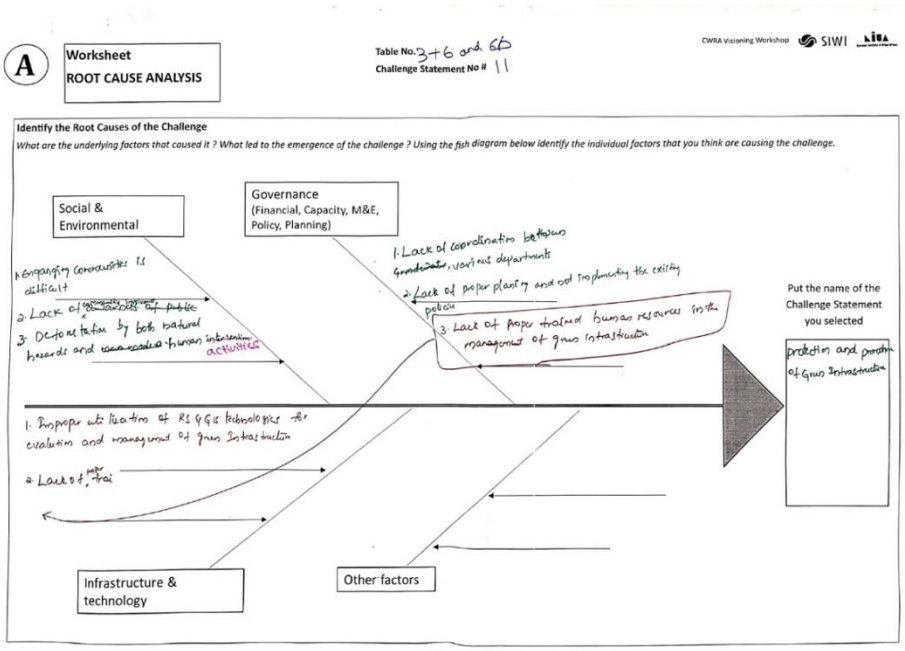


Figure 3 Example of group work on worksheet A (root cause analysis)

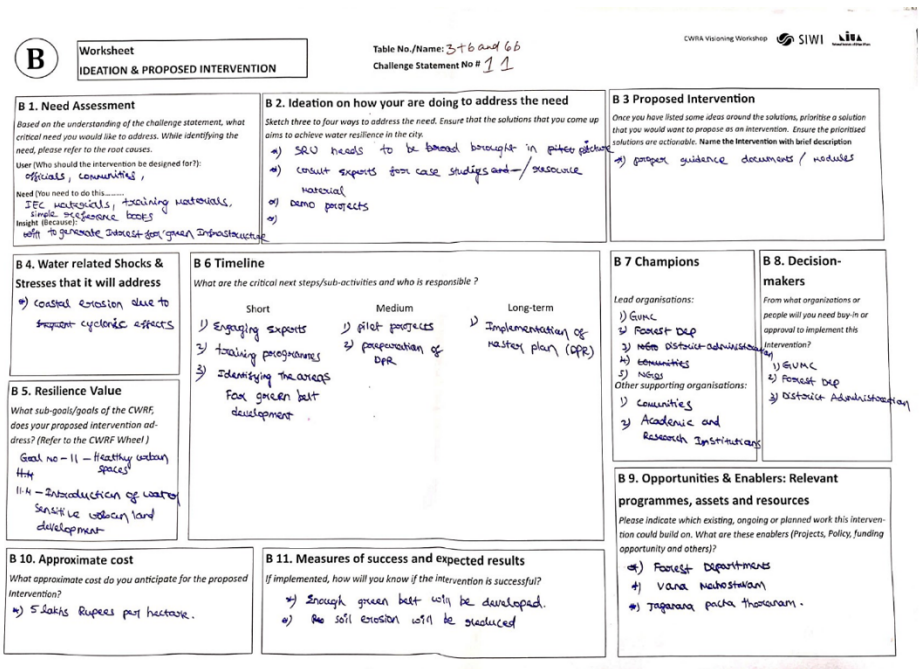
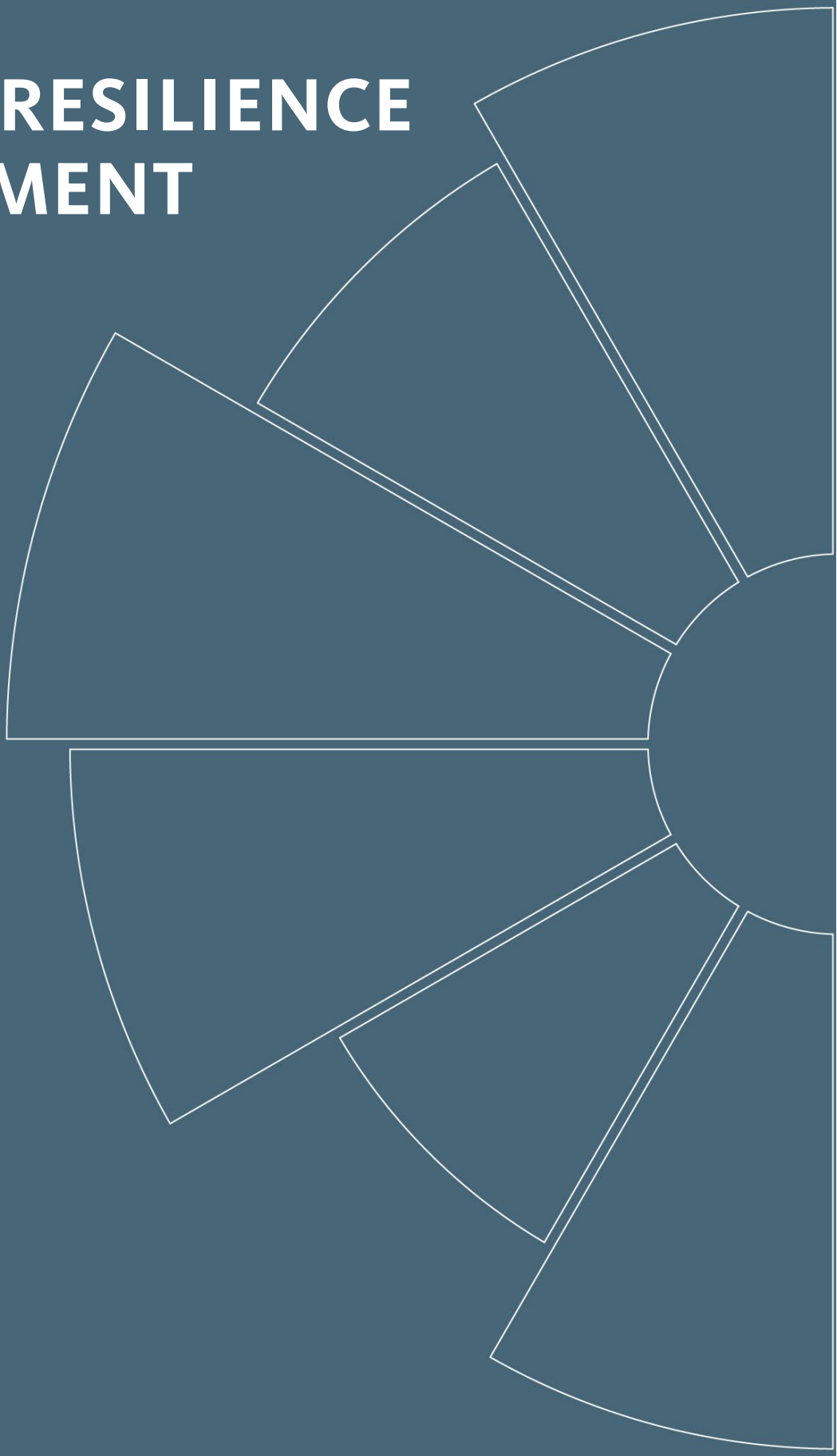


Figure 4 Example of group work on worksheet B (ideation and proposed intervention)

2. WATER RESILIENCE ASSESSMENT



Indicators describe the ideal or best-case scenario, and each indicator score reflects how well Visakhapatnam is currently performing when compared against that best-case. For example, workshop participants were asked to reflect on whether the statement 'a long-term strategy is in place to guide projects and programmes that build water resilience over time' accurately describes current practice in Visakhapatnam.

To help guide discussions, participants were provided with guiding criteria, which were designed based on desk research and expert inputs, that identify important considerations for each indicator. They establish a common language and frame of reference for participants, who often bring different perspectives, interests and expertise to the conversation.

Fishing harbour in Visakhapatnam, India.
© SNEHIT PHOTO/shutterstock.com

This section presents all the indicator questions, organized according to each sub-goal.

The Visakhapatnam Water Resilience Profile builds upon consultation with the city's SRU to understand the current urban water resilience capacity and the water-related shocks and stresses faced. Hybrid assessment workshops were hosted in December 2021. The CWRA team then worked closely with the SRU, with support from NIUA, to develop the city's profile based on workshop findings.

Indicator scores

The scores shown reflect the median score from the table, taken from all participants at the end of each round-table discussion. They range from 1 (poor, significant improvement is needed) to 5 (optimal, no improvement is needed).

Indicator scoring scale

4.5 to 5 – Optimal

This indicator fully reflects conditions in the city. No improvement is required.

3.5 to 4.4 – Good

This indicator mostly reflects conditions in the city. Minimal improvement is required.

2.5 to 3.4 – Fair

This indicator somewhat reflects conditions in the city. Some improvement is required.

1.5 to 2.4 – Low

This indicator mostly does not reflect conditions in the city. Significant improvement is required.

1 to 1.4 – Poor

This indicator does not at all reflect current conditions in the city.

N/A

This indicator is not relevant to the city.

Interpreting results

The indicator assessment results for each water resilience goal are shown in Figure 5.

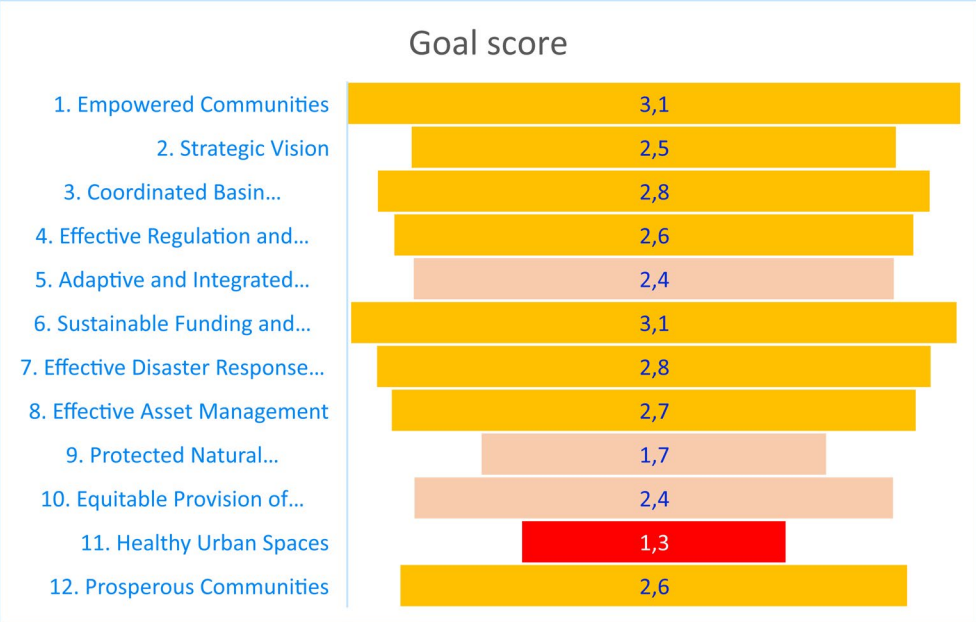


Figure 5 Water resilience goal scores

The CWRF wheel provides a snapshot of Visakhapatnam's strengths and weaknesses in building its resilience to water-related shocks and stresses. It describes how the area performs against a best-case scenario for each of the 62 sub-goals. Scores for all resilience sub-goals are along the outer edge of the wheel, while average scores for resilience goals are in the inner ring (Figures 6 and 7).

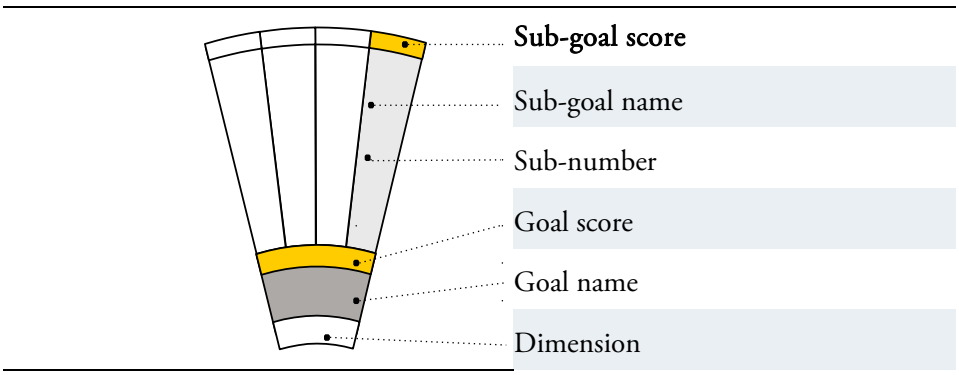


Figure 6 Explanation of wheel section

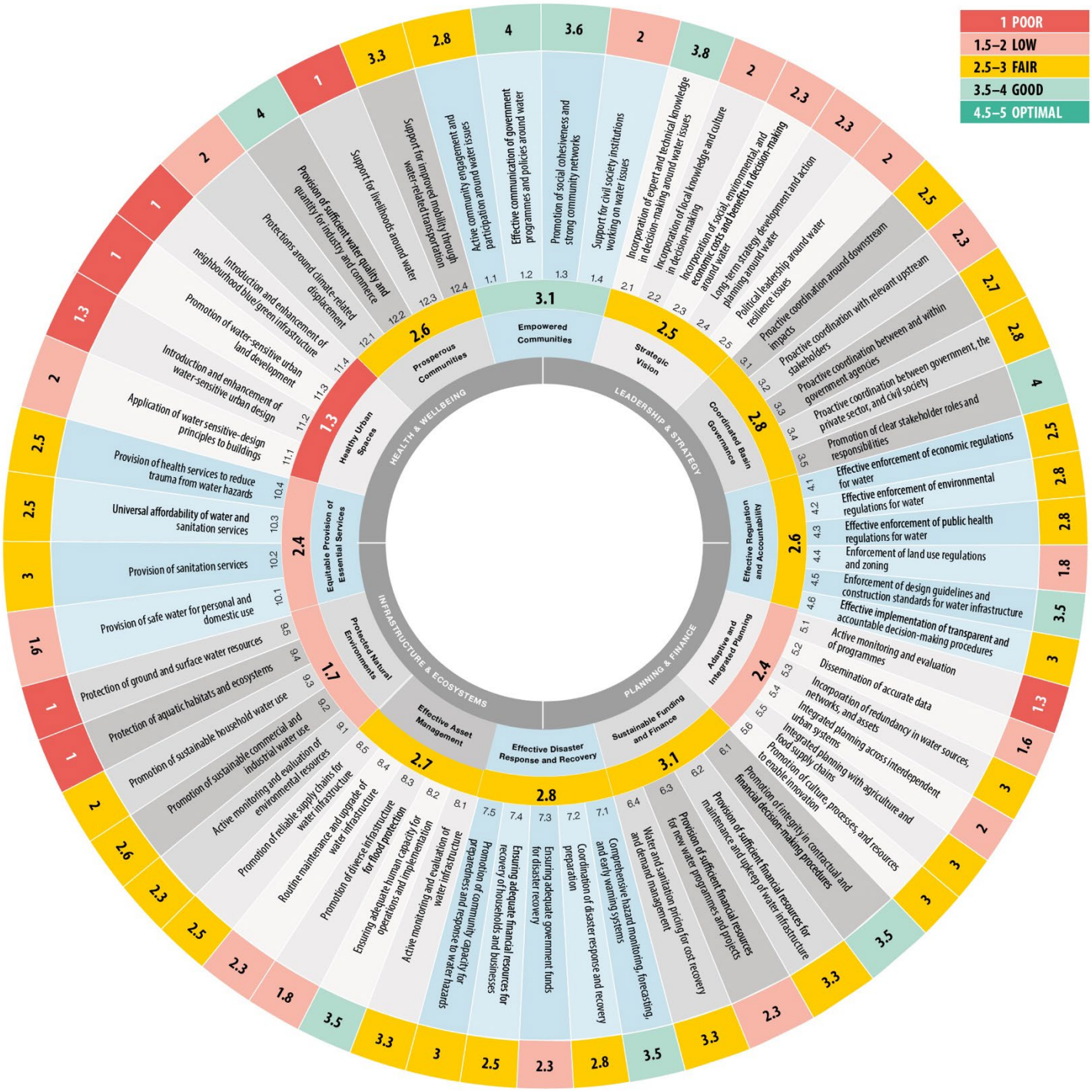


Figure 7 The City Water Resilience Framework (CWRF) wheel outlining the water resilience dimensions, goals and sub-goals for Visakhapatnam

Ramakrishna beach of Vizag city.
©Abir Roy Barman/shutterstock.com

Leadership and strategy

Under this dimension, the city assessed the goals of 'empowered communities', 'strategic vision' and 'coordinated basin governance'.

The city has initiated several programmes to improve community engagement. One through its ward secretariat, the *Sachivalayam*, has helped GVMC facilitate resident participation and strengthen the community network. During Covid-19, authorities were able to reach citizens and provide better services in the city through such established networks. Public authorities also regularly share information with residents on existing programmes and policies related to water use through these networks. Alongside, the municipality established a grievance mechanism, the Spandana programme, which has helped them improve community engagement. It is a platform for municipality officials to share information about different government programmes and for residents to raise concerns and issues with decision makers.

The city's leadership is committed to building a safe and smart city that is climate resilient. To this end the municipality initiated several programmes in climate adaptation, water body protection, green infrastructure, and the national Smart Cities mission. However, increased funding and political commitment are needed to address critical long-term needs and to promote water resilience as a key principle of the city's water strategies and programmes. Public policy encapsulates various combinations of government intentions, actions, processes, policies, and outcomes, therefore acknowledgment and advocacy at a political level will be crucial. Despite several ongoing community engagement programmes, considerable effort is still needed to ensure that the local knowledge and cultural values of all population groups is integrated in the water policies and strategies.

1. Empowered communities

1.1 Active community engagement and participation around water issues

Qualitative indicator

Legal and institutional frameworks and mechanisms promote active, free, and meaningful participation around issues related to water supply, sanitation, drainage, and flooding.

Qualitative score (2.8/5)

Summary of round-table discussion

The participants felt that although there might be institutional frameworks and participatory programmes, their implementation must be strengthened, particularly when it comes to maintaining drainage systems and flooding. Individual rainwater harvesting pits should be maintained to prevent flooding of low-lying areas and some active community engagement is needed. There have been efforts to improve water infrastructure and drainage systems, under the 15th finance commission, with financial support. This provides an opportunity to improve participatory approaches.

The participants also discussed a customer-service provider engagement, where they felt that customer feedback and complaint systems must be strengthened. Complaints are being registered on different platforms but not responded to on time or adequately.

1.2 Effective communication of government programmes and policies around water

Qualitative indicator

Mechanisms ensure that comprehensive information on government programmes and policies are disseminated to all stakeholders

Qualitative score (4/5)

Summary of round-table discussion

Participants agreed that information on government programmes is well disseminated through official government channels, including the ward secretariat system, consultation meetings, and media (print, social media, television). There are other programmes, such as the Smart Poles function under the SMART City initiative, set up across the city to monitor and disseminate information during emergencies.

Citizen consultations, focus group discussions, and campaign programmes are conducted by the municipality at community level, but participants felt that focused awareness programmes should be conducted on a regular basis. The GVMC's SRU human resources cell has designed public outreach and training programmes for civil society organizations and schools. The state pollution control board runs a number of outreach programmes, focused on water and solid waste management. The city is also working with i the National Institute of Urban Affairs (NIUA) to initiate an urban observatory, for data narrative to be provided to relevant stakeholders, including citizens.

1.3 Promotion of social cohesiveness and strong community networks

Qualitative indicator

Inclusive and participatory social networks (formal and informal) enable communities to learn from each other, self-organize, and act collectively in times of need.

Qualitative score (3.6/5)

Summary of round-table discussion

Ongoing *Sachivalayam* programmes and ward administration efforts have enabled communities to act collectively. For instance, during Covid-19, authorities were able to reach citizens and provide better services in the city through such established networks. The ward secretariat/*Sachivalayam* system was established in 2019 and is working effectively on good governance. During the Hudhud cyclone such a system was not in place but most of the community actively came forward to support government disaster relief operations. This provided learnings for the government and communities to establish such programmes.

1.4 Support for civil society institutions working on water issues

Qualitative indicator

Mechanisms ensure that financial, institutional, and technical support is provided to civil society institutions working on water issues

Qualitative score (2/5)

Summary of round-table discussion

Local government is taking on the support of civil society in dealing with water issues, mainly related to rainwater harvesting, water sanitation and hygiene, and solid waste management. Legal mechanisms, such as the Walta Act, promote water conservation and tree cover, and regulate the exploitation and use of ground and surface water to protect and conserve water sources, land and the environment, and all connected matters. Reports and publications support civil society in implementing water conservation efforts, such as rainwater harvesting. Scientists develop designs that can be implemented by the public. Rotary clubs encourage household level rainwater harvesting. However, efforts are needed to provide financial and technical support to civil society and community organizations. There are gaps that need to be addressed, such as insufficient funds and inefficient planning for funds, and a lack of coordination between organizations and between organizations and government.

2. Strategic vision

2.1 Incorporation of expert and technical knowledge into decision-making around water issues

Qualitative indicator

Technical knowledge is available, understood, and continuously incorporated into decision-making around water issues.

Qualitative score (3.8/5)

Summary of round-table discussion

The city administration receives technical support from both local and other water experts, covering national and international agencies. Andhra University, individual consultants and NGOs play a local key role. National organizations include National Institute of Urban Affairs (NIUA), The Energy and Resources Institute (TERI), University of Centre for Environmental Planning and Technology(CEPT), National Environmental Engineering Research Institute (NEERI), Environment Protection Training and Research Institute (EPTRI), Birla Institute of Technology & Science, Pilani (BITS-Pilani), Indian Institute of Technology(IIT) and others. GVMC provides the Port Trust with information that helps in their decision-making and also works closely with institutes such as TERI and IIT in water and wastewater technologies to develop programmes and projects around climate resilient infrastructure. Through programmes with development organizations such as USAID and UNDP, the municipality has been able to define mission targets that strengthen its goals around resilience.

2.2 Incorporation of local knowledge and culture into decision-making

Qualitative indicator

Local knowledge and cultural values of all population groups are referred to in decision-making around water issues.

Qualitative score (2/5)

Summary of round-table discussion

Local people need to be involved in decision-making processes through different bottom-up mechanisms to address the city's water challenges. For instance, by conducting public outreach programmes that prioritize the effective and meaningful participation of local communities and residents during all stages of project design, implementation and monitoring. In many states traditional and indigenous practices have been used to solve issues: the Nalgonda technique for removing excess fluoride in groundwater in Telangana state; in Srikakulam's urban mandals (district blocks or divisions) for groundwater quantity and quality issues.

2.3 Incorporation of social, environmental, and economic costs and benefits into decision-making around water

Qualitative indicator

The social, environmental, and economic impacts of increased water resilience are understood and incorporated into short-, medium-, and long-term decision-making around water issues.

Qualitative score (2.3/5)

Summary of round-table discussion

The participants raised the inadequate evaluation of ongoing and completed projects. Only economic impacts are considered not the environmental aspect, with the lowest priority given to natural resource conservation, which needs immediate attention to build a resilient city. Environment impact assessment studies need to be prioritized and implemented for any planned projects.

2.4 Long-term strategy development and action planning around water

Qualitative indicator

A long-term strategy is in place to guide projects and programmes that build water resilience over time.

Qualitative score (2.3/5)

Summary of round-table discussion

Most current approaches are short-term, based on planning and strategies that address immediate priorities in the water challenges faced by the city. Participants felt that long-term strategies must be developed to build resilience, that other relevant issues and challenges are not addressed, and that strategies are not communicated to target audiences. Also, inadequate human and technical resources challenge the ability to develop long-term planning and strategies for water resilience. Therefore, financial plans must be shared with all relevant stakeholders before any intervention and government officials must be trained to address the water- and climate-related shocks and stresses the city faces.

2.5 Political leadership around water resilience issues

Qualitative indicator

Political leadership promotes resilience as a priority issue in government decision-making.

Qualitative score (2/5)

Summary of round-table discussion

Public representatives need to participate in the conservation of urban water bodies and to promote water and climate resilience efforts. Recent developments have created such opportunities, for instance, after a gap of 11 years the council formed urban local bodies (ULBs). The capacity of a representative must be built on environment and climate aspects to promote water resilience at different levels. A is budget allocated, which could be utilized for water resilience efforts. City leadership must recognize the importance of water resilience and integrate it in policy and practice. Water resilience policies and strategies must be developed. Public policy is a combination of government intentions, actions, processes, policies, and outcomes, therefore acknowledgment and advocacy at a political level is crucial. There is no special representative responsible for water resilience priorities.

3. Coordinated basin governance

3.1 Proactive coordination around downstream impacts

Qualitative indicator

Coordination between city stakeholders and relevant downstream stakeholders minimize downstream impacts.

Qualitative score (2.5/5)

Summary of round-table discussion

Participants felt that mechanisms and guidelines must be developed to protect downstream water impacts. Currently, the city does not prioritize this aspect of basin governance and upstream–downstream implications. Treated wastewater is usually used for watering golf courses, while downstream locations are mostly beach areas, which need to be protected. Visakhapatnam is a critical stakeholder.

3.2 Proactive coordination with relevant upstream stakeholders

Qualitative indicator

Frameworks and mechanisms promote coordination between city stakeholders and relevant upstream stakeholders on water issues.

Qualitative score (2.3/5)

Summary of round-table discussion

Industry is usually the key upstream water user, using a supply that is diverted from the river Godavari. The major water supply company, the Visakhapatnam Industrial Water Supply Company (VIWSCO) has agreements with industry.

In reference to upstream–downstream coordination, participants discussed that quality of water sources and bodies must be regularly monitored, updated, and shared with all concerned stakeholders. Water testing laboratories need to be maintained that facilitate such activities.

3.3 (A) Proactive coordination between and within government agencies

Qualitative indicator (A)

Coordination exists between different government agencies operating at various administrative levels to define and implement water priorities.

Qualitative score (2.8/5)

Summary of round-table discussion

There are standardized operational procedures developed by ULBs, for different government agencies in the city to collaborate and engage in water project design and implementation. The city also engages with central authorities, such as the Central Ground Water Board (CGWB) and the Central Water Commission (CWC), as and when needed.

Existing programmes provide opportunities to strengthen coordination between government agencies within the city, such as those under the 15th Finance commission and AMRUT 2.0.

Different administrative procedures need to be fulfilled before a programme is designed and implemented that require approval from different agencies, sometimes outside the water sector. This requires effective coordination mechanisms.

3.3 (B) Proactive coordination between and within government agencies

Qualitative indicator (B)

Coordination exists within government agencies to define and implement water priorities.

Qualitative score (2.5/5)

Summary of round-table discussion

Coordination between such government agencies as the water works and public health departments is functioning well within the GVMC. Coordination between administrative and technical offices must be strengthened. Participants discussed that often the roles and responsibilities within government agencies are not clear, which needs to be improved. Therefore, mechanisms must be developed for project design and implementation in which roles are clearly mentioned.

3.4 Proactive coordination between government, private sector, and civil society

Qualitative indicator

Frameworks and mechanisms promote dialogue and deliberation around water and resilience issues between government and non-government actors.

Qualitative score (2.8/5)

Summary of round-table discussion

The discussion highlighted the Spandana (grievance mechanism) programme, which provides an opportunity for people to raise concerns and requests with the municipality in relation to water, electricity, and sanitation services. This state programme occurs on a weekly basis, led by the commissioner with all department heads. It was also raised that such programmes must be strengthened to address issues in a timely manner and to integrate the learnings in newly developed water programmes and projects.

Coordination between government and non-governmental stakeholders during emergencies is functioning well but funds must be allocated to build the capacity of government officials to improve this engagement and communications. Deliberation between non-government actors and government around water is rare and needs to be improved.

3.5 Promotion of clear stakeholder roles and responsibilities

Qualitative indicator

Frameworks and mechanisms clearly define the roles and responsibilities of water stakeholders.

Qualitative score (4/5)

Summary of round-table discussion

Participants discussed that the state government has given jurisdiction to the GVMC, as a key authority when it comes to managing water in the city. The Visakhapatnam Metropolitan Region Development Authority (VMRDA) has a separate mandate for managing urban development. Other state level stakeholders, such as the Andhra Pradesh Pollution Control Board, manage the regulations around water quality, wastewater, and treated water. The roles of key authorities are often clearly defined, whereas the roles and responsibilities within agencies are not clearly specified.

 A view of Vizag port from Venkateswara Temple Andhra Pradesh.
©Bottle Brush/Balan Madhavan/alamy.com

Planning and finance

Under this dimension, the city assessed the goals of 'effective regulation and accountability, 'adaptive and integrated planning', and 'sustainable funding and finance'.

The roles and responsibilities on regulation in the water sector is spread across multiple organizations, while environmental regulation is under the Andhra Pradesh Pollution Control Board, which is at state level. Tariffs and health regulations for water are managed by GVMC. The city is concerned about improving regulations enforcement in other interdependent urban systems, such as land regulation. Rapid urban expansion and weak enforcement of illegal housing development on the hill slope has put water and sanitation service providers under immense pressure. Although there are existing regulations, such as the Coastal Regulation Zone (CRZ) norms and act, their enforcement must be strengthened.

GVMC has been able to make considerable progress in improving their planning through the financial support received from national schemes and programmes, such as AMRUT and the Swachh Bharat Mission.

4. Effective regulation and accountability

4.1 Effective enforcement of economic regulations for water

Qualitative indicator

Economic regulation of water and sanitation services and water resources is performed independently and effectively, resulting in adequate provision of key services and high customer satisfaction.

Qualitative score (2.5/5)

Summary of round-table discussion

There are established norms, such as water tariffs to provide water and sanitation services. The GVMC revenue division is responsible for the tariff structure and for issuing new connections or fining customers, following government guidelines. However, participants felt that enforcement needs to be strengthened, particularly the regulation of informal service providers.

4.2 Effective enforcement of environmental regulations for water

Qualitative indicator

Environmental regulation is performed independently and effectively, resulting in high quality, protected water environments

Qualitative score (2.8/5)

Summary of round-table discussion

Environmental regulation comes under the Andhra Pradesh Pollution Control Board, which is at state level. There are rules and regulation to protect the environment, such as penalties imposed on defaulters with regard to solid waste, open littering, and use of plastic bags. However, in some areas of the city solid waste is a major concern and requires more monitoring at a local level.

The overextraction of groundwater is another key concern, as regular monitoring is not in place. The placement of meters for groundwater abstraction at household level has been raised on several platforms.

Participants also discussed opportunities. Under the 15th Finance Commission, the municipality plans to protect and rejuvenate water bodies in the city. Restoration, monitoring and surveying has been ongoing to protect nearly 250 water bodies, reservoirs, and tanks.

4.3 Effective enforcement of public health regulations for water

Qualitative indicator

Public health regulation for water is performed independently and effectively, resulting in water that is safe to consume and wastewater that can be returned to the water cycle with minimal environmental impact.

Qualitative score (2.8/5)

Summary of round-table discussion

The GVMC's public health department plays a key role in health regulations for water, for instance by monitoring water quality and ensuring it conforms to standard guidelines. However, some participants raised that, although the data is collected regularly, people are not aware of it nor is it publicly available.

Participants also raised the quality of the water from private service providers. With increasing demand for packaged drinking water in the city, this area needs attention. The dependence on packaged drinking water is mainly due to a lack of trust in the water quality provided by the municipality. Many households also rely on private borewells. Although municipal water supply services have improved over the years, with key attention given to water quality, consumers prefer alternative services.

There are mechanisms in place to regulate private water packages and bottles, but enforcement is weak and local and small private water service providers do not follow public health guidelines.

4.4 Enforcement of land use regulations and zoning

Qualitative indicator

A sound regulatory framework controls land use and urban expansion and reduces growth in high-exposure and water-poor areas.

Qualitative score (1.8/5)

Summary of round-table discussion

The group felt that regulatory frameworks are in place, such as the CRZ norms and act. However, the enforcement of land use regulation is weak. Land cover regulations and frameworks may be well planned but increasing urban expansion and illegal encroachment is becoming a challenge for city planners. For instance, illegal housing development on the hill slope in the city is rapidly expanding and putting pressure on the municipality to provide a water supply. Regulatory mechanisms and their effective implementation must be improved to monitor, control, and restrict illegal expansion.

4.5 Enforcement of design guidelines and construction standards for water infrastructure

Qualitative indicator

Technical standards and design guidelines define best practice for critical infrastructure.

Qualitative score (3.5/5)

Summary of round-table discussion

Standard guidelines and regulations for infrastructure are developed and updated as and when required. Infrastructure development is planned as per the guidelines of the Central Public Health and Environmental Engineering Organisation (CPHEEO). GVMC consults technical institutions and consultants in the design of any city infrastructure. For instance, TERI and USAID conducted a study on climate resilient infrastructure development in the city and the results were input to the city's smart city proposal.

4.6 Effective implementation of transparent and accountable decision-making procedures

Qualitative indicator

Decision-making procedures around water resource management, water and wastewater services are made clear and open to all stakeholders.

Qualitative score (3/5)

Summary of round-table discussion

Participants discussed the considerable progress in information sharing by decision makers. Stakeholder meetings are conducted during the framing of a project.

GVMC uses consultants and subject matter experts from universities to conduct in-depth research, knowledge exchange and discussion, before designing a project. For example, for the Smart City programme the municipality engaged different stakeholders through workshops, group discussions, questionnaires, and feedback apps. Information is shared with the general public through print media and press conferences organized by the municipality. The municipality works closely with the VMRDA, the irrigation and rural water supply departments, consultants, NGOs and the university.

Public consultation is also conducted through Monday morning meetings of the *Spandana* grievance programme. If any official or department is found not to be addressing concerns or issues in a timely manner, a memo is issued with a warning to comply with the process.

5. Adaptive and integrated planning

5.1 Active monitoring and evaluation of programmes

Qualitative indicator

Monitoring and evaluation mechanisms and frameworks measure how programmes have achieved intended outcomes and disseminate lessons learned.

Qualitative score (1.3/5)

Summary of round-table discussion

Government interventions are well designed through public feedback processes, but implementation and monitoring needs significant improvement. All types of amenities and mechanisms are available, but proper implementation is not seen. The establishment of the SRU was a considerable effort to improve the monitoring and evaluation mechanism. The SRU is focusing on preparing effective mechanisms with clearly defined roles and responsibilities for each section of GVMC and its officials.

5.2 Dissemination of accurate data

Qualitative indicator

Accurate data is used by key decision-makers in government, private sector, and civil society to promote urban water resilience.

Qualitative score (1.6/5)

Summary of round-table discussion

There is a need to improve real-time monitoring mechanisms as some data is not accurate, only annual averages are provided, and there are no mechanisms to disseminate open data. Data-generating mechanisms must be strengthened with adequate capacity and resources, particularly human resources and finances. Technical capacity is adequate. It is a challenge for the municipality to collect data for the entire city. Consultants and NGOs are hired to collect data, which can be unreliable and therefore hinders use of such data for decision-making.

The system has rules, regulations and policies in place but they are neither followed nor implemented properly. Open data and transparency in data sharing must be prioritized to improve water resilience for the city. The municipality shares appropriate data with the public, according to the Right to Information Act.

The city is currently preparing an Urban Observatory and over 50 smart poles are being placed for two-way communication with city officials.

5.3 (A) Incorporation of redundancy into water sources, networks, and assets

Qualitative indicator (A)

Redundancy exists in the networks and assets responsible for water supply, treatment and sanitation.

Qualitative score (2.6/5)

Summary of round-table discussion

Redundancy is a key element in water resources. Sanitation, sewage and wastewater treatment facilities need to be improved. Multiple facilities process water and wastewater and redundancy exists in transmission and sewage networks.

After treatment of wastewater, the recycled water is used by industry. Government is encouraging individual wastewater treatment for gated communities. Five sewage treatment plants and five domestic wastewater treatment plants are operating in the city. Programmes such as the Swachh Bharat Mission, are improving sanitation facilities,

such as toilets. But it is a challenge to supply water of adequate quality and in a timely manner in certain locations.

STPs in coastal areas are a major concern given such threats as cyclones. For instance, costal erosion measures for beaches need to be strengthened to protect infrastructure and make it resilient to disasters. Studies must be conducted to understand erosion and to determine what measures, such as increasing height, should be initiated. Backflooding, the backlog of sewage in households, may also impact in some locations. Where sea levels are rising, in areas such as Errigedda and Gangulugedda in Zone 5, rainfall causes inundation of channels and drainage system failure.

5.3 (B) Incorporation of redundancy into water sources, networks, and assets

Qualitative indicator (B)

Redundancy exists in the sources that supply water to the city.

Qualitative score (3.3/5)

Summary of round-table discussion

Proper contingency planning considers the safe supply of drinking water through all sources.

During cyclone Hudhud, the sewage facilities were not affected but water supply pipes were damaged as trees were uprooted. Participants raised that apartments and individual houses have electric pumps and rely on groundwater, so will be highly dependent on handpumps. The municipality supplies water through tankers to locations where wells and handpumps are not available, particularly slum areas.

Some participants also raised that the city's disaster management plan has been developed for such situations, and must prioritize resiliency in its planning and implementation.

5.4 Integrated planning across interdependent urban systems

Qualitative indicator

Coordination exists between public sector water agencies, water utilities and organizations working in related domains such as energy, telecommunications, waste management, and transportation.

Qualitative score (2/5)

Summary of round-table discussion

The group discussed that coordination is good within each department but that improvement is needed when it comes to coordination across different sectors. There are multiple agencies and departments whose duties overlap, which creates challenges. Clearly defined roles and responsibilities must be mapped when designing water and disaster management projects that involve multiple stakeholders.

5.5 Integrated planning with agriculture and food supply chains

Qualitative indicator

Coordination exists between water agencies and organizations involved in food supply and production.

Qualitative score (3/5)

Summary of round-table discussion

The GVMC is responsible for certain rural areas, where it is important that the people and water service providers coordinate across different water needs and use. This field is currently not prioritized when it comes to resilience to disasters and shocks, when it is important to have effective coordination between agriculture, domestic water use and industrial water use. Participants felt that the municipality must establish a coordination mechanism and platform for this.

5.6 Promotion of culture, processes, and resources to enable innovation

Qualitative indicator

Resources and processes reinforce a culture of innovation within the water sector.

Qualitative score (3/5)

Summary of round-table discussion

The group discussed that best practice must be mapped and used to facilitate resiliency in the water sector for the city's future investments. Water user associations exist in rural areas but not in urban areas/cities, which is a disadvantage. Engagement with the university and research institutions is one way of ensuring innovative solutions are explored. There have been efforts but resources must be allocated for such programmes.

6. Sustainable funding and finance

6.1 Promotion of integrity in contracting and financial decision-making procedures

Qualitative indicator

Financial procedures promote transparency, minimize risk and ensure that procurement processes are implemented fairly and efficiently.

Qualitative score (3.5/5)

Summary of round-table discussion

To maintain transparency, the city has adopted a digital e-procurement procedure and has empanelled contractors to participate, so that works can be undertaken. Defaulter contractors are blacklisted, and their details are available on the e-procurement portal. GVMC invites technical and financial bids. The Chief Engineer leads a technical committee that evaluates the bids as per predefined criteria and invites at least two to three to the financial bid opening to maintain transparency. Tendering is done both electronically and on paper. For emergency works e-procurement is not followed. For work above a certain value e-tendering is not followed, but open tendering is.

6.2 Provision of sufficient financial resources for maintenance and upkeep of water infrastructure

Qualitative indicator

Adequate funding exists to maintain water and sanitation infrastructure and to support existing programmes.

Qualitative score (3.3/5)

Summary of round-table discussion

The GVMC fixes its budget and allocates funds annually in February and March. Water and sanitation establishment work is under the engineering department, while operation and maintenance are with the public health department. The 15th Finance commission budget is available only for specific and allotted work; the general budget is used for water and sanitation works. The Jal Shakti Ministry and AMRUT 2.0 budget is also used for water and sanitation infrastructure. GVMC also uses corporate social responsibility (CSR) funds, particularly for solid waste management. The Hindustan Petroleum Corporation Limited has given Rs. 4–5 crores. For Swachh Bharat and in government schools, reverse osmosis systems have been provided.

6.3 Provision of sufficient financial resources for new water programmes and projects

Qualitative indicator

Adequate funding exists to finance new capital projects and programmes that support water resilience.

Qualitative score (2.3/5)

Summary of round-table discussion

GVMC is implementing projects under the AMRUT scheme and has tied grants to it, including a MoHUA grant and a Ministry of Jal Shakti grant. The amount is transferred to GVMC through the chief minister financing scheme, but disbursement from state to city is delayed. GVMC has been working on rejuvenating around 200 waterbodies using a geo-tagging exercise initiated with GVMC funds. After their revival, GVMC plans to supply semi-urban areas. City tax collection is quite satisfactory and is facilitated by tax kiosks across the city and a 5 percent tax rebate for advance payments.

6.4 Water and sanitation pricing for cost recovery and demand management

Qualitative indicator

Water tariff systems are sustainable and equitable.

Qualitative score (3.3/5)

Summary of round-table discussion

The GVMC has charged water supply tariffs in a structured manner for a long time. The tariffs are subsidized by socio-economic class. For example, under the BPL (below poverty level) scheme Rs. 50/annum is charged, while the AMRUT scheme provides new connections. The tariff for group houses, apartments, and gated communities (residential areas) is approximately Rs. 700 for six months. However, rates have not been revised since 2009. A weighted water tariff is applied to apartments and charges are divided by the number of flats.

Srisailam Dam, Andhra Pradesh.
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Infrastructure and ecosystems

Under this dimension, the city assessed the goals of 'effective disaster response and recovery, 'effective asset management', and 'protected natural environments'.

Multi-hazard early warning systems and effective coordination of disaster management is a priority for the city. The capacity building for disaster response and recovery has been improved. There is now effective coordination between the collector officer's disaster section, GVMC and the City Operation Centre, who collaborate on disaster mitigation and involve the National Disaster Response Force (NDRF), the State DRF, the fire department and officials of the factory department. There are adequate technical and managerial skills to operate key infrastructure and to implement projects. However, improvement is needed in capacity development to ensure effective and successful implementation, both to protect the ecosystem and to build an infrastructure resilient to floods and other hazards. Supply chains are not well managed and water infrastructure system mapping is needed to deploy and maintain adequate resources well in advance of possible disruptions.

The key aspects raised on protected natural environment areas included the need to improve environmental monitoring, restoring water bodies in the city, protecting groundwater from over-abstraction and promoting the use of alternatives sources (such as rainwater harvesting with a tax rebate), not only to meet water supply demand but also to improve the overall water potential.

6.5 Comprehensive hazard monitoring, forecasting, and early warning systems

Qualitative indicator

Monitoring, modelling, and early warning systems mitigate hazard risks.

Qualitative score (3.5/5)

Summary of round-table discussion

Although hazard plans are prepared and available to deal with different disasters, the early warning system needs further improvement to make it more community-based. The plans need to be reviewed and updated, which means considering and evaluating the loss of human life and economic and environmental resources. Participants from the various sectors are of the opinion that the early warnings are at their best, although there is still a delay in reaching all vulnerable sections. They expecting some impact-based models to assess the consequences.

6.6 Coordination of disaster response and recovery preparation

Qualitative indicator

Disaster response and recovery coordination plans and procedures are current, collaborative, well-rehearsed, and properly funded.

Qualitative score (2.8/5)

Summary of round-table discussion

Vizag city has faced cyclones regularly, so has planned well for disaster. The collector officer's disaster section, GVMC, and the City Operation Centre collaborate on disaster mitigation and involve the National Disaster Response Force (NDRF), the State DRF, the fire department and officials of the factory department during disasters. Training is organized by the National Institute of Disaster Management, with occasional seminars and workshops. Since 2015, UNDP has been supporting the Vizag Civil Department for disaster preparedness. Under the leadership of a special deputy collector, almost 200 urban volunteers have been trained under UNDP initiatives. First aid, water services, search and rescue, and communication-related rehearsals are carried out in city.

6.7 Ensuring adequate funds to government for disaster recovery

Qualitative indicator

Public authorities have access to funds for disaster recovery.

Qualitative score (2.3/5)

Summary of round-table discussion

The Andhra Pradesh Disaster Management Authority (APDMA) gives funds to every district based on the severity of the disaster and the risks involved. Due to SRU efforts, the first disaster management fund was created in the GVMC budget. Commissioner and Director of Municipal Administration (CDMA), AP state has asked every city in the state to prepare and submit their disaster management plan and the budget required to operationalize it. Vizag has submitted a plan, based on which CDMA will release funds. During cyclone Hudhud many corporations and neighbouring states poured in help quickly to diminish the disaster impact. The group reflected during the exercise that timelines and coordination need to be improved. The group also felt that the executive body should have more access to funds to return all stakeholders/sectors to normalcy as soon as possible.

6.8 Ensuring adequate financial resources for recovery of households and businesses

Qualitative indicator

Households and businesses have access to sufficient financial resources for recovery and continuity following shock events or persistent stresses.

Qualitative score (2.5/5)

Summary of round-table discussion

The group felt that households and businesses have minimal or low availability of financial resources to recover from disasters. In Vizag (or urban areas) the authority gives compensation or ex gratia payments if losses are the fault of GVMC or a government agency. For example, a warning is issued for heavy winds for all commercial hoardings, if it is not issued and a loss occurs then support is given. GVMC's town planning department visits sites, and the roads and buildings department will issue a fitness certificate for hoardings. If any violation of rules or encroachment is found then no support is given for disaster damage. There are some provisions for loss of crops and cattle in rural areas, after damage assessment.

6.9 Promotion of community capacity for preparedness and response to water hazards

Qualitative indicator

Mechanisms promote community preparedness for water-related shocks and stresses.

Qualitative score (3/5)

Summary of round-table discussion

The only serious shock related to water is acute shortage, mainly during the summer season. Sometimes the main reason is electric supply failure, when pumps cannot withdraw groundwater. Private tankers supply water through a GVMC mechanism based on a fixed amount for tankers with 1,000–5,000 litres capacity. The Tanker Supply Association, an independent body, decides on the charges. The tankers are parked in a GVMC campus and the suppliers are told when it is their turn to provide water. The GVMC charges for their registration, approximately Rs. 60/2,000 litres. Dedicated helplines are available for different filling stations that supply water. The public is only informed of damage, breakdown or maintenance through newspapers.

7. Effective asset management

7.1 Active monitoring and evaluation of water infrastructure

Qualitative indicator

Active monitoring and evaluation of water infrastructure and networks ensures data is current and accurate to help improve performance and reduce likelihood of failure.

Qualitative score (3.3/5)

Summary of round-table discussion

Monitoring and evaluation needs to improve. Participants highlighted data accuracy and monitoring water infrastructure to foresee likely hazards, thus avoiding operational failures and ensuring continued water services to city inhabitants.

7.2 Ensuring adequate human capacity for operations and implementation

Qualitative indicator

Technical and managerial staff are trained and knowledgeable in the operation of key infrastructure and in project implementation.

Qualitative score (3.5/5)

Summary of round-table discussion

Participants suggested that although staff are skilled and trained, implementation is not up to the mark due to the constraints during execution, hence there should be better alternative plans to overcome these hurdles.

7.3 Promotion of diverse infrastructure for flood protection

Qualitative indicator

Grey and green infrastructures provide protection from flooding and ensure adequate urban drainage.

Qualitative score (1.8/5)

Summary of round-table discussion

City authorities are seen as interested in promoting green infrastructure, but capacity development is critical to ensure effective and successful implementation, both to protect the ecosystem and to build an infrastructure resilient to floods and other hazards.

7.4 Routine maintenance and upgrade of water infrastructure

Qualitative indicator

Existing infrastructure is regularly maintained and upgraded to reduce likelihood of failure.

Qualitative score (2.3/5)

Summary of round-table discussion

Maintenance planning is not being complied with to the required extent, and this must be facilitated by funding allocation. This is critical to increasing the infrastructure's efficiency and lifespan.

7.5 Promotion of reliable supply chains for water infrastructure

Qualitative indicator

Supply chains for key water and sanitation infrastructure are reliable and have some redundancy.

Qualitative score (2.5/5)

Summary of round-table discussion

Water infrastructure system mapping is needed to deploy and maintain adequate resources well in advance of possible disruptions.

Supply chains are not well managed, but authorities should be able to deploy material when and where required. Hence there is room for improvement to be able to sustain and overcome hurdles created by emergencies.

8. Protected natural environments

(A) Active monitoring and evaluation of environmental resources

Qualitative indicator (A)

Environmental monitoring is conducted to assess the quality of water used for human consumption.

Qualitative score (2.2/5)

Summary of round-table discussion

The participants had limited knowledge of environmental monitoring but they did raise that during the rainy season, people received foul-smelling, turbid water from the supply system. Although municipalities may test for quality standards at WTPs and drinking water supply facilities, participants felt that improvements were needed to ensure regular monitoring. Most residents are dependent on filtering by reverse osmosis systems to purify the supplied water.

(B) Active monitoring and evaluation of environmental resources

Qualitative indicator (B)

Environmental monitoring is conducted to assess the health of environmental systems.

Qualitative score (2.4/5)

Summary of round-table discussion

Participants raised that no regular monitoring is carried out for water turbidity and biological parameter analysis. And that drains need to be lined because they leak and sewage and spillage water percolate into groundwater, while borewells near drains are polluted, particularly in winter and summer.

8.1 Promotion of sustainable commercial and industrial water use

Qualitative indicator

Mechanisms promote sustainable water use for commercial and industrial users.

Qualitative score (2.6/5)

Summary of round-table discussion

Industrial and commercial units receive a good water supply from the municipality, but strict actions and mechanisms are needed to monitor it. The inefficient use of groundwater and over-abstraction by industry has resulted in seawater intrusion. The Visakhapatnam Industrial Water Supply Company (VIWSCO) project will supply 51 percent of Godawari river canal water to industry and the remainder for drinking water.

8.2 Promotion of sustainable household water use

Qualitative indicator

Mechanisms promote sustainable water use for households.

Qualitative score (2/5)

Summary of round-table discussion

So far, 50 percent of households have a municipal water supply connection, and the remainder are supplied from groundwater and private sources. People also use groundwater because of an insufficient water supply. Participants felt that city

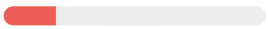
authorities must encourage use of alternatives sources, such as promoting rainwater harvesting with a tax rebate, not only to meet water supply demand but also to improve the overall water potential.

8.3 Protection of aquatic habitats and ecosystems

Qualitative indicator

Policies and programmes protect aquatic habitats and ecosystems.

Qualitative score (1/5)



Summary of round-table discussion

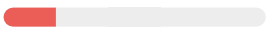
There are about 800 pounds or tanks within the GVMC boundary and about 270 water bodies. The storage capacity of these water bodies must be restored and augmented to meet the growing demand of water in the city. The sewage and spillage from residential areas flow directly into the water bodies. which must be managed to reduce pollution. Therefore, regular monitoring is required to maintain water quality. Moreover, release of domestic and industrial sewage into coastal waters need to be monitored on regular basis to maintain seawater quality and ecosystem health.

8.4 (A) Protection of groundwater and surface water resources

Qualitative indicator (A)

Protections exist to prevent over-abstraction and eliminate pollution of surface water sources.

Qualitative score (1/5)



Summary of round-table discussion

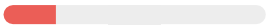
Many water bodies have disappeared during urbanization. Remaining ones are polluted by residential and industrial effluents and need to be protected from pollution and occupation.

9.5 (B) Protection of groundwater and surface water resources

Qualitative indicator (B)

Protections exist to prevent over-abstraction and eliminate pollution of groundwater sources.

Qualitative score (1/5)



Summary of round-table discussion

Groundwater is already being overexploited and aquifers are drying up in the summer. Overextraction is causing seawater intrusion around the coast. The state pollution control board is monitoring industry to control water pollution, but the municipality needs to play a greater role.

Bay of Bengal and Visakhapatnam coastline

Health and wellbeing

Under this dimension, the city assessed the goals of 'equitable provision of essential services', 'healthy urban spaces', and 'prosperous communities'.

The long-term sustainability of the city's water will require protection of its sources. A major concern is waste disposal impacting natural streams and polluting the sea.

Land use planning was raised as another critical area that needs attention. To prepare for urban development projects by updating existing city maps through geospatial mapping with the latest technologies. The city's master plans must be reviewed and updated through an integrated approach and consider the protection and conservation of water bodies such as wetlands.

Another priority area was to generate awareness among residents of water use efficiency and protecting the ecosystem.

9. Equitable provision of essential services

9.1 Provision of safe water for personal and domestic use

Qualitative indicator

All people have access to sufficient, safe and, accessible and affordable water for personal and domestic use.

Qualitative score (1.6/5)

Summary of round-table discussion

GVMC supply protected water to about 60 percent of the population, the remaining supply is based on groundwater. The protected water supply has some turbidity and quality deterioration so most people use reverse osmosis plants to purify their water. Protected water should be supplied to all households and be continuously checked for quality.

9.2 Provision of sanitation services

Qualitative indicator

All people have physical and affordable access to sanitation that is safe, hygienic, secure, and socially and culturally acceptable.

Qualitative score (3/5)

Summary of round-table discussion

Sanitation is good. The frequency of doorstep collection of solid waste needs to improve.

9.3 (A) Universal affordability of water and sanitation services

Qualitative indicator (A)

Safe water for consumption is made affordable to all users.

Qualitative score (2/5)

Summary of round-table discussion

Quality needs to improve, particularly during rainy seasons. Price is affordable but during the summer there is a shortage of potable water.

10.3 (B) Universal affordability of water and sanitation services

Qualitative indicator (B)

Safely managed sanitation services are made affordable to all users.

Qualitative score (3/5)

Summary of round-table discussion

It is fairly good when it comes to safely managing sanitation services that are affordable for all. Considerable work is needed in solid waste management, which should be given a higher priority.

9.4 Provision of health services to reduce trauma from water hazards

Qualitative indicator

High-quality health services are made available to residents to reduce impacts from water-related shocks and stresses, including waterborne diseases.

Qualitative score (2.5/5)

Summary of round-table discussion

Need more health centres, particularly when it comes to adapting to hazardous situations. Visakhapatnam Smart City's mission target is to develop as a 'healthy, resilient and liveable city'. Its health facilities are extending services to neighbouring districts and states. Recent developments in the city include a 'Health City', a cluster of hospitals in one place.

Government schemes, such as YSR Arogyashri (AP Government healthcare scheme), are available for BPL people. Under the ward secretariat system, health secretaries play a key role in keeping citizens safe and healthy. All programmes need to protect people's health and wellbeing during disasters and water-related stress, such as Covid-19.

10. Healthy urban spaces

10.1 Application of water-sensitive design principles to buildings

Qualitative indicator

Design principles are promoted to improve water performance for buildings.

Qualitative score (2/5)

Summary of round-table discussion

There is a lack of awareness about protecting the environment and water bodies. Participants raised the need to invest in advocacy efforts to create awareness among the general public, particularly on water use efficiency to reduce wastage and about the use of treated wastewater.

The group also discussed a need to introduce user guideline booklets to be disseminated widely among building owners and residents.

There are specific guidelines in the Energy Conservation Building Code (ECB) policy to promote residential rainwater harvesting but implementation is weak. This information must be disseminated to different stakeholders, including private residents.

10.2 Introduction and enhancement of water-sensitive urban design

Qualitative indicator

Water is incorporated as a design element in urban place-making.

Qualitative score (1.3/5)

Summary of round-table discussion

There have been good infrastructural developments in this regard, such as well-developed beach roads and sitting arrangements, but maintenance is a key issue. Improvement is needed in areas such as inclusive sanitation, to increase accessibility to such facilities.

Increasing waste disposal means water bodies, natural streams and estuaries are carrying waste to pollute the sea. So, there is a need to improve the approach and planning to maintain drainage systems and functioning canals, and to manage waste and pollution before water flows into the sea For example, solid waste and untreated sewage dumped

into the waters of *Ramakrishna* and *Pandurangapuram* Beach in the city. Poor waste management is increasing mosquitos in the area, further resulting in several diseases.

Thus, sanitation measures need to improve. There is some infrastructure, such as seating, pavements, and lights, but maintenance is poor. There is a need to raise awareness among residents to protect the environment, for example, not to throw waste into the sea or on the roads. The municipality must prioritize such advocacy through promotions, for example by providing dustbins and creating awareness drives in different media and on different platforms.

10.3 Promotion of water-sensitive urban land development

Qualitative indicator

Water is incorporated as a key consideration in land development.

Qualitative score (1/5)

Summary of round-table discussion

The city's development planning needs to be reconsidered. Participants discussed upgrading urban plans with geospatial mapping to update existing maps by using the latest technologies.

Although there a master plan has been prepared it needs to be reviewed through an integrated approach and by considering water sensitive development. This would also require strengthening land use regulations. There is a CRZ policy, but the group felt that it is not properly implemented. There should be a regulation that, during planning, some land must be dedicated to a recharging pond.

10.4 Introduction and enhancement of neighbourhood blue-green infrastructure

Qualitative indicator

Blue and green infrastructure is widely adopted in neighbourhoods.

Qualitative score (1/5)

Summary of round-table discussion

There are good examples in the city, such as horticulture departments offering green roof incentives, and providing adequate information and guidelines. However, more is needed with regard to blue infrastructure development and the conservation of wetlands is not prioritized. Urban development is affecting existing wetlands and technical capacity must be enhanced to deal with this.

Other efforts to develop and maintain green infrastructure are around engaging the Residential Welfare Association, responsible for maintaining city parks. However, its effectiveness needs to be monitored. Awareness in the building community about maintaining and developing green infrastructure could be increased.

Technical guidance and efforts are needed to improve blue/green infrastructure to promote nature-based solutions (NBS) in the city.

11. Prosperous communities

11.1 Protections around climate-related displacement

Qualitative indicator

Policies exist that protect vulnerable populations from displacement as a result of water-related shocks and stresses.

Qualitative score (2/5)

Summary of round-table discussion

Efforts are needed to build awareness and to advocate for such policies to protect vulnerable populations from displacement when the city is hit by climate disasters, such as a cyclone. Participants also discussed how existing policies are not adequate and sufficient resources must be allocated for implementation. For example, there should be proper channels to disseminate information and to implement such programmes effectively, so they reach everybody in vulnerable areas. After cyclone Hudhud in 2014 some of the population in coastal areas who lost their houses were shifted to the Hudhud rehabilitation colony. To establish the private Gangavaram Port three coastal fisher villages (Gangavaram, Dibbapalem and Srinagar) were shifted to inside the city.

11.2 Provision of sufficient water quality and quantity for industry and commerce

Qualitative indicator

Business and industry have access to sufficient water of appropriate quality.

Qualitative score (4/5)

Summary of round-table discussion

During extreme summer conditions the supply of water to industry is reduced to allow for domestic use.

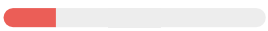
Visakhapatnam is basically an industrial city, with public and private, small-, medium-, and large-scale companies, mainly in three locations. Most chemical, fertilizer, oil, and gas industries are located in the middle of the city, which is a low-lying area, called an industrial bowl. Major establishments such as a steel plant, NTPC's power plant and pharma city are southwest of the city. Authorities take care to supply sufficient good quality water to these industries. The participants also shared that the Visakhapatnam Industrial Water Supply Company (VIWSCO) supplies 51 percent of Godawari river canal water to industry and the remainder for drinking water.

11.3 Support for livelihoods around water

Qualitative indicator

Jobs and skills are developed, and new opportunities created, for developing livelihoods around water.

Qualitative score (1/5)



Summary of round-table discussion

Discussion of job creation was around the protection of water bodies to prevent illegal dumping of waste and overfishing to ensure the resilience of water bodies in the city. Additional support and resources must be provided by the government for inland fisherfolk, with training and knowledge development of hatcheries and coral reefs to ensure food production and safety.

11.4 Support for improved mobility through water-related transportation

Qualitative indicator

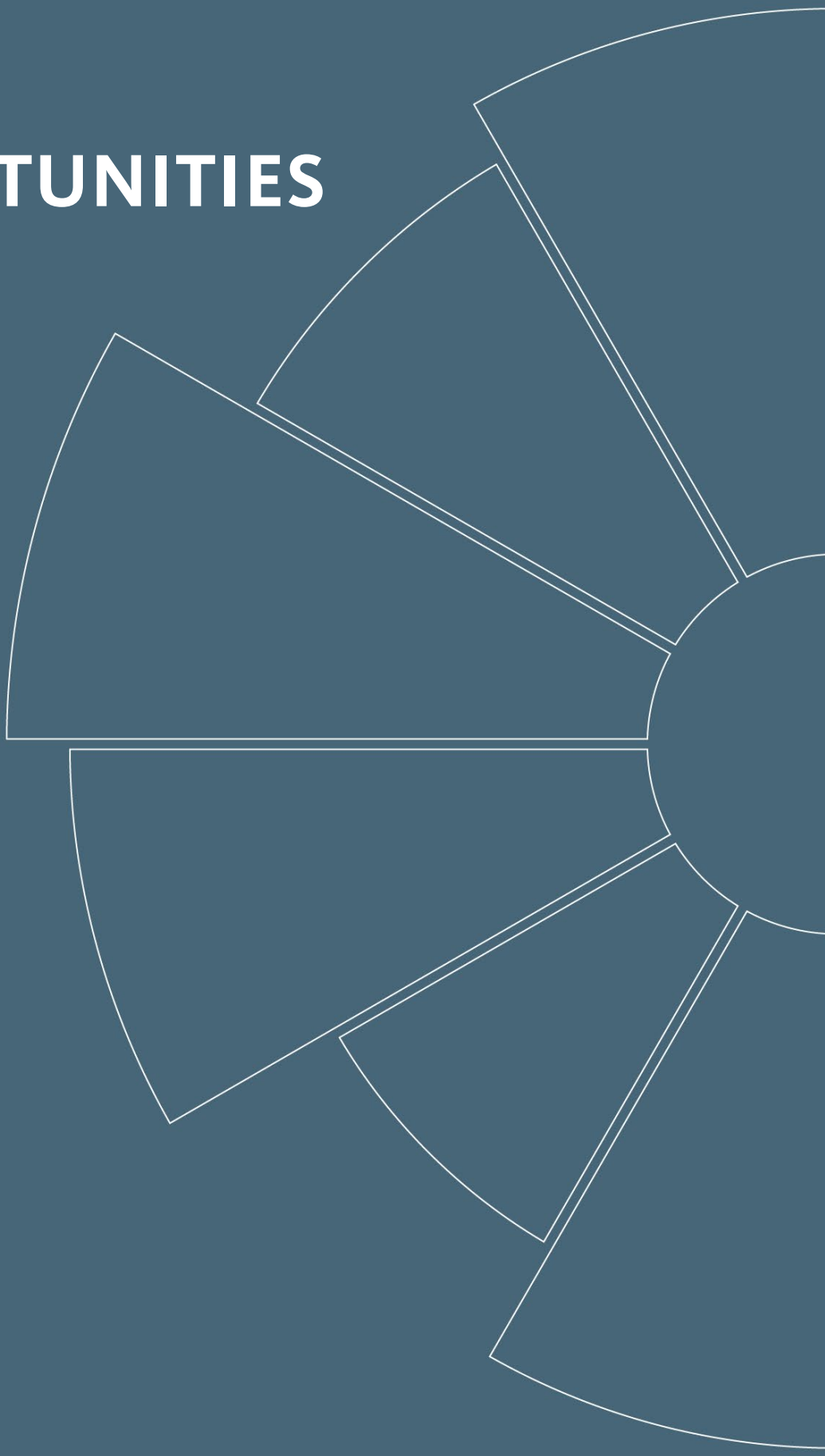
All communities have access to safe and reliable water-related transport where it is feasible to operate.

Qualitative score (3.3/5)

Summary of round-table discussion

Some participants felt that this indicator was not relevant to Visakhapatnam, given that the public does not use any water transportation. However, others acknowledged that port development in the city is good, with mobility around the harbour and port provided, but not primarily for public transportation.

3. OPPORTUNITIES AREAS



The city champions and the CWRA core team developed fifteen challenge statements based on an analysis of the qualitative indicators.

The challenge statements were divided among the workshop participant tables, based on the expertise in the groups and their relevance to the sub-goals and goals assessed by each group.

The participants selected nine statements as critical challenges for which solutions should be identified.

This section presents the opportunities discussed during the workshop in response to each of the nine critical challenges. Each summary contains an overview of intended outcomes, approximate costs, anticipated benefits and potential performance indicators for measuring success. Participants also suggested resilience champions – stakeholders that can help realize key actions – and identified next steps for each opportunity.

Timeframes refer to time elapsed after an opportunity has been initiated, rather than after the workshop date.

Table 4 Full list of challenges and opportunity areas

	Challenge statement	Opportunity area
1	Job opportunities around coastal resources	How can we create job opportunities around coastal resources, such as through recreational activities and water bodies protection, which are currently not leveraged properly?
2	Spaces and institutionalizing community engagement	How can we improve the engagement of a broader range of communities in decision-making around water programmes?
3	Capacity development on water resilience at different levels (political to community)	How can we build capacity of different stakeholders to operationalize water resilience at both strategic and community level?
4	Land regulation in water-poor areas (informal settlements)	What efforts can be taken to strengthen the enforcements to control the land use and urban expansion in water-poor areas such as informal settlements?
5	Access to disaster recovery funds	How the accessibility to disaster recovery funds be improved?
6	Early warning dissemination in a timely manner	What improvements are needed towards early warning dissemination to all in timely manner?
7	Water quality information dissemination to relevant stakeholders	What measures can be put in place to ensure water quality is regularly monitored, shared and disseminated among stakeholders, including communities?
8	Protection and promotion of green infrastructure	What measures and approaches must be taken to protect from loss of green cover in suburban areas, promote green spaces in the city, and to reduce the effect of disasters?
9	Monitoring the health of environmental ecosystems	How can environmental monitoring be strengthened to ensure ecosystem health is maintained?
10	Ageing grey infrastructure	How can the maintenance of grey infrastructure be improved to reduce the effect of disasters, including strengthening operations and maintenance plans that are sustainable and resilient?
11	Urban development lacking risk informed and water sensitive planning	What measures are needed towards having a more hazard risk informed and integration of water into urban design and planning to cope for future water challenges and disaster related stress?
12	Dissemination and integration of water data for informed decision-making	How to ensure that high quality, accurate, accessible useable water data is dissemination and shared between stakeholders in timely manner for planning and programme design and implementation?
13	Over-abstraction of water degrading environment, saltwater intrusion saline	What efforts could be taken to protect the environment and prevent saline intrusion, which is caused as a result of overuse of water by industry and other users?
14	Intermittency and affordability of water services	How can affordable and safe water services be made available to all people, including improved plans, infrastructures, and Operation and Maintenance?
15	Septage management	How to improve the monitoring, enforcement of existing guidelines and policies around septage management?

Job opportunities around coastal resources

How can we create job opportunities around coastal resources, such as through recreational activities and water body protection, which are currently not leveraged properly?

Description of the statement

City coastal areas can offer livelihood opportunities through the creation of unique jobs/employment. Local people can be empowered through skill development and job opportunities related to water, which are currently missing. Giving local youth knowledge about hatcheries and coral reefs will create resources for coastal tourism. Support to inland fisherfolk should be provided because they are crucial for food production. Awareness about protecting water bodies from the illegal dumping of waste, overfishing and so on will help them use resources sustainably. Government support is needed for this.

Related sub-goals/indicators

12.3 Jobs and skills are developed and new opportunities created for developing livelihoods around water (Goal: Prosperous communities)

Root causes identified

Social and environmental

- lack of awareness among communities about how to protect their environment and ecosystem
- tourism could be an opportunity but it has not been utilized, mostly due to rough seas, which are not tourism friendly
- security is another, as there is strict surveillance by naval forces.

Governance

- no concrete programmes to promote livelihood opportunities around water
- lack of coordination between government departments, for example tourism, marine, fisheries, and the port trust
- lack of proper implementation of existing policies to protect coastal resources.

Infrastructure and technology

- lack of innovative business models and marketing procedures
- outdated technology.

Other factors

- no industries/interpretation centres for marine activities, such as hatcheries, food processing, fishing, cargo-related logistic services, small-scale units
- unorganized/informal business activities.

Innovative marketing system to promote tourism and recreational activities, skill development, and business models

Description

Communities in and around the sea are the main target groups. They need to enhance their lifestyle and overcome economic and environmental losses through better livelihood opportunities and community growth. This requires an assessment of communities in coastal areas, with their active engagement, to update mechanisms and marketing to generate livelihood opportunities and skill development. This will expand tourism and business around small-scale, recreational activities in coastal areas.

Champions

- APDMA
- Fisheries department
- NGOs, community-based organizations, and youth clubs
- International development organizations.

Resources

Estimated cost is around Rs. 100 crores.

Next steps

Short term: establish and expand skill development and training centres; empower existing self-help groups and community-based organizations to build awareness about self-organizing, for instance, through mock drills for community-based response measures and involvement in recreational and tourism activities in coastal areas.

Medium term: promote the tourism industry, hatcheries, and cage culture development.

Long-term: Promote green business models-that captures environmental, social and economic values and benefits. , disaster preparedness mechanisms such as shelter belt plantations, and cyclone centres.

Outcome

Better standard of living, especially for the economically vulnerable.

Spaces and institutionalizing community engagement

How can we improve the engagement of a broader range of communities in decision-making around water programmes?

Description of the statement

Community engagement and participation in decision-making to develop strategies around water resilience and water projects can be further strengthened. Current spaces are either not well known and/or are not used by communities.

Also, further acceptance of their involvement by the administration and government is required. Need to establish publicly accessible platforms and spaces. Some exist, but improvement is required.

Related sub-goals/indicators

1.1 Active community engagement and participation around water issues (Goal: Empowered communities)

1.2 Effective communication of government programmes and policies around water.

Overlapping indicator/goal:

2.3: Incorporation of social, environmental, and economic costs and benefits in decision-making around water – short, medium, and long term (Goal: Strategic vision).

Root causes identified

People depend on intermediaries and community leaders in operations.

Governance

- ground staff capacity and availability
- lack of capacity.

Infrastructure and technology

- no proper communication modes (navigation equipment, radio)
- lack of solar and geo-water satellite systems at community and village levels.

Other factors

- need to develop awareness raising workshops for people at ground level to make sure they benefit from government programmes and interventions related to water.

Community secretariat

Description

A community secretariat system could establish a structure to engage with each colony, village and neighbourhood through awareness programmes and community meetings to make sure they benefit from government programmes. Introducing a helpline number would make it accessible to all. Literacy levels are a crucial factor for a successful community secretariat and schools can play crucial role in planning skill development activities. Exposure visits by government would empower communities in water management. Vizag is a port town with several affiliated industries whose CSR programmes could be a financial resource to implement activities. Government and communities have to be on board to establish a secretariat system.

Champions

- GVMC through the SRU
- Industry and the corporate sector
- APDMA
- NGOs, community-based organizations, and youth clubs
- International development organizations.

Resources

Estimated cost is Rs. 100 crores.

Next steps

To immediately create awareness among communities by distributing IEC pamphlets during community meetings, and using local newspapers, which are the best medium for spreading awareness. Walkie-talkies and ham radio systems would be very useful for effective communication, as mobile networks do not work during disasters. Geo-tagging vulnerable households and social infrastructure that could be damaged during disasters will be important to plan restoration activities.

Outcome

Accurate and timely dissemination of information to communities.

Capacity development on water resilience at different levels (political to community)

How can we build the capacity of different stakeholders to operationalize water resilience at both strategic and community levels?

Description of the statement

There is a lack of knowledge about what water resilience means and how it can be integrated at all levels in the city. Communication gaps and poor coordination between political leaders, key officials, and other stakeholders about prioritizing water resilience for the city is seen as a challenge. Mid- and ground-level officials with good theoretical and field observations are not able to pass their knowledge to top-level officials. Moreover, leadership changes in a three to five year political cycle impacts communication channels. How can water resilience strategies be embedded in existing interventions?

The following are needed:

- Improved quality interactions from top to bottom levels and vice versa. Focus groups at ward level will build awareness and proactively engage the community, academia, and political leaders in the process
- Programmes to train relevant actors to engage communities and related sectors in water resilience
- Capacity building and knowledge enhancement in the political leadership about what urban water resilience means and how it can be useful for the city
- Awareness-building and education around what water resilience implies in the wider population.

There is an opportunity in these areas to promote and institutionalize water resilience through the ongoing work of the SRU's four cells of environment, climate, disaster management, and human resource development. Water is well covered by its climate and disaster management. A critical focus for the SRU is research and innovation, particularly in environmental and climate resilience. However, there is no current water resilience plan or strategy for the city.

Related sub-goals/indicators

2.5. Political leadership promotes resilience as a priority issue in government decision-making (Goal: Strategic vision).

Overlapping indicator/goal:

12.1 Protections around climate-related displacement (Goal: Prosperous communities).

Root causes identified

Social and environmental

- loss of water resources
- community understanding of judicious water usage and of water pricing.

Governance

- decisions on maintaining water bodies left with technical officers
- lack of knowledge in decision-making with reference to water resilience.

Infrastructure

- lack of advanced information on technological aspects of various water management systems
- existing practices in the development and maintenance of water supply system infrastructures.

Other factors

- improper data management systems
- improper planning and implementation of projects.

Advocating and building awareness around best practice in urban water resilience

Description

Communities and residents should be sensitized to the consequences of water scarcity. They should be part of the processes and decision-making around building water resilience in the city. The administration and technical officers must also be sensitized to prioritize needs-based infrastructure development and projects.

Capacity building of administration, technical staff, public representatives and RWAs is needed to meet increasing demand for water and to balance demand and supply to avoid water stress. For instance, through rainwater harvesting, for which there are examples in Visakhapatnam that could be strengthened to address water scarcity.

Champions

- GVMC
- APPCB
- RWAs
- NGOs in the water sector
- Academic institutions.

Resources

Estimated cost is Rs. 15,00,000. Funds can be tapped through CSR and government.

Next steps

Design advocacy programmes to build awareness, in collaboration with NGOs and universities.

Promote water use efficiency among residents by collaborating with RWAs – for instance, the use of rainwater harvesting.

Training technical officials to assess climate risk and vulnerability and its impact on water supply and sanitation in the city.

Outcome

Improved capacity to cope and adapt to uncertainties such as water scarcity and climate change risks.

Changes in behaviour on water use efficiency.

Land regulation in water-poor areas (informal settlements)

What can be done to strengthen enforcement of land use and urban expansion in water-poor areas?

Description of the statement

Regulations might exist, but enforcement is poor. This is due to: i) lack of regulation dissemination to formal and informal settlements on public and private lands; ii) poor integration of water considerations in urban planning, so land regulations should be added to the master plan by involving boards and authorities, Mandal officers, and ward secretaries; iv) high risk areas, as stipulated in national laws at ULB or regional levels.

Related sub-goals/indicators

4.4. A sound regulatory framework controls land use and urban expansion and reduces growth in high-exposure and water-poor areas (Goal: Effective regulation and accountability).

Root causes identified

Social and environmental

- informal settlements on hill slopes
- transformation of vacant fertile lands into new development projects.

Governance

- poor integration of water consideration in urban planning
- protected water bodies and important vacant land details are not incorporated in master plans
- buffer areas needed – 100 metres for rivers, 9 metres for canals
- guidelines and rules are mostly violated.

Infrastructure and technology

- poor monitoring of encroachment on water bodies.

Other factors

- poor solid waste management, and dumping of waste in water bodies and surrounding areas.

Guidelines to protect water bodies and to improve monitoring of encroachment around water bodies

Description

City planners and revenue officials must map water-poor areas and protect water bodies in the city from illegal encroachment. Guidelines must be developed for new developments around water bodies, focused on blue/green infrastructure development. Notification regarding land use, strict enforcement of buffer zones around water bodies, removal of unauthorized construction in and around water bodies in the city must be prioritized. Green belt developments must consider limiting plantations to those plants that do not consume more water and that conserve the soil.

Champions

- Town planning wing of the ULB
- Revenue officials
- State horticulture department
- NGOs working on land conservation and natural farming
- Commissioner
- City planner
- District Collector
- Urban Community Development (UCD).

Resources

Estimated cost is Rs. 20 crores over 1–3 years.

Next steps

Assessing water, land zoning and environmental regulation processes that can facilitate guideline development.

Mapping water-poor areas and water bodies that need restoration and rejuvenation.

Town planning and revenue officials to carry out a joint study and mapping of water-poor areas and informal settlements that are encroaching on water bodies.

Develop a water master plan that integrates management of urban water bodies, water and sanitation services, and urban planning.

Outcome

Restoration of heritage sites related to water conservation; reduce incidents of drought; and reduce experiences of heat waves.

Access to disaster recovery funds

How can accessibility to disaster recovery funds be improved?

Description of the statement

Disaster recovery/relief funds are disbursed from the centre or the state, who have set up complex access procedures that make it a challenge for Vizag city to access and disburse them in a timely manner. This increases the vulnerability of the population. The group felt that an executive body should have better access to funds and decision rights, and that technology-enabled processes to help all stakeholders/sectors to return to normalcy as soon as possible. For better recovery/resilience improvements are required in: accurate damage assessment; management of remaining funds; assistance from national government, insurance and other sources; coordination; and time management.

There should also be more awareness among people, as well as knowledge among officials, about accessing relief funds.

Related sub-goals/indicators

7.3 Public authorities have access to funds for disaster recovery (Goal: Effective disaster response and recovery)

7.4. Households and businesses have access to sufficient financial resources for recovery and continuity following shock events or persistent stresses (Goal: Effective disaster response and recovery)

Root causes identified

Social and environmental

- unequal or partial distribution of relief funds
- false information from communities related to damage
- political interference.

Governance

- criteria and processes to access funds are not easy, which creates difficulties; threshold values to access funds based on damage are a big hurdle, as not meeting those values makes it impossible to access funds
- lack of awareness among officials about how to access disaster recovery funds; negligence, ignorance, and a lack of sincerity and integrity are other key factors
- for certain disasters, such as cyclone Hudhud, accountability exists to access funds.

Infrastructure and technology

- beneficiary database management is poor, which creates issues over funds reaching needy populations
- should be mixed approaches to managing funds and accounts related to disaster relief funds; a digital mode should be adopted to maintain transparency of fund distribution, with a backup manual mode.

Other factors

- after officials are transferred decisions are delayed as information is not documented/recorded
- issues of fund access within institutions and higher funding agencies
- after disasters, accurate scientific damage assessment is highly required, based on ground surveys and so on, so that the actual status is available for initiating and prioritizing funding of relief measures.

Develop a proper assessment framework to improve access to disaster funds

Description

Capacity building of officials and training of communities on how to do assessments and how to access funds. Updating a digital infrastructure and maintaining data, conducting periodic assessments to address gaps and to design training materials and practical approaches and methodologies with expert trainers in the field. Update existing plans and strategies by incorporating changes at national and state levels to access disaster funds.

Champions

To enable access to funds, all heads of department in government and public sector units will be required. GVMC's SRU could play a crucial role in developing an assessment framework based on the past experiences in the city.

Resources

GVMC receives grants primarily from central and state government in the event of a disaster. Ideally, all projects implemented by GVMC are eligible to take up the activities. Smart City Mission funds can also incorporate frameworks to access disaster funds.

Next steps

- As a short-term measure, identify a group of officials for a disaster orientation programme, to include training on fulfilling mandatory requirements when requesting central and state funds
- In the medium term, trained officials to train beneficiaries at community level on how to access government funds when they are affected by a disaster.

Outcome

Improved knowledge and skill among officials engaged in disaster mitigation. Better exchange of information between communities and officials for accurate damage assessment, which will lead to faster access to relief funds.

Early warning dissemination in a timely manner

What improvements are needed for early warning dissemination to all in a timely manner?

Description of the statement

The city's geographical extent limits access to correct information in remote areas, as early warning messages do not reach all groups in time, particularly the most vulnerable. Integrated planning is not in place that covers the entire city. There is a need to improve the early warning infrastructure and network. Participants opined that early warnings are at their best, however there is need for an exclusive monitoring cell.

Related sub-goals/indicators

7.1 Monitoring, modelling, and early warning systems mitigate hazard risks (Goal: Effective disaster response and recovery)

Root causes identified

Social and environmental

- coverage in remote areas, geographical extent
- misconception due to social media.

Governance

- non-availability of structured policy
- budget allocation under specific heads
- integrated planning.

Infrastructure and technology

- disaster resilient infrastructure is absent
- network issues that need upgrades
- lack of knowledge in appropriate methods to adopt suitable and adequate technology and infrastructure.

Other factors

- non-availability of sustained and exclusive monitoring cell
- lack of skill sets, knowledge, and training, and poor coordination.

AI technology and community-based risk management

Description

Innovative technology, including artificial intelligence (AI) needs to be adopted for thorough early warning dissemination in a timely manner. Mitigation plans and preparedness measures must be in place, along with a robust infrastructure. Towards this, an exclusive monitoring and warning cell must be established. A community-based disaster risk management approach will improve results.

Champions

- IMD, NIO departments, GVMC's SRU
- Vishakhapatnam Port Trust
- Private sector and leading NGOs.

Resources

Majority of government schemes supported by centre and state can be used. The APDMA will be the prime resource provider. City-based industries and port trust support can be leveraged in both technical and financial aspects.

Next steps

- short range forecast of 1–3 days to engage and involve most vulnerable communities (e.g. coastal communities, industrial areas, and low-lying and landslide prone areas)
- scope to preparedness can be increased to required level
- seasonal forecast of more than 30 days.

Outcome

Emergency preparedness will be improved with a preparedness and response mechanism in place and implemented effectively. Protection of assets and vulnerable groups to minimize the impact of uncertainties and disasters.

Water quality information dissemination to relevant stakeholders

What measures can be put in place to ensure water quality is regularly monitored, shared and disseminated among stakeholders, including communities?

Description of the statement

Water quality needs regular monitoring, as per ISO standards. For days during the rainy season, people receive turbid water then there is a foul smell in the water supply system. It is important that when it is reported, action is taken. Most residents using a filter to purify the water supplied by the corporation. There are no strict measures for protecting water quality. Water bodies are taken for granted by industry and the public.

All waterworks-related departments and concerned water resilience stakeholders need to be made to be aware of information tools, such as SCADA (supervisory control and data acquisition).

Stakeholder engagement builds water resilience.

Related sub-goals/indicators

3.2 Frameworks and mechanisms promote coordination between city stakeholders and relevant upstream stakeholders on water issues (Goal: Coordinated basin governance)

4.3 Public health regulation of water performed independently and effectively, resulting in water that is safe to consume and wastewater that can be returned to the water cycle with minimal environmental impact (Goal: Effective regulation and accountability)

12.2 Businesses and industry have access to sufficient water of appropriate quality (Goal: Prosperous communities)

Root causes identified

Social and environmental

- lack of water literacy.

Governance

- lack of transparency in data sharing
- lack of awareness among public, although information is available it is not well disseminated
- lack of coordination between different agencies around data sharing and dissemination
- lack of policy or mechanism to promote conjunctive use of surface water and groundwater – groundwater data is unavailable.

Infrastructure and technology

- lack of involvement through print media and social media
- sufficient infrastructure for assessing water quality but insufficient sampling points, testing labs, and agencies; frequency of sampling is poor.

Other factors

- lack of citizen feedback mechanisms on quality and quantity of water, and quality of services
- lack of communication.

Interactive, web-based, GIS portal with real-time monitoring of water data

Description

Interactive web-GIS portal for mapping, monitoring, and dissemination. It must cover real time status of water quality and quantity, detailed maps, and interactive tools. Households and ward officials will be able to monitor the water quality database through an interactive web portal.

Awareness campaigns must be conducted, with information disseminated by engaging ward *Sachivalayam*, staff volunteers. SMS or caller tunes could be used to build awareness. Plans must also promote conjunctive use of surface and groundwater.

Champions

- GVMC's SRU
- State Remote Sensing Agency
- APPCB
- State groundwater board.

Resources

Creation of this system will require around Rs. 5 crores. GVMC collects water charges from users so its own funds in addition to a grant from state government could be used.

Next steps

It is envisaged that it will take three to five years to establish this system. First, dedicated human resources will have to be deployed. Then data needs to be collected, analysed, and converted into a digital format. An interactive dashboard interface could improve monitoring of water quality.

Outcome

Real time monitoring will enable decision makers. Citizens will be cognizant about the quality of their water supply through a robust database on quantity and quality of city supplies.

Protection and promotion of green infrastructure

What measures and approaches must be taken to protect from loss of green cover in suburban areas, to promote green spaces in the city, and to reduce the effect of disasters?

Description of the statement

Vizag is witnessing land cover changes and a depletion of natural resources due to rapid urbanization. Green infrastructure is being degraded due to intensifying anthropogenic activities and migration. Loss of green cover in suburban areas damages the city's long-term resilience. Lack of awareness among officials about understanding and implementing relevant government policies, and a lack of inter-departmental coordination are key concerns in protecting green city assets. There is a need for better planning to integrate new developments with nature. New interventions in green infrastructure are needed, as well as protection measures. ULB's lack provision for these aspects of green infrastructures. A focus on green infrastructure as a protection measure will reduce the impact of disasters and create multiple benefits for the city's social, recreational, and environmental services.

Root causes identified

Social and environmental

- poor interest among communities makes it difficult to actively engage them
- damaging green cover through development and natural disasters.

Governance

- inter-departmental coordination
- adapting available policies at local level due to poor planning.

Infrastructure and technology

- none or ineffective utilization of remote sensing and GIS technologies to map and manage green infrastructure
- missing staff with the knowledge and skills to evaluate, plan, design, and implement green infrastructure projects.

Related sub-goals/indicators

8.3. Grey and green infrastructure provide protection from flooding and ensure adequate urban drainage (Goal: Effective asset management).

Overlapping indicator/goal:

11.4. Blue and green infrastructure is widely adopted in neighbourhoods (Goal: Healthy urban spaces).

Training modules on green infrastructure and nature-based solutions (NBS)

Description

Importance of green infrastructure and NBS to increase city resilience is less understood by city level functionaries. Vizag is already witnessing a depletion of green cover on hills, and coastal erosion due to cyclonic impacts, and so on. The capacity of officials is limited or there is a lack of awareness of the causes and impacts of green infrastructure loss in the long term. Therefore, there is a strong recommendation to create a skilled human force in this area, especially in government. The city has strong academic institutes, whose local expertise can be mobilized to create capacity-building programmes with tailor-made training modules, documentation of best practice, reference books, exposure visits, and so on. Information from other parts of the world will be useful for implementing and upscaling best practice in the city.

Stakeholders

- GVMC's SRU
- Academic and research institutes
- Forest departments
- District administrations
- Communities
- NGOs.

Next steps

On an immediate basis there is a need to engage experts who can: evaluate the current situation and identify gaps; prepare contextualized training material and needs-based capacity building programmes to build knowledge and skills in the municipality. An NBS toolkit, containing best practice from other global cities will provide guidance for the city to improve their capacity in this area.

The city can identify areas for pilots to learn from implementation, before upscaling widely. Terms of reference can be designed, based on training received, to prepare detailed project feasibility and design reports.

In the long run the city should prepare a master plan for protecting and promoting green infrastructure.

Resources

Estimated cost of implementing green infrastructure pilot projects would be Rs. 5 lakh/hectare.

Outcome

Green development of healthy urban spaces in Vizag city.

Meeting the objective of climate adaptation.

Water bodies are protected and the ecosystem conserved, along with meeting the city's growing demand for water.

Monitoring the health of environmental ecosystems

How can environmental monitoring be strengthened to ensure ecosystem health is maintained?

Description of the statement

The city currently does not have any monitoring in place to assess ecosystem health. There is a need to focus on regular monitoring for water turbidity and biological parameter analysis. Improved monitoring is of utmost importance for protecting groundwater. Leakage from pipes and drains and percolating sewage and spillage water is contaminating groundwater. Borewells near drains are getting polluted, particularly in winter and summer.

Water bodies and groundwater need to be protected from pollution in order to meet the city's increasing demand for water.

Related sub-goals/indicators

9.1b Monitoring assesses the health of environmental systems.

Root causes identified

Social and environmental

- lack of public awareness and inefficiency leads to pollution of water bodies
- encroachment on drainage systems and water bodies
- overexploitation of groundwater causing saltwater intrusion.

Governance

- lack of proper management of water bodies in the city
- lack of proper maintenance of pipelines
- deviation from the master plan by allowing high density populations at several locations.

Infrastructure and technology

- ageing infrastructures, such as old pipelines
- lack of a monitoring system for pipeline leakage
- lack of proper use of IT-based monitoring systems
- no maintenance of open drainage systems results in degradation of the environment.

Other factors

- lack of implementing state of the art technologies
- poor monitoring of environmental degradation and ecosystem management.

Developing guidelines and capacity development in ecosystem conservation

Description

Engaging the SRU through training programmes, using expertise from different resources, developing materials and demonstration projects.

Officials need guidelines and training materials to safeguard the health of environmental ecosystems.

Stakeholders

- APPCB
- Groundwater departments
- GVMC
- NGOs
- communities.

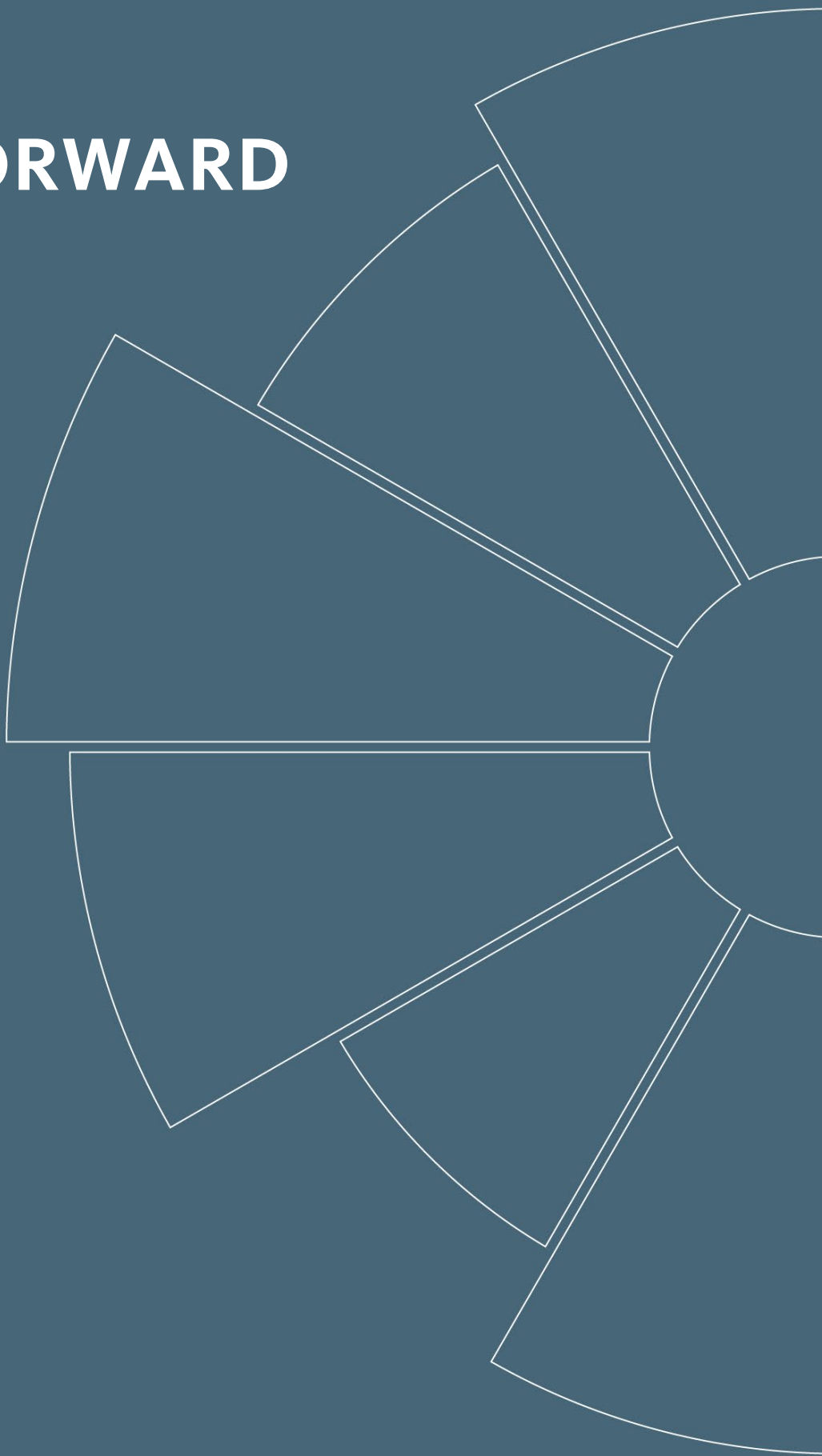
Next steps

Engaging relevant internal/external experts to develop training for capacity building programmes for officials. Evaluation of ageing pipeline systems. City should conduct pilot projects and prepare Detailed Project Reports (DPRs) for small project implementation.

Outcome

- Conservation efforts are implemented, ageing infrastructures such as pipelines are well maintained, and environmental monitoring is conducted to assess the health of environmental systems, which result in improvements to the surrounding environment and green space of the city
- proper maintenance of the health of water bodies in the city by protecting them from pollution
- proper maintenance of the pipeline system with good water quality.

4. WAY FORWARD



The findings and solutions from this water resilience assessment will be a useful resource for the city of Visakhapatnam in discussions with key organizations and stakeholders about future programmes and interventions to build a resilient water sector.

Key opportunities identified by workshop stakeholders will be further reviewed and refined by the SRU team to ensure they include all relevant programmes and existing projects. Resources and investment are required to facilitate the implementation of the critical opportunities that will help the city in its goals to achieve a resilient water system. It is expected to be an ever-evolving and improving blueprint for action – one that takes advantage of existing programmes and relationships, while building an enhanced network of people advancing change through individual and collaborative efforts towards outcomes that enhance our water systems and services.

Opportunities identified, such as capacity development of GVMC on design and development of NBS as a measure of climate adaptation, along with protection and restoration of water bodies, have been integrated in existing work plans and programmes.

Overall, the process of implementing a CWRA in the city helped to build the SRU's understanding of the need to focus on water resilience as a priority when building a safe, resilient, and smart city. Following the assessment and the visioning workshop, the ideas generated were integrated in the SRU's work plan and development proposal for submission to the 15th Pay Commission.

About this publication

The Visakhapatnam Water Resilience Profile illustrates key action areas for the city to continue building water resilience capacity and inform future planning and investment decisions.

The actions identified during the implementation of the City Water Resilience Approach (CWRA), build a foundation upon which stakeholders can effectively design and implement water resilience projects and programmes. It is expected to be an ever-evolving and improving blueprint for action that takes advantage of existing programmes and relationships while building an enhanced network of people advancing change through individual and collaborative efforts toward outcomes that enhance our water systems and services.

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