Review Paper:

Adaptive Governance for Disaster Risk Reduction: Lessons from Odisha

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Abstract

Located in eastern India, Odisha has demonstrated exceptional resilience in managing natural disasters. Its disaster management system serves as a model of effective collaboration among Government, community and technology, focused on preserving lives and property. Odisha's innovative strategies empower local communities to make informed decisions and take swift, necessary actions during crises. The State has also established a strong framework for disaster risk mitigation, enabling seamless cooperation among all stakeholders to minimise disaster impacts. Odisha's system has proven highly effective in reducing the consequences of disasters.

Through coordinated efforts and initiatives among the Government, community and technology, Odisha has created a resilient framework capable of facing even the most severe calamities. As natural disasters become more frequent and intense, Governments and communities worldwide need to collaborate on developing protective systems for lives, livelihoods and infrastructure. Odisha's achievements provide valuable insights for other regions confronting similar challenges. This study examines the evolution of Odisha's disaster management system over time, highlighting the collaborative efforts that have been instrumental in establishing a robust framework for disaster resilience.

Keywords: Adaptive Governance, Disaster Management, Resilience, Community Engagement, Decentralization.

Introduction

Disaster risk refers to vulnerabilities from hazards and socio-economic exposure[11]. India is the third most vulnerable country, with a score of 40.96, following the Philippines and Indonesia[7]. The high vulnerability faced by India underscores its urgent need for the reduction of disaster risk. There are major concerns due to the growing occurrence and intensity of natural disasters[3]. The critical importance of disaster risk reduction is undeniable, both in India and worldwide. India's diverse geography and climate make it vulnerable to a variety of natural disasters. Applying effective disaster risk reduction strategies is crucial for minimising the impact of these disasters on human lives, infrastructure and the economy. Disaster Risk Reduction (DRR) plays an important role in minimising both mortality and economic losses associated with disasters.

International frameworks including the "Sendai Framework for Disaster Risk Reduction" (SFDRR), emphasise the importance of understanding disaster risks, strengthening governance, investing in resilience and enhancing preparedness to accomplish the objective of "Building Back Better"[24]. By prioritizing DRR, nations can foster sustainable development and bolster their resilience against future disasters. In this context, adaptive governance has emerged as an effective mechanism for disaster risk reduction (DRR). It presents a holistic, inclusive and responsive framework for managing disaster risks, making it particularly effective in developing regions facing climate-induced challenges[25].

Hurlbert[10] described adaptive governance as: "A range of political, social, economic and administrative systems that develop, manage and distribute a resource in a manner that promotes resilience through collaborative, flexible and learning-based issue management across different scales." Adaptive governance encompasses a variety of principles to navigate the uncertainty and complexity inherent in Social-Ecological Systems (SETs). These principles include polycentric and multi-layered institutions, flexible issue management driven by social learning and continuous knowledge growth, self-organization and network development active participation and collaboration within governance processes[1,2,4,6,10].

Adaptive governance plays a crucial role in the Sendai Framework for Disaster Risk Reduction (SFDRR). It emphasizes the need for flexible and inclusive strategies to manage disaster risks. The framework notes that traditional governance often struggles to handle the complex and changing nature of these risks, especially due to climate change and economic factors. This governance approach encourages teamwork at various levels, continuous learning and cooperation among diverse groups, including governments, communities and businesses.

By combining scientific knowledge with local skills and innovative ideas, adaptive governance helps to build resilience and to reduce vulnerabilities. The ultimate goal of the Sendai Framework is to create a more resilient and sustainable society capable of effectively addressing disaster risks. Natural disasters pose significant threats to lives, livelihoods and infrastructure globally. Odisha, a State in India, frequently experiences cyclones, floods and droughts.

In response, the State has developed an adaptive governance approach to disaster risk reduction (DRR)[15]. However, there is limited literature on its implementation and comprehensive data availability, complicating the assessment of its effectiveness. This study intends to discuss important topics related to Odisha's adaptive governance model. It will examine how this model impacts the reduction of disaster risks. Additionally, the study will explore the significance of community involvement in this process. It will also take into account the perspectives of various groups, considering their views and opinions as well. By examining these aspects, the study aims to provide a clear understanding of how adaptive governance operates in Odisha and its overall impact on effective disaster risk management.

In the context of Odisha, disaster risk reduction has benefited greatly from adaptive governance. Role of Odisha is like a magnet for tackling various disaster situations, citing the success of the Odisha administration in managing severe cyclonic storms. The Odisha Government has implemented several measures, including utilizing the National Cyclone Risk Mitigation Project (NCRM) to construct multipurpose flood and cyclone shelters, as well as developing a village-level warning system[14]. Walch[25] emphasized the importance of adaptive governance in Odisha, pointing to the leadership and political will that have strengthened the system. Munene et al[16] explained the development of the idea of adaptive governance, regarding it as an approach for effectively implementing the Sendai framework in practice.

Djalante et al[6] described the shifting problems from local to global due to natural hazards, emphasizing the need for enhanced resilience to risks. They highlight the critical significance of adaptive governance in establishing a strong connection between resilience and disaster risk reduction, underscoring how adaptive strategies are essential for effectively managing and mitigating risks associated with potential disasters.

As Odisha moves forward, its disaster management model serves as an inspiration and learning opportunity for other regions facing similar challenges. The State's journey from vulnerability to resilience underscores the vital role of proactive planning, community involvement and adaptive strategies in mitigating the impacts of natural disasters in an era of climate uncertainty. Odisha's approach to disaster management is a shining example of adaptive governance. By combining Government, community and modern technology, the State has developed a robust system for disaster preparedness and response[13,15,20].

The network map (Fig. 1) illustrates the interconnectedness of various research topics including climate change, disasters and adaptation, particularly in relation to Odisha. While Odisha and climate change are significant subjects, the links to governance and decision-making processes appear to be weaker. This indicates a research deficiency regarding how governance systems can adapt to climate change and disasters in Odisha. The map also highlights strong connections between technical solutions, such as flood risk management and disaster governance; however, the role of governance and institutions in adapting to climate change remains less defined. The figure suggests that institutional adaptation and governance transformation have received limited research focus in the context of Odisha. Therefore, to establish a connection between Adaptive Governance, Disaster Risk Reduction and Odisha's Disaster Management system is necessary.

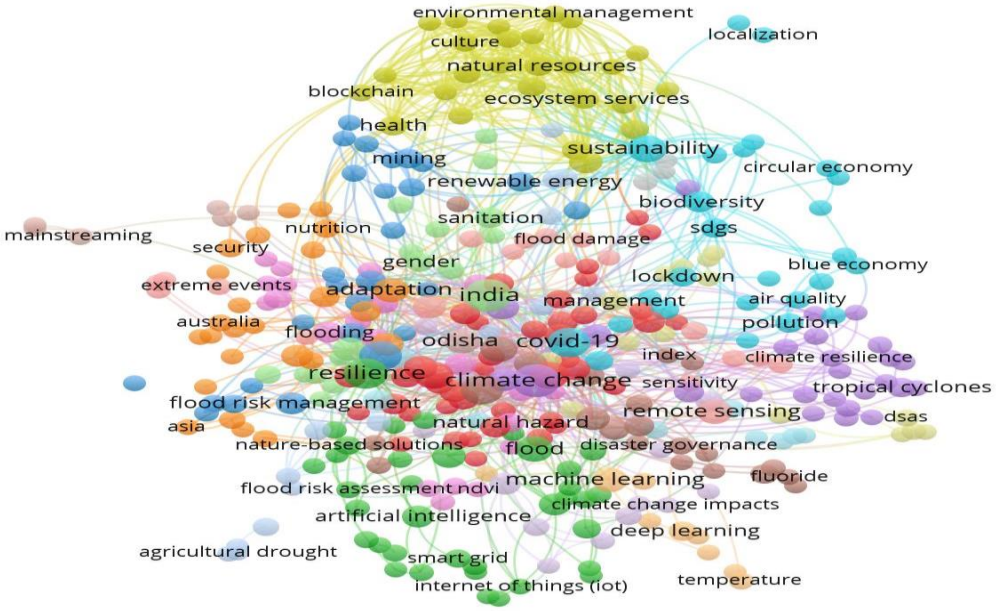

Fig. 1: Research Gap
Source: Elsevier Database

This study employed a secondary research methodology to examine the adaptive governance approach in Odisha, India and its contribution to effective disaster risk reduction. A comprehensive review of existing literature was conducted including academic journals, books and reports. The review focused on identifying key themes and patterns related to adaptive governance and disaster risk reduction in Odisha. Sources were selected based on their relevance, credibility and contribution to the understanding of adaptive governance in the context of disaster management. The literature review included works by prominent scholars and institutions, providing a robust foundation for the analysis.

By synthesizing findings from various sources, the study aimed to highlight the strengths and weaknesses of the adaptive governance approach in Odisha, offering insights into its effectiveness and areas for improvement. This methodology allowed for a thorough examination of existing knowledge, facilitating a deeper understanding of how adaptive governance can enhance disaster resilience in Odisha.

Odisha Overview

The State is divided into 30 districts, 58 subdivisions, 317 tehsils and 314 blocks, comprising of 6, 801 Gram Panchayats and 51, 51,349 villages. Odisha, a State in India, has been particularly vulnerable to various natural calamities such as cyclones, floods and droughts. Located in eastern India, Odisha is characterised by a rich cultural heritage and diverse geography. With a population of approximately 42 million, the State boasts a unique blend of tribal and urban communities. Geographically, Odisha spans 155, 155,707 square kilometers and features a 485- kilometre coastline along the Bay of Bengal. It is home to several major rivers including the Mahanadi, Brahmani and Baitarani.

Odisha' s economy is driven by agriculture, mining and industry, with significant contributions from steel, aluminum and textiles. The State is also renowned for its vibrant cultural landscape, featuring Odissi dance, Gotipua dance and Odia folk music.Tourism attractions include the iconic Konark Sun Temple, Puri Jagannath Temple, Bhitarkanika National Park and Chilika Lake. With its unique blend of natural beauty, cultural richness and economic growth, Odisha offers a fascinating profile that showcases the best of India' s diversity. Additionally, the State is prone to natural disasters including cyclones, floods and droughts. Its 485- kilometre coastline and low- lying topography make it vulnerable to these events.

Natural disasters pose a significant risk to the lives, livelihoods and infrastructure of communities. The State' s history is marked by devastating cyclones, such as the Super Cyclone of 1999, one of the most intense cyclones to hit India, causing widespread destruction and loss of life, with estimated damages of $ 4. 44 billion. Cyclone Phailin in 2013 was a powerful cyclone that affected over 12 million people, causing widespread damage and destruction. However, thanks to timely evacuations, the death toll was relatively low. Cyclone Fani in 2019 was a severe cyclone that caused significant damage and disruption, with estimated losses of over ₹ 12, 12,000 crores. These disasters have led to considerable loss of life, injury, displacement and economic hardship.

Fig. 2: Earthquake Zone of Odisha
Source: OSDMA[19]

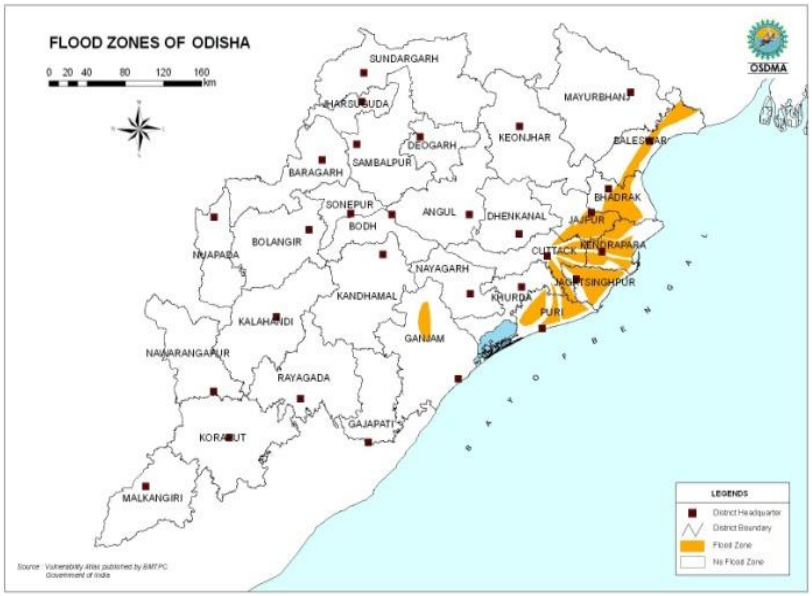

Fig. 3: Flood Zone of Odisha
Source: OSDMA[19]

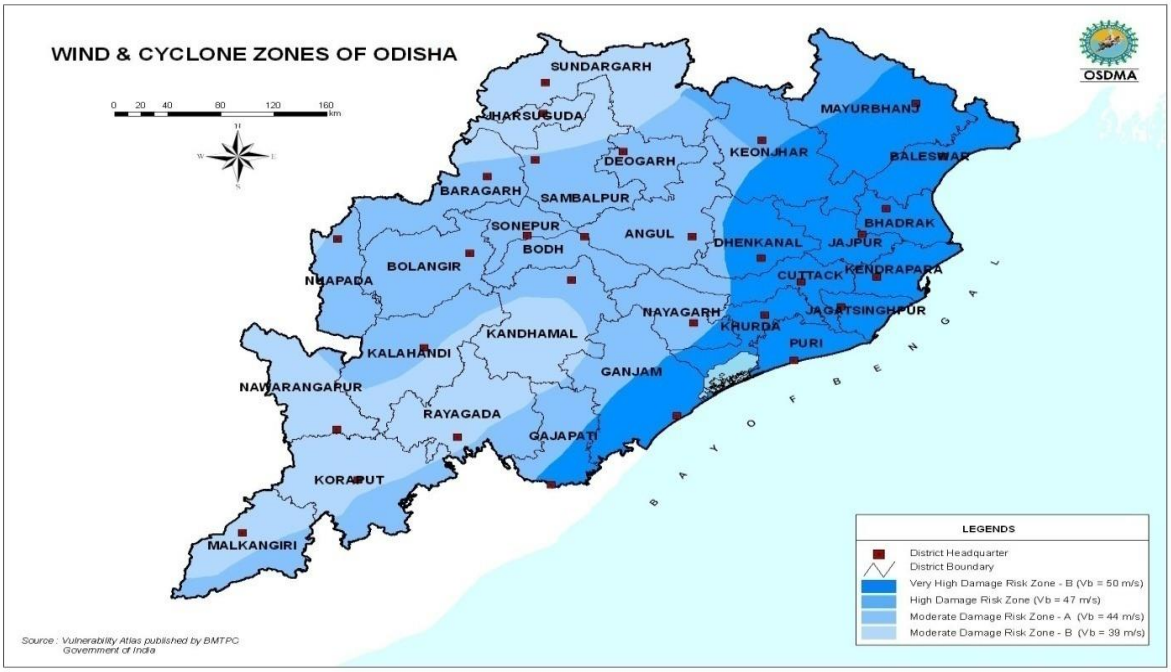

Fig. 4: Wind and Cyclone Zone of Odisha
Source: OSDMA[19]

Figures 2, 3 and 4 present a well-structured view of how Odisha is affected by multiple disasters. Odisha's economy and population are highly vulnerable to disasters, particularly due to its significant reliance on agriculture and rural livelihoods. With 83% of its population living in rural areas and depending on agriculture, the State is highly susceptible to climate-related disasters such as droughts, floods and cyclones. Furthermore, the State's land ownership pattern, characterized by small and marginal landholdings, exacerbates the vulnerability of rural communities. The shift in Odisha's economy from agriculture to services and industries, while positive, also creates new challenges in terms of disaster risk management. The State's high population density and poverty rates further compound its disaster vulnerability, making it essential for the Government to prioritize disaster risk reduction and management initiatives[8].

Adaptive Governance Framework in Odisha: Odisha's disaster management efforts are based on the four characteristics of Adaptive Governance (AG) mentioned by Djalante et al[6] which are crucial for enhancing resilience to natural hazards:

Fig. 5: Institutional Response to Disaster Risk Reduction in India[9,18,21-23]

Polycentric and Multilayered Institutions: Figure 5 illustrates that before independence, India began its journey toward disaster management. Several steps were taken from the pre-independence to post-independence periods, but they primarily focused on post-disaster actions. In the 21st century, a disaster risk reduction approach has emerged worldwide. Odisha has also made significant contributions to disaster risk reduction during this period. The Odisha State Disaster Management Authority (OSDMA)[19] was established on December 28, 1999, following the devastating super cyclone that struck the State.

Its primary objective is to oversee disaster mitigation and minimize its impacts on communities and ecosystems. Based in Bhubaneswar, OSDMA[19] covers the entire State, collaborating with various entities, including the State Disaster Management Authority, Revenue and Disaster Management Department and the Office of the Special Relief Commissioner. OSDMA collaborates with key stakeholders, including the State administration, district authorities, UN agencies and non-governmental organizations, to prepare for and respond to calamities. The State Disaster Management Authority, led by the Chief Minister, formulates policies and strategies to manage disasters, while the State Executive Committee assists in implementing these plans.

The Revenue and Disaster Management Department provides emergency support during calamities, such as floods, cyclones and earthquakes and manages relief and rehabilitation efforts. The Odisha Disaster Rapid Action Force (ODRAF) consists of a specialised unit equipped with state-of-the-art equipment to respond quickly and effectively to disasters[19].

Participation and Collaboration

Community-Based Organizations (CBOs) in Odisha play a crucial role in disaster risk reduction (DRR) by raising awareness, mobilizing resources and implementing community-based DRR strategies. They work closely with local communities to identify vulnerabilities and develop action plans, facilitate training and capacity-building programs to enhance community resilience and to collaborate with government agencies and NGOs for a coordinated response during disasters[17]. Categories of CBOs include Women Self-help Groups (WSHGs), Farmers Clubs, Caste Groups, Youth Clubs, Recreation Clubs and Village Level Disaster Resource Centers (VLDRC). CBOs perform roles such as providing early warnings, disseminating information, conducting risk assessments, preparing for evacuations and managing relief operations.

For example, CBOs in Odisha effectively shared information during Cyclone Fani, reducing panic and increasing efficiency. They also undertook post-cyclone activities like clearing debris, disposing of animal carcasses, reconstructing houses and distributing relief materials. Coordination among CBO members ensured no casualties and they supported community efforts by preparing and distributing food and collaborating with state officials for relief distribution. NGOs are important in managing disasters, especially in areas like Odisha that often face such events. They help in preparing for disasters, responding to them, recovering afterward and reducing their impact.

NGOs raise awareness, mobilize resources and implement community-based strategies. They work with local communities, Government agencies and other stakeholders to ensure a coordinated response. Their efforts include training programs, capacity-building, early warnings and managing relief operations. By fostering community resilience and promoting sustainable practices, NGOs help to reduce the impact of disasters and enhance the safety and well-being of vulnerable populations.

Self-Organisation and Networks: Disaster preparedness is not solely about having the right tools or plans; it is about fostering a culture of readiness. Youth organizations, such as the National Cadet Corps (NCC) and the National Service Scheme (NSS), play a vital role in this effort. They concentrate on community assistance, with their volunteers often being the first responders during disasters and leading

awareness campaigns. Bharat Scouts and Guides highlight survival skills and community projects, while Nehru Yuvak Kendra (NYK) focuses on training workshops and leadership development for rural youth. These organizations actively contribute to disaster management, spanning prevention to recovery, enhancing local infrastructure, initiating environmental conservation projects and ensuring first-aid training. They excel at raising awareness and preparing communities for disasters by organizing evacuation drills, managing relief camps and forming quick response teams that collaborate with local authorities.

Learning and Innovation: Odisha has enhanced disaster management through technology. Partnering with RIMES, the State employs forecasting systems for timely alerts about storms, floods and extreme weather. The Odisha State Disaster Management Authority[19] (OSDMA) has developed Decision Support Systems (DSS) to monitor risks such as heat waves, droughts, lightning and road accidents. Several disaster management applications improve preparedness. The Satark App, created by OSDMA and RIMES, provides early warnings for cyclones, floods and heat waves, along with emergency contacts. The One Stop Risk Management System integrates DSS tools for prompt alerts. The Early Warning Dissemination System, developed by DoT, sends critical messages to mobile devices in affected areas during emergencies.

Education in Odisha is crucial for disaster preparedness. The Odisha State Open University (OSOU) offers a Diploma in Disaster Management that covers risk assessment, preparedness, response and recovery, with practical training. The State Institute of Disaster Management (SIDM) provides specialized training for civil defense, police and Red Cross officials. NGOs conduct community training through mock drills and awareness campaigns. Schools and colleges also incorporate disaster management education, fostering a resilient and informed community.

Lessons from Odisha's Adaptive Governance Approach:

Strong Institutional Mechanisms: As mentioned in the National Disaster Management Policy, establish dedicated institutions like OSDMA and SIDM to oversee disaster management efforts. Empower local institutions to take ownership of disaster management efforts.

Community Engagement and Participation: Effective community engagement is crucial in disaster management, as it involves local communities in disaster risk reduction and management efforts through community-based approaches. Community-based organisations (CBOs) play a vital role in this process, significantly contributing to disaster risk reduction and management. Moreover, empowering vulnerable populations, such as women and children, to participate in disaster management efforts is essential for ensuring their safety and well-being during disasters.

Technology and Innovation: Using technology is crucial for enhancing disaster readiness and response in Odisha. Leveraging advanced technologies such as early warning systems, Geographic Information Systems (GIS) and remote sensing enables authorities to predict and respond to disasters more effectively.

Furthermore, the development of mobile applications like the “Satark” App provides critical early warning information and emergency contact details, empowering residents to take proactive measures during disasters.

Collaboration and Coordination: Effective disaster management in Odisha relies on collaboration among various agencies, including Government bodies, NGOs and community groups, to respond to disasters collectively. NGOs play a vital role in this process.

Capacity Building and Training: Investing in training and capacity building is a cornerstone of Odisha's disaster management strategy. This involves providing training programs for a range of stakeholders, including Government officials, community leaders and volunteers, to enhance their disaster management skills. Additionally, integrating disaster management education into school and college curricula raises awareness. It builds capacity among students, empowering the next generation to contribute to disaster resilience and mitigation efforts, thereby fostering a culture of disaster preparedness.

Emergency Preparedness and Response: Odisha's disaster management strategy prioritizes emergency preparedness, ensuring that emergency services, such as the Odisha Disaster Rapid Action Force (ODRAF), are equipped and trained to respond quickly and effectively to disasters. The State has also established clear protocols for evacuation and relief operations, utilizing cyclone shelters and relief camps to provide safe refuge for residents. Notably, Government-aided colleges and Anganwadi centers serve as critical cyclone shelters, offering shelter, basic amenities and essential supplies to evacuees. These community-focused centres demonstrate the collaborative effort and resilience of Odisha's disaster management framework, showcasing the State's proactive approach to safeguarding its residents during natural calamities.

Odisha's Achievements: Odisha's proactive disaster management approach is crucial for reducing disaster-related risks, especially for coastal communities. With 26 Tsunami Ready villages, Odisha exemplifies adaptive governance by integrating community involvement and preparedness measures.

Table 1 shows that the number of Tsunami ready villages across six districts in Odisha emphasises their preparedness for Tsunami threats. This data reflects Odisha's commitment in enhancing coastal resilience and disaster preparedness in these districts.

Table 1
Number of Tsunami-Ready Villages in Odisha

S.N.	District	Tsunami Prone Village Number	Tsunami Ready Villages
1	Balasore	62	4
2	Bhadrak	41	4
3	Kendrapara	61	4
4	Jagatsinghpur	43	5
5	Puri	109	4
6	Ganjam	65	5

Source: OSDMA[19] and 2nd Global Tsunami Symposium in Indonesia

There are a total of 12 indicators and fulfilling each of these strengthens a village's resilience against Tsunamis. Odisha has successfully met these criteria in 26 villages and other villages are also working towards achieving this status.

Recommendations for future research and policy interventions

Future research directions for Odisha's disaster management include conducting in-depth studies to assess the impact of its adaptive governance approach on disaster risk reduction and management. Additionally, a comparative analysis with other States or countries would help to identify best practices and areas for improvement. Investigating the factors that contribute to community resilience in Odisha and exploring how these can be strengthened, is also essential. Furthermore, the potential of emerging technologies, such as artificial intelligence and blockchain, should be explored to enhance disaster management in the region. The Government should emphasize initiatives for disaster risk reduction such as:

1. **Community Resilience Award**: Similar to the National Apda Prabandhan Puraskar, a State-level award should recognize community efforts in disaster risk reduction. Additionally, awareness campaigns and advertisements should be published to inform people about these initiatives, encouraging collective efforts for community betterment.
2. **Insurance for Disaster Risk**: While various crop and agricultural insurance schemes exist, compensation should be ensured for all types of disaster-related damages. Furthermore, a public-private partnership or joint venture could be established to develop better infrastructure for disaster risk reduction.
3. **Flood Preparedness Villages**: Just as India leads with the "Tsunami Ready Village" initiative, with 26 villages recognised under the program, a similar initiative should be launched to prepare communities for floods and earthquakes.
4. **Competition for Tsunami-Ready Villages:** In Odisha, out of 381 Tsunami-prone villages, only 26 have received official recognition. The remaining 355 villages need further development. To encourage this, the Government can provide financial assistance to help these villages to meet the recognition criteria.

These suggestions can significantly enhance disaster risk management by encouraging individuals to be prepared and resilient. Recognizing community efforts with awards can inspire teamwork and boost awareness about disaster risks. Providing insurance for all disaster damages can ensure financial security and help communities to recover more swiftly. Programs like flood preparedness and Tsunami ready competitions can educate communities on how to prepare better to respond to disasters. By implementing these ideas, Odisha can strengthen its disaster management system and can serve as a model for other regions.

Conclusion

Odisha's disaster management framework is a multifaceted approach that prioritizes community engagement, technology integration and inter-agency coordination. The State's proactive measures, including the establishment of the Odisha State Disaster Management Authority (OSDMA) and the Odisha Disaster Rapid Action Force (ODRAF), have enhanced its disaster resilience. The effective use of technology, such as early warning systems and mobile applications, has improved disaster preparedness and response. Furthermore, the State's emphasis on community-based approaches, capacity building and disaster management education has empowered local communities to take ownership of disaster management efforts. Overall, Odisha's disaster management strategy serves as a model for other States, demonstrating the importance of a collaborative and proactive approach to disaster management.

Odisha's adaptive governance approach to disaster risk reduction has been instrumental in saving countless lives and reducing the economic impact of disasters. The State's active and inclusive approach includes diverse entities, including Government agencies, non-governmental organizations and local communities, helping to create a culture of disaster readiness. By utilising technology, improving skills and encouraging community involvement, Odisha can enhance its ability to prepare for, respond to and recover from disasters. The significance of Odisha's adaptive governance approach lies in its ability to:

- Foster a collaborative and inclusive approach to disaster management
- Build capacity and promote community engagement

- Leverage technology to enhance disaster preparedness and response
- Promote a culture of disaster resilience
- Reduce the economic and human impact of disasters

Overall, Odisha's adaptive governance approach serves as a model for other States and countries, demonstrating the importance of a proactive, inclusive and technology-driven approach to disaster risk reduction.

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