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ENHANCING DISASTER RISK MANAGEMENT:

A SYSTEMIC PERSPECTIVE ON GLOBAL, NATIONAL, AND STATE FRAMEWORKS IN INDIA

About this document

This document provides an in-depth analysis of systemic risk management in India, with a focus on the states of Odisha and Andhra Pradesh. Using the Integrated Disaster Resilience framework and Systemic Risk Capability Assessment methodology, it highlights key gaps in disaster risk management and offers strategic recommendations. The study emphasizes the need for a systemic approach to enhance resilience across critical infrastructure and interconnected systems.

Potential user

Policymakers, disaster management practitioners, researchers, and infrastructure planners will find this document valuable for strengthening systemic risk resilience. It is also useful for stakeholders involved in governance, cross-sector collaboration, and climate adaptation initiatives.

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Published by
India Japan Laboratory, Keio University, Japan
Sphere India

September 2024

Please refer to this publication as follows:

Tyagi N., Mitra A., Mahajan, V. and Shaw R. (2024): Enhancing disaster risk management: A systemic perspective of global, national and state frameworks in India, India Japan Lab, Keio University and Sphere India, 101 pages

Preface

As we are witnessing the frequency and intensity of disasters rising in an increasingly interconnected world, addressing the cascading impacts of systemic risks has become one of the most pressing challenges for policymakers and practitioners alike. This study is among the first attempts to systematically explore the intricacies of managing systemic risks within the context of India's national and state-level disaster risk frameworks, with a special focus two Indian States- Odisha and Andhra Pradesh. In recent years, the acceleration of environmental degradation, socioeconomic pressures, and the impact of climate change have heightened the complexity of disasters, demanding we relook at traditional risk management strategies at national and sub national level. The interlinked nature of modern systems means that disruptions in one sector can have cascading effects across others, amplifying vulnerabilities and, in some cases, triggering far-reaching consequences.

The study deep dives into two coastal states of Odisha and Andhra Pradesh, which are vulnerable to a wide range of hazards, including coastal flooding and cyclones, that often leads to disruptions in critical infrastructure. Integrated Disaster Resilience (IDR) framework and the Systemic Risk Capability Assessment (SRCA) Methodology is utilised in this study to analyze the preparedness and gaps in managing systemic risks in these states.

We hope that this report offers a fresh perspective on disaster risk management in India, with valuable insights for policymakers, stakeholders, and researchers alike. By highlighting the urgent need for systemic resilience, we aim to contribute to the ongoing efforts in building a more resilient and adaptive disaster management framework in India.

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Executive Summary

1. Introduction: The Rising Tide of Systemic Risks

Disasters, propelled by rapid environmental and socioeconomic changes, are increasing both in frequency and impact, presenting unprecedented challenges to traditional risk management practices. The current landscape is dominated by systemic risks, which are characterized by their interconnections across sectors and borders, complicating the management of these risks using conventional approaches. Systemic risks, unlike traditional risks, do not remain confined within specific sectors; they cascade, amplify, and intersect with various vulnerabilities, often leading to catastrophic outcomes. This study examines these complexities, emphasizing the urgent need for a paradigm shift in policy, governance, and risk management practices globally, with a special focus on the 2 Indian states of Odish and Andhra Pradesh.

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2. Analytical Framework: A Holistic Approach to Systemic Risk Management

The study adopts a holistic approach to understanding and managing systemic risks, proposing the Integrated Disaster Resilience (IDR) framework and the Systemic Risk Capability Assessment (SRCA) Methodology as key tools. These frameworks aim to address the inherent interconnections among different systems, offering a structured method to evaluate and enhance systemic resilience. By integrating qualitative and quantitative research techniques—such as literature reviews, case studies, interviews, and surveys—the study seeks to fill the existing gaps in disaster risk management (DRM) frameworks, particularly concerning their application to systemic risks.

3. Key Findings:

The research reveals significant disparities in systemic risk readiness across the states of Odisha and Andhra Pradesh, as well as at key maritime infrastructure points like Vizag Port (VPA) and Paradip Port (PPA). The findings indicate**:**

- **Disparities in Systemic Risk Readiness:** Inter-system readiness consistently lags behind intra-system readiness across short, medium, and long-term projections. The gap is particularly pronounced in Odisha and Andhra Pradesh, with inter-system readiness trailing by 5%, 4%, and 11%, respectively. A declining trend in overall readiness is observed, with a drop of 13% in Odisha and 42% in Andhra Pradesh from the baseline year of 2023
- **Gaps in Current Frameworks: The Need for a Systemic Risk Management Paradigm**

Despite the growing recognition of systemic risks, current DRM frameworks are insufficiently equipped to operationalize systemic risk management effectively. The study identifies the following gaps:

- **Lack of Comprehensive Integration**: Existing frameworks often fail to integrate cross-sectoral and cross-border risks, limiting their effectiveness in managing cascading hazards.
- **Inadequate Focus on Inter-System Dependencies**: There is a critical need for frameworks that account for the dependencies between systems, as these dependencies are often where systemic risks manifest most acutely.
- **Data Availability and Quality**: The availability and quality of data pose significant challenges, particularly in emerging economies, hindering accurate risk assessment and the development of robust resilience strategies.

4. Recommendations: Towards a Resilient Future

To address the identified gaps and enhance systemic risk resilience, the study offers several recommendations:

- **Adoption of a Whole Systems Approach**: A shift towards a Whole Systems Approach is imperative, where systemic risks are managed not in isolation but as interconnected phenomena across sectors and borders.
- **Strengthening Governance and Collaboration**: Robust governance structures and enhanced collaboration among stakeholders—including governments, private sectors, and civil societies—are essential to operationalizing systemic risk management.
- **Focus on Nature-Based Solutions and Sustainable Land-Use Planning**: The study advocates for prioritizing nature-based solutions and sustainable land-use planning to mitigate the impact of systemic risks, particularly in coastal regions.

- **Enhancement of Critical Infrastructure Resilience**: Investments in strengthening critical infrastructure, especially in ports and supply chains, are vital to ensure their functionality and continuity in the face of escalating coastal hazards.
- **Development of Tailored Resilience Strategies for Different Systems**: The study emphasizes the need for bespoke resilience strategies that are tailored to the specific vulnerabilities and interdependencies of different systems, particularly in disaster-prone areas.

5. Future Directions: Expanding the Application of Systemic Risk Management

The study concludes by outlining future research directions:

- **Fine-Tuning of Methodologies**: Further refinement of the IDR framework and SRCA Methodology is recommended to enhance their applicability and effectiveness across different sectors and regions.
- **Expansion to Other Hazards and Systems**: The methodologies should be expanded to encompass other types of hazards and systems, thereby broadening the scope and impact of systemic risk management.
- **Integration into Development Processes**: Integrating systemic risk management frameworks into broader development processes is crucial for building long-term resilience at local, national, and global levels.

6. Conclusion: A Call to Action

This study contributes to the ongoing discourse on systemic risk management and resilience-building, particularly in the context of critical infrastructure. It calls for a proactive, integrated approach to managing the interconnected challenges posed by systemic risks, with an emphasis on governance, collaboration, and the adoption of innovative risk management frameworks. The findings underscore the urgent need for a paradigm shift in resilience strategies to address the growing complexities of systemic risks in our rapidly changing world.

Keywords: Systemic Risk, Disaster Resilience, Integrated Disaster Resilience Framework, Systemic Risk Capability Assessment, Coastal Hazards, Infrastructure, Governance, Sustainable Development

For both states, addressing these risks will require not only immediate action but also long-term planning. Strategies should emphasize building resilience into all systems, encouraging diversification to spread risk, and investing in both hard (infrastructure) and soft (community capacity, governance) measures to reduce vulnerability and enhance adaptability to changing conditions. Collaboration across all sectors of society and levels of government, as well as with international partners, will be key to achieving these goals.

I. INTRODUCTION

1. Introduction

1.1 Background of Disaster Risk Management and Systemic risks in India

Disasters are becoming increasingly common and unexpected as a result of the rapid environmental and socioeconomic changes occurring at several levels. They are often the result of systemic risks marked by complexity, uncertainty, ambiguity, and cross-border consequences. These systemic risks outperform traditional risk management practices, posing new, unsolved policy and governance issues and as risk grows, the effects of disasters on communities and whole systems also intensify. Natural disasters, climate change, ecological vulnerability, unplanned urbanisation, and political or financial insecurity all play a role. Systemic risks are connected with cascading and compounding effects that extend within and between systems and sectors (for example, ecosystems, health & infrastructure etc.) via the flow of people, products, money, and information across borders. As a result, critical system interdependencies, exacerbated by underlying vulnerabilities, underscore the rising need to better comprehend systemic risks, and potential governance solutions.

India is one of the most disaster-prone countries in the world. Due to its geo-climatic and socio-economic conditions, the country is prone to all kinds of disasters, such as floods, earthquakes, tsunamis, landslides, cyclones, droughts, thunderstorms and lightning strikes, glacial lake outburst flood (GLOFs), heat waves, biological and public health emergencies, fires (including forest fires), etc. In addition to the pre-existing systematic vulnerabilities, the impact of these disasters is further exacerbated by climate change, which intensifies the frequency and intensity of these extreme weather events.

FIGURE 1: CYCLONE MICHAUNG IMPACT ON ANDHRA PRADESH

Historically, in India the performance of disaster response-relief-reconstruction has been superior than that of disaster prevention-mitigation preparedness. While in the past few years there has been a paradigm systematic shifts towards resilience building rather than relief centric approach, India still confronts considerable hurdles in disaster management, and India's DRM framework does not significantly take systemic risks into account comprehensively. Some of the most pressing topics include inadequately explored definition and scope of systemic risks, scale discordance between international and national policy, lack of established approaches for assessment and management of systemic risks, inadequate database on systemic disaster events, inadequacy of institutional and financial mechanisms to address systemic risks and insufficient integration of climate change action and DRR measures.

Box 1: Defining disaster risk reduction and disaster risk management

The United Nations Office of Disaster Risk Reduction (UNDRR) ***defines disaster risk reduction (DRR)*** *as "preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development. DRR is the policy objective of disaster risk management, and its goals and objectives are defined in disaster risk reduction strategies and plans" (UNDRR).*

A number of national and international initiatives also focus on ***disaster risk management (DRM)****, including those in the three case study countries: Ghana, Peru and the Philippines. UNDRR defines DRM as "the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses" (UNDRR). The management of residual risks includes: preparedness, response and recovery activities, but also a mix of different financing instruments, such as national contingency funds, contingent credit, insurance and reinsurance and social safety nets (UNDRR)*

The COVID-19 pandemic is a prime example of how systemic risk materialised as a catastrophe when hazards (in this case, biological) combined with the present and historical realities of embedded and endogenous vulnerabilities. At a strategic level, there is a need to conceptualise and interpret disaster risk from a systemic

lens in order to provide a comprehensive picture. Given the potential gaps highlighted in the above section and the significance of disaster risk reduction in the pathway toward sustainable development, it is crucial to create a Systemic Risk Capability Assessment Model for disasters.

A multisectoral, multidisciplinary strategy is required in which reaction, recovery, and development must be handled concurrently and holistically, necessitating integrated multidimensional and multisectoral plans and activities because no one entity has the mission, capability, or resources to handle all elements of disasters, particularly in multi-hazard circumstances. Therefore, it is crucial to assess the capability to manage systemic risks. However, there is no model currently available to operationalize this concept. Therefore, the "Systemic Risk Capability Assessment Model" will act as a significant contribution to Odisha's DRM capabilities. This model can also be a best practice which other states Indian states can adopt to build systematic resilience.

1.2 Purpose and Scope of the Report

The aim of this study is to comprehensively examine the disaster risk management (DRM) framework in India, with a specific focus on understanding and addressing systemic risks with close focus of 2 States as case studies (Odisha and Andhra Pradesh). One of the key outcomes of this study will be a Systemic Risk Capability Assessment Model for disasters. The key objectives of the study being:

FIGURE 2: SELECTED STATES FOR THE STUDY

- To review and assess global frameworks for disaster risk management, including international agreements, conventions, and key principles, to identify guiding principles applicable to India's context.
- To analyse national policies, strategies, and institutional structures for disaster risk management in India.
- To examine state-level DRM frameworks, including risk profiles, policies, legislation, and preparedness mechanisms.
- To propose recommendations based on the findings of the study, aiming to enhance India's DRM capabilities, particularly in managing systemic risks.

1.3. Methodology

The methodology for this study encompasses a comprehensive approach focused on understanding Disaster Risk Management (DRM) and systemic risks, with a focus on both global and India-specific perspectives. In initial stages an in-depth literature review is conducted to document global and India-specific strategies and frameworks for Disaster Risk Management and to further identify key challenges and gaps in existing frameworks, based on literature and secondary analysis. Subsequently, interviews with key stakeholders in Odisha and Andhra Pradesh were conducted to gather insights into the strengths, weaknesses, and challenges of state-level DRM frameworks, as well as perspectives on policy effectiveness and coordination efforts at state level. The analysis phase involves comparing global, national, and state-level DRM frameworks to assess alignment with best practices and standards, followed by synthesizing findings from the literature review and stakeholder interviews to identify common themes, challenges, and opportunities. As an outcome of the study a conceptual framework for a Systemic Risk Capability Assessment Model tailored to the Indian context is being developed based on the documented insights. This methodology aims to provide a holistic understanding of Disaster Risk management at the state level and contribute to the development of effective systemic risk management strategies.

Literature Review:

- Conduct a thorough review of existing literature on disaster risk management (DRM) and systemic risks, focusing on global and India-specific perspectives to identify the key challenges and systematic gaps.

Interviews with Key Stakeholders in Odisha and Andhra Pradesh:

- Identify and interview key stakeholders involved in DRM at state levels, including government agencies, NGOs, and other stakeholders.
- Gather insights on strengths, weaknesses, and challenges of State level DRM framework, particularly in addressing systemic risks.
- Explore perspectives on policy effectiveness, institutional mechanisms, and coordination efforts in managing disasters and enhancing resilience.

Analysis:

- Compare global, national, and state-level DRM frameworks to assess alignment with best practices and international standards.
- Synthesize findings from literature review and stakeholder interviews to identify common themes, challenges, and opportunities in DRM landscape at state level.

Systemic Risk Capability Assessment Model Development:

- Develop a conceptual framework for a Systemic Risk Capability Assessment Model tailored to the Indian context.

FIGURE 3: STUDY METHODOLOGY

II. GLOBAL FRAMEWORKS FOR DISASTER RISK MANAGEMENT

2. Global Frameworks for Disaster Risk Management

2.1 Overview of International Agreements and Conventions

The increasingly complex and interconnected nature of disasters emphasizes the critical need of global disaster management systems. While establishing standard principles, rules, and best practices, the global frameworks can facilitate effective risk reduction, resilience building, and cross-border capacity development. These frameworks support the integration of risk reduction into more comprehensive development agendas, contributing to the global achievement of resilient and sustainable communities. In recent decades, number of international policy frameworks has been developed for specifically for disaster risk reduction and other broader development Agendas that also address disaster risk reduction and resilience building. Some of the Global Frameworks that act as catalyst for steering National Policies and Framework on Disaster Risk Management are discussed below:

International Strategy for Disaster Reduction (ISDR)

The International Strategy for Disaster Reduction (ISDR) was an initiative launched in 1999 by the United Nations to reduce social vulnerability and risks of natural hazards and related technological and environmental disasters. Its main purpose was to facilitate, in an inter-agency effort Governments and communities in disaster-prone areas in integrating the management of risk into their development policies, programmes and projects. The long-term goal was to enable communities to become resilient to disasters saving lives as well as social, economic, and environmental assets. By working through a network of international organisations, scientific and expert institutions, civil society, private sector interests and government officials, the ISDR aimed to increase public awareness about disaster reduction, to motivate commitment from public authorities, and to stimulate inter-disciplinary and inter-sectoral partnerships that can improve the scientific knowledge on natural hazards and the causes of disasters.

Hyogo Framework for Action (2005-2015)

In the year 2000, at the second world conference on Disaster Reduction held at Kobe, Hyogo, Japan, the Hyogo Framework for Action (HFA, 2005-2015) was adopted. HFA is considered as one of the most significant international documents on Disaster Risk Reduction, which put forth the concept of Disaster Risk reduction putting a stronger focus on disaster preparedness and prevention. HFA put forth five priorities for actions and guiding principles offering practical means for achieving disaster risk reduction and resilience.

FIGURE 4: HYOGO FRAMEWORK PRIORITIES FOR ACTION

In the year 2015, at the third world conference on disaster risk reduction, Sendai, Japan, the Hyogo framework for Action was succeeded by more ambitious Sendai framework for Disaster Risk Reduction.

Sendai Framework for Disaster Risk Reduction (2015-2030)

The Sendai Framework for Disaster Risk Reduction (SFDRR), 2015-2030, was adopted at third UN World Conference in Sendai, Japan. SFDRR draws guidance and builds on the gaps, assessment and lessons drawn from its predecessor i.e. the Hyogo framework for action instruments (2005-2015). Sendai Framework recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders.

Taking into account the experience gained through the implementation of the Hyogo Framework for Action, and in pursuance of the expected outcome and goal, there is a need for focused action within and across sectors by States at local, national, regional and global levels in the following four priority areas:

- Priority 1: Understanding disaster risk.
- Priority 2: Strengthening disaster risk governance to manage disaster risk.
- Priority 3: Investing in disaster risk reduction for resilience.
- Priority 4: Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

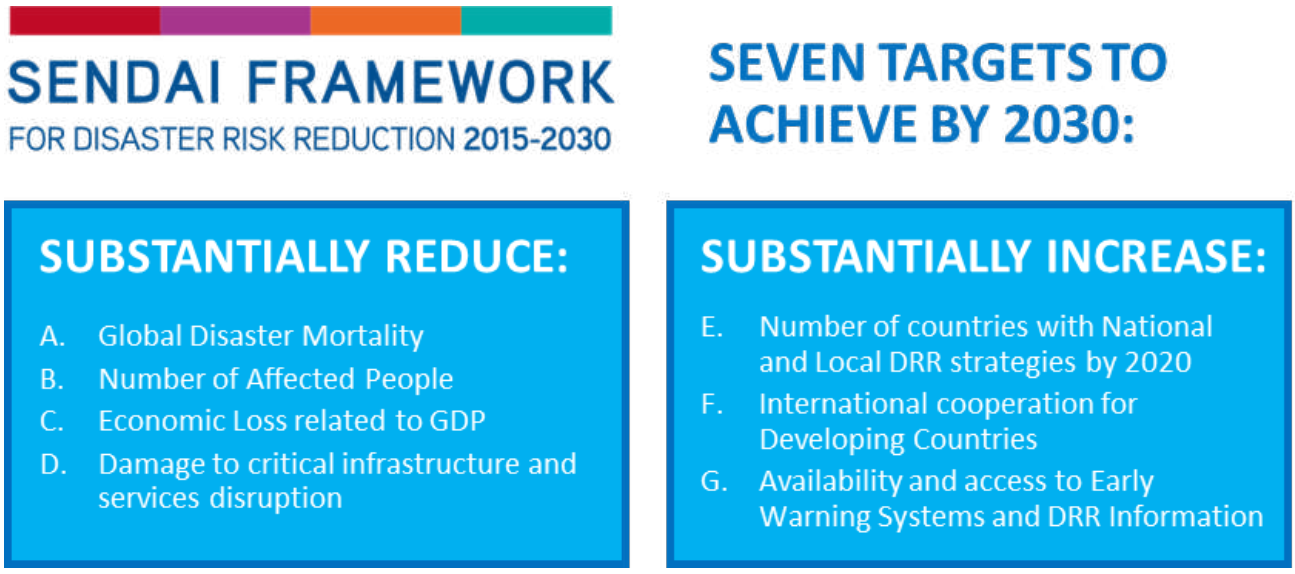

FIGURE 5: SEVEN GLOBAL TARGETS TO BE ACHIEVED BETWEEN 2015 AND 2030 OUTLINES BY SFDRR

International Disaster Relief Laws

'Guidelines for the domestic facilitation and regulation of international disaster relief and initial recovery assistance' commonly known as International Disaster Relief Laws (IDRL) were developed by International Federation of Red Cross and Red Crescent Societies (IFRC) which were unanimously adopted by states and national societies in the year 2007 at the 30 International Conference of Red Cross and Red Crescent. The guidelines provide set of recommendations to governments intended to help them in strengthening their disaster laws and plans related to international assistance during emergencies. These guidelines have been anchored in various international norms and standard including United Nation Assembly Resolutions, Sphere Minimum Standards in Disaster Response, Hyogo Framework for Action (2005-2015) etc.

- IDRL guidelines under the core responsibilities of assisting actors specifies the disaster relief and recovery assistance should be carried out so as to 'minimise negative impacts on economy, local community, environment and development objectives'.
- Also, the guidelines specify that it remains the responsibility of assisting states or assisting humanitarian organisations to 'remove or dispose unwanted or unused relief/initial recovery goods, particularly if they may pose potential threat to human health and safety or the environment'.

Sphere Minimum Standards

The Sphere project or 'Sphere' was initiated in the year 1997 by a group of humanitarian organisations and the international Red Cross and Red Crescent Movement. Sphere identified set of principles and minimum standards that must be achieved during humanitarian response.

- These standards have been framed based on the Humanitarian Charter and the Core Humanitarian Standards. Sphere Minimum Standards focus on four technical areas of humanitarian response which include: Water supply, sanitation and hygiene promotion (WASH), Food security and nutrition, shelter and settlement, and Health.
- While setting out sector-specific key actions, key indicator and guidance for achieving minimum standards during humanitarian response, sphere minimum standards also address number of cross-cutting issues related to gender, children, person with disabilities, environment, etc.
- The minimum standards emphasise on the need to prevent degradation and over-exploitation of environmental resources in order to reduce disaster risk and vulnerabilities and secure life-supporting functions of environment.
- The minimum standards seek to foster environmental sustainability in humanitarian response and introduce mechanisms promoting adaptability of natural ecosystems for self-recovery.
- The sphere minimum standards also try to address climate change and its impacts by considering and accommodating new patterns of risk, hazards and vulnerabilities drawn from future climatic scenarios.

Disaster Risk Management at Regional Level

Various regions have their own disaster management organizations and frameworks tailored to address regional challenges. Some of the frameworks and institutions focused on regional cooperation and strategy are listed below:

- **ASEAN Agreement on Disaster Management and Emergency Response (AADMER) (2005):** Overview: AADMER is a legally binding framework among the member states of the Association of Southeast Asian Nations (ASEAN). It aims to enhance regional cooperation in disaster management, including preparedness, response, recovery, and risk reduction.
- **European Civil Protection and Humanitarian Aid Operations (ECHO) (From 1990s):** ECHO is the European Union's mechanism for coordinating and providing assistance in response to disasters and crises within and outside the EU. It focuses on enhancing the collective response capacity of EU member states and partner countries.
- **Southern African Development Community (SADC) Disaster Risk Reduction Strategy (2010):** SADC has developed a regional strategy for disaster risk reduction to address common challenges and vulnerabilities in Southern Africa. The strategy aims to strengthen regional cooperation, build resilience, and promote sustainable development.
- **Caribbean Disaster Emergency Management Agency (CDEMA) (2009):** CDEMA is a regional organization responsible for coordinating disaster management efforts among Caribbean countries. It facilitates cooperation, capacity-building, and resource mobilization to enhance disaster preparedness and response in the region.
- **Pacific Disaster Risk Reduction and Disaster Management Framework for Action (2005):** Developed by the Pacific Islands Forum, this framework provides guidance and coordination mechanisms for disaster risk reduction and management in the Pacific region. It emphasizes community resilience, capacity-building, and partnership development.

2.2 Key Components and Principles of Global Frameworks

Global frameworks for disaster risk management provide as points of reference for different countries as they negotiate the challenging landscape of resilience-building and disaster risk reduction. These frameworks

should establish a strategic road map for planning actions, assigning resources, and implementing interventions meant to address the complex problems presented by disasters and extreme weather events. Global frameworks facilitate the adoption of a proactive and comprehensive approach to disaster management by countries by emphasizing essential elements. Furthermore, by integrating disaster risk reduction into larger development agendas, these frameworks help to coordinate disaster management initiatives with long-term objectives of sustainable development. Global frameworks enable joint action and solidarity in addressing common risks and vulnerabilities through international cooperation, capacity building, and partnership development.

Within these global frameworks, the Sendai Framework for Disaster Risk Reduction is a cornerstone which provides an exhaustive and inclusive strategy for different countries to address the challenges of disaster risk reduction and resilience-building. From the Hyogo Framework, the Sendai Framework represents an evolution that incorporates lessons learned and fills in the gaps found throughout its implementation. The Sendai Framework represents a substantial development in global disaster risk management efforts with its stronger focus on proactive risk reduction, more emphasis on inclusivity and accountability, and larger scope addressing a wide spectrum of hazards.

It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR), and advocates for: *The substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.* It emphasizes the importance of understanding disaster risk, strengthening disaster risk governance, investing in disaster risk reduction, and enhancing disaster preparedness for effective response.

The Framework recognizes that the strong commitment and involvement of political leadership in every country is crucial. State level governments share their responsibility to reduce disaster risk with other stakeholders such as local government, the private sector and other non-State actors. It puts in place 4 clear priorities for action and 7 global targets for the substantial reduction of disaster risk.

SFDRR provides action-oriented framework for reducing disaster risk and enhancing disaster resilience by setting out four priorities for action and seven global targets. SFDRR advocates for effective management of disaster risk rather than just the management of disasters.

- SFDRR through 'Priority 4' emphases on enhancing disaster preparedness for ensuring effective disaster response and building back better during recovery, rehabilitation and reconstruction.
- SFDRR highlights the needs for strengthening disaster preparedness to ensure capacities for effective disaster response and recovery are well in place at all the levels (SFDRR, 2015).
- SFDRR also advocates for utilising post disaster recovery, rehabilitation and reconstruction phases as an opportunity to 'build-back-better' and promoting disaster resilient development through integration of disaster risk reduction into post disaster developmental activities.
- The frameworks also identifies climate change as a driver of disaster risk and therefore calls for planning and preparedness anticipating climate change scenarios and their potential impact on disaster risk across all the sectors, facilitating participation of relevant institutions and stakeholders.
- SFDRR also emphasis on strengthening sustainable management and utilisation of ecosystems and implementing integrated natural resource management and disaster risk reduction approaches.

The Sendai Framework works hand in hand with the other 2030 Agenda agreements, including The Paris Agreement on Climate Change, The Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda, and ultimately the Sustainable Development Goals.

Mainstreaming Disaster Risk Reduction and Resilience Building with Development Agenda

Development, disaster risk reduction (DRR), and climate change adaptation (CCA) are all intricately linked to enhancing resilience in the face of growing challenges across the world. Although they function in distinct but related domains, they have the same overall objectives of strengthening adaptive capacity and decreasing vulnerability. For climate-related disasters to be effectively mitigated, disaster risk reduction (DRR) activities must be combined with methods for adapting to climate change, such installing early warning systems or constructing robust infrastructure. Similarly, by addressing underlying socioeconomic problems, development activities shape resilience and vulnerability. Communities may engage in risk-informed development and reduce vulnerabilities by including climate considerations into development planning. This will increase adaptive capacity and build more resilient societies. Countries are increasingly recognising the benefits of increased coherence in CCA and DRR, exemplified by the number of countries that either have developed joint strategies or put in place processes that facilitate co-ordination across the two policy areas.

Countries are faced with the growing challenge of managing increasing risks from climate change and climate variability, putting development and the achievement of the Sustainable Development Goals at risk. The adoption in 2015 of the Sendai Framework for Disaster Risk Reduction and the Paris Agreement on climate change provides a clear mandate for increased coherence in countries' approaches to climate and disaster risk reduction. While both frameworks refer to their respective goals and objectives, each guides progress towards a more sustainable, resilient and equitable future. Domestically, responsibilities for climate change adaptation (CCA) and disaster risk reduction (DRR) tend to be spread across different institutions and stakeholders; internationally, they are supported by separate UN agencies and related processes.

Disaster risk reduction (DRR) is an integral part of social and economic development, and is essential if development is to be sustainable for the future. This has been recognized by several global documents on DRR and sustainable development. The Yokohama Strategy and Plan of Action for a Safer World (1994), as the first major international framework for disaster risk reduction, recognized the interrelation between sustainable development and DRR. Ever since, this close interrelation was continuously strengthened within the key global agreements, from MDGs to the Johannesburg Plan of Implementation (Johannesburg, September 2002), to the "Hyogo Framework for Action (2005-2015)" and to the "Future We Want" (Rio, June 2012), to the Sendai Framework for DRR (Sendai, Mach 2016) and the 2030 Agenda for Sustainable Development (New York, September 2015).

Sustainable Development Goals 2030: The 2030 Agenda for Sustainable Development recognizes and reaffirms the urgent need to reduce the risk of disasters. In addition to direct references to the outcomes of the Third UN Conference on DRR (Sendai Framework), there are specific opportunities to achieve SDGs through reducing disaster risk. For example, by reducing exposure and vulnerability of the poor to disasters or building resilient infrastructure. There are also several SDGs and targets that can contribute to reducing disaster risk and building resilience, even where disaster risk reduction is not explicit.

Targets related to promoting education for sustainable development under SDG# 4, such as building and upgrading education facilities and ensuring healthy lives, as well as targets under SDG#11 (cities) and under SDG# 9 (building resilient infrastructure) reaffirm the interrelationship between disaster risk reduction and sustainable development. amongst others can be cited.

SDGs with Targets related to Disaster Risk: Disaster risk reduction cuts across different aspects and sectors of development. There are **25 targets related to disaster risk reduction in 10 of the 17 sustainable development goals**, firmly establishing the role of disaster risk reduction as a core development strategy.

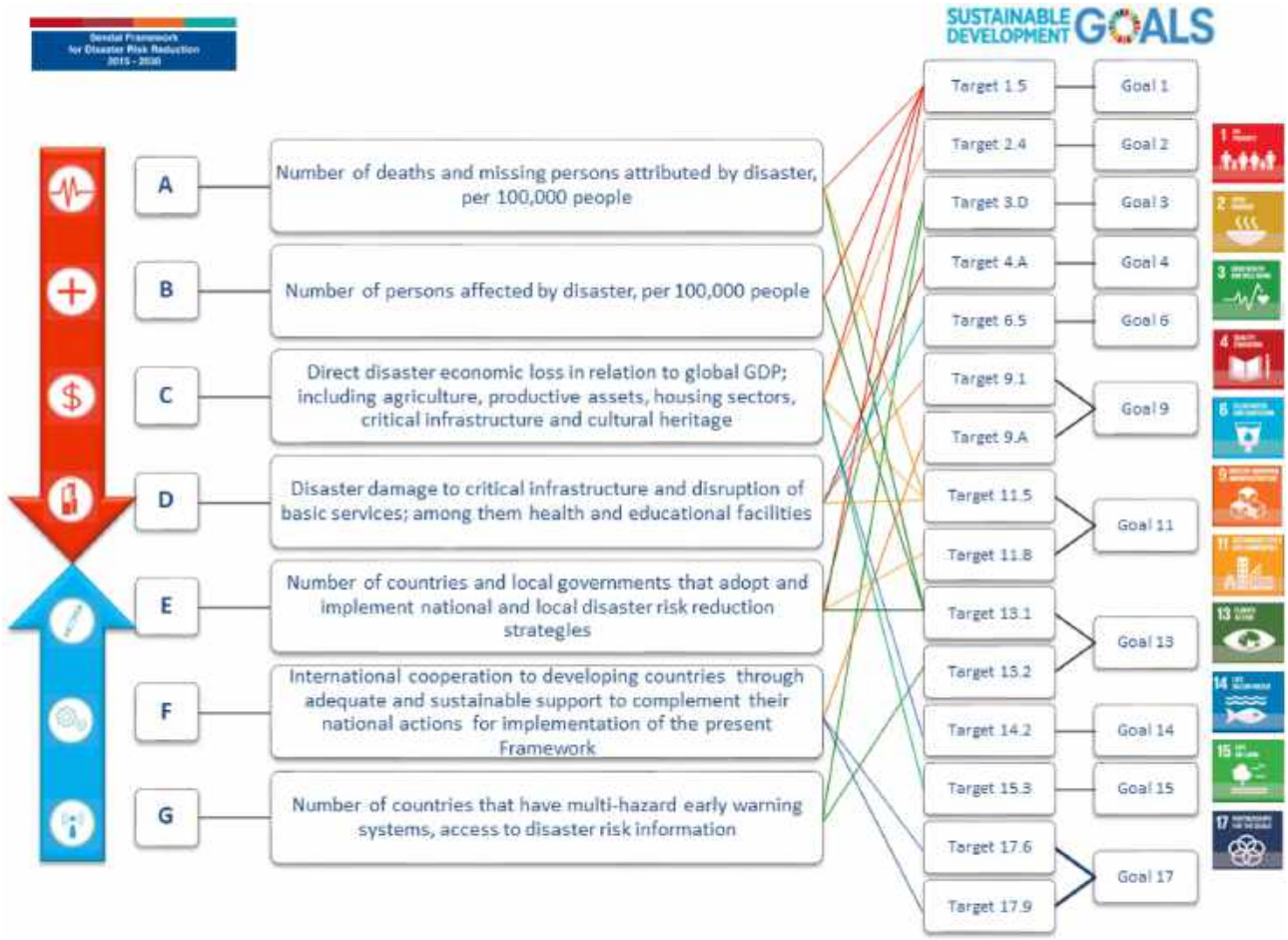

FIGURE 6: LINKS BETWEEN SENDAI FRAMEWORK TARGETS AND SUSTAINABLE DEVELOPMENT GOALS

(Source: Wright, N., Fagan, L., Lapitan, J.M. et al. Health Emergency and Disaster Risk Management: Five Years into Implementation of the Sendai Framework. Int J Disaster Risk Sci 11, 206–217 (2020). https://doi.org/10.1007/s13753-020-00274-x)

The Paris Agreement

Climate change is a global emergency that goes beyond national borders. It is an issue that requires international cooperation and coordinated solutions at all levels. To tackle climate change and its negative impacts, world leaders at the UN Climate Change Conference (COP21) in Paris reached a breakthrough on 12 December 2015: the historic Paris Agreement.

The Agreement sets long-term goals to guide all nations to:

- substantially reduce global greenhouse gas emissions to hold global temperature increase to well below 2°C above pre-industrial levels and pursue efforts to limit it to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change
- periodically assess the collective progress towards achieving the purpose of this agreement and its long-term goals
- provide financing to developing countries to mitigate climate change, strengthen resilience and enhance abilities to adapt to climate impacts.

The Agreement is a legally binding international treaty. It entered into force on 4 November 2016. Today, 195 Parties (194 States plus the European Union) have joined the Paris Agreement.

The Agreement includes commitments from all countries to reduce their emissions and work together to adapt to the impacts of climate change, and calls on countries to strengthen their commitments over time. The Agreement provides a pathway for developed nations to assist developing nations in their climate

mitigation and adaptation efforts while creating a framework for the transparent monitoring and reporting of countries' climate goals.

The Paris Agreement provides a durable framework guiding the global effort for decades to come. It marks the beginning of a shift towards a net-zero emissions world. Implementation of the Agreement is also essential for the achievement of the Sustainable Development Goals.

The Sendai Framework and the Paris Agreement have a lot in common, including a focus on resilience-building and risk reduction. Both models acknowledge that in order to improve adaptive capacity and lessen the effects of climate-related disasters, it is critical to address underlying risk factors and vulnerabilities. Countries can more effectively predict, plan for, and respond to the escalating frequency and intensity of climate-related hazards by incorporating climate change concerns into their disaster risk reduction policies. Furthermore, countries can maximize resources, prevent duplication of effort, and achieve higher efficiency and effectiveness in building resilience by coordinating climate action with catastrophe risk reduction initiatives.

III. NATIONAL FRAMEWORKS FOR DISASTER RISK MANAGEMENT

3. National Frameworks for Disaster Risk Management

3.1 Analysis of National Policies and Strategies

Evolution of India's Policy Frameworks

A conceptual shift towards anticipatory management of disasters began in the mid-1970s, as the culmination of a change in comprehension of disasters from 'acts of God' to social phenomena. Before this point, the international effort was largely reactive, institutionalised through bodies such as the United Nations Disaster Relief Office, created in 1971 to promote the 'study, prevention, control, and prediction of *natural* disasters. This conceptualization of disasters as 'natural' underwent a slow transition through the International Decade for Natural Disaster Reduction (IDNDR) during the 1990s – notably within the Yokohoma Strategy for a Safer World– and subsequently the UN International Strategy for Disaster Reduction (UNISDR) in 2000, renamed in 2019 as the UNDRR. A shift in focus towards viewing disasters as social and the increasing emphasis placed on disaster preparedness (as opposed to responsiveness) was further institutionalised with the introduction of the Hyogo Framework for Action in 2005, and in 2015 with the Sendai Framework for Disaster Risk Reduction with its four action priorities related to understanding and strengthening disaster governance to manage disaster risk, and 'Building Back Better' in recovery, rehabilitation and reconstruction. The current UN terminology regards Disaster Risk Reduction (DRR) as 'the policy objective of disaster risk management', with disaster risk management being the application of DRR strategies to prevent, reduce and manage disaster risk.

Echoing these shifts within the UN, India underwent a major shift in its approach towards disasters in 2005 with the introduction of the Disaster Management Act, like many countries in the mid-2000s. Nationally, major disasters such as the earthquakes of Uttarkashi (1991), Latur (1993) and Chamoli (1999), the Assam floods (1998), and the Odisha Super Cyclone (1999), pressed home the need to rethink the state of disaster management in the country. A High-Powered Committee on disaster management was constituted by the Central Government in 1999 to develop India's holistic approach towards 'natural' disasters, later extended to accommodate 'man-made disasters'. The report of the committee was submitted in 2001, the year of the Gujarat Bhuj earthquake, and the Bill made into an Act in 2005 following the Indian Ocean Tsunami (2004). The Act was followed by the National Policy on Disaster Management (2009)– guided by the Hyogo Framework (2005–2015) – and the National Disaster Management Plan, introduced in 2016 and revised in 2019, based on the Sendai Framework.

National Disaster Management Act (2005)

National Disaster Management Act was passed in the year 2005 and is known to be the foundational legislation in the country. National Disaster Management Act of India (2005) provides a detailed plan of action to drawing its implementing and executing a disaster management plan. The act laid down a comprehensive institutional and financial framework for managing disasters. The act distinctly defined institutional and financial structures, role and responsibilities of different agencies at national and sub-national level. The act mentioned about post disaster activities including evacuation, rescue and relief and rehabilitation and reconstruction. The act mainly focused on designating the responsibilities to national or sub-national authorities for management of these activities in case of any emergency. Sub-national authorities have the primary responsibility of managing post-disaster phases with support from national authorities as and when needed.

National Policy on Disaster Management (NPDM) (2009)

The National Policy on Disaster Management (NPDM) was prepared in tune with and in pursuance of the Disaster Management Act, 2005 with a vision to build a safe and disaster resilient India by developing a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention,

mitigation, preparedness and response. The Policy covers all aspects of disaster management covering institutional, legal and financial arrangements; disaster prevention, mitigation and preparedness, techno-legal regime; response, relief and rehabilitation; reconstruction and recovery; capacity development; knowledge management and research and development. It focuses on the areas where action is needed and the institutional mechanism through which such action can be channelized.

The NPDM aims to bring in transparency and accountability in all aspects of disaster management through involvement of community, community-based organizations, Panchayati Raj Institutions (PRIs), local bodies and civil society.

PMs 10 Point Agenda for Disaster Risk Reduction

The Prime Minister, Shri Narendra Modi, enunciated a Ten-Point Agenda in his inaugural speech at the Asian Ministerial Conference on Disaster Risk Reduction 2016, held in New Delhi during November 2016 (AMCDRR), which has also been incorporated in the NDMP. 10- Point Agenda on Disaster Risk Reduction, encompasses tools and approaches to address critical challenges in achieving sustainable development objectives and renewed efforts towards DRR. The ten key elements consist of the following:

1. *All development sectors must imbibe the principles of disaster risk management*
2. *Risk coverage must include all, starting from poor households to SMEs to multi-national corporations to nation states*
3. *Women's leadership and greater involvement should be central to disaster risk management*
4. *Invest in risk mapping globally to improve global understanding of Nature and disaster risks*
5. *Leverage technology to enhance the efficiency of disaster risk management efforts*
6. *Develop a network of universities to work on disaster-related issues*
7. *Utilise the opportunities provided by social media and mobile technologies for disaster risk reduction*
8. *Build on local capacity and initiative to enhance disaster risk reduction*
9. *Make use of every opportunity to learn from disasters and, to achieve that, there must be studies on the lessons after every disaster*
10. *Bring about greater cohesion in international response to disasters*

National Disaster Management Plan (2019)

National disaster management plan prepared in accordance with national Disaster Management Act 2005 and the national policy on disaster management (2009), provides an operational framework for managing disasters covering all aspects of disaster management cycle. The plan clearly defines scope, role and responsibilities of all the relevant stakeholders (government agencies, private sector organisations, local communities etc.). The revised national plan which put forth a holistic framework for disaster risk reduction is based on the salient features shared below:

1. Covers all phases of disaster management prevention, mitigation, response and recovery
2. Horizontal and vertical integration among all the agencies and departments of the Government;
3. Spells out the roles and responsibilities of all levels of Government right up to Panchayat and Urban Local Body and the plan has a regional approach;
4. The Plan has introduced coherence and mutual reinforcement of the post-2015 global frameworks Sendai framework for Disaster Risk Reduction (SFDRR), Sustainable development goals (SDGs) and conferences of parties (COP21) Paris Agreement on Climate Change, to which India is signatory.
5. Plan is aligned with the Prime minister's 10-point agenda for DRR
6. The Plan addressed social inclusion as ubiquitous and cross-cutting principle
7. Mainstreaming of DRR is an integral feature of the NDMP 2019

The plan provides a blueprint of disaster management cycle for all types of hazards and also takes account of viz. climate change, environmental degradation, development with risk zones, urbanisation, increasing population and industrialisation, aggravating the impacts and frequencies of these hazards. For each of

hazard, the plan provides an integrated planning framework for each of the hazards, grouped into six thematic areas- understanding risk, inter-agency coordination, investing in DRR- structural and non-structural measures, capacity development and climate change risk management detailing out strategies for disaster prevention, mitigation, response and recovery. The plan also includes chapters on cross-themes related to DRR such as coherence and mutual reinforcement of three post-2015 global framework, social inclusion and mainstreaming.

Sectoral approach to Disaster Risk Reduction:

One of the main objectives of national disaster management policy is to mainstream Disaster Risk Reduction into development planning process. The relationship between development and disaster risk, provides the core rationale for mainstreaming DRR into developmental planning and practice. Development can be a major driver of disaster risk, wherein disaster risk, vulnerabilities and exposure are constructed through development patterns, pathways and practices. Mainstreaming of DRR into developmental processes must be driven from within the developmental sectors so as to ensure that sectoral vulnerabilities are well assessed and risk management is institutionalised into policy planning, project cycles and practices. Mainstreaming DRR is a complex process and is highly context specific, however the key is to keep risk management at the centre of development processes rather looking at it as an add-on. Mainstreaming being a dynamic process can be operationalised through different entry points and pathways. However, policies and laws are often considered most common entry tools for mainstreaming DRR at national and subnational level. Table 6 enlist some of the national policies/schemes/programmes across key strategic sector that act as potential entry points for integrating disaster risk reduction.

TABLE 1: MAINSTREAMING DRR ACROSS SECTORAL POLICIES AND PROGRAMMES

Sector	Policies/schemes/programmes
Infrastructure	• Atal Mission for Rejuvenation of Urban Transformation (2015-2022) • Pradhan Mantri Gram Sadak Yojana (PMGSY) (2000 -Ongoing) • Smart Cities Mission (2015-2023)
Health and Sanitation	• National Rural Health Mission (NRHM) (2005-2012) • Integrated Child Development Services (1975-Ongoing) • Swastha Bharat Mission (Launched in 2021) • Swacch Bharat Mission (2014-2025)
Livelihood	• Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) (2005-Ongoing) • National Rural Livelihood Project (NRLP) (June 2011-Ongoing)
Education	• Mid-Day Meal (2001-Ongoing) • Sarva Shiksha Abhiyan (2001-Ongoing)
Agriculture	• Pardhan Mantri Krishi Sinchayee Yojana (2015-Ongoing) • Pardhan Mantri Fasal Bima Yojana (2016-Ongoing) • Soil Health Card Scheme (2015-Ongoing)

Source: Bhardwaj & Gupta (2021)

Sectoral, State, District and Local Level Plans for Disaster Management

Delineated by DMA 2005, NPDM 2009 and NDMP 2019, disaster management planning in India operates across multiple levels, encompassing sectoral, state, district, and local levels to ensure a comprehensive and coordinated approach to disaster risk reduction and response.

Across various levels Ministries and departments create sector-specific plans that are unique to their areas of responsibility, which include infrastructure, education, health, and agriculture. Within their respective

domains, these sectoral plans delineate approaches for risk mitigation, preparedness, and response coordination.

State governments also create disaster management plans, State Disaster Management Plans aligned with the strategic approaches and guidance framework set forth by National Disaster Management Plan 2019. In order to efficiently handle disasters within the state, these plans also specify institutional frameworks, resource distribution, and coordination procedures.

District Disaster Management Plans further localize operations by assigning roles, setting up early warning systems, and designating shelters and pathways for evacuation. Further, disaster management plans are created at the local level by panchayats and municipalities based on the unique requirements and risks of their communities. The objectives of these plans is to ensure increased local capacity, foster community resilience, and ensure timely reaction and recovery in the case of a disaster. The overarching goal of India's multi-tiered approach to disaster management planning is to promote cooperation, coordination, and efficient execution at all governmental and societal levels.

3.2 Assessment of Institutional Structures and Coordination Mechanisms

The Ministry of Home Affairs (MHA) discharges multifarious responsibilities, the important among them being - internal security, border management, Centre-State relations, administration of Union Territories, management of Central Armed Police Forces, disaster management, etc. The Ministry of Home Affairs continuously monitors the internal security situation, issues appropriate advisories, shares intelligence inputs, extends manpower and financial support, guidance and expertise to the State Governments for maintenance of security, peace and harmony without encroaching upon the constitutional rights of the States. As per Second Schedule of Allocation of Business Rules, Ministry of Home Affairs is mandated to look after the matters relating to loss of human life and property due to all natural and man-made calamities, other than drought or epidemics.

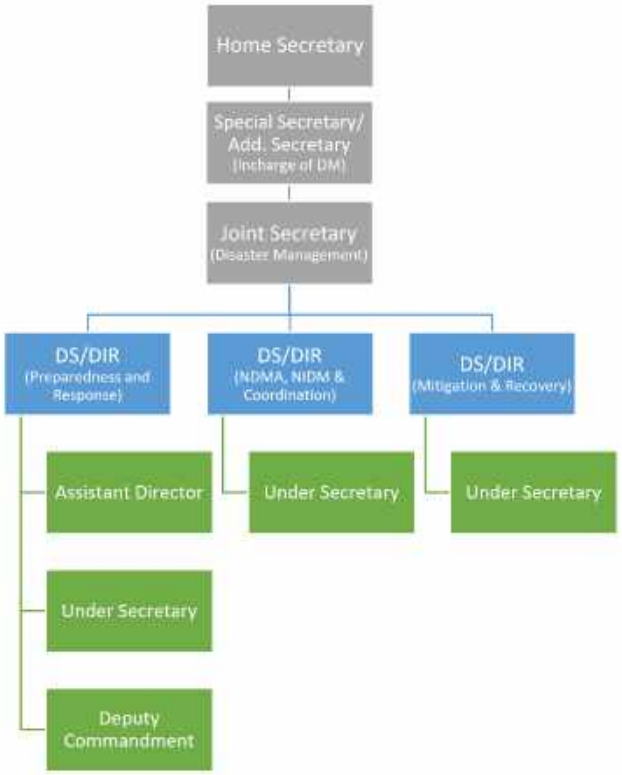

FIGURE 7: DISASTER MANAGEMENT (DM) DIVISION OF MHA

The Disaster Management (DM) Division is the nodal division in Ministry of Home Affairs (MHA) for disaster management. The Division is responsible for response, relief and preparedness for natural calamities and man-made disasters (except drought and epidemics). The Division is also responsible for legislation, policy, capacity building, prevention, mitigation and long-term rehabilitation.

The Disaster Management Act, 2005 was passed by the Government of India to provide for the effective management of disasters, ensuring measures for prevention and mitigation of the effects of disasters and for providing prompt response to any disaster situation across India. This act further strengthened the institutional structure for graded response and preparedness in India by the establishment of the National Disaster Management Authority (NDMA) as the apex body for Disaster Management in India, for laying down the policies, plans and guidelines on disaster management for ensuring timely and effective response to any disaster. The DM Act 2005, also mandated for the Constitution of National Executive Committee to act as the

coordinating and monitoring body for disaster management and is chaired by the Union Home Secretary. Some of the details of the governing bodies established by DMA 2005 are shared below:

1. **National Disaster Management Authority (NDMA):** The National Disaster Management Authority is headed by the Prime Minister of India as the chairperson and will have no more than nine members including a Vice-Chairperson. All the members will have a tenure of five years. The main responsibility of the NDMA is to lay down the policies, plans and guidelines for disaster management to ensure an effective response in the event of any disaster.
2. **National Executive Committee:** The DMA empowers the Central Government to create a National Executive Committee (NEC) to assist the National Disaster Management Authority. The NEC consists of Secretary level officers of the government in the home, health, power, finance and agricultural ministries. The NEC is responsible for the preparation of the National Disaster Management Plan for the whole country and to ensure that it is "reviewed and updated annually".
3. **State Disaster Management Authority:** The State Disaster Management Authority (SDMA) is responsible for drawing the disaster plan for its respective state. It consists of the Chief Minister who is the chairperson and 8 members appointed by the Chief Minister. The SDMA is mandated under section 28 to ensure that all the departments of the State prepare disaster management plans as prescribed by the National and State Authorities.
4. **District Disaster Management Authority:** The Chairperson of District Disaster Management Authority (DDMA) will be the Collector or District Magistrate or Deputy Commissioner of the district.
5. **National Disaster Response Force (NDRF):** The National Disaster Response Force is tasked with responding to a threatening disaster or a situation similar to it. The NDRF is led by a Director-General appointed by the Central Government. The NDRF has played a major role in rescuing people from many disaster-related events in the past such as the Kashmir floods of 2014 and the Kerala Floods of 2018.

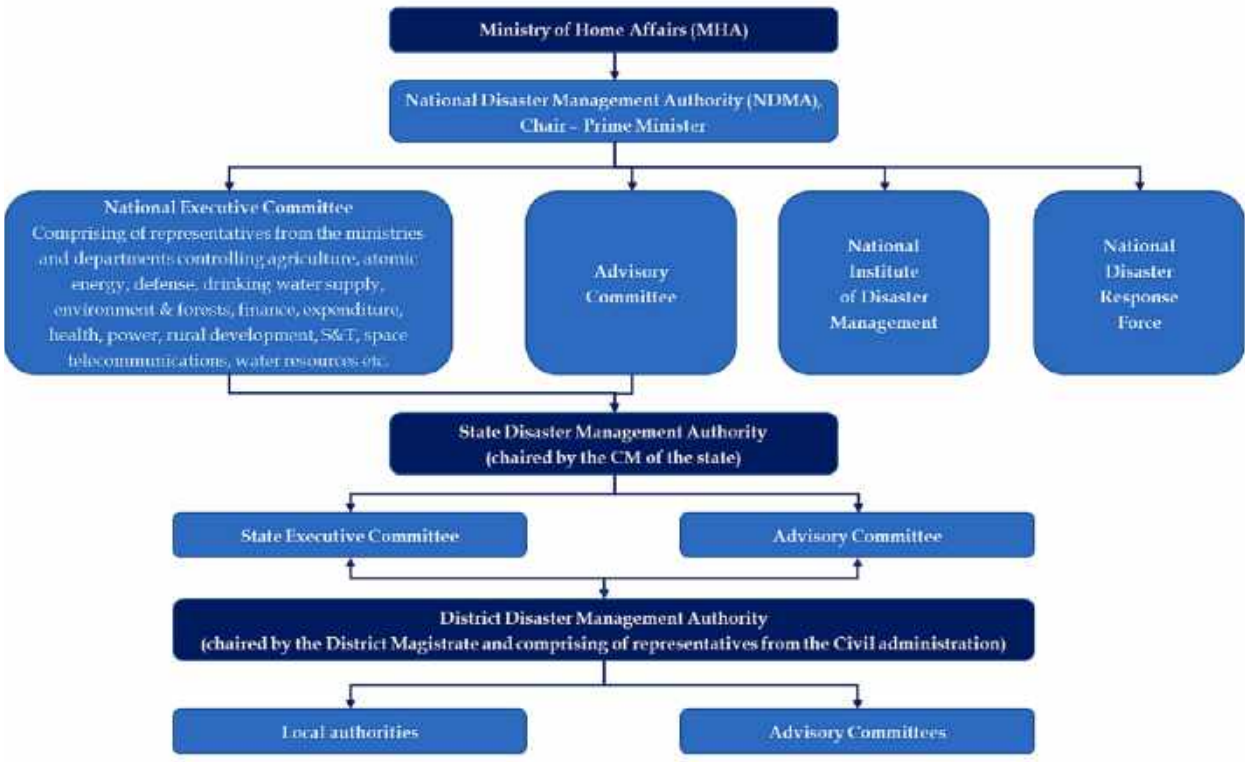

FIGURE 8: DISASTER MANAGEMENT STRUCTURE IN INDIA

Source: Mitra, Arunabh & Shaw, Rajib. (2023). Systemic risk management in India: An analytics perspective. Progress in Disaster Science. 18. 100279. 10.1016/j.pdisas.2023.100279.

3.3. Gaps in India's DRM framework from a systemic risk lens

Historically, disaster response, relief, and rebuilding have done better in the past than disaster prevention and preparedness. However, a full evaluation of hazards, vulnerabilities, and disaster risks at different levels, avoidance of new risks, reducing existing risks, and integrating disaster risk reduction into different development sectors haven't had as big of an impact. Despite its apparent strengths, India still faces significant obstacles in disaster management, and its DRM framework does not adequately account for systemic hazards. This section aims to provide a quick overview of the most significant issues while acknowledging that the stated issues are subjective and may vary between states.

a) **The concept and breadth of systemic risks are insufficiently explored.**

There are relatively limited grounds for long-term strategy and decision making to handle these risks due to the deficiencies in the definition and spectrum of systemic risks. At times, cascading and compound hazards are commonly, if not totally, used interchangeably with systemic risk. Furthermore, because the knowledge of systemic risks is so new and continually evolving, important stakeholders may be ignorant of them or lack past expertise in dealing with them. Furthermore, stakeholders' ability to recognise, discern, and identify the causes and effects of systemic catastrophes, as well as related vulnerabilities, may be restricted. Since systemic risks need rapid multisectoral, transboundary, and global collaboration to tackle them, a lack of knowledge of relevant duties and obligations among stakeholders may amplify their consequences.

b) International-National Policy Discordance Scale

Another barrier in disaster risk reduction (DRR) is the difficulty of converting international policy considerations into actual outcomes on the ground. This is due to the fact that information is frequently overly generic and does not correspond to local context, cultures, and institutions. This problem is not limited to disaster risk reduction; it also applies to studies on climate change and sustainable development change, which are closely intertwined. It's known as "scale discordance."and It occurs when scientific facts fail to represent the specific environmental circumstances and geographic scales in a way that aids decision-making.

c) Lack of defined methods for assessing and managing systemic risks

There is lack of scientific evidence-based approaches for detecting and mitigating systemic risks, and a single hazard approach appears to continue to dominate risk management and analysis. The pluralistic nature of the rising risk landscape, on the other hand, necessitates a multi-hazard approach to risk management, which indicates the degree of risk emergence within an interdependent set of systems, thereby giving clarity to policymaking. Overall, enhancing risk governance structures, procedures, and mechanisms at all layers will improve the ability to cope with complex and diversified risks.

d) Inadequate database on systemic disaster events:

There is a lack of information about past disasters, particularly systemic risks, and there is no centralised platform for collecting disaster-related data. As a result, it is challenging to understand the complexity of risks when conducting scientific evaluations and developing policies. There is also a lack of a database that can assist with risk prediction and there is no systematic documentation of trends in disaster occurrences and their impacts.

e) Insufficiency of institutional and financial systems to manage systemic risks:

There is insufficient expertise and coordination among implementing agencies, ministries, and other authorities in managing systemic risks. The lack of systemic risk-specific policies in development plans, local capacity to execute national-level policies, and suitable disaster risk finance mechanisms are significant issues that hinder resilient and sustainable planning. Moreover, the altering insurance environment and the systemic character of risk have indicated the potential limitations in the capacity of existing insurance systems to handle just "conventional" (and single-hazard) situations. In order to address this issue governing

authorities should collaborate with the private sector to co-create innovative financial mechanisms to enhance disaster risk reduction.

f) Insufficient integration of climate change action and DRR measures:

It is crucial to combine climate change initiatives with disaster risk reduction measures, particularly as climate change is increasingly recognised as a systemic issue. To achieve sustainable development, local governments should play an active role in incorporating climate change mitigation and adaptation measures along with the steps taken for disaster risk reduction. Policymakers, planners, and climate action negotiators can develop long-term strategies to build resilience while preparing for uncertainties in the long term.

IV. STATE-LEVEL FRAMEWORKS FOR DISASTER RISK MANAGEMENT

4. State-Level Frameworks for Disaster Risk Management

4.1 State (Risk) Profile

Odisha

Situated on the eastern coast of India, Odisha covers a land area of 1, 55, 707 square kilometres, accounting for approximately 4.87% of the country's total landmass. Its geographical coordinates range from 17°49" to 22° 34" N and 81° 27" to 87° 29" E. Odisha shares its borders with Bihar, Jharkhand, West Bengal, Andhra Pradesh, and Chhattisgarh, and is flanked by the Bay of Bengal to the east. The state encompasses diverse geographical regions including the Northern Plateau, Central River Basins, Eastern Hills, and Coastal Plains, offering a range of elevations from 500 metres in the north to 1500-1600 metres in the southwestern districts and 900 metres in the eastern hills.

Demography

As of the 2011 census, Odisha is home to 9, 661, 085 households, contributing approximately 3.9% to the total number of households in India. The state's population is primarily rural, with 83% residing in rural areas. Between 2001 and 2011, Odisha witnessed a decadal growth rate of 14%, resulting in a population density of 270/km². The sex ratio stands at 979 females per 1000 males, with a literacy rate of 72.87%. The working population comprises 1, 75, 41, 589 individuals, with 61% categorised as main workers and 39% as marginal workers. Administratively, Odisha is divided into 30 districts, further grouped into three revenue divisions, 58 sub-divisions, 317 tahasils, and 314 blocks, which include 6,801 Gram Panchayats and 51,349 villages. Additionally, the state features five Municipal Corporations, 45 Municipalities, 60 Notified Area Councils, and two Industrial towns.

TABLE 2: DEMOGRAPHIC PROFILE OF ODISHA

		SC/ST		
Population (2011) 41974218	**Population density (persons/sq. km) (2011) 270**	**(2011) SC – 16.5 % ST – 22.1 %**	**Population Below poverty line (2011-12)* 32.59 %**	**Children (0-6 years) (2011) 5273194**
Sex Ratio (2011) 978	**Child sex ratio (0 – 6 years) (2011) 934**	**Birth Rate (%) [2016] ** 18.6%**	**Death Rate (%) [2016] *** 7.8 %**	**Literacy rate (7+ years) (2011) 72.9 %**

*(Source: Census of India, 2011, * RBI, 2011-12: https://www.rbi.org.in/scripts/PublicationsView.aspx?id=16603,** Niti Aayog, 2016: https://niti.gov.in/content/birth-rate, *** Niti Aayog, 2016: https://niti.gov.in/content/death-rate)*

Risk profile

The geographic and climatic conditions prevailing in Odisha render the entire state susceptible to a diverse range of disasters. However, floods are the most frequent and devastating disasters in Odisha, affecting both coastal plains and inland areas due to heavy monsoon rainfall. Rivers like Mahanadi, Brahmani, and Baitarani are major contributors to flooding, causing extensive damage to crops, infrastructure, and livelihoods, especially in densely populated coastal and delta regions. With a coastline spanning 480 kilometers, cyclones

*A*also frequently impact coastal areas. *(OSDMA, 2019).* Cyclones originating from Bay of Bengal, expose Odisha to its full impact, while the presence of 11 major river systems results in recurrent flooding events. Globally, Odisha is one of the most cyclone-prone areas, with approximately 20% of severe cyclones hitting its coastline. Factors like poor socio-economic conditions, weak housing, and coastal industrialization further increase the vulnerability of the state. A CEEW study on Climate change vulnerability index, ranked Odisha 10th with an overall climate vulnerability index of 0.368, making it one among the most vulnerable states to extreme cyclones and associated events. *(Mohanty et al., 2021).*

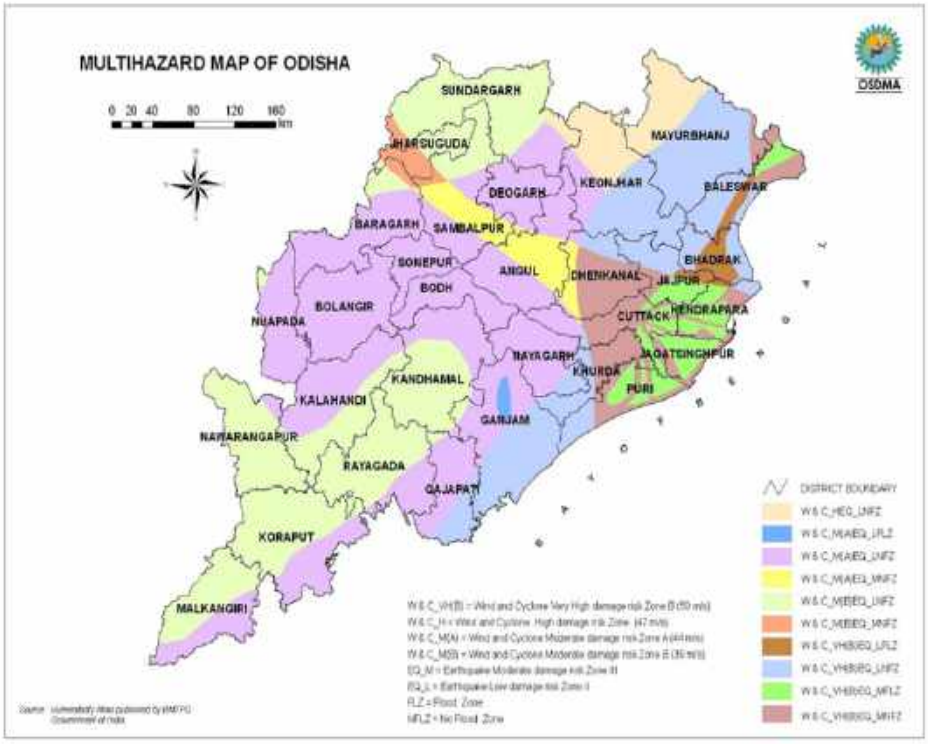

FIGURE 9: MULT HAZARD MAP OF ODISHA (SOURCE: OSDMA)

Additionally, approximately two-thirds of the total cultivated area in Odisha relies on rain-dependent agriculture, making the state particularly vulnerable to droughts in the event of monsoon failure. *(Bahinipati, 2014).* Moreover, certain regions fall within Earthquake Risk Zone III, indicating a moderate risk of damage, affecting 44 out of the state's 106 urban local bodies. Furthermore, the potential threat of tsunamis further adds to the array of hazards faced by Odisha. *(Disaster Preparedness in Odisha, OSDMA Report, 2019).*

TABLE 3: PAST DISASTERS IN ODISHA (MAJOR AND RECENT)

Year	Disaster	Loss and damage
1998	Heatwave	650 people lost their lives due to the extreme heatwave
1999	Paradip cyclone - Super cyclone	1.89 crore people were affected with 8243 human lives lost and 4.45 lakh livestock lives lost.
2000	Drought	Significant crop loss in 5 districts
2001	Flood	Affected more than 9.678 million people . Crop loss of over 0.891 million hectares
2009	Flood	59 people perished and 6.61 lakh people were affected
2009	Drought	Rainfall deficiency of- 60.6%. Crop loss 50% and above
2013	Cyclone Phailin	Very severe cyclone with. 13.23 million affected and 47 people died.
2019	Cyclone Fani	Odisha witnessed landfall, 159.85 lakh people affected, 64 lost lives. 1.49 lakh hectares of land affected.
2019	Heatwave	37 lives lost
2021	Flood and Heavy rain	More than 30 lakhs people were affected, 13 human lives lost, 1.46 lakh hectare crop inundated

2021	Cyclone Yaas	3 lives lost
2022	Flood and Heavy rain	24.7 lakh population affected, 15 human lives lost
2022	Heatwave	17 people lost their lives

(Source: US De, et al., (1998); Author's compilation of multiple sources (Annual Reports on Natural Calamities Special Relief Commissioner, Revenue and Disaster Management Department, Government of Odisha; Nayak, A. K. (2009); UNICEF Report on the Drought and Floods in India 28 Sep 2000; Situation reports, UNDMT and UNDP)

TABLE 4: RISK PROFILE SUMMARY, ODISHA

Hazard	Probability of Occurrence	Likely Impact	Risk Index	Hazard specific vulnerabilities
 Floods	Likely/Very likely	Significant/ Severe	High	7 silt loaded rivers and their deltas of which 4 are flood prone, flat coastal belt with poor drainage, heavy rainfall caused by storm surges triggering high tides make large areas flood prone. Encroachments on floodplains and high density of population in coastal regions elevate the risk and degree of damage.
 Cyclone	Possible	Moderate/ Significant	High	Experiences two cyclonic seasons (April-May & September-November); the state has 480 km of coastline. Coastal areas susceptible to extreme cyclonic disturbances and low pressure systems of high magnitude.
 Earthquake	Likely	Moderate	Moderate	EQ – Zone II/III, districts in the north and south-west parts, fall under Seismic Zone II, 43 urban centers with a population of nearly 27 lakh fall under Seismic Zone III. Mahanadi River Valley is heavily faulted.
 Tsunami	Likely/Very Likely	Significant	High	The faulted Mahanadi River Valley alongwith the Sumatra fault line and Burma Micro plate boundaries in the eastern part of the Bay of Bengal pose potential threats of tsunami causing earthquakes. 266 villages are vulnerably located.

(Source: Sphere India Landscape Analysis Report of NGO Involvement in Emergency Preparedness and Response in India)

The coastal regions in the state are susceptible to cyclones and flooding, exacerbated by climate change, posing challenges to infrastructure, livelihoods, and overall development efforts. When examining the historical statistics of disaster, demography, and climatic of the state, it becomes evident that cyclones and subsequent floods are inflicting severe damages and resulting in loss of lives in Odisha. According to data spanning two decades, approximately 8,357 people have lost their lives and 56.85 million people have been affected in Odisha due to cyclones alone. To sum up, the alarming data emphasizes the critical need for effective disaster risk management strategies that cater to Odisha's specific challenges in order to mitigate the devastating impact of cyclones and flooding on both lives and livelihoods.

Andhra Pradesh

Andhra Pradesh, state of India, located in the southeastern part of the subcontinent. It is bounded by the Indian states of Tamil Nadu to the south, Karnataka to the southwest and west, Telangana to the northwest and north, and Odisha to the northeast. The eastern boundary is a 600-mile (970-km) coastline along the Bay of Bengal. Telangana was a region within Andhra Pradesh for almost six decades, but in 2014 it was carved off to form a separate state. The capital of both Andhra Pradesh and Telangana is Hyderabad, in west-central Telangana.

Demography

Andhra Pradesh, one of the 28 states of India, is situated in the southeast part of the country. It is the seventh-largest state in India, covering an area of 162,970 sq. km(62,920 sq. mi). It is the tenth most populous state, with 49,386,799 inhabitants. The state is bordered by Telangana in the north-west, Chhattisgarh and Odisha in the north-east, Karnataka in the west, Tamil Nadu in the south, and to the east lies the Bay of Bengal. Andhra Pradesh has a coastline of 974 km – the second-longest coastline among the states of India, after Gujarat – with jurisdiction over almost 15,000 sq. km of territorial waters. The small enclave of Yanam, a district of Puducherry, lies to the south of Kakinada in the Godavari delta on the eastern side of the state. Fig:2 Vulnerability map of Andhra Pradesh

TABLE 5: DEMOGRAPHIC PROFILE OF ANDHRA PRADESH

		SC/ST		
Population **84580777**	**Population density (persons/sq. km)- 308**	**ST - 29,469** **SC - 0**	**Population Below poverty line (2011-12)** **9.20 %**	**Children (0-6 years)** **9142802**
Sex Ratio 958	**Child sex ratio (0 – 6 years)** **962**	**Birth Rate (%) [2014]** **22.4**	**Death Rate (%) [2014]** **7.2**	**Literacy rate (7+ years)** **72.19%**

(Source: *Census of India, 2011, http://niti.gov.in/content/infant-mortality-rate-imr-1000-live-births)*

Risk Profile

Andhra Pradesh is one of the most vulnerable States in India to multiple natural disasters like Cyclones, Heavy Rains and Floods, Hailstorms, Tsunamis on one hand and Drought on the other hand, because of its widespread and unique geographical location. Out of the 13 districts in the state, 9 located in the coastal Andhra region and 4 in Rayalseema are highly susceptible to cyclones, storm surges and floods. Around 44 percent of the state's area is vulnerable to tropical storms and related hazards. The section between Nizampatnam and Machilipatnam is the most susceptible to storm surges, although the entire Andhra coast is also at risk. The coastal districts are also vulnerable to flash floods caused by heavy rains induced by cyclonic depressions.

Additionally, the heavy monsoon rains often result in flooding in the coastal districts. The Godavari and Krishna Rivers sometimes overflow and cause floods in the East Godavari, West Godavari, and Krishna districts. More than 60 cyclones have hit the state in the past century, and their frequency seems to have increased in recent decades. Severe cyclones have become a common occurrence, happening every two to

three years. These natural disasters cause loss of life, damage to livelihoods, public and private assets, and disruption of economic activity. They also cause immense suffering and hardship to the affected population.

Although the fertile delta of the Godavari and the Krishna rivers is considered the backbone of the state's economy, it still faces the fury of floods and cyclones. Disasters, both natural and man-made, have repeatedly and severely affected the people and economy of the state, posing a serious threat to its development. Climate change, climate variability, and other factors are likely to exacerbate disaster risks in the state.

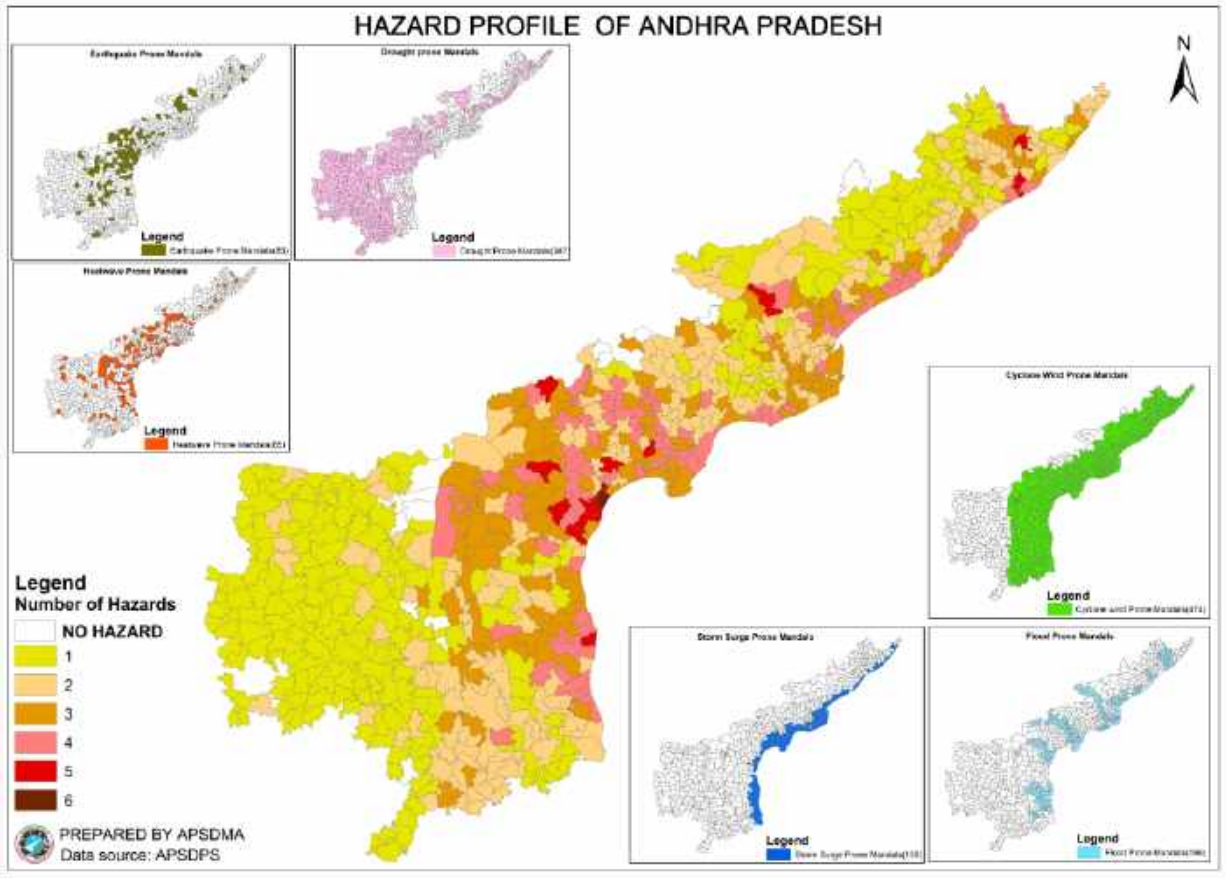

FIGURE 10: HAZARD PROFILE OF ANDHRA PRADESH

(Source: APSDMA)

TABLE 6: PAST DISASTERS (MAJOR AND RECENT)

Disaster	Month / Year	Loss and Damage
Cyclone Michaung	December 2023	The cyclone Michaung triggered heavy to very heavy rainfall accompanied with squally winds in parts of the Rayalaseema and south coastal Andhra Pradesh districts. Waterlogging was reported in parts of the Tirupati and Nellore districts due to heavy rain.
Krishna River floods	August 2021	Heavy rainfall led to the overflowing of the Krishna River, causing floods in various districts of Andhra Pradesh, displacing thousands and damaging homes and crops.
Vardah Cyclone	December 2016	Cyclone Vardah made landfall near Chennai but also affected Andhra Pradesh, causing widespread damage to infrastructure, uprooting trees, and disrupting power supply.
Godavari Pushkaralu	July 2015	Stampede during the Godavari Pushkaralu festival resulted in the death of several pilgrims and injuries to many others along the banks of the Godavari River.

Hudhud Cyclone	October 2014	Hudhud was a severe cyclonic storm that caused extensive damage to infrastructure, agriculture, and property in Andhra Pradesh, particularly in Visakhapatnam district.
2004 Indian Ocean Tsunami	December 2004	Though the epicentre was in the Indian Ocean, Andhra Pradesh's coastline faced significant impacts, including loss of lives, damage to property, and disruption of livelihoods.

(Source: https://ncdc.gov.in/WriteReadData/l892s/8636946202163230397 4.pdf)

TABLE 7: RISK PROFILE SUMMARY, ANDHRA PRADESH

Hazard	Probability of Occurrence	Likely Impact	Risk Index	Hazard specific vulnerabilities
 Droughts	Likely	Severe	High	Four districts in Rayalaseema are drought prone; trend of increased frequency in the recent decade severely impacting the State's GDP; Recurrence of the phenomenon has led to challenges of food security, loss of livelihood, under nourishment/ malnutrition related health issues, especially among pregnant or lactating women and children; Forced migration entails its own safety and protection risks
 Cyclones	Likely	Severe/ Significant	High	Longest coastline in India of 972 kms; Coast between Ongole and Machilipatnam most vulnerable to storm surges and cyclones; 44% of the total state area at risk of tropical storms translating into heavy rainfall triggering off floods in the inland rivers; drainage problems in the coastal delta has increased the frequency and potential of the cyclones and consequent floods; In addition to loss of life and property, ecosystem disturbances, high risk of epidemics and PTSD (especially among children) occur.
 Floods	Likely	Significant	High	The Krishna and Godavari basins in Central and coastal parts of the state experience frequent flooding; the common factors are silting of the riverbeds, reduction of the carrying capacity of river channels, leading to changes in river courses, obstructions to flow due to landslides, breaches due to inadequate maintenance of irrigation systems synchronization of floods in the main and tributary rivers and retardation due to tidal effects. Drought prone areas adjacent to coastal districts are at risk of flash floods caused by torrential rains caused by cyclonic depressions;

(Source: Sphere India Landscape Analysis Report of NGO Involvement in Emergency Preparedness and Response in India)

In Andhra Pradesh, cyclones of varying magnitude are a recurring natural calamity every year due to the extensive coastal boundary and climatic conditions. Even if cyclones do not directly impact coastal areas, the accompanying depressions often result in substantial rainfall, significantly affecting the state. In addition to heavy rainfall and strong winds, cyclones also induce storm surges, population displacement, economic losses, and disruptions to essential services. Andhra Pradesh's cyclical cyclones require extensive disaster

planning and response strategies in order to protect the coastline and reduce the multiple impacts on the state's infrastructure, economy, and general well-being.

4.2 Review of State Policies and Legislation

Odisha

Policies, Plans and Regulatory Frameworks

The State of Odisha, situated in a sub-tropical littoral region, faces a multitude of natural hazards and industrial risks, necessitating meticulous planning and preparedness for effective disaster management. The State Disaster Management Plan (SDMP), initially drafted in 2013 and periodically updated (last updated in 2023), serves as a comprehensive framework for disaster management cycles, aligning with provisions of the Disaster Management Act-2005. Developed through collaborative efforts of the Odisha State Disaster Management Authority (OSDMA) and the Special Relief Organization (SRO), the SDMP integrates global perspectives such as the Sendai Framework for Disaster Risk Reduction (SFDRR) and the Sustainable Development Goals (SDGs). Odisha SDMP underscores the state's evolving approach and priorities towards disaster management, emphasising the imperative of coordinated action among governmental and non-governmental stakeholders for its successful implementation. Other Policies and Frameworks adopted in the State of Odisha are shared below:

FIGURE 11: POLICIES, PLANS AND REGULATORY FRAMEWORKS IN ODISHA

(Source: Odisha State Disaster Management Authority, Odisha State Disaster Management Plan 2019)

Hazard and Vulnerability Assessment

The Odisha State Disaster Management Plan, 2023, provides an in-depth assessment of the state's vulnerability to a range of natural and man-made disasters in its Hazard and Vulnerability Assessment section. Through a detailed breakdown of the impacts and damages due to various disasters from 2006 to 2022, offering insights into past patterns and future threats the state may encounter.

The plan emphasizes the various types of natural disasters that Odisha faces, including floods, cyclones, droughts, heat waves, lightning, drowning, snakebite injuries, earthquakes, tsunamis, and forest fires. Furthermore, it broadens its scope to cover man-made disasters such as chemical and industrial accidents, traffic accidents, fire accidents, and health risks, therefore covering a wide range of potential crises.

Moreover, the plan explores the State's Coastal Vulnerability Index (CVI), providing a detailed grasp of the coastal areas' vulnerability to environmental disturbances. The plan also recognizes the complex relationship between socioeconomic vulnerabilities and disaster resilience by taking into account factors including social

structure, education levels, gender discrimination, individuals in need of special care, and patterns of urbanization.

The Hazard and Vulnerability Assessment essentially acts as a cornerstone for proactive and well-informed measures related to preparedness and mitigation of disasters. OSDMA has also developed district wise Mult hazard maps for all districts of Odisha.

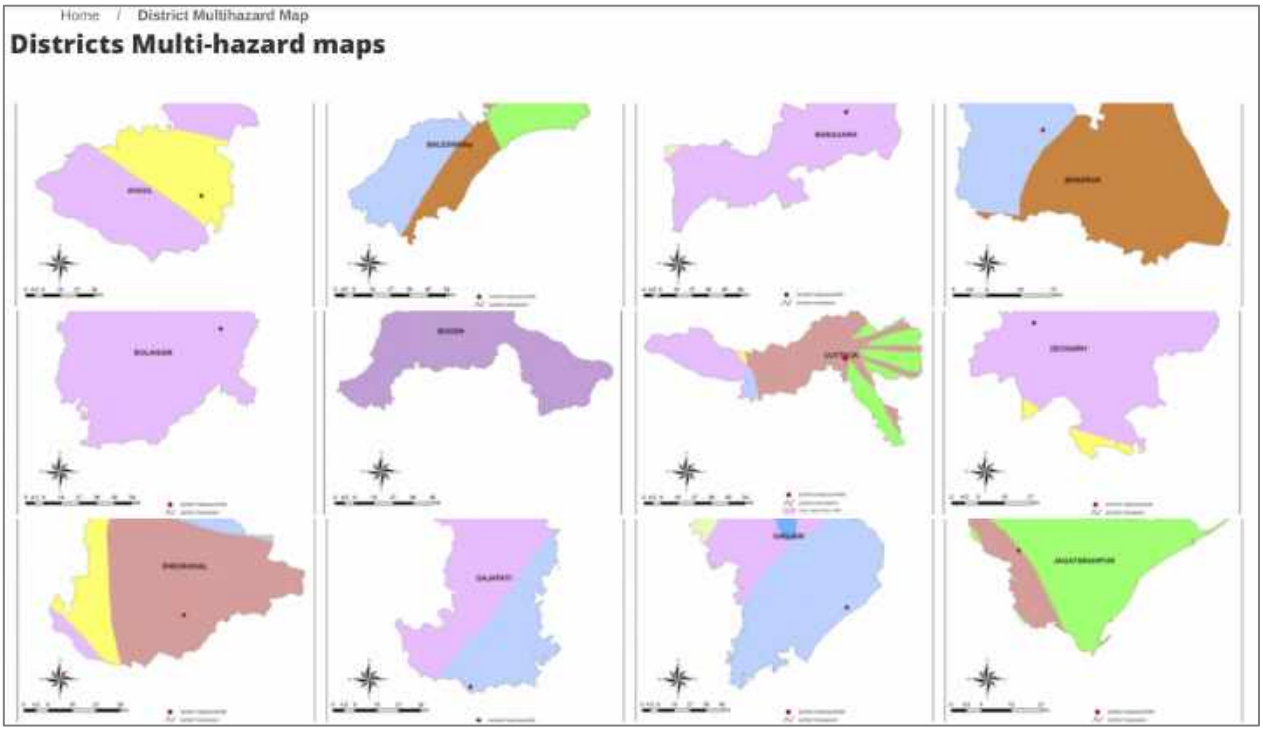

FIGURE 12: DISTRICT MULTI-HAZARD MAPS- ODISHA

(Source: Odisha State Disaster Management Authority)

Institutional Framework (Organizational structure, coordination/collaboration, Capacities, etc.)

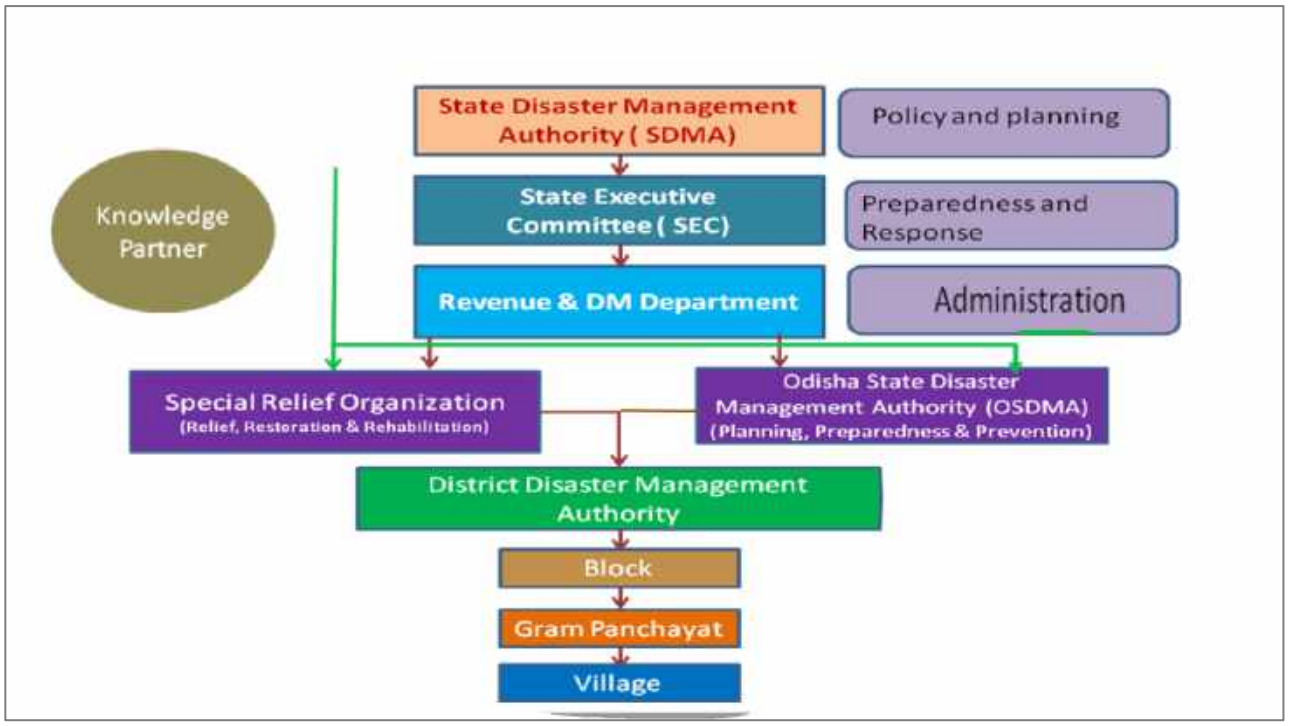

FIGURE 13: NETWORK OF ODISHA STATE DISASTER MANAGEMENT AUTHORITY

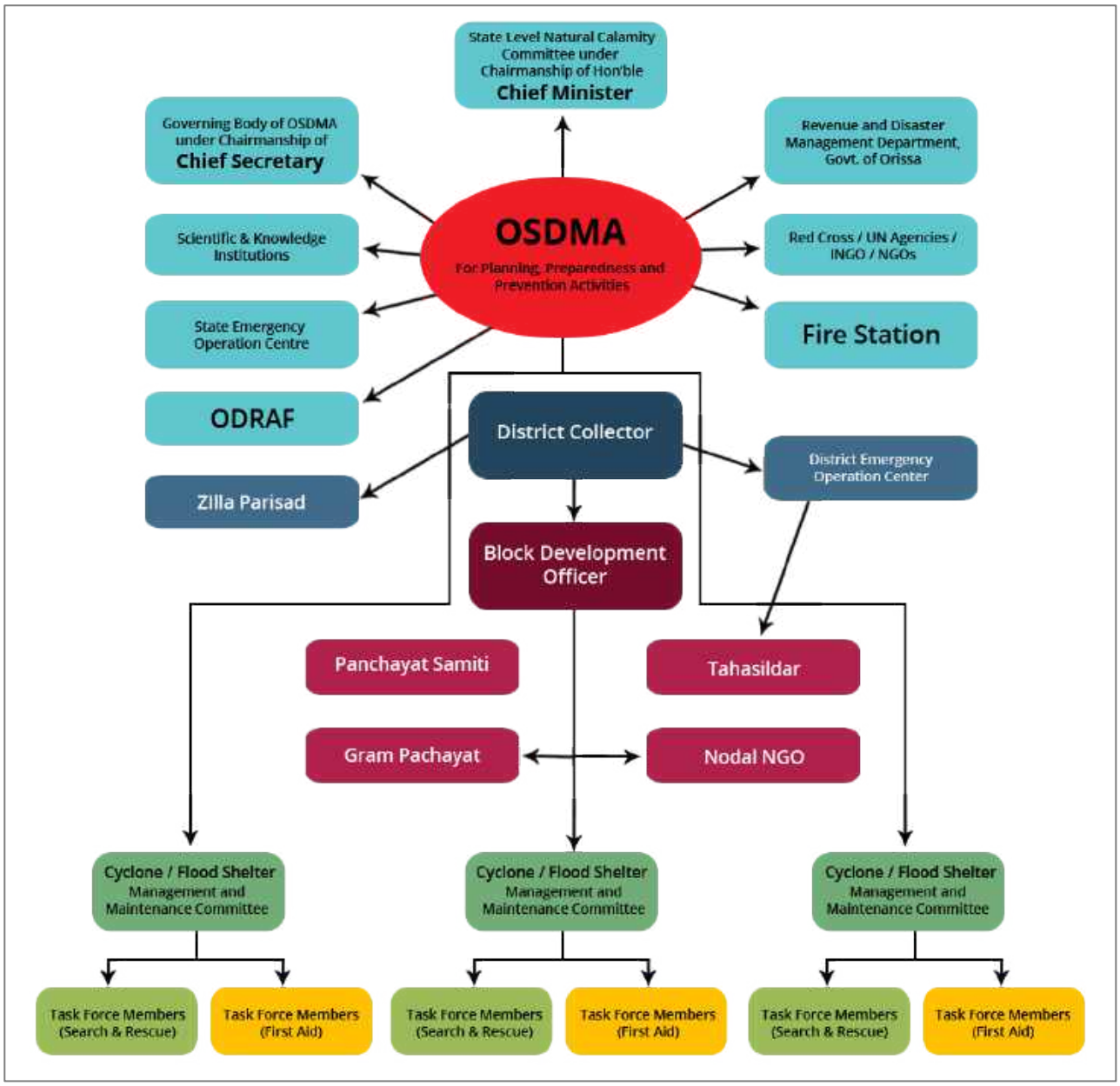

FIGURE 14: NETWORK OF ODISHA STATE DISASTER MANAGEMENT AUTHORITY

(Source: Odisha State Disaster Management Authority)

TABLE 8: ROLES AND RESPONSIBILITIES OF DIFFERENT AGENCIES INVOLVED IN DISASTER RISK MANAGEMENT

Agencies	Roles & Responsibilities
Odisha State Disaster Management Authority	• Promote an integrated and coordinated system of disaster management including prevention and mitigation of disaster by the State, local authorities, other stakeholders and communities. • Collect/cause to be collected data on all aspects of disasters and disaster management and analyze it and further cause and conduct research and study relating to the potential effects of events that may result in disasters. • Act as a repository of information concerning disasters and disaster management. Prepare and update the policies and plans for disaster management in the State. Promote or cause to be promoted awareness and preparedness, advise and train the community and stakeholders with a view to increasing capacity of the community and stakeholders to deal with potential disasters.

	• Coordinate and monitor activities relating to prevention and mitigation of disasters, including capacity building. • Monitor the progress of the preparation and updating of disaster management plans and coordinate the implementation of such plans.
State Crisis Group (SCG):	• The State Crisis Group is the apex body in the State to deal with major chemical accidents and to provide expert guidance for handling such accidents. • Without prejudice to the functions specified under sub-rule (1), the State Crisis Group shall, a) Review all district off-site emergency plans in the State with a view to examine its adequacy in accordance with the Manufacture, Storage and Import of Hazardous Chemicals, Rules and forward a report to the Central Crisis Group once in three months. b) Assist the State Government in managing chemical accidents at a site. c) Assist the State Government in the planning, preparedness and mitigation of major chemical accidents at a site in the State. d) Continuously monitor the post-accident situation arising out of a major chemical accident in the State and forward a report to the Central Crisis Group. e) Review the progress report submitted by the District Crisis groups. f) Respond to queries addressed to it by the District Crisis groups. g) Publish a list of experts and officials in the State who are concerned with the management of chemical accidents.
Local Crisis Group	• Prepare local emergency plan for the industrial pocket. • Ensure dovetailing of the local emergency plan with the district off-site emergency plan. • Train personnel involved in chemical accident management. • Educate the population likely to be affected in a chemical accident about the remedies and existing preparedness in the area. • Conduct at least one full scale mock- drill of a chemical accident at a site every six months and forward a report to the District Crisis Group. • Respond to all public inquiries on the subject.
District Crisis Group (DCG)	• Assist in the preparation of the district off-site emergency plan. • Review all the on-site emergency plans prepared by the occupier of Major Accident Hazards installation for the preparation of the district off-site emergency plan. • Assist the district administration in the management of chemical accidents at a site lying within the district. • Continuously monitor every chemical accident. • Ensure continuous information flow from the district to the Centre and State Crisis Group regarding accident situation and mitigation efforts. • Forward a report of the chemical accident within fifteen days to the State Crisis Group. • Conduct at least one full-scale mock-drill of a chemical accident at a site each year and forward a report of the strength & the weakness of the plan to the State Crisis Group.
Odisha State Legal Services Authority (SALSA):	• Odisha State Legal Services Authority is a Statutory Body established under the Legal Services Authorities Act, 1987. The Hon'ble Chief Justice of High Court of Odisha is the Patron-in-Chief of the Odisha Legal Services Authority and the Sr. Judge of the High Court of Orissa is the Executive Chairman of the Odisha Legal Services Authority.

	• To look after the legal services pertaining to the High Court, there is the High Court Legal Services Committee, that is chaired by a sitting Judge of the High Court and the Registrar (Judicial). The Orissa High Court is functioning as the Secretary of High Court Legal Services Committee. • The State Legal Services Authority monitors and guides the District Legal Services Authorities and Taluk Legal Services Committees in achieving the aims and objectives of the Act. There are 30 District Legal Services Authorities in the State of Odisha and 81 Taluk Legal Services Committees functioning under them.
Odisha Disaster Rapid Action Force (ODRAF)	• In the post-super cyclone reconstruction and preparedness phase, it was felt necessary to constitute a professionally trained group equipped with State-of-the-art emergency equipment to assist the civil administration in search & rescue operation and relief line clearance for effective management of disasters in the event of natural as well as human induced disasters. • The Government of Odisha formed Odisha Disaster Rapid Action Force (ODRAF) vide notification no.939/CD dated 07.06.2001. ODRAF is a multi-disciplinary, multi-skilled, high-tech force for all types of disasters. ODRAF aims at reducing casualties, clearance of communication channels, quick deployment of personnel & equipment's and minimize expenditure & time lag and support institutional arrangement. • In 3 phases, ten units of ODRAF have been set up. The ODRAF units are strategically located throughout Odisha. Locations of these units are identified on the basis of vulnerability profile to cut down the response time for their deployment. The ODRAF Units do not have any geographical /territorial restrictions in terms of area of operation.
State Emergency Operation Centre	• The State Emergency Operation Centre has been made operational at Rajiv Bhawan, Bhubaneswar, with state of art communication net-work. The State EOC functions round the clock throughout the year. • The Organisation is headed by the Special Relief Commissioner (SRC) who exercises all administrative and financial powers. He is assisted by a group of experienced officers and staff. During any natural disaster, the office functions round the clock in an emergency mode.

Emerging Policy Level Gaps

- **Institutional Gaps and Governance Issues:** Existing policies do not sufficiently address the identification and strengthening of institutional gaps within specific departments, organisations and sections. To address existing silos, there is also a need for better communication and collaboration among various government bodies, inclusive decision-making processes, and continuous evaluation of government disaster relief policies and frameworks.
- **Inadequate Coordination and Integration of Departmental Plans:** There is a significant disconnect between individual departmental disaster management plans and the overarching Odisha State Disaster Management Plan (OSDMP). During the emergnecy response and recovery phases, this lack of integration results in uncoordinated response efforts and inefficient use of resources. Disconnect between departments handling disaster management and climate change adaptation, also results in a siloed approach.
- **Inadequate Integrated Risk Assessments and Continuous Evaluation:** Comprehensive and integrated risk assessments, particularly for critical infrastructure, are missing in current disaster management policies. Additionally, there is a gap in the continuous assessment of infrastructure

vulnerabilities at various phases of the disaster lifecycle, which is essential for efficient preparedness and action.

- **Equitable Compensation and Inclusion Policies:** Inequitable aid distribution stems from inclusion biases in compensation processes, that mostly harm sharecroppers, landless farmers and other marginalized groups. Further, it remains difficult to adequately account for and represent vulnerable groups in disaster risk reduction and response planning, such as individuals with disabilities.
- **Inclusive Disaster Response and Community Involvement:** There is insufficient focus on creating disability-friendly infrastructure in cyclone shelters and other critical facilities, thus exuberating their vulnerability. This is often due to limited involvement of vulnerable communities in disaster management planning, increased necessitating community consultation and multi-stakeholder involvement for effective policy formulation and execution.
- **Budgetary Constraints and Financial Preparedness:** Policies do not adequately address the need for sufficient budgetary support for departmental training and capacity building. Furthermore, there is a lack of comprehensive financial readiness plans, including risk reduction, insurance plans, and financial support for local enterprises and industries, which are crucial for economic stability post-disaster.
- **Sustaining Interest and Ownership During Non-crisis Periods:** Challenges in maintaining interest and ownership of disaster management systems during non-crisis times, affecting readiness and sustainability of the systems.
- **Inadequate Urban Planning for Disaster Risk Management:** Cyclones disproportionately affect informal housing structures and cause severe damage to physical infrastructure, indicating a lack of urban planning focused on disaster risk management in Odisha. Addressing this gap requires integrating disaster resilience into urban planning frameworks to mitigate risks effectively.

Case Study: Cyclone Yaas Response by State Government

Cyclone Yaas – Impacts	
Population Affected	87.42 lakhs
District Affected	12 (Balasore, Bhadrak, Cuttack, Dhenkanal, Jagatsinghpur, Keonjhar, Khorda, Kendrapara, Mayurbhanj, Jaipur, Puri, and Sundergarh)
Villages Affected	13,541
Persons Evacuated	7,03,058
Houses Damaged	18,094
Humans Lives lost	03
Crop Affected	5672.99 Ha
Maximum Wind Speed	30 – 140 gusting to 155 kmph
Rain	Heavy to extremely heavy rainfall at isolated places over Coastal Odisha on 25th May and heavy to very heavy rainfall at a few places and extremely heavy rains at isolated places on 26th May over North Odisha

Damage and Loss: Cyclone Yaas affected 87.42 lakh people in 13541 villages of 125 Blocks and 533 wards of 35 Urban Local Bodies (ULBs) in 12 districts. Extensive damage occurred to agriculture/ horticulture crop & livestock/ poultry of farmers, net & boat of fishing communities, equipment, accessories & raw materials/finished goods of traditional artisans/ weavers. Besides, substantial damage was to public properties. Total 18094 housed were damaged along with 3024 cow sheds. 2197.34 Ha of crop area was also damaged along with 443.38 Kms. of River/ saline embankment (including breaches) fully/ partially damaged due to cyclone. In terms of Damage to Public Infrastructure, 13241.14 Km of Total length of road with breaches was damaged along with 2377 Public Buildings. Drinking Water Systems were also damaged in urban and rural areas across 5 districts. 3 nos. of feeder transformer, 29259 nos. of poles, 23305 kms. of conductors and 1975 nos. of distribution transformer were also damaged due to cyclone.

FIGURE 15: DAMAGED HOUSES IN BHADRAK DISTRICT (IMAGE 1 & 2) AND MAYUBHANJ DISTRICT (IMAGE 3)

(Image Source: Field volunteers of Sphere India Coalition)

Response by State Government

Review and Coordination by State government (Revenue and Disaster Management Department, Government of Odisha, 2021)

- The Hon'ble Chief Minister reviewed the status of preparedness for impending cyclone with the Secretaries of line Departments & the Collectors on 22.05.2021 through VC. Three rounds of preparatory meetings were faced by the Chief Secretary and the Special Relief Commissioner (SRC) with the Collectors of 14 probable districts likely to be affected by the cyclone.

- District Administration alerted and guided through elaborate Video Conferencing by the Special Relief Commissioner and the Chief Secretary.

Dissemination of Warnings and Bulletins (Revenue and Disaster Management Department, Government of Odisha, 2021)

- IMD weather Bulletins & cyclone warnings were disseminated to the Collectors, Departments and other stake holders at regular intervals.
- Early warning voice messages were disseminated through Alert Siren Systems installed in coastal areas under Early Warning Dissemination System (EWDS).
- Community Level Volunteers and Task Force Team members of Multipurpose Cyclone/ Flood Shelters were engaged for ensuring family preparedness, warning dissemination and expediting evacuation.

Preparedness of Districts (Revenue and Disaster Management Department, Government of Odisha, 2021)

- The district administration of 14 vulnerable districts were directed to keep Multipurpose Cyclone Shelters (MCS)/ Multipurpose Flood Shelters (MFS) in readiness and to identify adequate safe RCC roofed public buildings for use as additional shelters to accommodate evacuees observing COVID-19 protocol.
- Total 6891 (860 MCS/ MFS and 6031 additional shelters) shelters were identified and kept in readiness with cumulative capacity to accommodate more than 9 lakh people in 14 districts, maintaining social distancing norms.
- Facility verification check had been conducted in all the Multi-Purpose Cyclone and flood shelters in the coastal & adjoining districts.

Evacuation Plan (Revenue and Disaster Management Department, Government of Odisha, 2021)

- Evacuation Plan was made for evacuation of people from the vulnerable locations. PRIs and WSHGs were involved in evacuation and Shelter management.
- Total 7,03,058 peoples were evacuated and accommodated in 6870 relief camps.

Deployment of Response Forces (Revenue and Disaster Management Department, Government of Odisha, 2021)

- 52 teams of NDRF, 60 teams of ODRAF, 206 Fire Service teams and 86 wood cutting teams of Forest & Environment Department (Total- 404 Teams) were pre-positioned in 10 coastal & adjoining districts for search & rescue operation and road clearance.

Communication (Revenue and Disaster Management Department, Government of Odisha, 2021)

- The Collectors, the State Disaster Response Forces and other officers having Satellite Phones were directed to recharge and keep the phones ready for use. The Digital Mobile Radio installed in six coastal districts were also tested and kept ready for use for communication with the Collectors, the BDOs and others in case the telephone / cell phone networks are down due to cyclone.

Preparedness Measures taken by various departments (Revenue and Disaster Management Department, Government of Odisha, 2021)

- Engineering Departments like Works, Rural Development, Housing and Urban Development, Energy, Water Resources and Panchayati Raj & Drinking Water (PR&DW) also made arrangement for immediate restoration of damaged infrastructure.

Andhra Pradesh

Policies, Plans and Regulatory Frameworks

After its bifurcation, the State of Andhra Pradesh has started a journey for accelerated economic growth, development of world class infrastructure and industrial promotion in the State. At the same time AP is highly prone to Cyclone, drought and foods which are highly capable of reducing the pace of development with its potential for making long term effects to human and infrastructure. Through State Disaster Management Plan, the Government expresses its intent not only to save life, livelihood and assets of people of the State but also safeguard all investments to be made both in private and public sector. Andhra Pradesh State Disaster Management Plan 2017-18 assesses various hazard, vulnerability, capacity and risk associated with the state and lays down various measures and guidelines for prevention and Mitigation for all stakeholders. It further mainstreams disaster management concerns into the developmental planning process, while developing efficient, streamlined and rapid disaster response and relief mechanisms in the state with build back better approach. Other Policies and Frameworks adopted in the State of Andhra Pradesh are shared below:

FIGURE 16: POLICIES, PLANS AND REGULATORY FRAMEWORKS IN ANDHRA PRADESH

(Source: Andhra Pradesh State Disaster Management Authority)

Hazard and Vulnerability Assessment

The Andhra Pradesh State Disaster Management Plan's Hazard, Vulnerability, and Risk Analysis section thoroughly looks at a wide range of possible hazards, such as cyclones, floods, earthquakes, droughts, tsunamis, fire accidents, industrial and chemical disasters, as well as different accidents like train and road accidents, dam failures, and boat capsizing incidents. In addition, the plan considers heatwaves, stampedes, and epidemic outbreaks into consideration, further also explaining the seasonal tendencies of these threats based on past patterns. The analysis also explores social, economic, and environmental aspects of vulnerability, identifying the various vulnerabilities that communities around the state face. It assesses infrastructure and human resource capacity to withstand and recover from disasters, identifying opportunities for development and engagement.

Further, Hazard Maps have been developed for the state at Mandal level covering various hazards along with Multi Hazard Profile of the state.

Institutional Framework (Organizational structure, coordination/collaboration, Capacities, etc.)

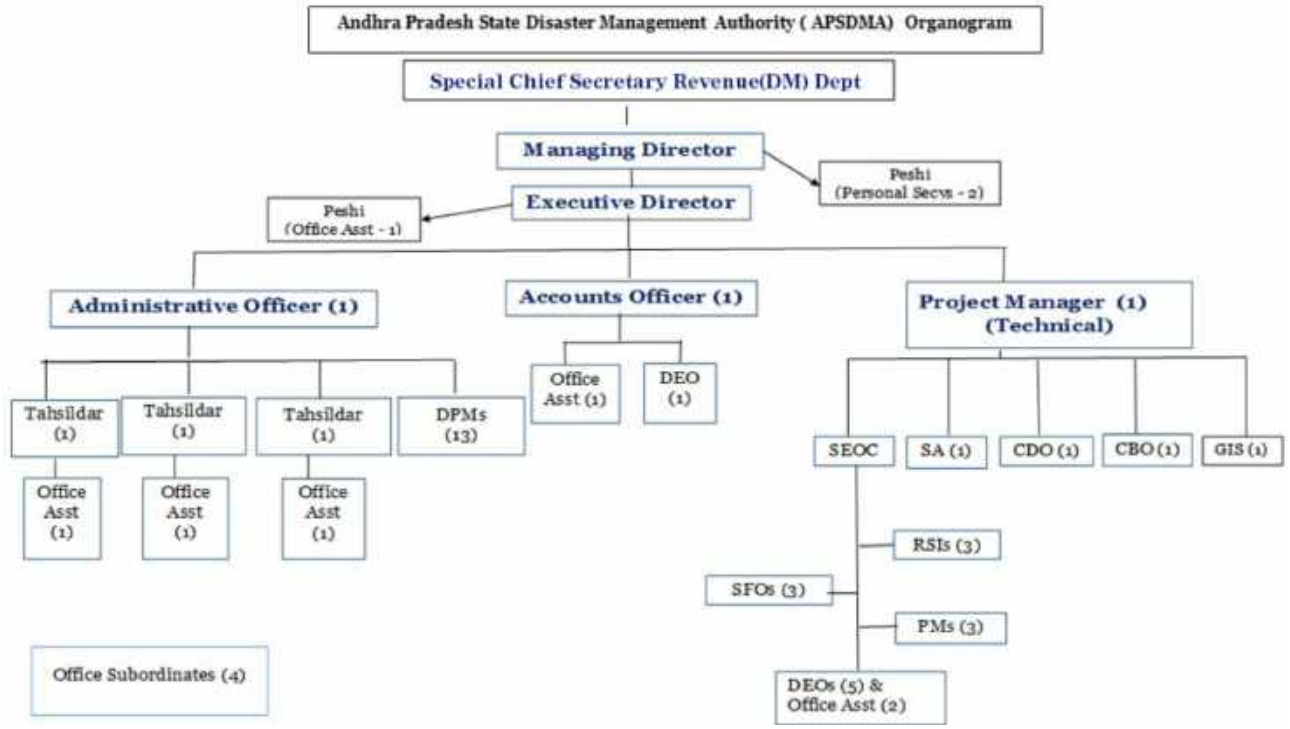

FIGURE 17: INSTITUTIONAL SETUP APSDMA

(Source: Andhra Pradesh State Disaster Management Authority)

TABLE 9: ROLES AND RESPONSIBILITIES OF DIFFERENT *AGENCIES* INVOLVED IN DISASTER RISK MANAGEMENT

Agencies	Roles & Responsibilities
Andhra Pradesh State Disaster Management Authority	The APSDMA, in close co- ordination and with assistance of Revenue Departments is *responsible for the following:* • Promotes an Integrated and coordinated system of disaster management including prevention or mitigation of disaster by the State, local authorities, stakeholders and communities. • Collect/cause to collect data on all aspects of disasters and disaster management and analyze it and further cause and conduct research and study relating to the potential effects of events that may result in disasters. • Acts as a repository of information concerning disasters and disaster management • Lays down policies and plans for disaster management In AP. • Promotes or causes to promote awareness and preparedness, advices and trains the community and stakeholders
Andhra Pradesh State Development Planning Society (APSDPS)	• AP Government established the AP State Disaster Mitigation Society (APSDMS) as an autonomous Society that came into effect from 1.3.2003 under the administrative control of Planning Department. • It was entrusted to take up Disaster Mitigation studies relating to "Rainfall, Run off, Flood Forecasting, Cyclone model for Track, Wind and Storm Surge forecast to improve the early warning capabilities of State on natural disasters. • The society in course of its working also started studies on Coastal Zone Management, Delta Water management. Preparation of SOPs and Disaster Management Plans related to Cyclone, Drought and Earthquakes as part of its long term mitigation measures.

State and District Crisis Groups	• Apex body at state and at district levels to deal with major chemical accidents and provide expert guidance on the same. • Assists administration in industrial and chemical accidents. • Reviews on site Emergency Plans. • Ensures continuous information flow.
(LEOC) Local Emergency Operation Centre	• Local Emergency Operating Centers (LEOCs) are the lowest level of the disaster management that is directly interacting with the vulnerable population and conveying the information received from SEOCs and DEOCs to the people • Collection, collation and dissemination of information to the DEOC, relevant local agencies and officers, and the public. • Implementation of operational decisions of DEOCs • Coordination of available resources including those allocated by SEOCs or DEOCs to support the disaster affected community. SOP Document For Cyclone Management • Report the compliance of the activities entrusted to it. • Appraise the requirements and ground situations to DEOCs for better understanding of the event by DEOCs /SEOCs.
Village /Habitation Committee	• A committee comprising of sarpanch and members of panchayat or members from local communities like fisherman etc shall be formed to look after the wellbeing of cyclone shelter or identified shelter structure. • The committee shall be entrusted with responsibility to take up annual maintenance of the shelter, keeping the shelter for alternate use during normal phase and to maintain the access to the shelter in accessible condition. • The committee shall be encouraged to keep utensils required for cooking, arranging water storage space at shelter and create space for storing consumables like rice etc
MEOC (Mandel emergency operation center)	• Mandal Emergency Operation Centers (MEOCs) have been established in the Tahsildar office across seventy-six (76) identified Coastal Mandals. • Dissemination of warning to the Communities along the 76 Coastal Mandals of AP. • To provide reliable, responsive and dedicated Communication from MEOC to MPCS, FLC, DEOC and SEOC.
DEOC (District Emergency Operation Center)	• District Emergency Operation Centers (DEOCs) have been established in the Collector offices of nine (9) Coastal Districts. • DEOC ensures timely distribution of warnings to coastal communities through coordinated efforts and various communication channels. • Establishes direct communication channels to relay critical information to villagers and fishermen at sea. • DEOC provides reliable, responsive, and dedicated communication services at state, district, and mandal levels. • DEOC enhances the early warning system by utilizing advanced technologies and conducting regular drills for system evaluation and improvement. • They develops and maintains communication infrastructure, ensuring redundancy and interoperability for effective coordination during emergencies. • Conducts education and awareness campaigns to empower coastal communities with knowledge and skills for disaster preparedness and response.

SEOC (State Emergency Operation Centers)	• SEOC coordinates with various government agencies, departments, and stakeholders to ensure a cohesive and effective response to emergencies and disasters. • They collects, analyzes, and disseminates information related to emergencies and disasters to relevant authorities and the public. This includes real-time updates on the situation, resource availability, and response activities. • SEOC provides decision-makers with timely and accurate information, analysis, and recommendations to guide effective response actions and resource allocation during emergencies. • SEOC serves as a communication hub, facilitating communication between different response agencies, government departments, and the public to ensure smooth coordination and information exchange during emergencies.
APSDRF (Andhra Pradesh state disaster response force)	• APSDRF comprising of six companies with two teams each setup in 2016 (vide G.O. Ms.No.3 Home(Legal.II) Department Dtd 13.1.2016. • Location of Battalions - 2 nd Bn APSP Kurnool, 3rd Bn APSP Kakinada, 5 th Bn APSP Vizianagaram, 6 th Bn APSP Mangalagiri, 9th Bn APSP Venkatgiri Nellore Dist, 16th Bn APSP Visakhapatnam
APSDRFS (State Disaster Response & Fire services Department)	• APSDRF ensures prompt and effective emergency response through its network of 175 fire stations. • The department conducts training programs to educate the public about fire safety measures. • APSDRF maintains specialized task forces equipped to handle complex emergencies at district headquarters. • It provides fire safety arrangements for various events, ensuring participant safety. • APSDRF offers fast-track NOC services to industries for compliance with fire safety regulations. • The department continuously updates its strategies to address evolving challenges in disaster response and fire safety.

Emerging Policy Level Gaps

- **Ineffective Implementation of Early Warning Systems:** Despite government initiatives like the Common Alerting Protocol (CAP) and Andhra Pradesh Alert for cyclone early warning, challenges in implementation and effectiveness persist. Cyclone alerts through speaker towers, aimed at reaching digitally unreachable populations, are ineffective in several areas due to inadequate physical infrastructure. There is a need to address these gaps to ensure timely and effective dissemination of early warnings to vulnerable communities.
- **Inadequate Funding and Resource Allocation:** Limited financial resources and budget allocations hinder the maintenance and functionality of disaster management infrastructure and systems. There is a need for proper funding allocation for infrastructure upkeep, disaster relief fund allocation, and restoration efforts. There's a need for increased investment in resilience-building measures within the economic and financial sectors. Policies should incentivize businesses to adopt disaster-resilient practices and promote insurance schemes to mitigate financial losses, along with encouraging public-private partnerships (PPPs) for resource mobilization.
- **Lack of Coherence in Policy Alignment:** Policies related to disaster management, climate change adaptation, and sustainable development should be coherent and aligned, but there's a gap in policy coherence. There's a need to ensure that these policies are harmonized to maximize synergies and minimize trade-offs in disaster management efforts.

- **Discrepancies in Compensation Policies:** Certain norms in compensation policies favor specific groups based on land ownership, leading to exclusion biases in compensation distribution. Policy unintentional exclusivity results in inequitable distribution of compensation, particularly for marginalized groups like sharecroppers. There is a need to review compensation policies to address biases and ensure fairness and inclusivity for all affected groups.
- **Limited Focus on Proactive Community Preparedness:** While relief efforts are often provided post-disaster, there's a lack of emphasis on proactive planning and community preparedness. Government initiatives should prioritize integrating disaster training into existing programs and providing financial assistance for community capacity-building efforts.
- **Exclusion of Vulnerable Groups in Governance Processes:** Vulnerable communities, including people with disabilities and marginalized groups, face exclusion and limited representation in disaster governance processes. Policies should focus on prioritizing the inclusion of these groups in decision-making and response efforts to ensure equity and effectiveness in disaster management.
- **Challenges in Governance and Coordination:** The need for integrated risk management approaches involving multiple stakeholders and sectors is recognized, but there's a gap in effective coordination mechanisms.

Case Study: Cyclone Michaung Response by State Government (Andhra Pradesh)

Cyclone Michaung – Impacts	
Population Affected	40 Lakhs
District Affected	08 (Bapatla, Konaseema, East Godavari, Kakinada, Prakasam, SPS Nellore, Tirupati, and West Godavari districts)
Villages Affected	194
Persons Evacuated	15,173
Houses Damaged	333
Humans Lives lost	05
Maximum Wind Speed	110 kmph
Rain	Light to moderate rainfall at most places and heavy to very heavy rainfall at a few places with extremely heavy falls at isolated places over coastal Andhra Pradesh on 4th & 5th December. Exceptionally heavy rainfall at some places over south coastal Andhra Pradesh on 4th and over north coastal and adjoining south coastal region on 5th December.

Damage and Loss: Cyclone Michaung affected a population of 40 lakh in Andhra Pradesh alone, resulting in the loss of five human lives. Among the 194 affected villages, 25 have were inundated. The cyclone also caused extensive damage to infrastructure, including 770 kilometers of roads and 333 houses. Additionally, three livestock have perished, 35 trees have been uprooted, and 14 irrigation sources have been damaged. The districts most severely impacted were Bapatla, Krishna, Prakash, and Nellore. Relief efforts were mobilized, with 204 relief camps established initially, providing shelter to 15,153 displaced inmates.

FIGURE 18: HOUSES DAMAGED BY CYCLONE MICHAUNG IN ANDHRA PRADESH

(Image Source: Field volunteers of Sphere India Coalition)

Response by State Government

Review and Coordination by State government

- The Chief Minister reviewed the situation regularly from December 3rd to December 13th, coordinating efforts to ensure facilities in the camps, with a special focus on food, drinking water, supply of medicines, and sanitation. Collectors were instructed to take all measures necessary to face the stormy conditions.
- The Chief Minister conducted an aerial survey of cyclone-affected areas in Tirupati district, then held face-to-face meetings with cyclone victims in Balireddypalem. He also inspected areas between Balireddypalem-Gangannapalem and Swarnamukhi River.
- New Arogya Shree Cards were announced from December 18th, with special attention given to medical treatments for identified patients under the Jagananna Arogya scheme.
- Chief Minister conducted reviews and coordinated efforts with officials in the camp office regarding the program of free treatment up to Rs.25 lakh under YSR Arogyashri, which started on December 18th
- A team of five members from the Union government, including the Executive Director of the National Institute of Disaster Management, visited the affected areas on December 13th and 14th.

Dissemination of Warnings and Bulletins

- IMD weather Bulletins & cyclone warnings were disseminated to the Collectors, Departments and other stake holders at regular intervals from 27th November and predicted formation of cyclonic storm by 02nd December.
- APSDMA issued a low-pressure alert on November 29th, followed by a heavy rain alert on December 2nd, and a cyclone Michang alert on December 3rd
- In the context of heavy rain and strong winds, alert messages were repeatedly sent using the Common Alert Protocol to more than 4.06 million subscribers.

Evacuation Plan

- Individuals residing in hazardous low-lying regions have been evacuated to safer areas.
- According to the APSDMA bulletin dated December 5th, 204 relief camps have been established, accommodating 15,173 evacuees. Additionally, the distribution of aid includes 18,073 food pouches and over 100,000 safe water pouches. Furthermore, 80 medical staff members have been deployed to provide assistance.
- To support people returning home from relief camps, the Chief Minister has announced financial aid—Rs 1,000 for individuals and Rs 2,500 for families, along with other essential items. Houses damaged in the cyclone will be compensated with Rs 10,000 each.

Deployment of Response Forces

- On Tuesday, six State Disaster Response Force teams and 10 teams of National Disaster Response Force were deployed. With the receding rainwater, the state government has decided to assess agriculture and horticulture damage.
- Special officers have been appointed in Andhra Pradesh for all cyclone-affected districts, and the government has released Rs 2 crore each for rescue and relief works. Officials have been instructed to prioritize safeguarding crops, particularly by procuring paddy and preserving the kharif harvest.

Preparedness Measures taken by various departments

- Chief Minister, along with top officials of the state government, convened a meeting with the central team tasked with assessing the post-cyclone situation in the state. The Chief Minister conducted a video conference with 8 District Collectors to address storm-related issues.
- A 24-hour State Control Room was established at the Disaster Management Agency due to heavy rains since December 3rd.
- Farmers were advised to take necessary precautions, while fishermen were instructed to refrain from fishing activities.
- Additionally, special officers were appointed for Bapatla, Konaseema, East Godavari, Kakinada, Prakasam, SPS Nellore, Tirupati, and West Godavari districts. Comparative Analysis and Findings

V. COMPARATIVE ANALYSIS AND FINDINGS

5. Comparative Analysis and Findings

5.1 Cross-Comparison of Global, National, and State Frameworks

#	Indicator	Global Guidance	Guidance & sub-Indicators (synthesised through SFDRR and NDMP 2019)	SDMP Odisha and Other Initiatives	SDMP Andhra Pradesh and Other Initiatives
1	**Disaster Risk Assessment & Information Management**	*Sendai Framework emphasizes the importance of understanding disaster risk and enhancing information management systems to support risk assessment and early warning.*	*Provisioning for disaster risk assessment in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment in the respective state's disaster management plans and policies (considering climate-change-induced and non-climatic disasters). Digital and innovative analytics, management and dissemination of information/ knowledge relative to risks in DMPs.*	• Utilization of advanced technologies such as Satellite-Based Mobile Data / Voice terminals (SBMDV), Digital Mobile Radio (DMR), and Mass Messaging for effective communication during emergencies. • Establishment of Coastal Early Warning Dissemination System (EWDS) with sirens and alert towers covering 327 vulnerable villages. • District Emergency Operation Centers (DEOCs) equipped with fax, telephone, and wireless connectivity to relay warning messages to field levels. • Satellite phones and optical fiber telephone lines are provided for enhanced communication in cyclone-prone areas.	• Implementation of GIS-based risk assessment tools to identify vulnerable areas. • The Andhra Pradesh Disaster Research Centre with Geospatial Laboratory is designed to act as the centralized facility in Andhra Pradesh to carry out all disaster management related Geo-spatial services in the State. • The state-of-the-art lightening alerting system set up in the SEOC has a detailed operating procedure to monitor effectively and warn in advance regarding thunderstorms and lightening. • Electronic equipment's like routers, servers, digital mobile radios, work stations, satellite phones, electronic sirens etc. are being installed in SEOC, DEOCs and MEOC for EWS.
2	**Disaster Prevention and Mitigation**	*Sendai Framework advocates for proactive risk reduction measures and the integration of disaster risk reduction into development policies and planning processes.*	*Existing disaster risk prevention and reduction mechanism through structural and non-structural measures to enhance the economic, social, health and cultural resilience of persons, communities, and their assets, as well as the environment. Such measures are instrumental to saving lives, preventing and reducing losses and ensuring effective recovery and rehabilitation.*	• Mainstreaming Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) into development policies and planning. • OSDMP outlines various flagship programs that could serve as entry points for mainstreaming DRR and CCA into development plans with key steps that can be undertaken in each. • Awareness campaigns for availing insurance policies and disaster-proof construction practices. • Various sectoral measures like Construction of resilient shelters and infrastructure, such as multi-purpose flood/cyclone shelters, community shelters, robust sheds, and healthcare facilities built on raised grounds, to withstand disasters like floods and cyclones. These measures also include the implementation of fire safety measures in critical facilities.	• Each department to develop Departmental DM Plans that Integrate disaster risks into departmental development schemes, projects and programmes. • DM department has prepared Departmental DM plans for 71 key departments with the assistance of UNDP. • As part of risk mitigation efforts and in order to reduce the burden on government as well as victims, the Government promotes risk transfer tools like insurance. • Construction of cyclone shelters and flood embankments in high-risk areas. There are 138 MPCS which house the alert sirens on top of the building. These sirens are used to fore warn the nearby population of any impending disaster. • Promotion of resilient infrastructure designs

				• Implementation of surveillance mechanisms, coordination mechanisms through nodal officers, and public awareness campaigns conducted by various departments to disseminate preventive messages, display Do's & Don'ts signage, distribute leaflets, and conduct information campaigns through print and electronic media.	incorporating disaster-resistant building codes. • Afforestation and watershed management to mitigate landslide and flood risks.
3	**Disaster Response**	*Sendai Framework emphasizes the need for timely and effective disaster response, including the establishment of early warning systems and the strengthening of emergency preparedness and response mechanisms.*	*Existing and proposed frameworks in state disaster management policies and plans to strengthen disaster preparedness for response, considering the steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters. The mechanism in place for taking action in anticipation of events, integrating disaster risk reduction in response preparedness and ensuring that capacities are in place.*	• The State Emergency Operation Center (SEOC), headed by the Special Relief Commissioner (SRC), serves as the nerve center for disaster response, Equipped with state-of-the-art communication networks. • Standard Operating Procedure (SOP) for Emergency Operation Centres (EOCs) • SOP of Departments to Respond to Various Disasters. • Incident Response System (IRS) • Regular drills involving multiple response agencies for disaster preparedness. • Coordination with organizations like Odisha Space Application Centre, India Meteorological Department (IMD), and National Disaster Management Authority (NDMA) for information sharing and response planning. • Deployment of Odisha Disaster Rapid Action Force (ODRAF) for swift response during disasters.	• DDMAs and local authorities will carry out relief needs of the affected people in the immediate aftermath of a disaster in order to mobilise, deploy the resources in the most efficient manner. • Establishment of state-of-the-art Emergency Operation Centers equipped with communication and coordination facilities. • The AP State Disaster Response and Fire services (APSDR & FS) are also one of the Rescue operations forces for search and rescue operations during the natural calamities. The Andhra Pradesh Fire and Emergency Operations and Levy of Fee Rules, 2006 were established to ensure the safety and well-being of the people. • Regular drills and simulations for emergency response teams to ensure preparedness. • Stockpiling of essential relief supplies strategically across the state for rapid deployment. • Departments also need to provide resources and support in response, relief, rehabilitation and recovery measures.
4	**Disaster Recovery and Reconstruction**	*Sendai Framework highlights the importance of integrating disaster risk reduction into post-disaster recovery and reconstruction efforts to "build back better" and promote disaster-resilient development.*	*Existing disaster recovery and reconstruction mechanism through structural and non-structural measures to enhance the economic, social, health and cultural resilience of persons, communities, and their assets, as well as the environment.*	• Integration of disaster risk reduction measures into post-disaster rehabilitation plans. • Reconstruction of infrastructure with disaster-resilient designs and standards. • Under the Chief Minister's Relief Fund (CMRF), assistance is provided for the aged, differently able' orphans, HIV/AIDS affected persons/families and those otherwise differently able or incapable of earning their livelihood. • Strategies for "Building Back Better" during recovery, rehabilitation, and reconstruction efforts. • SOP for involving Panchayati Raj and Drinking Water Department in Recovery and Rehabilitation.	• APSDMA will develop and implement reconstruction & recovery programme with the objective of preventing the affected community from sliding into further poverty and deprivation with plans focusing on livelihood restoration and community rehabilitation. • In the phase of reconstruction other government projects on housing will also be integrated with programs to fulfil the needs. • Integration of disaster-resilient features in reconstruction projects, such as earthquake-resistant building standards. • Implementation of cash-for-work programs to accelerate recovery efforts and boost local economies.

5	**Disaster Risk Finance**	*Sendai Framework calls for innovative financial mechanisms and instruments to support disaster risk reduction and response efforts, including risk financing strategies and insurance schemes.*	*Approaches for disaster risk reduction and climate action funding or financing as provisioned under the respective state's disaster management plans. Public and private investment in disaster risk prevention and reduction, dedicated budgeting, business models, innovative fund pooling mechanism, etc. needs to be evaluated and comprehended.*	• The plan highlights the necessity of allocating adequate budget and dedicated staff for effective mainstreaming of DRR and CCA. • Allocation of 10% of all district-level funds to schemes supporting DRR. • Utilization of State Disaster Response Fund (SDRF) and National Disaster Response Fund (NDRF) for financing disaster management activities. • Flexi-fund component within 66 Centrally Sponsored Schemes used for conducting mitigation or restoration efforts following natural disasters. • Implementation of Odisha Chief Minister's Relief Fund to offer aid to marginalised individuals affected by calamities.	• 5% of the annual allocation to SDRF will be kept for specified capacity building activities by the state in the area of disaster management. • Allocation of budgetary resources for disaster risk reduction activities in state and district disaster management plans. • Each key stakeholder department shall make a provision in their annual budgets for the critical DRR & CCA activities and mitigation measures identified. • Promotion of community-based insurance schemes to enhance financial resilience at the grassroots level. • Andhra Pradesh is piloting Public Private Partnership (PPP) in Disaster Risk Reduction (DRR) in the cities of Vijayawada and Vishakhapatnam
6	**Community Engagement and Participation**	*Sendai Framework emphasizes the involvement of local communities and stakeholders in disaster risk reduction and decision-making processes.*	*Active involvement of communities in all phases of disaster management, fostering a sense of ownership, empowerment, and resilience-building within communities. Key aspects include establishing mechanisms for community consultation, engaging with local community-based organizations, and promoting participatory decision-making processes.*	• Assistant Executive Engineers are expected to work closely with local bodies and NGOs for community participation during flood fighting. • Active participation of local bodies and NGOs in disaster response and recovery efforts.	• Establishment of Community Disaster Management Committees at the village and ward levels for grassroots participation. • Conducting awareness campaigns and training workshops on disaster preparedness and response. • Facilitation of community-led risk mapping exercises to identify local hazards and vulnerabilities. • Andhra Pradesh is building capacities of its school to be centres of disaster risk reduction (DRR) in the communities that surround the schools.
7	**Capacity Building and Training**	*Sendai Framework advocates for the development of human and institutional capacities at all levels to enhance disaster risk management and response capabilities.*	*Strategies for enhancing the skills and capabilities of individuals, institutions, and systems involved in disaster management through provision of accessible training programs, enhancing institutional capacity, developing specific disaster management skills.*	• Comprehensive training for personnel of Odisha Disaster Rapid Action Force (ODRAF) and other stakeholders. • Integration of disaster management and risk reduction into school and college curricula. • Conducting Training Needs Assessments (TNAs) to gauge existing capacities within departments and sectors impacted by climate change-induced disasters. • Incorporating DM and DRR principles into higher education and engaging organizations like the National Service Scheme (NSS) and	• Departments should Integrate disaster risk management into the departmental training curriculum and undertake preparedness & capacity building measures • The APSDMA has developed an online platform for integrating capacity building initiative in the state. The web based capacity building tool aggregates and compiles training programs/workshops/courses offered by state level agencies as well as national level agencies. • SDMP Recommended to Establish platforms to connect universities and HR development institutions

				National Cadet Corps (NCC) are also done for fostering a culture of disaster resilience and preparedness within communities. • The plan also outlines State-level, District-level and Community-level capacity building plans for departments like MSME, Housing and Urban development department, Food supply and consumer welfare department, etc. • Aapda Mitra Volunteers in the State who play a crucial role in evacuation, early warning dissemination, relief distribution, and search and rescue operations.	and formulate short term programmes and trainings with virtual as well as physical classes
8	**Monitoring and Evaluation**	*Sendai Framework underscores the importance of regular monitoring and evaluation of disaster risk reduction efforts to track progress, identify gaps, and inform future actions.*	*Robust monitoring and evaluation frameworks to assess the effectiveness, efficiency, and impact of disaster management initiatives, enabling evidence-based decision-making and adaptive management.*	• Regular monitoring and evaluation of DRR and CCA interventions to assess effectiveness and gather evidence. – • The SOP for Early Warning also includes Monitoring as a crucial part • SDMP 2023 identifies Monitoring and Information sharing as one of the crucial Role of NGOs and other stakeholders. • SOP of Departments to respond to various disasters also outlines the monitoring activities to be undertaken by various departments.	• The Disaster Management Department shall review the progress made by the stakeholder departments on annual basis by identifying key initiatives in each department to be implemented. • Emergency Operation Centres Emergency operating centres (EOCs) will the focal points in the disaster management system for monitoring • Utilization of feedback mechanisms from stakeholders to enhance accountability and transparency.
9	**Climate Action**	*Sendai Framework emphasizes the importance of incorporating climate change considerations into disaster risk reduction strategies and fostering collaboration between disaster risk reduction and climate change adaptation efforts.*	*Integration of climate change considerations into disaster management planning and implementation, aligning efforts to mitigate climate-related risks and promote sustainable development.*	• Formulation of Climate Action Plan involving various departments and agencies. • Establishment of a dedicated Climate Change Cell for coordination and monitoring of climate change actions. • Implementation of Integrated Coastal Zone Management Project (ICZMP) to enhance coastal resilience and mitigate climate risks.	• Integration of climate change adaptation strategies into disaster risk reduction plans, focusing on resilient infrastructure and ecosystem restoration. • Being a highly prone state to both Flood and Cyclone disasters APSDMA will give prime importance to enhance the mitigation and risk management measures related to Cyclone and Flood

5.2 Emerging Gaps and Challenges in State level plans

1. **Governance and Coordination:**

- As disaster risk management is a multisector and multistakeholder subject, there is a crucial need to address institutional gaps within specific organizations/departments and siloed approaches to disaster management, which hinders seamless communication and collaboration among government bodies.
- There's a gap between policies on paper and their real-world execution, highlighting the need for a process-oriented system in governance with inclusive inter-agency collaboration, accountability mechanisms, and performance evaluation frameworks.
- In cases where there is no single operation system for Response, there is a need to strengthen the communication and coordination between all relevant departments for effective response.

2. **Economic and Financial Preparedness:**

- Challenges in linking departmental plans with the overarching disaster management plan, and inadequate budgetary allocations for disaster risk reduction and resilience response efforts.
- In cases, where budgetary allocations have been made for DRR and Adaptation, departments and other stakeholders lack the technical know how to develop and subsequently implement a DRR program integrated with development initiatives.

3. **Infrastructure Resilience:**

- Absence of departmental SOPs or Disaster Management Plans or poor implementation of the existing protocols, especially for engineering departments, is a major setback that will subsequently lead to damages to physical infrastructure.
- There is a need to focus to building resilient systems and infrastructure at policy level through SDMPs.
- Lack of comprehensive assessments and maintenance strategies for critical infrastructure, leading to vulnerabilities and ownership issues during non-disaster times.

4. **Social Concerns:**

- Inequitable compensation distribution and inadequate representation of vulnerable groups like people with disabilities in disaster response planning.
- There is a need to strengthen the Early Warning systems and the evacuation plans and ensure that it is inclusive towards all sections of the society.
- Health sector challenges and the need for a balanced approach to social protection to facilitate effective disaster recovery and community resilience.

5. **Monitoring and Evaluation:**

- A strong monitoring system and social audit is required to ensure effective execution and implementation of State, District and Village level Disaster Management Plans.

6. **Policy-Level Gaps:**

- Existing policies often lack specificity and detailed guidelines for implementation and coordination by different stakeholders, which creates ambiguity and inconsistency in disaster management practices.
- There is a need for a coherent policy framework that integrates disaster risk reduction and climate change adaptation into all levels of planning and development, beyond Disaster Management Plans.
- Policy frameworks should include clear mandates for capacity building, resource allocation, and guidelines and SOPs to enhance resilience, preparedness and response capabilities.

VI. ASSESSMENT OF SYSTEMIC RISK IN THE STATE ECOSYSTEM: A CASE STUDY OF ODISHA AND ANDHRA PRADESH

6. Assessment of Systemic Risk In The State Ecosystem: A Case Study of Odisha and Andhra Pradesh

6.1. Analysis:

In the analysis section of the study, the state ecosystem is examined from two perspectives. Firstly, an investigation is conducted through the lens of State characterization, and secondly the findings of the SRCA survey are synthesized.

1) Analysis of State Characterization:

This section is based on a detailed analysis of the complexity within Odisha(O) and Andhra Pradesh (AP), with each of the 5 system playing an integral role in state functionality and interconnectivity, essential for a comprehensive assessment of systemic risks. Further, the top four components were identified within each of these systems, totalling 20 components. This identification was a critical step in understanding the multifaceted dynamics of the state ecosystem. The selection of these components was based on their centrality to state's functionality, interconnectedness with other systems, and overall influence on the resilience and efficiency of state's operations. This targeted approach, refined through extensive literature review and consultations, ensured a focused assessment of systemic risks within the state ecosystem. Additionally, stakeholder mapping within these systems was conducted to understand the diverse range of entities and individuals influencing or influenced by the state's operations. Lastly, the identification and mapping of critical assets within these systems were undertaken. This step involved a detailed mapping of key assets within the state's environments. This comprehensive cataloguing aimed to create a holistic spatial representation of the state's assets, facilitating an in-depth analysis of how these assets interact within and across the systems, thereby contributing to the overall functionality and resilience of the state. Steps A to H articulated below represent the output of these analysis:

A. Identification of relevant systems: The purpose of this step was to identify the key systems in the state ecosystem. Towards this objective, 5 critical systems were identified (as depicted in Table 10 below), namely Physical and Infrastructure, Economic, Human, Cultural and Social, Environmental and Ecological, and Political and Governance. The rationale behind choosing the five systems for this study stems from a detailed analysis of the state ecosystem's complexity. These systems were selected based on their integral roles in state functionality and their interconnectivity, which are essential for a comprehensive assessment of systemic risks. The Physical and Infrastructure system forms the backbone of state operations, the Economic system underpins the commercial viability, while the Human, Cultural, and social system reflects the human capital and community interactions. The Environmental and Ecological system is crucial for sustainable operations, and the Political and Governance system governs the regulatory framework and policymaking. This selection process was guided by the objective to encompass all critical aspects of state ecosystems, ensuring that the study captures the multifaceted interactions and dependencies that define their resilience and vulnerability to various challenges.

1	Physical & Infrastructure System
2	Human, Social, and Cultural System
3	Economic and Finance System
4	Ecological and Environmental System
5	Political and Governance System

Table 10: Key Systems identified in the state ecosystem

B. Identification of key components within the systems: In this section, the key components were identified within the Odisha and AP state ecosystems, as depicted in Table 11 below, laying the foundation for an in-depth analysis of the SRCA methodology's comprehensive framework.

Systems	Components	Contextualisation in State Ecosystem
Physical & Infrastructure	Transportation networks	Essential for the movement of goods and connectivity with supply chains; directly impacts the state's operational capacity.
	Energy infrastructure	Provides the necessary power for all state operations and is critical for maintaining continuous activity.
	Telecommunications infrastructure	Facilitates the flow of information, which is vital for logistics, coordination, and emergency responses.
	Water supply and sanitation systems	Ensures the health and safety of state workers and the cleanliness of the state environment.
Human, Social, and Cultural	Education system	Provides training and skills development for state citizens, contributing to the efficiency and safety of operations.
	Healthcare system	Critical for maintaining the well-being of state citizens and handling any on-site emergencies.
	Social welfare programs	Supports the social structure of the state community and provides a safety net for citizens.
	Cultural diversity	Affects how state's operations are integrated into the local community and influences the overall culture
Economic and Finance	Trade and Commerce	Directly linked to the state's primary function and economic contribution through the facilitation of imports and exports.
	Banking and financial institutions	Supports financial transactions and provides the economic infrastructure for trade financing and insurance.
	Labor market and employment	The availability of a skilled workforce is vital for state operations and influences the economic health of the region.
	Industrial and manufacturing sectors	The state serves as a hub for the imports and exports of industrial goods, affecting the economic activities of these sectors.
Ecological and Environmental	Biodiversity and ecosystems	The ecological health of the state's surrounding environment is essential for sustainability and regulatory compliance.
	Air and water quality	States have a significant impact on local environmental quality and are subject to strict regulations.
	Pollution control and environmental regulations	Adherence to environmental regulations is crucial to minimize impact and maintain operational licenses.
	Climate change and mitigation strategies	States must adapt to and mitigate the effects of climate change
Political and Governance	Government structure	Defines the state's operational framework, affecting everything from day-to-day activities to strategic development.
	Policy and Regulation	Determines the legal and operational boundaries within which the state must operate.
	Public administration and bureaucracy	The efficiency of administrative processes can significantly affect the state's ability to facilitate trade and comply with regulations.
	Law enforcement and security forces	Ensures the security of the state's assets, personnel, and operations against threats and illicit activities.

Table 11: Key components identified within the five identified systems in the state ecosystem.

C) Stakeholder Mapping: The next step was to identify the key stake holders of the 20 components within the 5 systems under study within the context of the Odisha and AP ecosystem, as depicted in Table 12 below:

Systems	Components	Primary Stakeholders	Secondary Stakeholders
Physical & Infrastructure	Transportation Networks	Department of Transportation, Public Transit Agencies, Transport Service Providers, Commuters, Logist	Environmental Groups, Local Communities, Emergency Services
	Energy Infrastructure	Energy Regulatory Authority, Energy Providers (Public and Private), Industries, Consumers	Environmental Organizations, Local Communities, Government Agencies
	Telecommunications Infrastructure	Telecommunication Companies, Federal Communications Commission, Internet Service Providers, Cons	Government Regulators, Local Communities, Emergency Services
	Water Supply and Sanitation Systems	Water Utility Companies, Environmental Protection Agency, Consumers, Local Authorities	Environmental Organizations, Public Health Agencies, Community Groups
Human, Social, and Cultural	Education System	Department of Education, Schools, Teachers, Students, Parents	Educational Boards, Parent-Teacher Associations, Communities
	Healthcare System	Ministry of Health, Hospitals, Healthcare Providers, Patients, Medical Professionals	Pharmaceutical Companies, Health Insurance Providers, Community Health Centers
	Social Welfare Programs	Department of Social Welfare, Beneficiaries, Social Workers, Non-Governmental Organizations (NGOs)	Donors, Charitable Foundations, Advocacy Groups
	Cultural Diversity	Cultural Institutions, Ethnic and Cultural Communities, Artists, Cultural Heritage Organizations	Tourism Industry, Educational Institutions, Local Government
Economic and Finance	Trade and Commerce	Ministry of Commerce, Businesses, Exporters/Importers, Trade Associations	Chambers of Commerce, Shipping Companies, Custom Authorities
	Banking and Financial Institutions	Central Banks, Commercial Banks, Investors, Account Holders	Stock Exchanges, Regulatory Bodies, Financial Advisors
	Labor Market and Employment	Ministry of Labor, Workers, Employers, Labor Unions, Job Seekers	Employment Agencies, Vocational Training Centers, Job Placement Services
	Industrial and Manufacturing Sectors	Industrial Associations, Manufacturing Companies, Factory Workers, Suppliers	Environmental Agencies, Safety Regulators, Supply Chain Partners
Ecological and Environmental	Biodiversity and Ecosystems	Department of Environment, Conservation Organizations, Wildlife Agencies, Indigenous Communities	Researchers, Tourist Operators, Land Developers
	Air and Water Quality	Environmental Protection Agencies, Environmental Researchers, Residents, Industries	Health Departments, Water Treatment Facilities, Environmental Advocates
	Pollution Control and Environmental Regulations	Environmental Regulatory Authorities, Industries, Environmental Impact Assessment Firms	Environmental NGOs, Legal Firms, Public Health Organizations
	Climate Change and Mitigation Strategies	Climate Change Departments, Renewable Energy Companies, Policy Makers, Scientists	International Organizations, Clean Energy Advocates, Carbon Credit Traders
Political and Governance	Government Structure	Government Officials, Elected Representatives, Public Services, Citizens	Political Parties, International Diplomatic Missions, Public Interest Groups
	Policy and Regulation	Policy Makers, Regulatory Agencies, Legal Experts, Industry Representatives	Lobbying Groups, Think Tanks, Advocacy Organizations
	Public Administration and Bureaucracy	Civil Servants, Government Administrators, Public Service Recipients, Taxpayers	Training Institutions, Public Administration Consultants, Audit and Oversight Bodies
	Law Enforcement and Security Forces	Police Departments, Military Forces, Security Personnel, Law Abiding Citizens	Human Rights Organizations, Legal Aid Societies, Community Watch Groups

Table 12: Key Stakeholders within the components of the state ecosystem

D)**Identification of key assets:** The subsequent phase, known as "Asset Mapping," involved identifying the key assets in the stateecosystem across hard and soft assets in Odisha and AP states, as detailed in *Table 13* below:

Systems	Components	Key Hard Assets	Key Soft Assets
Physical & Infrastructure	Transportation Networks	Roads, Bridges, Vehicles	Infrastructure Plans, Maintenance Procedures
	Energy Infrastructure	Power Plants, Grids, Transmission Lines	Energy Policies, Energy Efficiency Programs
	Telecommunications Infrastructure	Fiber Optic Cables, Cell Towers, Data Centers	Telecommunication Regulations, Service Agreements
	Water Supply and Sanitation Systems	Water Treatment Plants, Pipelines, Reservoirs	Water Quality Standards, Water Management Policies
Human, Social, and Cultural	Education System	Schools, Classrooms, Educational Materials	Curriculum, Teaching Methods, Educational Policies
	Healthcare System	Hospitals, Medical Equipment, Pharmaceuticals	Healthcare Guidelines, Medical Expertise
	Social Welfare Programs	Social Centers, Financial Aid Programs	Case Workers, Counseling Services, Program Evaluation
	Cultural Diversity	Cultural Heritage Sites, Artifacts, Museums	Cultural Preservation Initiatives, Heritage Knowledge
Economic and Finance	Trade and Commerce	Ports, Warehouses, Trade Agreements	Trade Policies, Market Research, Trade Facilitation
	Banking and Financial Institutions	Banks, ATMs, Financial Instruments	Financial Regulations, Economic Indicators
	Labor Market and Employment	Job Centers, Job Listings, Skills Training	Labor Laws, Employment Services, Workforce Data
	Industrial and Manufacturing Sectors	Factories, Machinery, Raw Materials	Industrial Standards, Supply Chain Relationships
Ecological and Environmental	Biodiversity and Ecosystems	Natural Reserves, Wildlife Habitats, Species	Conservation Programs, Ecological Research
	Air and Water Quality	Air Quality Monitoring Stations, Water Testing	Pollution Control Measures, Environmental Assessments
	Pollution Control and Environmental Regulations	Emission Control Systems, Monitoring Equipment	Environmental Laws, Regulatory Compliance Framework
	Climate Change and Mitigation Strategies	Renewable Energy Sources, Carbon Credits	Climate Policies, Carbon Reduction Strategies
Political and Governance	Government Structure	Government Buildings, Administrative Systems	Legal Frameworks, Governance Protocols
	Policy and Regulation	Legislation, Regulatory Frameworks	Policy Analysis, Regulatory Enforcement
	Public Administration and Bureaucracy	Public Service Offices, Records Management	Administrative Procedures, Decision-Making Processes
	Law Enforcement and Security Forces	Police Stations, Armaments, Vehicles	Law Enforcement Protocols, Training Programs

Table 13: Key Assets within the components of the state ecosystem

E) Identification of critical impacts: In this section of the study, the output of the Critical Impact Identification step plays a pivotal role in understanding the resilience of the state ecosystem against severe cyclonic storms and long-term climate change issues at Odisha and AP states. This step was executed using a mixed-methods approach, combining historical data analysis of past events with expert consultations. This dual approach enabled us to capture a comprehensive picture of both perceived and projected impacts of these environmental challenges. The analysis revealed a layered structure of impacts, categorized into three distinct levels. The first-order impacts were observed to directly affect the state's immediate operations. These impacts were primarily operational disruptions caused by severe weather events, which necessitated immediate response and mitigation strategies. Second-order impacts were more complex, involving indirect and cascading effects on the interconnected systems within the state. These impacts often manifested in the form of economic repercussions, social implications, and disruptions in the supply chain networks linked to the state's operations.

The interconnected nature of these impacts highlighted the need for a systemic approach to resilience planning, one that considers the ripple effects of operational disruptions. Third-order impacts were the most far-reaching, encompassing long-term and systemic changes in the state's operational environment. These impacts were primarily related to the gradual effects of climate change, such as rising sea levels and altered weather patterns, which pose significant challenges to the long-term sustainability and planning of state operations. The identification of these impacts was crucial in developing strategies for adaptation and resilience in the face of evolving climate conditions. In all 60 impacts were arrived at for the 20 components as detailed in *Table 14* below:

System	Components	First Order Impacts (Immediate and Direct)	Second Order Impacts (Immediate but Cascading & Indirect)	Third Order Impacts (Not Immediate and Indirect and Systemic)
Physical & Infrastructure	Transportation networks	Damage to infrastructure; disrupted Transport	Delays in delivery and supply chains	Long-term economic impact due to reduced trade
	Energy infrastructure	Power outages; damage to facilities	Loss of operation in state facilities	Increased operational costs; recovery expenses
	Telecommunications infrastructure	Communication breakdowns	Hampered coordination and response efforts	Delayed recovery and information dissemination
	Water supply and sanitation systems	Contaminated water supply; broken pipes	Public health concerns	Long-term water scarcity and sanitation issues
Human, Social, and Cultural	Education system	School closures; disrupted education	Interrupted professional training	Skill gaps affecting future state operations
	Healthcare system	Overwhelmed medical facilities	Spread of diseases	Long-term health system strain
	Social welfare programs	Immediate need for shelter and relief	Strain on social services and programs	Increased poverty and social inequality
	Cultural diversity	Disruption of cultural events	Loss of cultural heritage sites	Weakening of community bonds
Economic and Finance	Trade and Commerce	Halted state operations; trade disruptions	Financial losses for businesses	Economic downturn in the region
	Banking and financial institutions	Inaccessibility to financial services	Liquidity problems; credit shortages	Economic recession; reduced investment
	Labor market and employment	Loss of livelihood	Reduced consumer spending	Long-term unemployment, migration
	Industrial and manufacturing sectors	Stoppage of production	Supply chain disruptions	Industry relocation or closure
Ecological and Environmental	Biodiversity and ecosystems	Habitat destruction; wildlife displacement	Disrupted ecological functions	Long-term loss of biodiversity
	Air and water quality	Immediate pollution from debris	Contaminated water sources	Long-term environmental degradation
	Pollution control and environmental regulations	Increased pollutants; regulatory non-compliance	Strained waste management systems	Reevaluation of environmental policies
	Climate change and mitigation strategies	Increased vulnerability to extreme weather	Compromised adaptation efforts	Need for enhanced resilience planning
Political and Governance	Government structure	Disrupted governance & emergency measures	Political instability	Long-term changes in governance priorities
	Policy and Regulation	Immediate enforcement challenges	Reassessment of regulatory frameworks	Overhaul of policies for better risk management
	Public administration and bureaucracy	Breakdown of administrative processes	Hindered reconstruction and aid efforts	Systemic reforms in public administration
	Law enforcement and security forces	Compromised state security	Increased risk of crime and looting	Long-term security policy changes

Table 14: Key Impacts within the components of the state ecosystem

F) Assigning 'Critical for Resilience'(CTR) Rating: In this section an analysis was conducted on the Critical for Resilience (CTR) rating of various components within the state ecosystems of Odisha and AP. This evaluation was conducted using a series of decision matrices, designed to ascertain the resilience criticality of respective components at three distinct impact levels. These matrices cross-referenced the severity of each component's impact on state operations (Impact Severity, IS) with the challenges faced in restoring the component to normal operations post-impact (Recovery Difficulty, RD), across both immediate (1st and 2nd order combined) and systemic, long-term (3rd order) impacts. The decision matrices were instrumental in categorizing components into High, Medium, or Low Criticality. This categorization considered factors such as the extent to which a component affects state operations when impacted, the challenge faced in restoring it to normal operation, and the long-term systemic impacts and recovery difficulties. Particularly, the 3rd order impacts were examined additionally through the lens of potential climate change issues, such as rising sea levels, increased cyclone intensity, and altered rainfall patterns.

Furthermore, the comprehensive decision matrix evaluated the criticality of components by considering the combined effect of Impact Severity and Recovery Difficulty across all three orders of impact. This approach allowed us to categorize components into three ratings that reflect their overall criticality: High Criticality (HC) for components with high impact severity and/or recovery difficulty, Medium Criticality (MC) for those with medium levels in either category, and Low Criticality (LC) for components with low impact severity and recovery difficulty across all orders of impact. These ratings, when validated and refined through expert insights, highlighted components deemed essential for resilience planning in the face of long-term, systemic impacts. Table 15 below represent the output of this analysis-

System	Components	Impact Severity (IS)	Recovery Difficulty (RD)	3rd Order SIS	3rd Order SRD	Overall Criticality
Physical & Infrastructure	Transportation networks	High	High	High	High	High
	Energy infrastructure	High	High	Medium	High	High
	Telecommunications infrastructure	High	Medium	High	Medium	High
	Water supply and sanitation systems	Medium	High	Medium	High	High
Human, Social, and Cultural	Education system	Low	Medium	Low	Low	Medium
	Healthcare system	High	High	High	High	High
	Social welfare programs	High	High	High	High	High
	Cultural diversity	Low	Low	Low	Low	Low
Economic and Finance	Trade and Commerce	High	High	High	High	High
	Banking and financial institutions	Medium	Medium	Medium	Medium	Medium
	Labor market and employment	High	Medium	High	Medium	High
	Industrial and manufacturing sectors	High	High	High	High	High
Ecological and Environmental	Biodiversity and ecosystems	High	High	High	High	High
	Air and water quality	Medium	Medium	Medium	Medium	Medium
	Pollution control and environmental regulations	Medium	High	Medium	High	High
	Climate change and mitigation strategies	Medium	High	High	High	High
Political and Governance	Government structure	High	High	High	High	High
	Policy and Regulation	High	High	High	High	High
	Public administration and bureaucracy	Medium	High	Medium	High	High
	Law enforcement and security forces	High	Medium	Medium	Medium	Medium

Table 15: CTR ratings by component in the state ecosystem

G. Inter Component Relationship Analysis: In this section of the study, the Inter-Component Relationship Analysis played a pivotal role in elucidating the complex web of interconnections within the stateecosystem of Odisha and AP. This part of the methodology was dedicated to mapping out the Operational Interdependence (OI) among various components of the state ecosystem, aiming to understand how each component is functionally interconnected with others. Through this analysis, certain components displaying high interdependence was identified, marking them as critical nodes within the system. The significance of these nodes lies in their ability to substantially impact other components, either positively or negatively, based on their performance or failure. The operational interdependence matrix - the outcome of this analysis, can be further refined and validated in consultation with stakeholders. This collaborative approach will not only enrich our understanding but also ensure that the matrix accurately reflected the real-world intricacies of the state operations. Particularly noteworthy will be the emergence of components with multiple 'High' interdependence ratings. These components were identified as crucial within the operational network of the states, thereby becoming key focal points in the risk management and resilience strategies. Table 7 below represents the output of this analysis. Furthermore, Table 16 shows an overall categorisation of components by their OI rating, arranged in descending order.

	Systems	Physical & Infrastructure				Human, Social, and Cultural				Economic and Finance				Ecological and Environmental				Political and Governance			
Systems	Component \ Interconnected With	A1 (Transportation)	A2 (Energy)	A3 (Telecom)	A4 (Water Systems)	B1 (Education)	B2 (Healthcare)	B3 (Social Welfare)	B4 (Cultural Div.)	C1 (Trade)	C2 (Banking)	C3 (Labor Market)	C4 (Ind. & Manuf.)	D1 (Biodiversity)	D2 (Air & Water Qual.)	D3 (Pollution Ctrl.)	D4 (Climate Strategies)	E1 (Government)	E2 (Policy)	E3 (Public Admin.)	E4 (Law Enforcement)
Physical & Infrastructure	A1 (Transportation)	-	H	H	H	L	H	M	L	H	H	H	H	M	H	M	M	H	H	H	M
	A2 (Energy)	H	-	H	H	L	H	M	L	H	H	H	H	M	H	M	M	H	H	H	M
	A3 (Telecom)	H	H	-	M	M	H	H	L	H	H	H	H	M	M	M	M	H	H	H	H
	A4 (Water Systems)	H	H	M	-	M	H	H	L	M	M	M	H	H	H	H	H	H	H	H	M
Human, Social, and Cultural	B1 (Education)	L	L	M	M	-	H	H	H	L	L	H	L	L	L	L	L	H	H	H	M
	B2 (Healthcare)	H	H	H	H	H	-	H	L	M	M	H	M	M	H	M	M	M	M	M	M
	B3 (Social Welfare)	M	M	H	H	H	H	-	H	M	M	H	M	L	H	H	M	M	M	M	M
	B4 (Cultural Div.)	L	L	L	L	H	L	H	-	L	L	L	L	L	L	L	L	L	L	L	L
Economic and Finance	C1 (Trade)	H	H	H	M	L	M	M	L	-	H	H	H	M	M	M	M	H	H	H	M
	C2 (Banking)	H	H	H	M	L	M	M	L	H	-	H	H	M	M	M	M	H	H	H	M
	C3 (Labor Market)	H	H	H	M	H	H	H	L	H	H	-	H	M	M	M	M	H	H	H	M
	C4 (Ind. & Manuf.)	H	H	H	H	L	M	M	L	H	H	H	-	M	M	M	M	H	H	H	M
Ecological and Environmental	D1 (Biodiversity)	M	M	M	H	L	M	L	L	M	M	M	M	-	H	H	H	M	M	M	M
	D2 (Air & Water Qual.)	H	H	M	H	L	H	H	L	M	M	M	M	H	-	H	H	M	M	M	M
	D3 (Pollution Ctrl.)	M	M	M	H	L	M	H	L	M	M	M	M	H	H	-	H	M	M	M	M
	D4 (Climate Strategies)	M	M	M	H	L	M	M	L	M	M	M	M	H	H	H	-	M	M	M	M
Political and Governance	E1 (Government)	H	H	H	H	H	M	M	L	H	H	H	H	M	M	M	M	-	H	H	H
	E2 (Policy)	H	H	H	H	H	M	M	L	H	H	H	H	M	M	M	M	H	-	H	H
	E3 (Public Admin.)	H	H	H	H	H	M	M	L	H	H	H	H	M	M	M	M	H	H	-	H
	E4 (Law Enforcement)	M	M	H	M	M	M	M	L	M	M	M	M	M	M	M	M	H	H	H	-

Table 16: Inter-Component Relationship by component in the state ecosystem

Legend:

- *H: High Interdependence*
- *M: Medium Interdependence*
- *L: Low Interdependence*
- *No direct interdependence or self-reference*

Interpretation:

- *High Interdependence (H): Indicates that the operation of one component is highly dependent on, or significantly impacts, another component. For example, "A1 (Transstateation)" has a high interdependence with "A2 (Energy)", indicating that transstateation networks heavily rely on the energy State.*
- *Medium Interdependence (M): Suggests a moderate level of operational connection or impact.*
- *Low Interdependence (L): Implies minimal or indirect operational connections.*

System	Component	OI Rating
Physical & Infrastructure	Transportation Networks	H
Physical & Infrastructure	Energy Infrastructure	H
Physical & Infrastructure	Telecommunications Infrastructure	H
Physical & Infrastructure	Water Supply and Sanitation Systems	H
Human, Social, and Cultural	Healthcare System	H
Economic and Finance	Trade and Commerce	H
Economic and Finance	Banking and Financial Institutions	H
Economic and Finance	Labor Market and Employment	H
Economic and Finance	Industrial and Manufacturing Sectors	H
Ecological and Environmental	Government Structure	H
Ecological and Environmental	Policy and Regulation	H
Political and Governance	Public Administration and Bureaucracy	H
Political and Governance	Education System	M
Political and Governance	Social Welfare Programs	M
Political and Governance	Biodiversity and Ecosystems	M
Human, Social, and Cultural	Air and Water Quality	M
Human, Social, and Cultural	Pollution Control and Environmental Regulations	M
Ecological and Environmental	Climate Change and Mitigation Strategies	M
Ecological and Environmental	Law Enforcement and Security Forces	M
Human, Social, and Cultural	Cultural Diversity	L

Table 17: Overall categorization of components by their Operational Interdependence (OI) rating

H) 'System breakdown risk' rating: In this section of the study, the System Breakdown Risk rating of components emerged as a pivotal aspect of the analysis. The approach employed a bespoke decision-making matrix which weaves together two pivotal dimensions—Criticality to Resilience (CTR) and Operational Interdependence Impact (OII)—to accurately appraise the risk of system breakdown for each component. By methodically cross-referencing these dimensions, the matrix indicates key risks, guiding targeted resource allocation and strategic planning to enhance the resilience of vital system components. This comprehensive approach allowed us to systematically evaluate the potential risks associated with each component. The output of this matrix, which was further validated through expert consultations, provided critical insights into the state ecosystem's resilience atOdisha and AP. This prioritization is crucial for directing resources effectively and planning interventions that enhances the resilience of essential components, thereby mitigating the risk of partial or complete system breakdowns. Table 18 below represents the output of this analysis-

System	Component	CTR Rating	OI Rating	Component Breakdown Risk Rating
Physical & Infrastructure	Transstateation Networks (A1)	H	H	H
Physical & Infrastructure	Energy Infrastructure (A2)	H	H	H
Physical & Infrastructure	Telecommunications Infrastructure (A3)	H	H	H
Physical & Infrastructure	Water Supply and Sanitation Systems (A4)	H	H	H
Human, Social, and Cultural	Healthcare System (B2)	H	H	H
Economic and Finance	Trade and Commerce (C1)	H	H	H
Economic and Finance	Labor Market and Employment (C3)	H	H	H
Economic and Finance	Industrial and Manufacturing Sectors (C4)	H	H	H
Ecological and Environmental	Government Structure (E1)	H	H	H
Ecological and Environmental	Policy and Regulation (E2)	H	H	H
Political and Governance	Public Administration and Bureaucracy (E3)	H	H	H
Political and Governance	Social Welfare Programs (B3)	H	M	H
Political and Governance	Biodiversity and Ecosystems (D1)	H	M	H
Ecological and Environmental	Climate Change and Mitigation Strategies (D4)	H	M	H
Economic and Finance	Banking and Financial Institutions (C2)	M	H	M
Political and Governance	Education System (B1)	M	M	M
Human, Social, and Cultural	Air and Water Quality (D2)	M	M	M
Human, Social, and Cultural	Pollution Control and Environmental Regulations (D3)	M	M	M
Ecological and Environmental	Law Enforcement and Security Forces (E4)	M	M	M
Human, Social, and Cultural	Cultural Diversity (B4)	L	L	L

Table 18: Component Breakdown risk rating

Interpretation:

- *Low Risk: Components in this category are less likely to cause a system breakdown due to lower interdependence or lower criticality.*
- *Medium Risk: These components present a moderate risk of causing a system breakdown. They may have medium-level interdependence or criticality*
- *High Risk: Components with high ratings in CTR and OI, are highly likely to cause a system breakdown if they fail. They are critical to system resilience, highly interconnected with other components, and/or difficult to recover.*

By cross-referencing the CTR and OI decision-makers can better understand the potential risks associated with each component within the stateecosystem. This understanding is crucial for prioritizing risk management efforts and planning for resilience enhancement. Components identified as "High Risk" should be the focus of robust planning and preparedness strategies. Table 19 shows the System breakdown risk rating considering the individual component level breakdown ratings.

System	Component	Component Breakdown Risk Rating	System Breakdown Risk Rating
Physical & Infrastructure	Transstateation Networks (A1)	H	H
Physical & Infrastructure	Energy Infrastructure (A2)	H	
Physical & Infrastructure	Telecommunications Infrastructure (A3)	H	
Physical & Infrastructure	Water Supply and Sanitation Systems (A4)	H	
Human, Social, and Cultural	Education System (B1)	M	M
Human, Social, and Cultural	Healthcare System (B2)	H	
Human, Social, and Cultural	Social Welfare Programs (B3)	H	
Human, Social, and Cultural	Cultural Diversity (B4)	L	
Economic and Finance	Trade and Commerce (C1)	H	H
Economic and Finance	Banking and Financial Institutions (C2)	M	
Economic and Finance	Labor Market and Employment (C3)	H	
Economic and Finance	Industrial and Manufacturing Sectors (C4)	H	
Ecological and Environmental	Biodiversity and Ecosystems (D1)	H	H
Ecological and Environmental	Air and Water Quality (D2)	M	
Ecological and Environmental	Pollution Control and Environmental Regulations (D3)	M	
Ecological and Environmental	Climate Change and Mitigation Strategies (D4)	H	
Political and Governance	Government Structure (E1)	H	H
Political and Governance	Policy and Regulation (E2)	H	
Political and Governance	Public Administration and Bureaucracy (E3)	H	
Political and Governance	Law Enforcement and Security Forces (E4)	M	

Table 19: System Breakdown risk rating

Thus, the fundamental elements of stateState characterization within theOdisha and AP stateecosystems were identified in this section, establishing the groundwork for a comprehensive examination of the SRCA methodology's framework.

2) Synthesis of Findings: Outcome of SRCA Survey

In this section of the analysis, we explore the findings derived from the Systemic Risk Capability Assessment (SRCA) survey, a crucial element in assessing systemic risk and resilience within the Odisha and AP resilience ecosystems. The SRCA tool, known for its multifaceted framework, plays a pivotal role in dissecting the resilience of state ecosystems across various dimensions. Data collection for the SRCA tool involves administering a questionnaire survey to key stakeholders. These respondents rate each parameter on a scale from 1 (indicating poor) to 5 (reflecting the best), offering valuable insights into the current and prospective state of resilience within the seaport ecosystem. The accuracy and reliability of these results rely on the expertise and knowledge of the respondents. Following data collection, analysis can be conducted using spreadsheet tools, and the findings can be visualized through spider diagrams, providing a clear representation of prevailing conditions across different dimensions and domains. Additionally, correlation analysis can be utilized to establish connections between various aspects of the ecosystem, yielding context-based insights to inform effective solutions.

The foundational framework of this assessment is built upon two essential perspectives:

A. Intra-System Perspective: The Intra-System Perspective explores the dynamics and capabilities inherent to the ports under examination, encompassing a comprehensive evaluation of specific capabilities associated with five key systems: the Physical and Infrastructure System, Economic and Finance System, Ecological and Environmental System, Human, Social, and Cultural System, and Political and Governance System. This perspective sheds light on the inherent strengths and weaknesses within the operational systems of the ports themselves.

B. Inter-System Perspective: Conversely, the Inter-System Perspective primarily focuses on the broader, interconnected aspects of risk management, covering domains such as Institutional Design and Capacity, Governance, and System Understanding across the aforementioned five systems within the port ecosystem. These factors are crucial in assessing how effectively a port authority navigates and manages risks of a systemic nature, which often transcend the confines of a single system.

Each of these perspectives undergoes further examination through a series of carefully crafted questions, eliciting responses that provide a quantitative basis for our analysis. These questions are meticulously designed to delve deeply into each focal area, facilitating a comprehensive understanding of the strategies employed for risk management within both the intra and inter-system realms of the ports.

Key Observations and Analytical Assessments

In the comparative assessment of Odisha and Andhra Pradesh data, there is a noticeable variability in their proficiency in both Inter System and Intra System capabilities. The average scores across various categories reflect a range that oscillates between high to moderate to low, indicating a diverse array of capabilities and preparedness levels, as depicted in Figure 19 below.

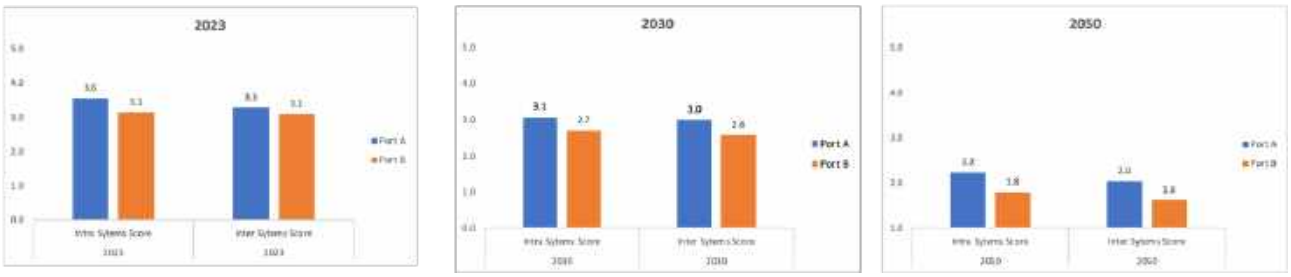

Figure 19: Systemic Risk Capability Assessment score between Odisha and Andhra Pradesh as of 2023, 2030 and 2050

The scores reveal comparable levels of preparedness at both ports in the present, near, and distant future, albeit with decreasing total scores as time progresses. When considering the extended perspective up to 2050, the systemic risk capabilities of both Odisha and Andhra Pradesh exhibit a substantial decline. This decline in both ports' scores over time reflects difficulties in sustaining long-term resilience and managing risks effectively. The above summary of readiness at an Intra and Inter system level can be further substantiated by the underlying data by domains for both Odisha and Andhra Pradesh, which show a similar trend as the overall all scores depicted in Figure 20 below.

Figure 20: Domain wise score Inter and Intra system scores for Odisha and Andhra Pradesh data for 2023, 2030 and 2050.

Qualitative insights emerging from the Inter Systems Scores: By Domain

In examining the domain wise scores of the Inter Systems Scores within the VPA and PPA ecosystems, several significant findings have emerged. This analysis delves into these findings to shed light on the existing strengths and areas that require attention within these domains.

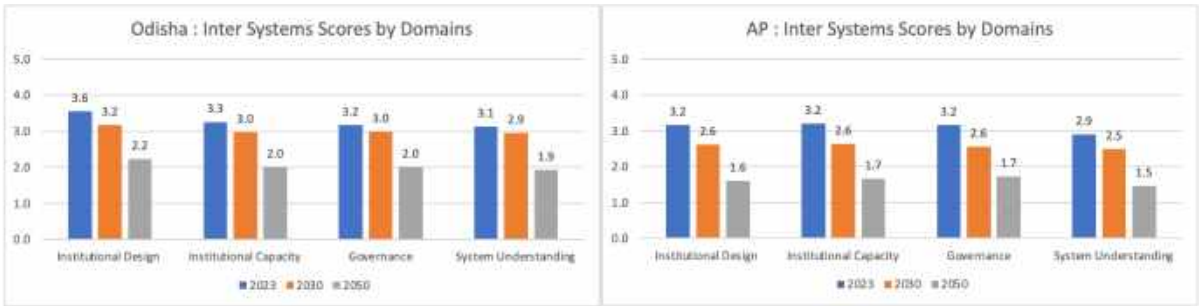

Figure 21: Domain wise break up of Inter system scores for Odisha and Andhra Pradesh for 2023, 2030 and 2050.

The examination of institutional design for systemic resilience management (SRM) in Odisha and Andhra Pradesh (AP) unveils critical insights into their foundational approaches. Understanding the nuances of vision, policies, stakeholder integration, budget allocation, and the mainstreaming of SRM in development and planning is pivotal for comprehending the efficacy and areas of enhancement within their institutional frameworks.

A. Institutional Design:

- Vision and Charter for SRM: In both Odisha and AP, there exists a commendable vision and a shared charter dedicated to pursuing SRM, which has initially demonstrated significant impacts. However, the long-term sustainability and effectiveness of these visions require improvement, especially in AP where the focus is comparatively limited.
- Coherent Policies and Regulation: Across various stakeholder departments, both states showcase comprehensive policies and regulations aligned with the goals of SRM. However, in AP, certain departments exhibit limitations in their policies or regulatory frameworks, suggesting the need for refinement and alignment with broader SRM objectives.
- Integration of Perspectives of Affected People: The integration of perspectives from affected communities is evident in the initial phases, with active engagement observed in both states. However, over time, particularly in AP, this integration diminishes, highlighting a concerning trend of minimal engagement with affected communities in the long term.
- Budget Allocation for SRM: Adequate financial resources are allocated to support SRM efforts across various systems in both Odisha and AP, ensuring continuity in short and long-term resilience-building endeavours.
- Mainstreaming of SRM in Development and Planning: While both states have made strides in integrating SRM into development and planning processes, including disaster risk reduction (DRR) and climate change adaptation, there remains a need for enhancement. The mainstreaming efforts exhibit a moderate to limited presence and impact, particularly in AP, indicating areas for improvement in long-term planning and policy coherence.

The analysis of institutional design uncovers significant insights into the SRM frameworks of Odisha and AP. While both states exhibit strengths in certain aspects such as vision clarity and budget allocation, there are notable differences in long-term planning, stakeholder integration, and policy coherence. Odisha's institutional design emerges as superior, particularly at the state, district, and block levels. Addressing the identified gaps in AP's institutional design holds the potential to significantly enhance its resilience and preparedness in the face of systemic risks.

This table provides a concise comparison of the short-term and long-term perspectives across various aspects of institutional design for systemic resilience management in Odisha and Andhra Pradesh.

Category	Insights
A. Institutional Design	1. In both Odisha and AP, there exists a commendable vision and a shared charter dedicated to pursuing SRM, which has initially demonstrated significant impacts. However, the long-term sustainability and effectiveness of these visions require improvement, especially in AP where the focus is comparatively limited.
	2. Across various stakeholder departments, both states showcase comprehensive policies and regulations aligned with the goals of SRM. However, in AP, certain departments exhibit

	limitations in their policies or regulatory frameworks, suggesting the need for refinement and alignment with broader SRM objectives.
	3. The integration of perspectives from affected communities is evident in the initial phases, with active engagement observed in both states. However, over time, particularly in AP, this integration diminishes, highlighting a concerning trend of minimal engagement with affected communities in the long term.
	4. Adequate financial resources are allocated to support SRM efforts across various systems in both Odisha and AP, ensuring continuity in short and long-term resilience-building endeavors.
	5. While both states have made strides in integrating SRM into development and planning processes, including disaster risk reduction (DRR) and climate change adaptation, there remains a need for enhancement. The mainstreaming efforts exhibit a moderate to limited presence and impact, particularly in AP, indicating areas for improvement in long-term planning and policy coherence.

The analysis of institutional design uncovers significant insights into the SRM frameworks of Odisha and AP. While both states exhibit strengths in certain aspects such as vision clarity and budget allocation, there are notable differences in long-term planning, stakeholder integration, and policy coherence. Odisha's institutional design emerges as superior, particularly at the state, district, and block levels. Addressing the identified gaps in AP's institutional design holds the potential to significantly enhance its resilience and preparedness in the face of systemic risks.

Key insights from an Institutional Capacity perspective (Inter)

The assessment of institutional capacity within the context of Systemic Risk Management (SRM) in seaport ecosystems yields valuable insights into the readiness and effectiveness of both Odisha and Andhra Pradesh.This analysis examines critical aspects of institutional capacity, highlighting both strengths and areas requiring attention.

A. Institutional Capacity

- Incorporation of multi-hazard Risk Assessment, Horizon Scanning, and Scenario planning: In the short term, there is substantial integration of multi-hazard risk assessment methodologies, horizon scanning, and scenario planning, resulting in significant positive impacts. However, in the long term, this incorporation diminishes, especially in AP, posing challenges in comprehensive risk management strategies:
- Existence of established protocols or procedures for coordination and restoration efforts after a cyclone and inter-agency coordination: Short-term protocols ensure effective coordination and restoration efforts post-cyclone, contributing to swift responses. However, their long-term sustainability is questionable, with limited incorporation and minimal impact observed, indicating potential weaknesses in long-term coordination strategies.
- Awareness levels on Systemic Risk Management across all stakeholders: Stakeholders exhibit substantial awareness of systemic risk management in the short term, yielding significant impacts. However, in the long term, awareness dwindles, particularly in AP, highlighting a concerning lack of sustained engagement and awareness campaigns.

- Effectiveness of proactive capacity building across the ecosystem: Short-term endeavours showcase moderate effectiveness and partial impact in building proactive capacity across various sectors. Conversely, long-term initiatives prove ineffective, underscoring the need for re evaluation and reinforcement of capacity-building efforts.
- Existence of technology and data to support effective systemic resilience: Short-term initiatives demonstrate substantial utilization of technology and data, significantly enhancing systemic resilience. However, in the long term, there's room for improvement, presenting an opportunity to leverage advanced technologies and enhance data-driven approaches for long-term resilience.

This table provides a concise comparison of the short-term and long-term perspectives across various aspects of institutional design for systemic resilience management in Odisha and Andhra Pradesh.

Category	Insights
A. Institutional Capacity	1. Incorporation of multi-hazard Risk Assessment, Horizon Scanning, and Scenario planning - Short term: Substantial incorporation with significant impact. Long term: Limited incorporation of multi-hazard risk assessment, especially in AP.
	2. Existence of established protocols or procedures for coordination and restoration efforts after a cyclone and inter-agency coordination - Short term: Significant protocols ensuring effective coordination. Long term: Limited incorporation with minimal impact.
	3. Awareness levels on Systemic Risk Management across all stakeholders - Short term: Substantial awareness with significant impact. Long term: Limited to no awareness, especially in AP.
	4. Effectiveness of proactive capacity building across the ecosystem - Short term: Moderate effectiveness with partial impact. Long term: Proactive capacity building is ineffective.
	5. Existence of technology and data to support effective systemic resilience - Short term: Substantial platforms with significant impact. Long term: Opportunity to enhance the usage of tech, data, and advanced technologies for the long term.

The analysis underscores the importance of sustained efforts in institutional capacity building and resilience strategies for effective disaster risk management. It highlights the necessity for long-term planning and continuous evaluation to address emerging challenges and enhance resilience against natural disasters like cyclones, particularly in regions prone to such calamities.

Key Takeaways from a Governance Perspective (Inter)

The governance perspective within the context of Systemic Risk Management (SRM) in seaport ecosystems of Odisha and Andhra Pradesh offers crucial insights into the collaborative efforts and mechanisms in place to address systemic risks effectively. This analysis examines governance-related aspects, highlighting both notable achievements and areas requiring sustained attention.

- Existence of Multi-Stakeholder Platforms: Presently, there exists an adequate array of multi-stakeholder platforms inclusive of various entities such as governmental bodies at different administrative tiers, market representatives, civil society organizations, and community stakeholders. These platforms exhibit a partial but discernible impact, facilitating collaboration among diverse stakeholders in DRM endeavours. However, there is a concerning trend emerging, particularly noticeable in the state of Andhra Pradesh (AP), where the existence of multi-stakeholder platforms is either limited or non-existent in the long term. This trend raises significant apprehensions regarding the coordination and cooperative efforts necessary for effective DRM initiatives, potentially impeding long-term resilience-building endeavours.
- Effectiveness of Transboundary Governance: Multi-stakeholder platforms demonstrate a moderate level of effectiveness in transboundary governance, showcasing partial success in coordinating DRM activities across various governance levels and sectors. While these platforms have facilitated some collaboration and coordination, their long-term effectiveness appears to be diminishing. This decline is especially pronounced in AP, indicating challenges in addressing cross-border issues and fostering sustained collaboration among stakeholders. Consequently, there is a pressing need to bolster transboundary governance mechanisms to better address the evolving DRM landscape effectively.
- Mechanisms for Transparency and Accountability: The mechanisms in place to ensure transparency and accountability within the states risk management practices are currently robust, yielding significant positive impacts. These mechanisms foster trust among stakeholders, promote responsible decision-making, and enhance the overall efficacy of DRM efforts. However, looking ahead, there are indications that these mechanisms may not have been sufficiently developed, particularly in AP. This raises concerns regarding potential opacity in DRM practices, highlighting the imperative for proactive measures to address transparency and accountability deficits.

This table provides a concise comparison of the short and long-term perspectives on governance aspects, highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
A. Existence of Multi-Stakeholder Platforms	1. Presently, there exists an adequate array of multi-stakeholder platforms inclusive of various entities such as Port Authority, governmental bodies at different administrative tiers, market representatives, civil society organizations, and community stakeholders. These platforms exhibit a partial but discernible impact, facilitating collaboration among diverse stakeholders in DRM endeavors. However, there is a concerning trend emerging, particularly noticeable in the state of Andhra Pradesh (AP), where the existence of multi-stakeholder platforms is either limited or non-existent. This trend raises significant apprehensions regarding the coordination and cooperative efforts necessary for effective DRM initiatives, potentially impeding long-term resilience-building endeavors.
B. Effectiveness of Transboundary Governance	1. Multi-stakeholder platforms demonstrate a moderate level of effectiveness in transboundary governance, showcasing partial success in coordinating DRM activities across various governance levels and sectors. While these platforms have facilitated some collaboration and coordination, their long-term effectiveness appears to be diminishing. This decline is especially pronounced in AP, indicating challenges in

	addressing cross-border issues and fostering sustained collaboration among stakeholders. Consequently, there is a pressing need to bolster transboundary governance mechanisms to better address the evolving DRM landscape effectively.
C. Mechanisms for Transparency and Accountability	1. The mechanisms in place to ensure transparency and accountability within the port's risk management practices are currently robust, yielding significant positive impacts. These mechanisms foster trust among stakeholders, promote responsible decision-making, and enhance the overall efficacy of DRM efforts. However, looking ahead, there are indications that these mechanisms may not have been sufficiently developed, particularly in AP. This raises concerns regarding potential opacity and inefficiency in DRM practices, highlighting the imperative for proactive measures to address transparency and accountability deficits.

In conclusion, this analysis underscores the dynamic nature of governance in DRM, with short-term achievements juxtaposed against long-term challenges, particularly evident in AP. The waning presence of multi-stakeholder platforms and uncertainties surrounding transparency and accountability mechanisms underscore the criticality of sustained efforts to fortify governance structures, foster collaboration, and ensure the effective management of disaster risks. Addressing these challenges is paramount for enhancing resilience and mitigating the impacts of disasters, particularly in coastal regions like Odisha and AP.

Key Takeaways from System Understanding perspective (Inter)

The analysis of System Understanding within the context of Systemic Risk Management (SRM) in state ecosystems provides valuable insights into the depth of comprehension and readiness to address systemic risks. This analysis delves into various aspects of System Understanding, revealing noteworthy findings and areas that warrant substantial attention.

- Intra-System Mapping: Subsystem Identification: At the core of systemic resilience lies the ability to delineate subsystems within each of the five systems under scrutiny and establish transparent relationships among their components. In the short term, mapping efforts reveal satisfactory progress, with approximately 3 to 4 out of the 5 systems adequately mapped. However, as we project into the long term, concerns arise as mapping initiatives are forecasted to dwindle, potentially impeding our understanding of internal system dynamics.
- Inter-System Mapping: Extending beyond individual systems, the mapping endeavours seek to unravel the intricate web of relationships between them. This entails mapping the boundaries of each system and identifying stakeholders, while also pinpointing critical tipping points. Short-term achievements highlight substantial progress in mapping 2 out of the 5 systems. Nevertheless, as we peer into the future, the outlook dims, with projections indicating limited to no mapping, thereby underscoring potential challenges in comprehending systemic interconnectedness.
- Transboundary Effects Mapping: A crucial aspect of systemic resilience involves assessing both direct and indirect transboundary effects, which necessitates robust mapping efforts. In the short term, mapping endeavours exhibit adequacy in capturing these effects, providing valuable insights into cross-border risks. However, long-term projections paint a less optimistic picture, with indications of limited to no mapping, particularly conspicuous in the region of Andhra Pradesh (AP), thus signalling potential vulnerabilities in addressing transboundary risks.
- Outcome Identification from System Failures: Anticipating outcomes and impact areas resulting from intra and inter-system failures is paramount for effective risk management. Short-term mapping initiatives showcase commendable progress in this aspect, enhancing our preparedness to address

systemic failures. However, as we look ahead, concerns arise regarding the adequacy of long-term mapping efforts, especially in AP, highlighting the imperative of bolstering foresight capabilities to navigate future challenges effectively.

This table provides a concise comparison of the short and long-term perspectives on System Understanding aspects, highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
A. Intra-System Mapping	1. Subsystem Identification: In the short term, there is adequate mapping of subsystems in 3 to 4 out of 5 systems. However, in the long term, mapping becomes limited to nonexistent.
	2. Inter-System Mapping: Short-term efforts result in substantial mapping between systems in 2 out of 5 instances. However, this mapping diminishes significantly in the long term.
B. Transboundary Effects Mapping	3. Mapping Transboundary Effects: In the short term, mapping of transboundary effects is adequate. However, in the long term, this mapping is limited, especially in Andhra Pradesh.
C. Outcome Identification from System Failures	4. Identification of Impact Areas: Initial mapping adequately identifies impact areas resulting from system failures in the short term. However, this mapping becomes limited in the long term, particularly in Andhra Pradesh.

In conclusion, while short-term mapping endeavors provide valuable insights into intra and inter-system dynamics, the long-term prognosis raises pertinent questions about the sustainability and efficacy of mapping initiatives, particularly in AP. Addressing these challenges is imperative to fortify systemic resilience and mitigate risks effectively across the studied regions.

Qualitative insights emerging from the Intra Systems Scores: By System

Upon closer examination of the system-level readiness (Figure 22 below) which forms a critical component of the Intra-system readiness levels, the readiness of each system shows a variability within the Odisha and Andhra Pradesh with the overall Intra system readiness scores dropping over the short, medium, and long term.

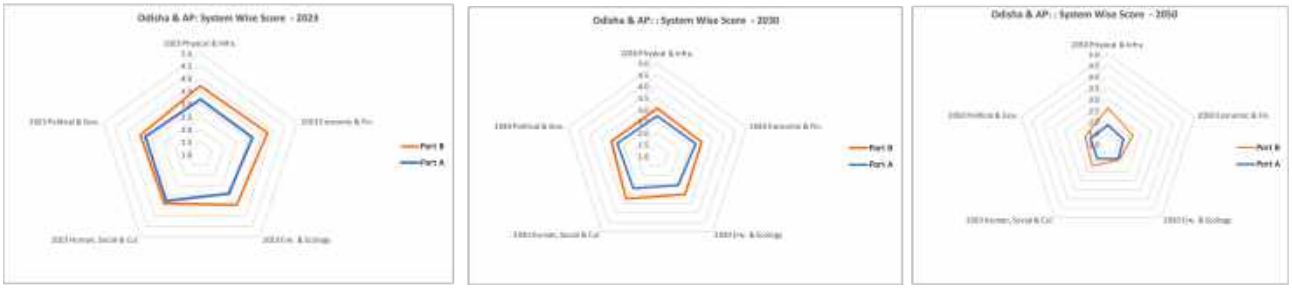

Figure 22: System wise scores for Odisha and AP or 2023, 2030 and 2050.

1.Physical and Infrastructure System

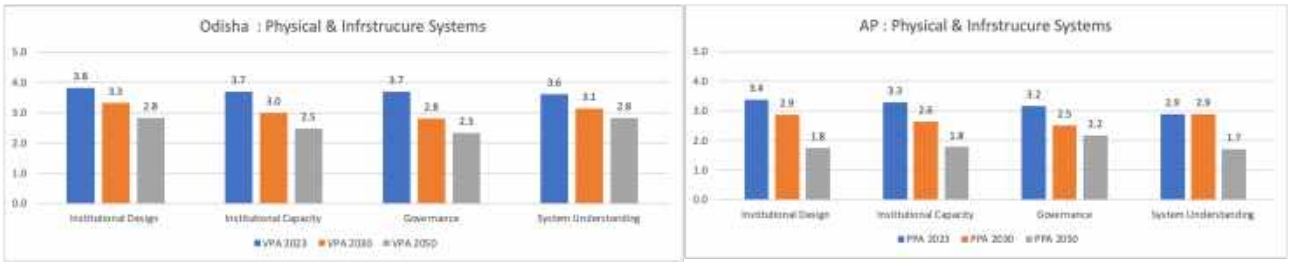

Figure 23: Physical and Infrastructure System

In this section, we analyze the institutional design, capacity, governance, and system understanding concerning Physical and Infrastructure Systems, focusing on disaster risk management (DRM) strategies. We evaluate short-term and long-term perspectives to discern the effectiveness and sustainability of current approaches in mitigating systemic risks in Odisha and Andhra Pradesh.

A) Institutional Design:

- Vision and Charter: In the short term, both Odisha and Andhra Pradesh exhibit substantial vision and charter, positively impacting systemic risk management (SRM). However, long-term planning requires improvement, particularly in AP.
- Public-Private Partnerships (PPP): Short-term PPP initiatives demonstrate substantial incentives, yet long-term sustainability remains limited, albeit with evident intent.
- Budget Availability: Adequate budgets are accessible for both short and long terms, facilitating effective SRM across all systems.
- Mainstreaming SRM: While there's moderate to limited mainstreaming in development and planning, its impact remains partial in both states.

B) Institutional Capacity:

- Awareness of Impact Areas: Short-term awareness of climate change-induced extreme weather events is comprehensive, but long-term awareness diminishes, especially in AP.
- Risk Assessment and Planning: Short-term efforts involve substantial risk assessment and mitigation, but long-term planning lacks focus, particularly in AP.
- Infrastructure Adequacy: Both short and long terms witness adequate design, construction, and maintenance of critical infrastructure components to withstand cyclones and flooding.
- Coordination Protocols: Short-term protocols ensure effective coordination post-disaster, but long-term incorporation is limited, impacting restoration efforts.
- Stakeholder Awareness: Short-term awareness of systemic risk management is substantial but diminishes in the long term, particularly in AP.
- Capacity Building: Short-term proactive capacity building shows moderate effectiveness, but long-term initiatives are lacking, especially in AP.
- Technology and Data: Short-term platforms demonstrate significant impact, but long-term utilization of technology and data for systemic resilience is adequate.

C) Governance:

- Multi-Stakeholder Platforms: Short-term existence of multi-stakeholder platforms is moderate but lacks significant impact in the long term.
- Transboundary Governance: Short-term effectiveness of transboundary governance through multi-stakeholder platforms is moderate, with limited effectiveness in the long term.

D) System Understanding:

- Outcomes Mapping: Short-term mapping of outcomes resulting from intra and inter-system failures is limited, with minimal progress in the long term.
- Identification and Mapping: Short-term mapping of actors, system boundaries, and sub-systems is adequate but diminishes in the long term

Overall, while short-term initiatives demonstrate commendable progress in addressing systemic risks, long-term sustainability and effectiveness, particularly in Andhra Pradesh, require substantial improvement. Strategies for enhancing vision, PPP sustainability, awareness, capacity building, and governance effectiveness are crucial for ensuring long-term resilience in Physical and Infrastructure Systems.

The below table provides a concise comparison of the short and long-term perspectives on the Physical and Infrastructure system, highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Key Insights
A) Institutional Design	1. Substantial vision and charter in the short term, requiring long-term planning improvement, particularly in Andhra Pradesh.
	2. Short-term PPP initiatives show substantial incentives, with limited sustainability in the long term, albeit with evident intent.
	3. Adequate budgets available for both short and long terms, facilitating effective SRM across all systems.
	4. Moderate to limited mainstreaming of SRM in development and planning, with partial impact observed in both states.
B) Institutional Capacity	1. Comprehensive short-term awareness of climate change-induced extreme weather events, diminishing in the long term, especially in AP.
	2. Substantial short-term risk assessment and planning, lacking focus in the long term, particularly in AP.
	3. Adequate design, construction, and maintenance of critical infrastructure components for withstanding cyclones and flooding observed in both short and long terms.
	4. Short-term protocols ensure effective coordination post-disaster, but long-term incorporation is limited, impacting restoration efforts.

	5. Short-term awareness of systemic risk management is substantial but diminishes in the long term, particularly in AP.
	6. Moderate effectiveness of short-term proactive capacity building, lacking long-term initiatives, especially in AP.
	7. Short-term platforms demonstrate significant impact, with adequate long-term utilization of technology and data for systemic resilience.
C) Governance	1. Moderate existence of multi-stakeholder platforms in the short term, lacking significant impact in the long term.
	2. Short-term effectiveness of transboundary governance through multi-stakeholder platforms is moderate, with limited effectiveness in the long term.
D) System Understanding	1. Limited short-term mapping of outcomes resulting from intra and inter-system failures, with minimal progress in the long term.
	2. Adequate short-term mapping of actors, system boundaries, and sub-systems, diminishing in the long term.

2.Economic and Financial Systems

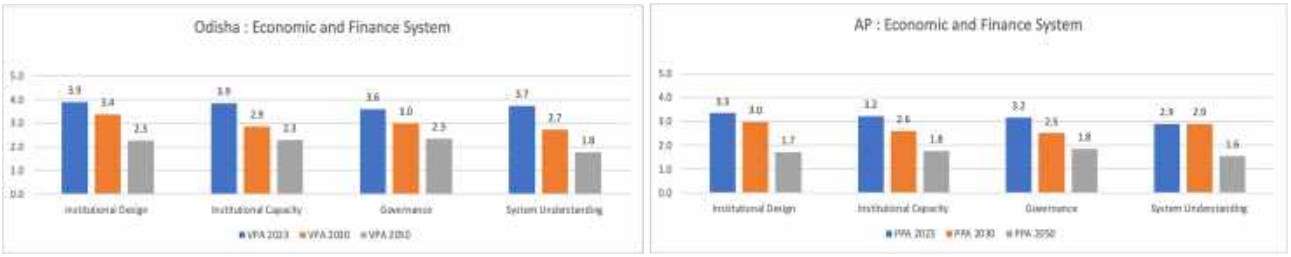

Figure 24:Economic and Financial Systems

The analysis section examines the institutional design, capacity, governance, and system understanding within the Ecological and Environmental System. Each aspect is assessed in both short and long-term perspectives to discern trends, challenges, and areas for improvement.

A) Institutional Design

- Overall Vision and Common Charter for SRM: In the short term, both Odisha and Andhra Pradesh demonstrate substantial vision and charter, yielding significant impacts. However, long-term planning requires improvement, particularly in AP, to sustain resilience effectively.
- Coherent and Incentivized PPP: Short-term observations reveal the presence of PPP with substantial incentives, yet their long-term sustainability is limited, although the intent persists.
- Budget Availability for SRM: Adequate budgets are available in both the short and long terms, ensuring financial support for SRM across all systems.
- Mainstreaming of SRM in Development and Planning: While there's moderate to limited mainstreaming with partial impact in both states, inclusive of Disaster Risk Reduction (DRR) and

climate change adaptation, there's room for improvement in integrating SRM into state authority planning, especially in AP.

B) Institutional Capacity

- Awareness of Impact Areas: Short-term comprehensive awareness exists, but long-term awareness declines, particularly in AP.
- Incorporation of Multi-hazard Risk Assessment: In the short term, there's substantial assessment and effective mitigation, albeit with limited focus on multi-hazard scenarios, especially in AP. Long-term assessments and planning are further constrained.
- Availability of Contingency Plans and Insurance Coverage: Both short and long-term periods witness the availability of contingency plans and insurance coverage to mitigate financial losses from cyclonic events.
- Awareness Levels on Systemic Risk Management: Short-term observations reveal substantial awareness across stakeholders, with significant impacts. However, long-term awareness diminishes significantly.
- Effectiveness of Proactive Capacity Building: While short-term capacity building efforts demonstrate moderate effectiveness, there's a pressing need for proactive measures in the long term to enhance systemic risk management.
- Existence of Technology and Data Support: Substantial platforms supporting effective systemic resilience are evident in the short term. However, there's limited evidence of technology and data usage for long-term resilience.

C) Governance

- Existence of Multi-Stakeholder Platforms: Multi-Stakeholder platforms exist with partial impact in the short term but diminish in the long term, indicating a need for sustained collaboration.
- Effectiveness of Transboundary Governance: Short-term effectiveness of transboundary governance through Multi-Stakeholder Platforms is adequate, albeit with partial impact. However, this effectiveness diminishes over the long term.

D) System Understanding

- Pre-identified Outcomes and Impact Areas: Short-term observations reveal pre-identified outcomes, but there's limited mapping in the long term, particularly in AP.
- Proactive Identification and Mapping of Actors and Boundaries: While short-term efforts demonstrate adequate mapping, long-term mapping is limited, posing challenges to effective systemic risk management.

The below table provides a concise comparison of the short and long-term perspectives on the **.Economic and Financial Systems** highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
Institutional Design	1. Substantial vision and charter with significant impact for both Odisha and Andhra Pradesh in the short term.

	2. Limited long-term vision and planning, especially in Andhra Pradesh, necessitating improvement for sustained resilience.
	3. Presence of PPP with substantial incentives in the short term, but long-term sustainability is limited, indicating intent but challenges in continuity.
	4. Adequate budgets available for disaster management in both short and long terms, ensuring financial support for SRM across all systems.
	5. Moderate to limited mainstreaming of SRM in development and planning, with partial impact in both states, highlighting the need for better integration.
Institutional Capacity	1. Comprehensive awareness of impact areas in the short term, contrasting with limited awareness in selected areas, especially in AP, in the long term.
	2. Substantial assessment and effective mitigation in the short term, but limited focus on multi-hazard scenarios, especially in AP, in the long term.
	3. Availability of contingency plans and insurance coverage in both short and long terms to cope with financial losses from cyclonic events.
	4. Substantial awareness across stakeholders in the short term, declining significantly in the long term, indicating a need for sustained awareness efforts.
	5. Moderate effectiveness of proactive capacity building in the short term, emphasizing the need for proactive measures to enhance long-term resilience.
	6. Substantial platforms supporting effective systemic resilience in the short term, but limited evidence of technology and data usage for long-term resilience.
Governance	1. Existence of Multi-Stakeholder platforms with partial impact in the short term, diminishing in the long term, highlighting the need for sustained collaboration.
	2. Adequate effectiveness of transboundary governance through Multi-Stakeholder Platforms in the short term, diminishing over the long term.
System Understanding	1. Pre-identified outcomes exist in the short term, but there's limited mapping in the long term, particularly in AP.
	2. Adequate mapping of actors and boundaries in the short term, but limited mapping in the long term, posing challenges to effective systemic risk management.

The analysis underscores the critical importance of integrating short and long-term perspectives in enhancing resilience within the Ecological and Environmental System. While commendable progress is evident in various aspects, sustained efforts and improvements are imperative to address emerging challenges and ensure long-term resilience effectively.

3. **Ecological and Environmental System**

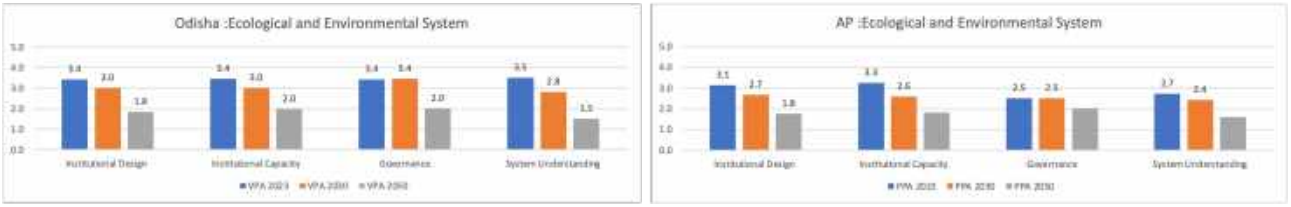

Figure 25: Ecological and Environmental System

The examination of ecological and environmental systems, particularly concerning systemic risk management (SRM), is paramount in understanding the resilience of regions vulnerable to natural disasters. This analysis delves into the institutional design, institutional capacity, governance, and system understanding within the ecological and environmental context, focusing on Odisha and Andhra Pradesh (AP). By scrutinizing these dimensions, this study aims to offer comprehensive insights into the short-term progress and long-term challenges in disaster risk management practices.

A. Institutional Design

- Existence of overall vision and common charter: In the short term, both Odisha and AP exhibit a substantial vision and charter for pursuing SRM, significantly impacting disaster preparedness and response strategies. However, the long-term outlook suggests a need for improved vision and planning, particularly in AP, to address evolving challenges effectively.
- Coherent & incentivized Public-Private Partnerships (PPP): Short-term observations reveal the presence of PPPs with substantial incentives supporting systemic resilience in the port ecosystem. However, long-term sustainability of these partnerships is limited, albeit with intent, signaling the necessity for continuous monitoring and adaptation.
- Availability of budgets/funds: Adequate budgets are available for SRM across all systems in both the short and long terms, ensuring financial stability for disaster management efforts.
- Mainstreaming of SRM in development and planning: SRM mainstreaming in development and planning processes shows moderate to limited presence, with partial impact observed in both states, especially in AP. This underscores the need for enhanced integration into core planning strategies continuously.

B. Institutional Capacity

- Awareness of Impact Areas: Short-term assessments indicate comprehensive awareness of climate change-induced extreme weather events, contrasting with limited awareness in selected areas, notably in AP, over the long term.
- Incorporation of Risk Assessment and Initiatives: While short-term assessments show moderate efforts in assessing the vulnerability of biodiversity and ecosystem services to cyclones, long-term initiatives, especially in AP, are limited, indicating potential gaps in resilience enhancement strategies.
- Regulation and Enforcement of Environmental Laws: Short-term effectiveness in regulating activities exacerbating ecological impacts of cyclones is moderate, but long-term effectiveness diminishes, necessitating strengthened enforcement measures.

- Awareness Levels on Systemic Risk Management: Substantial awareness across stakeholders is noted in the short term, but long-term awareness levels decline, suggesting the need for sustained awareness campaigns.
- Effectiveness of Proactive Capacity Building: Short-term effectiveness in proactive capacity building is moderate; however, long-term strategies must be implemented to enhance proactive measures for long-term resilience.
- Existence of Technology and Data Support: Short-term observations reveal substantial platforms supporting systemic resilience, but evidence of long-term utilization of advanced technologies is limited, highlighting the importance of continuous innovation.

C. Governance

- Existence of Multi-Stakeholder Platforms: Short-term observations indicate the existence of multi-stakeholder platforms with partial impact, but their effectiveness diminishes in the long term, underscoring the need for sustained collaboration.
- Transboundary Governance Effectiveness: While short-term transboundary governance through multi-stakeholder platforms demonstrates adequate effectiveness, its impact diminishes over the long term, necessitating continuous improvement.

D. System Understanding

- Pre-identified Outcomes and Impact Areas: Short-term assessments affirm the existence of pre-identified outcomes, yet long-term mapping, particularly in AP, is limited, highlighting potential gaps in understanding systemic risks.
- Identification and Mapping of Actors: Adequate mapping of actors and system boundaries is observed in the short term, but long-term mapping efforts, especially in AP, are limited, posing challenges to effective systemic risk management.

The below table provides a concise comparison of the short and long-term perspectives on the **Ecological and Environmental System** highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
Institutional Design	1. Existence of overall vision and common charter: Short term - Substantial vision and charter with significant impact for both Odisha and AP. Long term - Vision and planning needs improvement, especially in AP.
	2. Existence of coherent & incentivized PPP: Short term - PPP with substantial incentives. Long term - Limited but with intent.
	3. Availability of budgets/funds: Adequate budgets available for both short and long term.
	4. Mainstreaming of SRM in development and planning: Moderate to limited mainstreaming with partial impact in both states, especially in AP.
Institutional Capacity	1. Awareness of Impact Areas: Short term - Comprehensive awareness with in-depth understanding. Long term - Limited awareness in selected areas, especially in AP.

	2. Incorporation of Risk Assessment and Initiatives: Short term - Moderate assessment with some initiatives. Long term - Limited initiatives, especially in AP.
	3. Regulation and Enforcement of Environmental Laws: Short term - Moderate effectiveness with partial enforcement. Long term - Low effectiveness with partial enforcement.
	4. Awareness Levels on Systemic Risk Management: Short term - Substantial awareness with significant impact. Long term - Limited to no awareness.
	5. Effectiveness of Proactive Capacity Building: Short term - Moderate effectiveness. Long term - Proactive capacity building needs improvement.
	6. Existence of Technology and Data Support: Short term - Substantial platforms with significant impact. Long term - Limited evidence of use of advanced technologies.
Governance	1. Existence of Multi-Stakeholder Platforms: Short term - Existence with partial impact. Long term - Limited platforms.
	2. Transboundary Governance Effectiveness: Short term - Adequate effectiveness with partial impact. Long term - Limited effectiveness of transboundary governance.
System Understanding	1. Pre-identified Outcomes and Impact Areas: Short term - Existence confirmed. Long term - Limited mapping, especially in AP.
	2. Identification and Mapping of Actors: Short term - Adequate mapping observed. Long term - Mapping efforts limited, especially in AP.

In conclusion, this analysis provides critical insights into the institutional, capacity, governance, and system understanding aspects of disaster risk management in ecological and environmental systems. While short-term progress is evident across various dimensions, long-term challenges necessitate sustained efforts and adaptation to effectively address evolving systemic risks and enhance resilience in Odisha and Andhra Pradesh

4. Human, Social, and Cultural System Analysis:

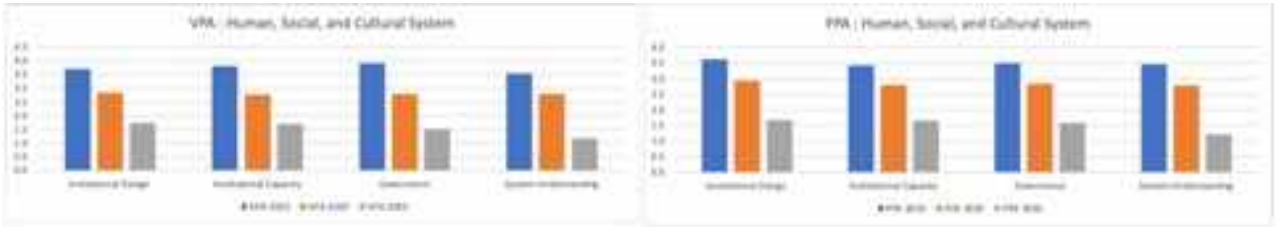

Figure 26: Human, Social, and Cultural System Analysis

The analysis of human, social, and cultural systems within the framework of Systemic Risk Management (SRM) presents critical insights into disaster preparedness and resilience. This section delves into various dimensions of institutional design, capacity, governance, and system understanding, highlighting both short-term achievements and long-term challenges.

A. Institutional Design:

- Existence of Overall Vision and Common Charter: Both Odisha and AP exhibit substantial vision and charter for SRM, primarily focusing on saving lives and preventing casualties. However, there's limited emphasis on addressing social and cultural aspects, particularly noticeable in AP.
- Existence of Coherent & Incentivized PPP: The presence of coherent and incentivized Public-Private Partnerships (PPP) is limited, with AP showing particular scarcity despite intent.
- Availability of Budgets/Funds: Adequate budgets are accessible for both short and long terms, ensuring financial support for SRM initiatives.
- Mainstreaming of SRM: Substantial mainstreaming efforts have been made, with a primary focus on saving lives and avoiding casualties. However, there's a noticeable gap in addressing social and cultural aspects, especially in AP.

B. Institutional Capacity:

- Awareness of Impact Areas: Comprehensive awareness exists concerning human aspects, but there's limited focus on social and cultural aspects, particularly evident in AP.
- Existence of Early Warning Systems and Evacuation Plans: Comprehensive and highly effective systems and plans are in place to ensure population safety during cyclonic events, both in the short and long terms.
- Availability and Accessibility of Essential Services: Robust systems and plans, including healthcare, shelter, and food distribution, ensure the needs of affected communities are met effectively.
- Psychosocial Well-being: While there are comprehensive programs for physical well-being, initiatives directed towards psychosocial well-being are less visible, especially for communities impacted by cyclones.
- Awareness Levels on Systemic Risk Management: Substantial awareness exists in the short term, but it becomes adequate to limited in the long term, especially in AP.
- Effectiveness of Proactive Capacity Building: While effectiveness is adequate across various stakeholders in the short term, there's a need for proactive capacity building, particularly in AP.
- Existence of Technology and Data: Substantial platforms exist in the short term, but evidence of long-term use of advanced technologies and data is limited.

C. Governance:

- Existence of Multi-Stakeholder Platforms: Multi-Stakeholder platforms exist with a strong impact, but governance focuses more on human aspects rather than social and cultural aspects, particularly noticeable in AP. However, there's limited existence of such platforms in the long term, especially in AP.
- Effectiveness of Transboundary Governance: While effectiveness is adequate in the short term, it becomes limited in the long term, especially in AP, posing challenges for transboundary governance through Multi-Stakeholder Platforms.

D. System Understanding:

- Pre-identified Outcomes/Impact Areas: While outcomes are identified for human systems, there's limited mapping for social and cultural systems, especially in AP. This mapping remains limited across all aspects in the long term.

- Proactive Identification and Mapping: Adequate mapping exists for human systems in the short term, but it's limited for social and cultural systems, with similar limitations persisting in the long term, especially in AP.

The below table provides a concise comparison of the short and long-term perspectives on the **Human, Social, and Cultural System** highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
A. Institutional Design	1. Existence of overall vision and common charter for pursuing SRM across all systems - Short term & Long term: Substantial vision and charter with significant impact for both Odisha and AP, focus mainly on saving lives and avoiding casualties. Limited focus on social and cultural aspects, especially in AP.
	2. Existence of coherent & incentivized PPP supporting the goal for Systemic Resilience in the port ecosystem - Short term & Long term: Existence of coherent & incentivized PPP is limited but the intent is there, especially in AP.
	3. Availability of budgets/funds to support SRM across all systems - Adequate budgets available for both short and long term.
	4. Mainstreaming of SRM in development and planning of port authority (inclusive of DRR and climate change adaptation) - Short term & Long term: Substantial mainstreaming with significant impact for both VPA and PPA, focus mainly on saving lives and avoiding casualties. Limited focus especially in AP.
B. Institutional Capacity	1. Awareness of Impact Areas of climate change-induced extreme weather events on the seaport ecosystem - Short term & Long term: Comprehensive awareness with in-depth understanding in human aspects but Limited focus on social and cultural aspects especially in AP.
	2. Existence of early warning systems and evacuation plans - Short term & Long Term: Comprehensive systems and highly effective plans in place to ensure the safety and well-being of the population during cyclonic events.
	3. Availability and accessibility of essential services - Short term & Long Term: Comprehensive systems and highly effective plans, including healthcare, shelter, and food, to meet the needs of affected communities.
	4. Psychosocial well-being - Short term & Long Term: Comprehensive programs to support the physical well-being of individuals and communities; however, limited

	visibility to initiatives directed towards psychosocial well-being of individuals and communities impacted by cyclones.
	5. Awareness levels on Systemic Risk Mgt across all stakeholders - Short term: Substantial awareness with significant impact; Long term: Adequate to limited awareness especially in AP.
	6. Effectiveness of proactive capacity building - Short term: Adequate effectiveness across the ecosystem to manage the systemic risk portfolio; Long term: Proactive capacity building needs to be in place, especially in AP.
	7. Existence of technology and data - Short term: Substantial platforms with significant impact to support effective systemic resilience across the 'pre-during-post' lifecycle of an incident; Long term: Limited evidence of use of tech, data, and advanced technologies for the long term.
C. Governance	1. Existence of Multi-Stakeholder Platforms - Short term: Existence of Multi-Stakeholder platforms with strong impact; however, governance is more focused on human aspects rather than social and cultural aspects. Long term: Limited Multi-Stakeholder Platforms across the systems, especially in AP.
	2. Effectiveness of transboundary governance - Short term: Adequate effectiveness of Multi-Stakeholder platforms with partial impact through Multi-Stakeholder Platforms; Long term: Limited Effectiveness of transboundary governance through Multi-Stakeholder Platforms, especially in AP.
D. System Understanding	1. Pre-identified outcomes/impact areas - Short term: Yes for human systems, limited for social and cultural systems; Long term: Limited mapping across all aspects of human, social, and cultural systems especially in AP.
	2. Proactive identification and mapping - Short term: Adequate Mapping for human systems, limited for social and cultural systems; Long term: Limited mapping across all aspects of human, social, and cultural systems especially in AP.

The examination of human, social, and cultural systems underscores the importance of integrating diverse perspectives into SRM frameworks. While notable progress has been made, particularly in human-centric approaches, there's a critical need to address social and cultural dimensions comprehensively, especially in regions prone to systemic risks like AP. Continuous efforts in institutional capacity building, governance effectiveness, and system understanding are imperative to enhance overall resilience and ensure inclusive disaster preparedness and response strategies.

5.Political and Governance System Analysis:

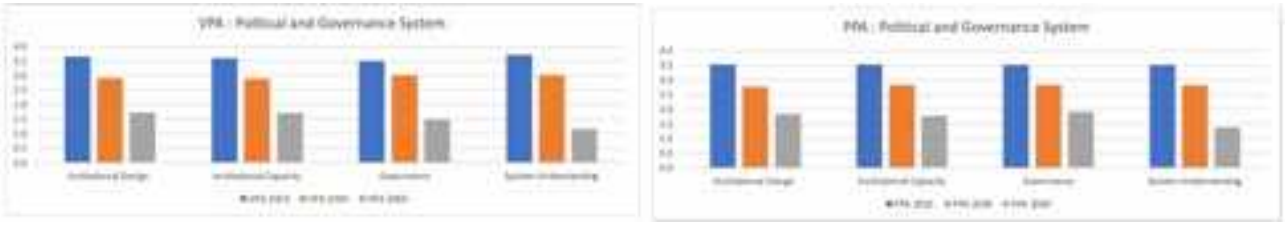

Figure 27: Political and Governance System Analysis

In the realm of disaster risk management (DRM), the political and governance system plays a pivotal role in shaping policies, implementing strategies, and responding to crises effectively. This analysis delves into the institutional design, capacity, governance, and system understanding within the political and governance system, focusing on short-term achievements and long-term challenges.

A. Institutional Design

- Overall Vision and Charter: In the short term, there's a substantial vision and charter, particularly notable in Odisha. However, in the long term, this vision appears limited, especially in Andhra Pradesh (AP), underscoring the need for enhanced long-term planning.
- Public-Private Partnerships (PPP): Both in the short and long term, the existence of coherent and incentivized PPPs is observed, albeit with limitations. While the intent is evident, concerted efforts are required to strengthen these partnerships.
- Budget Availability: Adequate budgets are available for both short and long terms in both states, ensuring financial stability for SRM efforts.
- Mainstreaming of SRM: Substantial mainstreaming is observed in the short term, particularly in Odisha, with limited visibility in the long term, especially in AP, indicating the need for greater integration into planning processes.

B. Institutional Capacity

- Awareness of Climate Change Impacts: In the short term, comprehensive awareness prevails, particularly in Odisha, while in the long term, awareness diminishes, highlighting the need for sustained education and focus, especially in AP.
- Architecture of Political Systems: Short-term observations reveal substantially adequate architecture supporting decision-making, with long-term prospects indicating moderately adequate systems with room for improvement, especially in AP.
- Established Protocols: Well-established protocols exist in the short term, focusing on stability, transparency, and adaptability, although long-term protocols address some aspects but require further enhancement.
- Awareness Levels on Systemic Risk Management: Short-term awareness is limited but impactful, with long-term awareness dwindling, emphasizing the importance of continuous education and advocacy efforts.
- Proactive Capacity Building: While short-term effectiveness is adequate across the ecosystem, long-term proactive capacity building requires improvement, particularly in AP.
- Technology and Data Utilization: Short-term initiatives demonstrate substantial impact, but long-term utilization of technology and data remains limited, signaling the need for continuous innovation and investment.

C. Governance

- Multi-Stakeholder Platforms: Short-term observations reveal the existence of multi-stakeholder platforms with positive impacts, albeit with areas for improvement. However, long-term prospects suggest limited existence, especially in AP, necessitating future-facing governance strategies.
- Transboundary Governance: Adequate effectiveness is noted in the short term, but long-term effectiveness is limited, especially in AP, indicating challenges in addressing future governance needs.

D. System Understanding

- Pre-identified Outcomes/Impact Areas: Short-term mapping is extensive, but long-term mapping across all aspects of each system, especially in AP, is limited, necessitating comprehensive analysis and planning.
- Proactive Identification and Mapping: Adequate mapping is observed in the short term, but long-term mapping requires enhancement, particularly in AP, to address evolving challenges effectively.

The below table provides a concise comparison of the short and long-term perspectives on the **Political and Governance System Analysis** highlighting the evolving challenges and potential areas for improvement in disaster risk management practices.

Category	Insights
A. Institutional Design	1. Overall Vision and Charter: Short-term vision and charter are substantial, notably in Odisha, but long-term vision is limited, especially in AP.
	2. Public-Private Partnerships (PPP): Existence of coherent and incentivized PPPs observed in both short and long term, albeit with limitations.
	3. Budget Availability: Adequate budgets available for both short and long terms in both states.
	4. Mainstreaming of SRM: Substantial mainstreaming in the short term, particularly in Odisha, but limited visibility in the long term, especially in AP.
B. Institutional Capacity	1. Awareness of Climate Change Impacts: Comprehensive awareness in the short term, especially in Odisha, but diminished in the long term, particularly in AP.
	2. Architecture of Political Systems: Substantially adequate architecture supporting decision-making in the short term, with room for improvement in the long term, especially in AP.
	3. Established Protocols: Well-established protocols for stability, transparency, and adaptability in the short term, with some long-term improvements required.
	4. Awareness Levels on Systemic Risk Management: Limited but impactful awareness in the short term, diminishing in the long term, especially in AP.
	5. Proactive Capacity Building: Adequate effectiveness in the short term, with improvements needed in long-term capacity building, particularly in AP.

	6. Technology and Data Utilization: Substantial impact of technology and data in the short term, but limited long-term utilization, emphasizing the need for continuous innovation.
C. Governance	1. Multi-Stakeholder Platforms: Existence of multi-stakeholder platforms with positive impacts in the short term, but limited presence in the long term, especially in AP.
	2. Transboundary Governance: Adequate effectiveness in the short term, but limited long-term effectiveness, particularly in AP, suggesting challenges in future governance.
D. System Understanding	1. Pre-identified Outcomes/Impact Areas: Extensive mapping in the short term, but limited mapping, especially in AP, in the long term, necessitating comprehensive analysis.
	2. Proactive Identification and Mapping: Adequate mapping observed in the short term, but enhancements required in the long term, particularly in AP, to address evolving challenges.

In conclusion, while notable progress has been made in various aspects of DRM within the political and governance system, significant challenges persist, especially in AP. Strengthening long-term planning, enhancing awareness, improving governance effectiveness, and deepening system understanding are imperative for ensuring robust resilience in the face of evolving risks. Continued collaboration, innovation, and adaptation are essential for navigating future challenges effectively.

6.2 Discussion:

SWOT Analysis of Inter System Readiness:

The examination of institutional design, capacity, governance, and systemic understanding within the context of Systemic Risk Management (SRM) in Odisha and Andhra Pradesh unveils critical insights into their readiness and resilience against systemic risks. This comprehensive analysis delves into the strengths, weaknesses, opportunities, and threats (SWOT) inherent in their approaches, highlighting key areas for improvement and strategies for enhancing resilience. Understanding the nuances of vision clarity, stakeholder engagement, policy coherence, and technological integration is pivotal for comprehending the efficacy of their institutional frameworks and fostering sustainable resilience-building efforts. By leveraging strengths, addressing weaknesses, seizing opportunities, and mitigating threats, policymakers and stakeholders can enhance the resilience of communities and infrastructure, thereby mitigating the impacts of disasters and building a more sustainable and resilient future.

Strengths:

- Vision and Charter for SRM: The presence of a commendable vision and shared charter dedicated to pursuing Systemic Resilience Management (SRM) in both Odisha and Andhra Pradesh signifies a strong commitment to disaster preparedness and resilience-building efforts. This provides a clear direction and purpose for systemic resilience initiatives.

- Comprehensive Policies and Regulation: Both states showcase comprehensive policies and regulations aligned with SRM goals across various stakeholder departments. This ensures a robust regulatory framework, enhancing the efficacy of disaster risk management strategies and initiatives.
- Budget Allocation for SRM: Adequate financial resources allocated to support SRM efforts in both states ensure the continuity of resilience-building endeavors. This enables the implementation of necessary infrastructure upgrades, capacity-building programs, and other resilience-enhancing measures.
- Existence of Multi-Stakeholder Platforms: The presence of multi-stakeholder platforms inclusive of various entities facilitates collaboration among diverse stakeholders in Disaster Risk Management (DRM) endeavors. This fosters a holistic approach to resilience-building, leveraging the expertise and resources of multiple stakeholders.
- Mechanisms for Transparency and Accountability: Robust mechanisms in place to ensure transparency and accountability within the states' risk management practices foster trust among stakeholders and promote responsible decision-making. This enhances the overall effectiveness and integrity of DRM efforts.

Weaknesses:

- Long-term Vision Sustainability: While both states have commendable visions for SRM, the long-term sustainability and effectiveness of these visions require improvement, particularly in Andhra Pradesh. This highlights the need for continuous review and refinement of long-term resilience strategies.
- Diminishing Stakeholder Engagement: Over time, the integration of perspectives from affected communities diminishes, especially in Andhra Pradesh. This trend raises concerns about the sustained engagement of stakeholders and the inclusivity of resilience-building efforts.
- Limited Mainstreaming of SRM: Despite strides in integrating SRM into development and planning processes, there remains a need for enhancement, particularly in Andhra Pradesh. Limited mainstreaming of SRM indicates gaps in long-term planning and policy coherence.
- Long-term Protocol Sustainability: The sustainability of protocols for coordination and restoration efforts after a cyclone and inter-agency coordination is questionable, especially in Andhra Pradesh. This highlights the importance of developing robust and adaptable protocols for long-term resilience.
- Waning Multi-Stakeholder Platforms: The diminishing presence of multi-stakeholder platforms, particularly noticeable in Andhra Pradesh, raises concerns about coordination and cooperative efforts necessary for effective DRM initiatives. This underscores the importance of maintaining and strengthening collaborative mechanisms.

Opportunities:

- Enhanced Long-term Planning: Addressing identified gaps in institutional design and capacity building in Andhra Pradesh presents an opportunity to significantly enhance resilience and preparedness against systemic risks. This includes refining long-term visions and strategies to ensure sustainability and effectiveness.
- Improved Stakeholder Engagement: Strengthening long-term engagement with affected communities and stakeholders, particularly in Andhra Pradesh, can foster a more inclusive and resilient approach to DRM. This involves prioritizing community participation and feedback in resilience-building initiatives.

- Advanced Technology Integration: Leveraging advanced technologies and enhancing data-driven approaches for long-term resilience presents an opportunity to strengthen systemic resilience across both states. This includes investing in innovative solutions for early warning systems, risk assessment, and decision support tools.
- Policy Refinement: Refining policies and regulatory frameworks, particularly in Andhra Pradesh, to align with broader SRM objectives and enhance long-term planning and policy coherence. This involves conducting regular reviews and updates to ensure policies remain relevant and effective in addressing evolving risks.

Threats:

- Climate Change Impacts: Increasing frequency and intensity of climate-related hazards pose significant threats to coastal infrastructure and overall resilience efforts in both states. This includes risks such as sea-level rise, extreme weather events, and changes in precipitation patterns, which can exacerbate vulnerabilities and disrupt livelihoods.
- Limited Stakeholder Collaboration: Diminishing multi-stakeholder platforms and coordination efforts, especially in Andhra Pradesh, threaten the effectiveness of DRM initiatives and resilience-building endeavors. This hampers the ability to leverage collective expertise and resources for comprehensive resilience strategies.
- Resource Constraints: Budgetary constraints and limited resources may impede long-term sustainability and effectiveness of SRM efforts, particularly in Andhra Pradesh. This includes challenges in securing funding for infrastructure upgrades, capacity-building programs, and other resilience-enhancing measures.
- Governance Challenges: Governance deficits, including transparency and accountability issues, pose threats to the effectiveness and impact of DRM practices, particularly in Andhra Pradesh. This includes risks such as corruption, bureaucratic inefficiencies, and inadequate enforcement of regulations, which can undermine resilience-building efforts.
- Population Growth and Urbanization: Rapid population growth and urbanization exacerbate vulnerabilities and increase exposure to systemic risks, necessitating robust resilience strategies and planning measures. This includes risks such as overcrowding, inadequate infrastructure, and limited access to essential services, which can amplify the impacts of disasters and hinder recovery efforts.

Conclusion:

In conclusion, leveraging strengths such as vision clarity and budget allocation while addressing weaknesses such as diminishing stakeholder engagement and limited mainstreaming of SRM is crucial for enhancing overall readiness and resilience against systemic risks in Odisha and Andhra Pradesh. Additionally, seizing opportunities for enhanced long-term planning, stakeholder engagement, and technology integration while mitigating threats such as climate change impacts and governance challenges are essential for fostering comprehensive resilience across both states. By proactively addressing these factors, policymakers and stakeholders can enhance the resilience of communities and infrastructure, thereby mitigating the impacts of disasters and building a more sustainable and resilient future.

SWOT Analysis of Intra System Readiness:

In this section, we present a comprehensive SWOT analysis that encapsulates the collective insights gleaned from the examination of multiple systems within the context of disaster risk management (DRM) in Odisha and Andhra Pradesh.

Strengths:

- Adequate budget allocation and coordination protocols within the Physical and Infrastructure system ensure financial stability and effective disaster response post-events. This includes the establishment of cyclone shelters, early warning systems, and robust infrastructure maintenance programs.
- Comprehensive risk assessment and contingency planning in the Economic and Financial systems support proactive measures to mitigate economic losses from disasters. This includes insurance coverage, emergency funds, and investment in resilient infrastructure.
- Short-term vision and awareness levels are notable strengths across all systems, fostering a proactive approach to disaster management. This includes public awareness campaigns, stakeholder training programs, and the integration of disaster risk reduction strategies into development plans.
- Robust infrastructure and coordination protocols within the Political and Governance systems contribute to efficient response and decision-making during crises. This includes the establishment of disaster management authorities, inter-agency coordination mechanisms, and legislative frameworks for disaster risk reduction.

Weaknesses:

- Long-term planning and stakeholder engagement are lacking, particularly evident in Andhra Pradesh, across various systems. This includes limited integration of climate change projections, inadequate community participation in decision-making, and insufficient investment in long-term resilience-building initiatives.
- Limited mainstreaming of Systemic Risk Management (SRM) and diminishing awareness over time pose challenges to sustained resilience efforts. This includes the marginalization of SRM in development policies, inadequate funding for resilience projects, and declining public interest in disaster preparedness.
- Governance effectiveness and technology utilization remain inadequate in addressing systemic risks comprehensively. This includes bureaucratic inefficiencies, corruption in resource allocation, and underutilization of advanced technologies for risk assessment and early warning systems.
- Inadequate integration of social and cultural aspects into disaster preparedness strategies hinders holistic resilience-building efforts. This includes the neglect of indigenous knowledge systems, cultural practices, and social networks in disaster risk management planning.

Opportunities:

- Enhancing long-term vision and sustainability of Public-Private Partnerships (PPPs) can improve collaboration and resource allocation for disaster resilience. This includes incentivizing private sector investment in resilience projects, fostering innovation in disaster risk financing, and promoting multi-stakeholder partnerships for resilience-building.
- Strengthening long-term risk assessment, proactive capacity building, and governance mechanisms presents opportunities for enhancing systemic readiness. This includes investing in scientific research on emerging risks, developing community-based early warning systems, and reforming governance structures to enhance transparency and accountability.
- Improving stakeholder engagement, mainstreaming SRM, and utilizing advanced technology can augment long-term disaster preparedness efforts. This includes engaging communities in participatory decision-making processes, mainstreaming SRM into sectoral policies and programs, and harnessing the potential of big data analytics and artificial intelligence for risk assessment and decision support.

- Investing in comprehensive planning and awareness campaigns can address emerging challenges and capitalize on opportunities for resilience enhancement. This includes developing risk-informed land use planning regulations, conducting public education campaigns on disaster preparedness, and fostering a culture of resilience at all levels of society.

Threats:

- Diminishing awareness levels and limited utilization of technology pose threats to sustained disaster preparedness and response efforts. This includes the erosion of public support for disaster risk reduction initiatives, the digital divide exacerbating inequalities in access to early warning systems, and cyber threats compromising the integrity of critical infrastructure.
- Inadequate mainstreaming of SRM and governance ineffectiveness may exacerbate vulnerabilities to systemic risks over time. This includes policy inertia in addressing systemic risk drivers such as urbanization, environmental degradation, and climate change, governance failures leading to mismanagement of disaster response funds, and regulatory capture undermining efforts to strengthen building codes and land use regulations.
- Insufficient stakeholder engagement and coordination could hinder the effectiveness of resilience-building initiatives in the face of evolving threats. This includes conflicts of interest among stakeholders leading to fragmentation in disaster risk management efforts, the marginalization of vulnerable groups in decision-making processes, and social unrest exacerbating governance challenges during crises.
- Climate change-induced extreme weather events and other emerging risks pose significant threats to the resilience of communities and infrastructure systems. This includes the increasing frequency and intensity of cyclones, floods, and heatwaves, ecological tipping points leading to cascading disasters, and geopolitical tensions exacerbating transboundary risks.

Conclusion

In conclusion, the SWOT analysis highlights the multifaceted nature of systemic readiness in Odisha and Andhra Pradesh, encompassing strengths, weaknesses, opportunities, and threats across various dimensions of disaster risk management. Addressing the identified weaknesses, leveraging opportunities, and mitigating threats are essential for enhancing resilience and ensuring sustainable development in the face of evolving risks. By adopting a holistic approach that integrates stakeholder engagement, technology innovation, governance reform, and long-term planning, policymakers can build robust systems that withstand the challenges of an uncertain future.

6.3 Synthesis of findings for states

The strategic analysis conducted on the resilience ecosystems of Odisha and AP reveals a nuanced portrait of preparedness that intersects multiple systemic dimensions. In the immediate present, both states display a degree of systemic risk management (SRM) capabilities -especially Odisha, founded on a shared vision and operational coherence, reflected in their SRM strategies and institutional arrangements. However, as we project these findings into the future, there's an observable downward trajectory in overall systemic readiness, underscoring challenges in sustaining long-term resilience and effectively managing risks. This trend points to the inherent difficulties in maintaining momentum in SRM efforts and adapting to evolving systemic pressures over extended temporal horizons. Through three distinct scenarios spanning from 2024 to 2050, varying in the severity of coastal hazards, critical insights have been gleaned to inform discussions on preparedness, adaptation strategies, and the effectiveness of current resilience measures.

- **Scenario 1: Building on Existing Capacities**

In the scenario depicting 2023, characterized by mild impacts, the analysis reveals a generally positive outlook regarding the management capacity of the Vulnerability and Preparedness Assessment (VPA) and Policy and Planning Analysis (PPA) systems. Existing infrastructure and policies are deemed adequate for addressing the challenges posed by coastal hazards at this stage. However, the analysis also identifies areas for improvement, particularly in optimizing inter-system coordination to enhance integrated preparedness strategies. This scenario highlights the importance of leveraging current strengths while simultaneously addressing identified weaknesses to ensure sustained resilience in the face of evolving risks.

- **Scenario 2: Addressing Lagging Adaptation**

The projection for 2030 indicates a moderate increase in the intensity and frequency of coastal hazards, exposing a misalignment between the pace of adaptation and the accelerating risk landscape. Despite initial adaptations, the lag in inter-system preparedness underscores a critical gap in collective response capabilities. This scenario emphasizes the urgency for more concerted efforts in enhancing both horizontal and vertical coordination among stakeholders. Strengthening governance structures, fostering collaboration across sectors, and investing in innovative technologies are essential components of a proactive approach to address the evolving risk landscape effectively.

- **Scenario 3: Urgent Need for Comprehensive Action**

By 2050, the scenario forecasts severe impacts from escalated coastal hazards, revealing systemic vulnerabilities at both intra and inter-system levels. Weaknesses in long-term planning, stakeholder engagement, governance effectiveness, and technology utilization exacerbate the challenges posed by the escalated hazards. This scenario underscores the imperative for urgent and comprehensive action to address systemic vulnerabilities, enhance resilience, and ensure the sustainability of communities and infrastructure systems. Integrated approaches that prioritize community engagement, promote adaptive governance mechanisms, and leverage cutting-edge technologies will be critical in mitigating the adverse impacts of coastal hazards and building resilient societies capable of withstanding future challenges.

In conclusion, the findings of this study underscore the importance of proactive risk management strategies to address systemic vulnerabilities to coastal hazards. By leveraging existing capacities, enhancing inter-system coordination, and embracing adaptive governance principles, policymakers can better prepare communities and infrastructure systems to withstand the increasing frequency and intensity of coastal hazards. Investing in robust infrastructure, fostering collaboration among diverse stakeholders, and empowering local communities will be essential in building resilient coastal communities capable of thriving in the face of uncertainty.

VII. RECOMMENDATIONS FOR ODISHA AND ANDHRA PRADESH

7. Recommendations for Odisha and Andhra Pradesh

7.1 Generic Policy Recommendations for States:

		Impact
Institutional Design	• Create frameworks for policy continuity across government administrations to maintain consistency in resilience efforts • Promote sustained engagement of affected individuals and communities in decision-making processes, particularly focusing on vulnerable communities • Promote greater mainstreaming of systemic risk management principles into core developmental & planning strategies.	High
Institutional Capacity	• Integrate horizon scanning and scenario planning techniques to anticipate and prepare for future risks effectively. • Evaluate use of advanced technologies such as AI, IoT, and Big Data Analytics for comprehensive risk management purposes.. • Continuously monitor and revise protocols for coordination among agencies to ensure coherence and efficiency in response effort • Promote proactive capacity building and awareness for current and future risks across all stakeholders.	High
Governance	• Establish platforms for ongoing dialogue and collaboration between government agencies, NGOs, communities, and other stakeholders. • Facilitate regular discussions and coordination sessions among relevant stakeholders to ensure a comprehensive, long-term vision in policy-making • Enhance transparency and accountability mechanisms to ensure that decisions are made in the best interest of all stakeholders.	High
System Understanding	• Promote thorough and proactive understanding of intra and inter-system dependencies to bridge gaps and avoid siloed approaches • Proactively identify and map actors, system boundaries, and sub-systems to understand the transboundary effects of disasters and disruptions. • Develop strategies for managing and mitigating these effects through cross-border cooperation and coordination.	High

Table 20: Generic Policy Recommendations for States

- Vision and Charter: Establish an enhanced vision and planning framework for sustained resilience and effective response over the long term, aligning with global best practices and local context.
- Coherent Policies and Regulations: Continuously monitor and revise policies and regulations to maintain coherence and effectiveness. Establish mechanisms for policy continuity across government administrations to ensure consistency in addressing systemic risks.
- Perspectives of Affected People: Sustain engagement with affected individuals and communities in decision-making processes, particularly vulnerable communities, to ensure their voices are heard and integrated into resilience strategies.
- Budgets: Allocate sufficient funds for long-term resilience development, including investments in infrastructure, technology, and capacity building.
- Public-Private Partnerships (PPP): Promote coherent and incentivized PPP models for collaborative risk management and infrastructure development, ensuring private sector engagement aligns with public resilience goals.
- Mainstreaming in Development and Planning: Integrate systemic risk management principles into core developmental and planning strategies, ensuring resilience considerations are mainstreamed into all aspects of governance and development.
- Multi-hazard Risk Assessment, Horizon Scanning, and Scenario Planning: Incorporate multi-hazard risk assessment into decision-making processes for comprehensive long-term risk management, enabling proactive responses to emerging risks.
- Protocols or Procedures for Coordination: Continuously monitor and revise protocols to maintain coherence in inter-agency coordination, ensuring seamless communication and collaboration during disasters and crises.
- Awareness Levels: Promote proactive capacity building and awareness among all stakeholders for current and future risks, enhancing the resilience of communities and organizations.
- Capacity Building: Invest in capacity building programs to enhance the resilience of communities, organizations, and government agencies, ensuring they are equipped to respond effectively to disasters and systemic risks.
- Technology and Data Usage: Evaluate the use of advanced technologies such as AI, IoT, and Big Data Analytics for comprehensive risk management purposes, enabling more accurate risk assessments and timely responses.

- Multi-Stakeholder Platforms: Facilitate regular discussions and coordination sessions among relevant stakeholders to ensure a comprehensive, long-term vision in policy-making, fostering collaboration and knowledge sharing.
- Transboundary Governance: Establish frameworks for transboundary governance to address systemic risks that transcend political boundaries, ensuring coordinated responses to shared risks.
- Transparency and Accountability: Promote community participation in decision-making processes through outreach programs and platforms for local voices to be heard, enhancing transparency and accountability in governance.
- Intra-System Mapping: Promote a thorough and proactive understanding of intra and inter-system dependencies, bridging gaps between systems and avoiding siloed approaches by fostering collaboration across sectors.
- Inter-System Mapping: Develop mechanisms for mapping inter-system dependencies, ensuring a holistic understanding of systemic risks and their potential impacts.
- Transboundary Effects Mapping: Proactively identify and map actors, system boundaries, and sub-systems to understand transboundary effects of systemic risks, enabling coordinated responses to shared risks.
- Pre-Identified Impact Areas: Pre-identify outcomes and impact areas resulting from intra-system failures, including impacts to various services and sectors, to enable targeted risk management strategies.

7.2 Specific Policy Recommendations for Odisha:

As part of the research context specific recommendations have been provided for both states. The below table provided the key policy recommendations for Odisha and the following section provides a detailed narration of the same.

Odisha : Specific Recommendations

Maintenance and Accessibility of Cyclone Shelters:	• Allocate dedicated funds in the state budget for the construction, maintenance, and upgrade of cyclone shelters across Odisha's coastal districts, • Ensure compliance with disabled-friendly design standards. Address caste-based discrimination in accessing cyclone shelters by promoting community ownership and involvement in shelter management	High
Climate-Resilient Urban Planning	• Integrate climate change considerations into urban planning frameworks across AP • Implement adaptive strategies such as green infrastructure, rainwater harvesting, and sustainable waste management practices. Address flood-prone areas through infrastructure upgrades and natural solutions, ensuring the involvement of local communities.	High
Community Involvement in Governance	• Establish community consultation mechanisms, such as Gram Sabhas (village assemblies) and Urban Ward Sabhas (urban ward assemblies), to involve vulnerable and disadvantaged communities in DRM • Facilitate capacity-building programs for community members to enhance their participation and ensure their representation in governance structures	High
Migration as a Form of Adaptation	• Recognize and support migration as a valid adaptation strategy for communities in Odisha, particularly those affected by environmental degradation and declining fishing quality, such as in Puri. • Provide skills training and facilitate access to safe and dignified migration opportunities within and outside the state.	Medium
Care for the Aging Population	• Develop targeted programs to support the aging population of Odisha, in line with the state's projected demographic changes. Invest in community-based care services, promote intergenerational solidarity, and provide skills development opportunities for elderly individuals to contribute to community resilience.	Medium

Table 21: Key Recommendation for Odisha

- Develop Comprehensive Disaster Management Policies: Formulate robust disaster management policies with a long-term vision, integrating climate change adaptation measures and ensuring coordination among various departments and agencies involved in disaster response and recovery.

- Allocate Funds for Long-Term Infrastructure Development: Develop a sustainable funding mechanism that prioritizes long-term infrastructure development over immediate relief efforts, ensuring resources are allocated strategically to build resilience against future disasters.
- Improve Maintenance Mechanisms for Critical Infrastructure: Establish stringent maintenance protocols for cyclone shelters and critical infrastructure to ensure they remain functional and effective during disasters, reducing the risk of damage and loss of life.
- Enhance Urban Planning for Disaster Resilience: Integrate disaster and climate change considerations into urban planning, focusing on improved drainage systems, flood mitigation measures, and sustainable land use practices to minimize the impact of disasters on urban areas.
- Implement Nature-Based Solutions: Promote nature-based solutions such as mangrove plantation to reduce the impact of cyclones, enhance coastal resilience, and preserve biodiversity, contributing to sustainable disaster risk reduction efforts.
- Ensure Equitable Distribution of Compensation: Establish transparent and equitable mechanisms for distributing compensation for disaster impacts, addressing biases and ensuring that vulnerable and marginalized communities receive fair compensation for their losses.
- Enhance Community Participation: Foster greater community participation in disaster planning and response activities, promoting collaboration between government agencies, NGOs, and local communities to build resilience at the grassroots level.
- Incorporate Vulnerable Groups' Needs: Incorporate the needs and priorities of vulnerable groups, including people with disabilities and marginalized communities, into disaster risk reduction plans, ensuring inclusivity and equitable access to resources and support.
- Strengthen Capacity Building Programs: Strengthen capacity building programs for disaster preparedness at the grassroots level, empowering communities to respond effectively to disasters and reduce their vulnerability.
- Foster Cultural Resilience: Promote cultural resilience and traditional knowledge systems, integrating indigenous practices with modern disaster management approaches to enhance community resilience and preserve cultural heritage.

7.3 Specific Policy Recommendations for Andhra Pradesh:

As part of the research context specific recommendations have been provided for both states. The below table provided the key policy recommendations for AP and the following section provides a detailed narration of the same.

AP : Specific Recommendations

		Impact
Maintenance and Equity in Cyclone Shelters	• Ensure proper maintenance of cyclone shelters through dedicated funding and community involvement in upkeep and inspections. • Promote equity by addressing caste discrimination and prioritizing the needs of vulnerable groups, such as persons with disabilities and the elderly, in shelter management and relief distribution.	High
Community Preparedness and Capacity Building	• Implement a state-wide training program for young adults (18-35 years old) in rural areas as first responders, Integrate emergency response training for Anganwadi workers: Anganwadi centers in Andhra Pradesh serve as crucial hubs for healthcare, nutrition, and early childhood education. • Establish community emergency response teams (CERTs) in each village or cluster of villages:.	High
Nature-based Solutions for Climate Change Adaptation	• Implement a comprehensive shelter belt program along the coastline: Andhra Pradesh's coastline stretches across nine districts, making it highly vulnerable to cyclones and coastal erosion. • Promote water conservation through Palmyra tree plantation: Palmyra trees are native to the state and have traditionally been used for irrigation and water conservation. • Integrate climate change into local governance: Panchayats and districts can play a pivotal role in climate change adaptation and mitigation by incorporating it into their development plans.	High
Climate-Resilient Urban Planning	• Integrate climate change considerations into urban planning frameworks across AP • Implement adaptive strategies such as green infrastructure, rainwater harvesting, and sustainable waste management practices. Address flood-prone areas through infrastructure upgrades and natural solutions, ensuring the involvement of local communities.	High
Inclusion of Vulnerable Communities	• Ensure representation of vulnerable groups, including Scheduled Castes and Tribes, persons with disabilities, women, and coastal communities, in disaster governance and planning processes • Address their specific needs during rescue operations and provide targeted support to vulnerable communities impacted by climate change such as fishermen along the state's 974 km coastline,	Medium

Table 22: Key Recommendation for Andhra Pradesh

- Strengthen Cyclone Shelter Maintenance: Implement regular inspection and repair programs for cyclone shelters to ensure they remain functional and safe during disasters.
- Develop Robust Evacuation Plans: Create comprehensive evacuation plans and infrastructure that prioritize the needs of vulnerable groups, ensuring their safe and timely evacuation during emergencies.
- Allocate Funds for Long-Term Infrastructure Development: Allocate funds for long-term infrastructure development to enhance resilience against disasters, focusing on sustainable and climate-resilient projects.
- Implement Community-Based Disaster Response Initiatives: Collaborate with organizations and communities to develop effective community-based disaster response initiatives, leveraging local knowledge and resources for better disaster management.
- Incorporate Climate-Resilient Design Principles: Integrate climate-resilient design principles into urban planning and infrastructure development projects to enhance resilience against climate change impacts.
- Advocate for Coastal Regulations and Protection of Fishery Resources: Advocate for policies that protect coastal areas and fishery resources, ensuring the sustainability of livelihoods for vulnerable communities.
- Allocate Funds for Capacity Building Programs: Allocate sufficient funds for disaster management capacity building and sensitization programs to enhance preparedness at all levels.
- Ensure Equitable Distribution of Compensation: Ensure equitable distribution of compensation for disaster-affected individuals, addressing exclusion biases and ensuring fairness for all affected groups.
- Promote Sustainable Livelihood Programs: Promote sustainable livelihood programs to mitigate the economic impacts of climate change on vulnerable groups, ensuring their long-term resilience.
- Advocate for Long-Term Investments in Disaster Risk Reduction: Advocate for long-term investments in disaster risk reduction rather than focusing solely on immediate relief efforts, emphasizing the importance of prevention and preparedness.
- Incorporate Needs of Vulnerable Groups: Incorporate the needs and priorities of vulnerable groups, including people with disabilities, into disaster risk reduction and response planning to ensure inclusivity and accessibility.
- Enhance Community Participation: Enhance community participation in disaster planning and decision-making processes, empowering communities to take ownership of their resilience efforts.
- Address Biases in Compensation Policies: Address biases in compensation policies to ensure fairness and inclusivity for all affected groups, including vulnerable and marginalized communities.
- Collaborate for Post-Disaster Support: Collaborate with disability departments and relevant stakeholders to improve post-disaster support for individuals with disabilities, ensuring their needs are met effectively.
- Conduct Awareness Programs: Conduct awareness programs and community sensitization efforts to promote environmental conservation and disaster preparedness, fostering a culture of resilience in the community.
- Stress Significance of Mangrove Forests: Highlight the significance of mangrove forests in mitigating the effects of calamities and prioritize conservation efforts to protect these critical ecosystems.
- Implement Nature-Based Solutions: Implement nature-based solutions and green infrastructure projects to enhance resilience and sustainability, integrating natural systems into disaster risk reduction strategies.
- Advocate for Environmental Policies: Advocate for policies to address environmental degradation, such as regulating industrial activities and promoting sustainable land use practices, to reduce vulnerability to disasters.

The overarching goal is to create a symbiotic relationship between the ports and their respective states, ensuring that policies are not developed in silos but are instead part of a cohesive strategy that recognizes the interconnectedness of economic, environmental, and social objectives. This requires establishing formal mechanisms for collaboration, such as joint planning committees and shared funding initiatives, as well as informal platforms for ongoing dialogue and exchange of best practices. By fostering this integrative approach, Odisha and AP can become catalysts for broader state development, sustainability, and resilience initiatives.

When it comes to developing an integrative approach, the role of banks is crucial during a disaster. Banks play an essential role beyond financial transactions; they are instrumental in disaster response and recovery, stabilizing the economy, and aiding societal recovery. In addition to having robust contingency planning measures to withstand physical damage to infrastructure and economic losses, banks facilitate emergency financing, expedite insurance claims, and restore services to maintain economic stability in disaster scenarios. They collaborate with government and NGOs to ensure efficient aid distribution. Thus, enhancing the resilience of banks through improved infrastructure and active community involvement is crucial for minimizing systemic risks and ensuring that banks not only withstand these challenges but also actively support recovery efforts. This proactive approach in building robust banking systems is vital for economic stabilization and effective disaster management in cyclone-prone regions.

In conclusion, the recommendations presented herein represent a synthesis of scholarly insights and empirical evidence aimed at catalyzing transformative change in the resilience trajectories of Odisha and Andhra Pradesh. Grounded in interdisciplinary scholarship and informed by best practices from around the globe, these recommendations offer a roadmap for policymakers and stakeholders to navigate the complexities of systemic risks and foster resilience in the face of uncertainty.

7.4 Future Directions and Research Implications

Looking ahead, it is crucial to transform the findings obtained from this study into practical policy suggestions and strategic interventions. Additional research is necessary to delve deeper into specific areas identified for enhancement, including the effectiveness of governance, engagement of stakeholders, and the integration of technological innovations. Conducting longitudinal studies to monitor the implementation of resilience measures and their effectiveness over time will offer valuable insights into the progression of strategies for managing coastal hazards and climate change in the states of Odisha and AP. Furthermore, there is a need to explore the contribution of community-based approaches and traditional knowledge systems in enhancing systemic resilience. By addressing these gaps in research and promoting interdisciplinary collaboration, we can advance our comprehension of systemic vulnerabilities to coastal hazards and formulate more resilient and inclusive strategies.

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