Climate Responsive Land Governance and Disaster Resilience: - Safeguarding Land Rights in Asia

(By :- R.D. Shah, Officer Surveyor,)
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Abstract

Climate change and disaster risks pose an increasing threat to the livelihoods and land rights of vulnerable communities across Asia. Effective land governance systems that are responsive to climate challenges are critical for safeguarding land rights, building resilience, and fostering sustainable development. This paper explores the intersection of climate-responsive land governance, disaster resilience, and land rights in Asia. It provides insights into regional challenges and highlights the importance of inclusive, adaptive governance mechanisms that integrate climate change mitigation, disaster risk reduction, and land tenure security. Furthermore, the paper emphasizes the need for multi-stakeholder collaboration, capacity-building, and knowledge-sharing to address these challenges.

This study outlines the importance of effective land governance in mitigating climate change and disaster risks for sustainable development. Advanced technologies like LiDAR enable precise inundation mapping, which supports accurate flood risk assessments, strategic land-use planning, and the protection of vulnerable communities. Hazard mapping, which covers both natural and man-made risks, is vital for disaster management and depends on reliable data collection, risk assessment, and GIS-based visualization.

Modernizing land records through CORS, drones, and GIS improves transparency in land ownership, reduces disputes, and enhances governance. Developing frameworks that are responsive to climate change and disaster resilience is crucial for safeguarding at-risk communities. Utilizing geospatial technologies further bolsters land-use planning and disaster risk management.

Beside of above the paper also emphasizes the need for establishing local land use monitoring groups is key for implementing climate-adaptive practices on the ground. Collaboration among multiple stakeholders promotes knowledge sharing, capacity-building, and technology transfer, ensuring long-term resilience and sustainability in land governance.

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1. Introduction :-

Climate change is one of the most significant global challenges, with disproportionate impacts on vulnerable regions, particularly in Asia, where rapid urbanization, population growth, and environmental degradation exacerbate the effects of climate-related disasters. The region faces a variety of climate risks, including floods, cyclones, droughts, and sea-level rise, all of which threaten land security, especially for marginalized and low-income communities. Safeguarding land rights and promoting disaster resilience through climate-responsive land governance are essential to ensuring sustainable development, disaster risk reduction, and the well-being of affected populations.

This paper focuses on:

- The impact of climate change on land rights in Asia.

- The role of land governance in building climate and disaster resilience.

- Policy frameworks and best practices for inclusive and adaptive land governance.

- The importance of multi-stakeholder collaboration for capacity building and knowledge-sharing.

A. Climate Change and Land Rights in Asia

Asia is one of the most disaster-prone regions globally, with natural disasters such as floods, landslides, and typhoons occurring frequently. Climate change is intensifying these disasters, leading to displacement, loss of livelihoods, and increased competition for land. Coastal regions are particularly vulnerable, as rising sea levels and coastal erosion threaten the land and homes of millions.

Impact on Vulnerable Communities and Land Rights at Risk

The most affected populations are often those with insecure land tenure, including smallholder farmers, indigenous communities, and informal settlers. Inadequate land governance systems leave these communities without the protection needed to withstand climate shocks. As land becomes increasingly scarce, disputes and conflicts over ownership and usage rights are likely to increase.

1	**Land Loss Due to Environmental Degradation**	**Rising Sea Levels**:	Coastal communities face the loss of land as sea levels rise, leading to coastal erosion, saltwater intrusion, and the displacement of people from their homes and farmlands. Small island nations and low-lying coastal areas are particularly vulnerable. The gradual loss of land due to submergence undermines land tenure security for these communities
		Desertification	In arid and semi-arid regions, climate change exacerbates desertification, leading to the degradation of productive agricultural land. As land becomes barren and unproductive, farmers lose their rights to

			fertile land and may be forced to migrate in search of better opportunities.
		Deforestation	Forest-dependent communities, such as indigenous groups, face loss of access to forests due to climate-induced deforestation, including wildfires and shifts in forest ecosystems. Their traditional rights to use and manage forest resources are compromised when forests deteriorate or are converted to other uses.
2	**Increased Land Conflicts**	**Competition for Resources**	As climate change reduces the availability of arable land, water, and grazing areas, competition for remaining resources intensifies. This leads to land conflicts between different communities, such as pastoralists and farmers, or between local populations and government authorities seeking to use land for development projects or conservation.

		Forced Displacement and Migration	Climate-related disasters like floods, droughts, and storms can force people to leave their land, leading to displacement and migration. When communities are displaced, they may lose their land rights or face challenges in securing new land in their destination areas. This often creates conflicts over land ownership in places where migrants settle.
		Land Grabs and Exploitation	Vulnerable communities are often at risk of **land grabbing by powerful actors, including corporations or government entities, especially when environmental degradation reduces the value of their land. Weak land tenure systems, coupled with the increasing value of land for agricultural or industrial purposes, make vulnerable communities more susceptible to exploitation and displacement.

3	**Disruption of Traditional Land Use and Tenure Systems**	**Indigenous Land Rights**	Indigenous peoples often have traditional land tenure systems based on communal ownership and sustainable land use practices. Climate change, through extreme weather patterns and shifts in ecosystems, disrupts these practices. For instance, changing rainfall patterns or temperature shifts affect their ability to manage forests, practice shifting cultivation, or rely on wildlife. This undermines their cultural connection to the land and the recognition of their land rights.
		Pastoralist Communities	Pastoralists rely on seasonal migration to graze livestock. Climate change disrupts grazing patterns and water availability, forcing pastoralists to encroach on lands traditionally used by other communities, leading to conflict. Government policies may restrict their mobility or fail to protect their traditional rights to land and resources
4	**Insecure Land Tenure**	**Lack of Legal Recognition**	Many vulnerable communities, such as indigenous peoples or informal settlers, do not have formal legal recognition of their land rights. Climate change can exacerbate this vulnerability as governments and private actors seek to acquire land for climate adaptation or mitigation projects, such as forest conservation, renewable energy installations, or infrastructure projects. Without secure tenure, these communities can be displaced or denied access to their ancestral lands.
		Erosion of Customary Land Rights	Customary land rights, particularly in rural areas, are often based on unwritten traditions and communal ownership. Climate change-related pressures, such as land degradation and migration, strain these systems. In the absence of legal documentation, community members may face challenges in defending their land from external claims or government appropriation.

5	**Impact on Livelihoods**	**Agricultural Productivity**	Small-scale farmers and agricultural communities are among the most vulnerable to climate change impacts, such as changing precipitation patterns, prolonged droughts, and heatwaves. Reduced agricultural productivity diminishes their ability to maintain their land, often leading to loss of land through debt or forced migration. This loss of productive land can undermine their rights to access and use land for agricultural purposes.
		Livelihood Shifts	As traditional livelihoods become less viable due to climate impacts, vulnerable communities may need to shift to alternative livelihoods. However, access to land for new forms of income, such as tourism, aquaculture, or renewable energy, may be restricted. This can further marginalize vulnerable groups and limit their ability to adapt to changing environmental conditions
6	**Displacement and Resettlement**	**Climate-Induced Displacement**	Natural disasters such as floods, storms, and landslides can displace entire communities. Displacement often results in the permanent loss of land, as returning to homes or farms may be impossible due to environmental degradation or new land use policies. Displaced individuals may have no legal claims to new land or find themselves in precarious informal settlements with limited rights.
		Inadequate Resettlement Programs	When governments implement resettlement programs for communities displaced by climate change or development projects, these programs often fail to provide secure tenure in new locations. Communities may be resettled in areas with poor infrastructure, inadequate land for farming, or without legal titles to the land, leading to long-term insecurity.
7	**Government Policies and Adaptation Projects**	**Climate Mitigation and Adaptation Projects**	Government policies aimed at mitigating climate change, such as forest conservation, reforestation, or the creation of protected areas, can undermine the land rights of vulnerable communities. For example, communities living in forested areas may lose access to forest land when it is designated for carbon sequestration or conservation projects. Similarly, large-scale infrastructure projects related to climate

			adaptation, such as dams or flood barriers, may displace communities without adequate compensation or relocation plans.
		Land Use Changes	Governments may prioritize land use changes for climate adaptation (e.g., creating buffer zones along coasts or floodplains) that restrict access to land traditionally used by vulnerable communities. Without proper consultation and compensation, these communities may lose their land rights in the name of climate action.

8	**Gender-Specific Impacts**	**Women's Land Rights**	Women, particularly in rural areas, are disproportionately affected by climate change due to their dependence on land for agriculture and household livelihoods. In many communities, women's land rights are insecure because they are often secondary to men's rights under customary laws. As climate change depletes natural resources, women may face increased marginalization and may lose access to land needed for subsistence farming, water collection, or fuelwood gathering.
9	**Legal and Policy Gaps**		Lack of Climate-Responsive Land Laws: Many countries lack land laws that account for the impacts of climate change on vulnerable communities. Governments may prioritize economic growth over social equity, resulting in policies that favor land acquisition for development or conservation at the expense of vulnerable groups. Legal frameworks may not recognize or protect the land rights of informal settlers, indigenous peoples, or other marginalized groups affected by climate change.

B. Climate-Responsive Land Governance

Climate-responsive land governance is essential for reducing vulnerability to climate-related risks and ensuring that land rights are preserved even in the face of disasters. A proactive approach to land governance integrates climate change adaptation strategies and disaster risk management into land-use planning, tenure security, and policy development.

Key Principles

Adaptability

Land governance systems must be flexible enough to adapt to changing environmental conditions and disaster risks. This requires updating land policies, zoning regulations, and land-use plans to incorporate climate projections and disaster risk assessments.

Inclusiveness

Effective land governance must be inclusive, ensuring the participation of all stakeholders, especially marginalized groups, in decision-making processes. Women's land rights and the land tenure of indigenous and local communities are particularly important.

Equity

Equitable access to land and resources is vital in times of climate stress.

Land governance should prioritize the protection of vulnerable communities, ensuring that their land rights are recognized and secured.

Transparency and Accountability

Transparent land administration systems are crucial for reducing corruption and ensuring fair distribution of land resources in the aftermath of disasters.

C. Disaster Resilience and Land Governance

Building disaster resilience requires integrating land governance with broader disaster risk reduction strategies. Strengthening land tenure systems and improving land use planning are central to reducing vulnerabilities and enhancing recovery efforts.

Role of Land Governance in Disaster Resilience:

- Prevention :- Implementing land-use policies that restrict development in high-risk areas, such as floodplains or coastal zones, can prevent loss of life and property.

- **Response :-** After a disaster, secure land rights are critical for effective recovery and reconstruction. Establishing clear procedures for land restitution or compensation is essential to avoiding land disputes.

- **Recovery :-** Post-disaster recovery programs must include land tenure security as a core component, ensuring that displaced communities can return to their land or receive equitable compensation.

Land governance plays a crucial role in disaster management by ensuring that land is used, planned, and managed in ways that reduce vulnerability to natural disasters. Here's a brief list of its key roles:

1. Risk Assessment and Zoning: Land governance involves creating hazard maps and zoning regulations to identify high-risk areas prone to disasters like floods, landslides, or earthquakes, and restricting development in these zones.

2. Land Use Planning: It ensures that land use planning integrates disaster risk reduction strategies, guiding the location of settlements, infrastructure, and economic activities to safer areas.

3. Secure Land Tenure: Strengthening land tenure security ensures that vulnerable communities can rebuild after disasters, reducing conflicts and displacement risks.

4. Resilient Infrastructure: Land governance promotes the construction of disaster-resilient infrastructure, such as flood barriers and earthquake-resistant buildings, especially in high-risk areas.

5. Post-Disaster Recovery: Effective land governance facilitates the fair and timely distribution of land for rebuilding and relocation after disasters, ensuring equitable access to resources for affected populations

6. Community Involvement: Involving local communities in land management ensures that disaster risk reduction measures are culturally appropriate and sustainable.

7. Environmental Protection: It promotes sustainable land use practices that protect natural ecosystems, such as wetlands and forests, which act as natural buffers against disasters.

Best Practices for Land Governance in Disaster Contexts:

Best Practices for Land Governance in Disaster Contexts focus on creating resilient, inclusive, and adaptive land use policies that reduce disaster risk, enhance recovery, and safeguard the land rights of vulnerable populations. Here are some key best practices:

1. Integrated Risk Assessments

- **Conduct Hazard Mapping:** Identify areas prone to natural hazards such as floods, landslides, earthquakes, or droughts using comprehensive hazard maps. Incorporate these into land-use planning and zoning regulations.

- **Assess Vulnerability**: Assess the vulnerability of different populations and sectors to disasters, factoring in socio-economic, environmental, and cultural considerations.

2. Risk-Informed Land Use Planning

- Disaster-Resilient Zoning: Implement zoning regulations that restrict development in high-risk areas, like floodplains, coastal zones, or landslide-prone regions, while promoting safer zones for settlements and infrastructure.

- **Climate Adaptation:** Integrate climate adaptation strategies into land use planning to ensure long-term sustainability, including preserving natural buffers like wetlands and forests that reduce disaster impacts.

3. Strengthening Land Tenure and Rights

- **Secure Tenure for Vulnerable Communities:** Ensure that vulnerable groups, including women, indigenous peoples, and informal settlers, have secure land rights. This facilitates rebuilding efforts post-disaster and reduces the risk of land grabs or forced displacement.

- **Legal Frameworks:** Strengthen land tenure systems by updating legal frameworks to recognize customary and informal land rights, especially in post-disaster recovery.

4. Inclusive and Participatory Governance

- **Community Involvement:** Engage local communities, especially marginalized groups, in land governance processes. Their input ensures that disaster risk reduction measures are contextually appropriate and sustainable.

- **Multistakeholder Coordination**: Foster collaboration between government agencies, local authorities, civil society, and the private sector to coordinate land use decisions and disaster risk reduction strategies.

5. Sustainable Land Management

- **Protect Ecosystems**: Promote land management practices that conserve natural ecosystems, such as forests, wetlands, and mangroves, which act as natural defenses against disasters like floods and storms.

- **Sustainable Agriculture:** Encourage sustainable farming practices that reduce land degradation, enhance soil fertility, and minimize the impacts of droughts or floods.

6. Building Resilient Infrastructure

- **Disaster-Resistant Construction**: Enforce building codes that ensure infrastructure is resilient to hazards such as earthquakes, floods, and storms, particularly in high-risk areas.

- **Relocation Strategies**: Develop relocation plans for communities in extremely high-risk areas, ensuring fair and transparent processes that respect land rights and provide adequate compensation.

7. Post-Disaster Land Recovery

- **Clear Land Rights in Recovery:** After disasters, ensure swift and clear identification of land ownership to facilitate reconstruction. This minimizes land disputes and allows faster rebuilding.

- **Fair Compensation and Resettlement**: Ensure that land-based compensation and resettlement programs are equitable, transparent, and provide secure tenure to displaced communities.

8. Data Collection and Technology Use

- **GIS and Remote Sensing:** Use Geographic Information Systems (GIS) and remote sensing technologies for real-time data collection on land use, hazards, and vulnerabilities. These tools help in planning and disaster management.

- **Digital Land Registries:** Develop and maintain digital land registries to keep track of land ownership and use. This helps with efficient disaster recovery and reduces corruption or disputes.

9. Legal and Policy Reforms

- **Land Policy Harmonization**: Ensure that disaster risk reduction policies are aligned with broader land policies, climate change adaptation, and sustainable development goals (SDGs).

- Regular Updates to Land Laws: Continuously update land governance laws and policies to address emerging risks from climate change and other environmental threats.

10. Monitoring and Enforcement

- **Regular Inspections**: Conduct regular inspections of high-risk areas to ensure compliance with zoning laws, building codes, and disaster-preparedness measures.

- **Early Warning Systems:** Establish early warning systems that provide communities with real-time information about impending natural hazards, allowing for evacuation and other preventive measures.

5. Case Studies from Asia

Several countries in Asia have made progress in integrating climate resilience into land governance systems. This section presents brief case studies that highlight the success and challenges of such efforts.

A. Bangladesh

Background:

Bangladesh is one of the world's most vulnerable countries to climate change due to its low-lying geography, population density, and reliance on agriculture. It faces increasing risks from floods, cyclones, and rising sea levels, which have prompted the government to integrate climate resilience into its land use and governance systems.

Key Initiatives:

- **Coastal Zone Management**: The Bangladesh Coastal Zone Policy (2005) focuses on reducing the vulnerability of coastal communities by promoting sustainable land use, protecting mangroves, and restricting development in high-risk areas. This policy integrates climate resilience by managing land in a way that reduces the impact of cyclones and storm surges.

- Land Use Planning Act (2010): This act outlines disaster-sensitive land use planning, promoting the development of infrastructure in safer areas. It supports zoning regulations that restrict settlements in flood-prone areas while improving drainage and flood protection measures.

- **National Adaptation Plan of Action (NAPA):** Bangladesh's NAPA promotes community-based adaptation strategies, including flood-resistant housing, saline-tolerant crops, and the restoration of natural floodplains. This plan integrates climate resilience into agriculture and land management to mitigate the impact of floods and cyclones.

Outcomes:

- Resilient Housing: The construction of flood- and cyclone-resistant houses has helped protect vulnerable communities from frequent disasters.

- **Mangrove Reforestation**: Bangladesh's successful reforestation of mangrove forests, such as in the Sundarbans, has provided natural protection against cyclones, protecting both people and land.

- **Community-Based Adaptation**: Local communities are directly involved in disaster planning and land management, making them more resilient to climate-induced changes.

B. NEPAL

1. National Land Use Policy (2015)

Nepal's National Land Use Policy (2015) is a critical framework for integrating climate resilience into land governance. The policy aims to regulate land use based on its capability, risk levels, and the need to protect vulnerable areas. It emphasizes the importance of climate-adaptive land use practices, risk-informed zoning, and sustainable natural resource management.

- **Land Zoning and Hazard Mapping:** The government has categorized land into different zones (agricultural, forest, urban, and industrial), with specific restrictions on land use based on climate and disaster risks. High-risk areas, such as floodplains and landslide-prone zones, are designated for conservation or restricted development.

- **Community-Based Forest Management**: Forest land, particularly in hilly regions, is managed through community-based systems. These systems focus on sustainable forest management, erosion control, and promoting ecosystem resilience, which helps protect vulnerable communities from climate-induced disasters.

2. Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)

Nepal has made efforts to mainstream disaster risk reduction and climate change adaptation into land governance policies.

- Local Adaptation Plans of Action (LAPAs): The LAPA framework ensures that local governments integrate climate resilience into land-use decisions. Communities participate in identifying climate risks and implementing adaptation measures such as water management systems, slope stabilization projects, and reforestation to prevent landslides.

- Building Codes and Disaster-Resilient Infrastructure: Nepal has adopted building codes to ensure that infrastructure development, especially in urban areas, considers seismic and climate risks. The focus on climate-resilient construction helps reduce vulnerability to earthquakes, floods, and landslides.

3. Glacial Lake Outburst Flood (GLOF) Risk Reduction

With the growing threat of GLOFs due to climate change, Nepal has implemented targeted measures to reduce risks from glacial lakes.

- **Early Warning Systems:** Nepal has installed early warning systems in areas at risk of GLOFs, particularly around large glacial lakes. These systems help protect communities downstream by providing real-time information on potential floods.

- **Monitoring and Drainage of Glacial Lakes:** The government, with support from international agencies, monitors and manages glacial lakes, reducing water levels through controlled drainage systems to minimize the risk of sudden outbursts.

4. Land Tenure and Vulnerable Communities

Nepal's climate resilience efforts also focus on ensuring land tenure security, particularly for vulnerable groups like indigenous communities, women, and smallholder farmers. Secure land tenure is essential for climate adaptation, as it empowers communities to invest in long-term land management practices.

- **Legal Recognition of Customary Land Rights:** Nepal's land governance framework acknowledges customary land rights, particularly for indigenous communities living in forests and high-risk areas. This recognition allows these communities to engage in sustainable resource management practices that enhance climate resilience.

- **Gender-Inclusive Land Governance**: Land governance reforms in Nepal aim to improve land rights for women, who are often disproportionately affected by climate change. Providing women with secure land tenure enables them to implement climate-resilient agricultural practices and strengthens community resilience.

5. Sustainable Agriculture and Climate-Resilient Practices

Agriculture is a major source of livelihood in Nepal, and integrating climate resilience into farming practices is critical to protecting food security and rural livelihoods.

- **Climate-Smart Agriculture**: Nepal promotes climate-smart agriculture through soil conservation, drought-resistant crops, and improved irrigation techniques. Terrace farming, a traditional method in the hilly regions, has been revitalized to prevent soil erosion and manage water resources more effectively.

- **Agroforestry**: Agroforestry systems, which combine trees and crops, are being promoted to enhance soil fertility, reduce erosion, and provide a buffer against climate impacts.

6. Institutional Strengthening and Capacity Building

Effective land governance requires strong institutions and local capacity. Nepal has invested in strengthening institutions to implement climate-resilient land governance.

- **Training and Capacity Building:** Local governments and communities are trained in climate-resilient land use practices, hazard mapping, and disaster preparedness. This ensures that land governance at the local level is equipped to handle climate challenges.

- Cross-Sectoral Collaboration: The integration of climate resilience into land governance involves collaboration between various sectors, including agriculture, forestry, urban planning, and disaster management. This holistic approach helps ensure that land use decisions are informed by climate risks.

C India

Integrating Climate Resilience into Land Governance Systems

Background

India faces growing climate risks due to rising temperatures, erratic monsoons, and increased intensity of extreme weather events. Vulnerable regions like coastal areas, river basins, and semi-arid lands are home to millions of people who depend heavily on agriculture, fisheries, and natural resources for their livelihoods.

Key challenges include:

- **Increased Frequency of Disasters :** India experiences regular natural disasters, including floods, cyclones, and droughts, exacerbated by climate change.

- **Vulnerable Communities:** Many marginalized communities, including small-scale farmers, fishers, and coastal populations, are highly vulnerable due to their reliance on climate-sensitive livelihoods.

- **Pressure on Land Resources:** Rapid urbanization and population growth exert pressure on land, leading to unsustainable land use practices that increase vulnerability to disasters.

Policy Frameworks for Climate Resilient Land Governance

1**. National Action Plan on Climate Change (NAPCC):**

India's NAPCC, launched in 2008, is the cornerstone of its climate policy. It comprises eight national missions, several of which focus on integrating climate resilience into land governance:

- **National Mission for a Green India (GIM):** Focuses on reforestation and ecosystem restoration, emphasizing land management practices that protect vulnerable areas and communities from the impacts of climate change.

- **National Mission for Sustainable Agriculture (NMSA):** Aims to promote climate-resilient agriculture through sustainable land management techniques, including crop diversification, water conservation, and soil management to reduce vulnerability to droughts and floods.

2. **Disaster Management Act, 2005:**

This act institutionalizes disaster risk reduction (DRR) as part of land governance in India. It mandates disaster risk assessments and hazard mapping, ensuring that land use planning considers disaster risks. For example, regions prone to floods or landslides have special zoning regulations to restrict development in high-risk areas.

3. National Policy on Resettlement and Rehabilitation (2007):

This policy addresses the resettlement of communities displaced by natural disasters or climate change impacts, ensuring that their land rights and livelihoods are protected during relocation.

4. SOCIETY OF INTEGRATED COASTAL MANAGEMENT (SICOM) MINISTRY OF ENVIRONMENT & FORESTS conducted ICZM project for Provision of Ground Controls and Digital Photogrammetric Work of approximately 7 km. wide coastal belt of Indian mainland including major deltaic areas and back waters, for delineation of hazard line.Since India has about 7500 Km coastal line (5400Km on mainland) and 250 million people are living with in 50 Km distance from Sea shore.The coastal area of India accommodates 130 cities and large number of villages.

In view of above. Swami Nathan committee recommended to number of reforms to facilitate conservation of eco system in coastal zone to promote economic development and poverty reduction in the costal areas. The MINISTRY OF ENVIRONMENT & FORESTS had take up this work with collaboration with Survey of India ,Ministry of Science & Technology

Main technical factor for hazard lime mapping under ICZM was as under:

1. 05 metre elevation contour map on 1:10000 scale upto 7 Km from sea shore

2. .Digital elevation Model DEM

3. used digital stereo aerial photographs of 9 cm GSD for delineation of hazard line

4. Planning and Provision of Planimetric ground control points by dual frequency GNSS/GPS receivers in relative static positioning mode and heights by differential Spirit Levelling (Total Station / GPS Levellling in Hilly/difficult areas) required for Photogrammetric Block control.

5. Inundation Modelling and digitization of Flood line and determining areas of inundation by the estimated flood of 100 years return period

6. Digital shoreline Analysis of time series coastline data (3 nos.) to study the trends of shore-line change and arithmetically project the shoreline for next 100 years.

7. Prepared of digital maps on the base of ortho-imagery and depicting contours at 0.5m (2.5m for hills)

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Key Initiatives Integrating Climate Resilience and Land Governance

1. Climate-Resilient Agriculture in Maharashtra:

Maharashtra, a state prone to severe droughts, has implemented climate-resilient agricultural practices through the Maharashtra Climate Resilient Agriculture Project (MCRAP). The initiative integrates land governance with climate adaptation strategies by:

- Land Management for Water Conservation: Techniques like contour bunding, watershed management, and rainwater harvesting help mitigate the impacts of drought.

- **Sustainable Land Use**: The project encourages farmers to adopt sustainable cropping patterns and climate-resilient crops, reducing the dependence on water-intensive crops.

2. Odisha's Cyclone Resilient Land Use Planning:

In India, Odisha is widely acknowledged as a leading state in implementing disaster resilience, particularly in terms of preparedness and response to coastal disasters like cyclones, using maps developed under the Integrated Coastal Zone Management (ICZM) project. Odisha's approach to building disaster resilience is often regarded as a model for other states and countries, especially in the context of cyclone management. Through ICZM projects, the following types of maps were prepared to support disaster resilience efforts.

Name of Map	Purpose	Uses	Example	Remarks
Hazard Mapping	To identify areas at risk from natural hazards like cyclones, tsunamis, coastal flooding, and erosion.	Hazard maps show which parts of the coastal zone are most vulnerable to natural disasters, allowing authorities to prioritize risk reduction	In Odisha, hazard maps are used to highlight cyclone-prone zones and areas at risk of flooding from storm surges. This helps in planning evacuation routes and determining where to	
Vulnerability Mapping	To assess the vulnerability of coastal communities, infrastructure, and ecosystems.	Vulnerability maps combine information on social, economic, and physical vulnerabilities, such as population density, poverty levels, and weak infrastructure.	Vulnerability maps of coastal regions in West Bengal help determine which areas need more robust evacuation plans and where infrastructure needs to be fortified to withstand storms.	

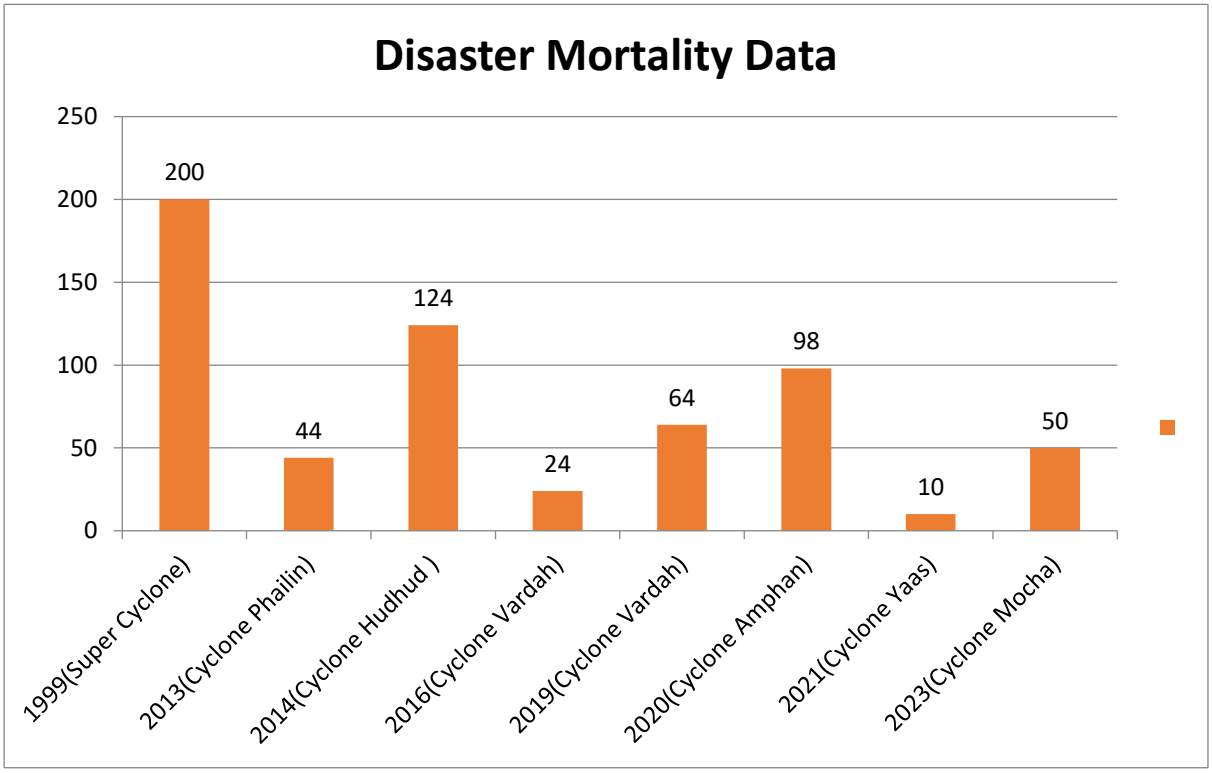
Risk Mapping	To integrate hazard and vulnerability data to create risk maps.	These maps help planners assess the overall risk in a coastal area by factoring in both the likelihood of hazards and the community's capacity to cope with them.	Risk maps are used in Gujarat to prioritize investments in protective infrastructure like seawalls and mangrove restoration, aimed at reducing the overall risk of coastal erosion and flooding.	
Ecosystem and Land Use Mapping	To track changes in coastal ecosystems and land use, helping in ecosystem-based disaster risk reduction.	Land use maps show areas where human activities, such as construction or agriculture, are impacting coastal ecosystems. This helps in planning interventions like mangrove reforestation to enhance natural barriers.	In Odisha, mangrove mapping is used to identify areas where mangroves have degraded and need restoration. Mangroves act as natural buffers against storm surges, reducing the impact of cyclones.	

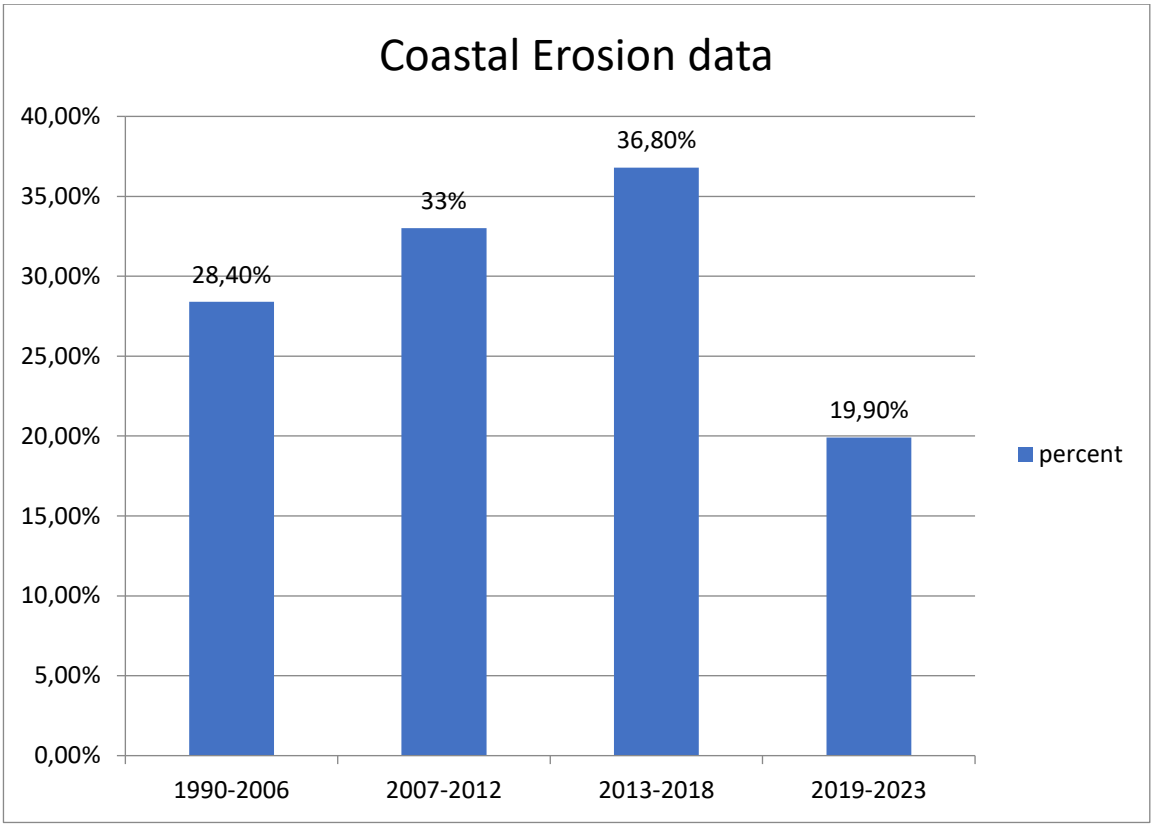
Real-Time Mapping and Early Warning Systems	To provide real-time data on approaching hazards, allowing for timely evacuations and disaster response.	Satellite-based maps, along with Geographic Information System (GIS) technology, can provide real-time updates on weather patterns, water levels, and storm surges.	Real-time flood maps are used in Tamil Nadu to track rising water levels during monsoons and cyclones, helping authorities coordinate evacuations in low-lying areas.	

Shoreline Change Mapping:	To monitor coastal erosion and accretion (land buildup), which is vital for planning long-term coastal resilience.	Shoreline change maps show how the coastline is shifting due to natural processes and human activities. These maps help in planning protective measures like beach nourishment or constructing embankments.	In Gujarat, shoreline change mapping is used to predict areas at risk of erosion and determine where to build coastal protection structures.	
Infrastructure Mapping	To map critical infrastructure (e.g., roads, hospitals, schools, and shelters) that needs to be protected or upgraded to withstand disaster	Odisha, frequently hit by cyclones, has developed a comprehensive land use planning strategy to protect coastal communities:		
Coastal Zone Management Plans	Odisha's Integrated Coastal Zone Management (ICZM) project focuses on sustainable land use practices, including mangrove restoration, which acts as a natural buffer against storm surges.			
- **Resilient Housing and Infrastructure**	In cyclone-prone regions, land governance policies require the construction of cyclone-resistant housing and infrastructure, reducing			

	vulnerability during extreme weather events			

Based on the above maps, the state of Odisha implemented measures and developed infrastructure accordingly. The results of these efforts have been observed in a decreasing trend, as outlined below.





3. Rajasthan's Drought Mitigation Efforts:

Rajasthan, one of the driest states in India, has integrated climate resilience into its land governance system to address recurring droughts:

- **Watershed Management and Land Conservation**: The state's programs focus on improving land use in drought-prone areas through water harvesting, soil conservation, and reforestation projects.

- **Desert Development Program**: This program integrates land use planning with climate adaptation to combat desertification and improve the livelihoods of rural communities dependent on agriculture.

D. The Philippines:

Land Use Planning and Hazard Mapping for Climate Resilience

Background:

The Philippines is frequently affected by typhoons, floods, and landslides. As a response, the government has adopted a multi-faceted approach to integrate climate resilience into its land governance system through legislation, land use planning, and hazard mapping.

Key Initiatives:

- **Philippine Disaster Risk Reduction and Management Act (2010):** This law mandates the integration of disaster risk reduction into national and local land use planning, ensuring that development activities are designed to minimize exposure to natural hazards.

- **Hazard Mapping and Land Use Plans**: The Philippines has developed "nationwide hazard maps" that show areas vulnerable to floods, landslides, and storm surges. These maps inform local governments on zoning restrictions and land use policies. They also help identify safer areas for housing and infrastructure development.

- **Enhanced Local Climate Change Action Plans (LCCAPs):" The** Climate Change Act (2009)" requires local governments to develop LCCAPs, integrating climate adaptation strategies into their land use policies. These plans are informed by hazard maps and include restrictions on building in high-risk areas.

Outcomes:

- **Resilient Infrastructure:** Local governments have developed disaster-resilient infrastructure, such as flood control systems, and have relocated vulnerable communities to safer zones.

- **Improved Zoning Laws**: Hazard maps have strengthened zoning regulations that prevent construction in landslide-prone and flood-prone areas, thus reducing the exposure of communities to natural disasters.

- **Public Awareness:** Through public education campaigns, citizens are more aware of climate risks, contributing to more informed land use decisions.

E. Vietnam :

Integrating Climate Adaptation into Land Management

Background:

Vietnam is one of the most climate-vulnerable countries due to its long coastline and dependence on agriculture. Rising sea levels, increasing temperatures, and extreme weather events, such as typhoons and floods, threaten its coastal and delta regions.

Key Initiatives:

- **National Strategy for Natural Disaster Prevention, Response, and Mitigation (2007-2020)**: This strategy integrates disaster risk reduction and climate adaptation into land use planning, particularly in

the highly vulnerable Mekong Delta region. It emphasizes zoning regulations that restrict settlements in flood-prone areas and encourages the construction of flood-proof houses.

- **Mekong Delta Plan:** The government has adopted an integrated approach for the Mekong Delta region, focusing on land use changes, water management, and climate adaptation. The plan promotes shifting agricultural practices to saline-tolerant crops and encouraging farmers to relocate from high-risk areas to safer locations.

- **Law on Land (2013):** Vietnam's land law integrates climate resilience by ensuring that land allocation and zoning decisions take climate risks into account. This is particularly relevant in areas prone to coastal erosion and saltwater intrusion.

Outcomes:

- **Adaptive Agriculture:** Farmers in the Mekong Delta have adopted climate-resilient agricultural practices, including switching to saline-tolerant rice varieties, which have reduced the impact of sea level rise on livelihoods.

- **Relocation of Vulnerable Communities:** Vietnam has relocated thousands of people from areas at risk of flooding and coastal erosion to safer, inland areas. The government provides land titles in these new areas to ensure security of tenure.

- **Ecosystem-Based Adaptation**: The country has undertaken efforts to restore mangroves and wetlands to act as natural buffers against storms and floods, protecting both land and communities.

6. Building Capacity and Fostering Collaboration

Addressing the complex challenges of climate-responsive land governance and disaster resilience requires collaboration between governments, civil society, the private sector, and international organizations. This paper calls for a multi-stakeholder approach that fosters knowledge-sharing, capacity-building, and technology transfer.

Capacity Building:

Building the capacity of national and regional institutions is crucial for implementing climate-responsive land governance policies. This includes training policymakers, land administrators, and community leaders in climate adaptation, disaster risk reduction, and inclusive land governance.

Technology Transfer and Innovation:

Innovative technologies, such as GIS, drones, and remote sensing, offer new opportunities for improving land governance and disaster resilience. Collaborative efforts between governments and technology providers can enhance the ability to monitor land use, assess climate risks, and respond to disasters effectively.

Multi-Stakeholder Dialogues:

Regional and national platforms for dialogue between governments, academia, non-governmental organizations, and the private sector can facilitate the exchange of best practices and innovative solutions for climate-resilient land governance.

7. Conclusion

Safeguarding land rights in the face of climate change and disaster risks is a critical challenge for Asia. Climate-responsive land governance offers a pathway to protecting vulnerable communities, reducing disaster risks, and promoting sustainable development. The integration of adaptive land governance policies, disaster risk reduction, and inclusive participation can help build resilient systems that ensure land rights for all, even in the face of climate-induced challenges. Through capacity-building, technology transfer, and multi-stakeholder collaboration, the region can develop solutions that safeguard land rights and foster long-term resilience.

8. Recommendations:-

A-Conduct Inundation mapping using advance Tecchnlogy :-Inundation maps are critical tools for flood risk assessment and disaster management, especially in flood-prone areas along rivers. These maps help identify areas that are likely to be flooded during heavy rainfall or high river discharge, enabling effective land use planning and, if necessary, the relocation of inhabitants from high-risk zones. LiDAR (Light Detection and Ranging) technology plays a key role in creating large-scale inundation maps with high accuracy and precision, especially in regions with complex terrain or dense vegetation.

B-Conduct Hazard mapping :-This is an indispensable tool for disaster management and land use planning. By identifying high-risk areas, these maps enable governments, organizations, and communities to mitigate risks, design resilient infrastructure, and improve emergency preparedness. As climate change increases the frequency and intensity of many natural hazards, the importance of accurate, up-to-date hazard mapping continues to grow. Through ongoing advancements in remote sensing technologies like LiDAR and GIS, hazard maps are becoming more precise, allowing for better decision-making and enhanced resilience to future disasters.

Types of Hazards mapping

1. **Natural Hazards:**

i. **Earthquakes:** Seismic hazard maps show zones prone to earthquakes based on fault lines, historical seismic activity, and geological conditions.

ii. **Landslides:** Slope stability, soil types, and rainfall patterns are used to predict landslide-prone areas.

iii. **Cyclones:** Coastal regions vulnerable to cyclones and storm surges are mapped based on wind speed models and historical storm patterns.

iv. **Droughts:** Hazard maps identify regions at risk of prolonged dry spells by analyzing rainfall, soil moisture, and climate data.

v. **Volcanic Eruptions:** Volcanic hazard maps highlight areas vulnerable to lava flows, ashfall, and pyroclastic surges.

2. **Man-made Hazards:**

i. **Industrial Accidents:** Hazard mapping identifies areas around factories or plants where toxic releases, explosions, or fires could occur.

ii. **Nuclear Accidents:** Maps focus on zones around nuclear power plants that would be at risk of radiation exposure in the event of a disaster.

iii. **Transportation Accidents:** These maps identify high-risk transportation routes (e.g., roads, railways) where accidents involving hazardous materials could happen.

Components of Hazard Mapping

1. **Data Collection:** Hazard mapping relies on collecting accurate and extensive data from multiple sources:

i. **Historical Data**: Information on past disasters is essential for understanding where hazards have occurred and their impacts.

ii. **Geospatial Data**: Remote sensing technologies like LiDAR, satellites, and aerial surveys provide valuable topographical and environmental data.

iii. **Hydrological and Meteorological Data:** Weather patterns, river discharge levels, and other environmental factors help in predicting hazards like floods and droughts.

iv. **Seismological Data**: For seismic hazards, data on fault lines, tectonic plates, and earthquake activity are crucial.

2. **Risk Assessment:** After data collection, risk assessments are conducted to estimate the probability of a hazard occurring in a given area and the potential consequences. These assessments consider factors like**:**

i. **Population Density:** More densely populated areas are at greater risk in the event of a disaster.

ii. **Infrastructure:** Critical infrastructure such as bridges, roads, schools, and hospitals is factored into risk assessments**.**

iii. **Land Use Patterns:** Urban areas, agricultural land, and natural ecosystems are assessed for vulnerability based on their exposure to hazards**.**

3. **Modeling**: Mathematical models and simulations are used to forecast the potential impact of future hazards. For example, flood models simulate how water would flow across different terrains, while seismic models predict the spread of earthquake waves. These models help refine hazard maps, making them more precise and reliable.

4. **Visualization:** Once data is collected and analyzed, hazard maps are generated, typically with Geographic Information Systems (GIS). The maps are often color-coded to show different levels of risk

i. **Red Zones:** High-risk areas where hazards are likely to occur with severe consequences.

ii. **Yellow Zones:** Moderate-risk areas where hazards may occur less frequently but still pose a significant threat**.**

iii. **Green Zones:** Low-risk areas that are less likely to experience hazards**.**

1. **Earthquake Hazard Maps:** Earthquake hazard maps show regions susceptible to seismic activity based on tectonic plates and fault lines. These maps are used to guide building codes, ensuring that structures are designed to withstand potential earthquake forces, especially in high-risk zones.

2. **Landslide Hazard Maps**: Landslide hazard maps are developed for mountainous or hilly areas where soil erosion, rainfall, and steep slopes can lead to landslides. These maps aid in infrastructure development and prevent construction in areas where the risk of landslides is high.

3. **Cyclone/Storm Surge Maps:** These maps show coastal areas at risk from cyclones, high winds, and storm surges. They are crucial for early warning systems and emergency evacuation planning, helping to protect coastal populations and infrastructure.

4. **Drought Hazard Maps:** Drought maps identify areas vulnerable to prolonged water shortages, particularly in semi-arid or arid regions. They support water resource management, agricultural planning, and drought resilience strategies.

5. **Volcanic Hazard Maps**: Volcanic maps highlight zones around active volcanoes that could be affected by lava flows, ashfall, or pyroclastic surges. These maps help authorities issue evacuation orders and implement hazard mitigation measures**.**

C- Preparation of Digital Land Records Using CORS, Drone Technology, and GIS Platform

The preparation of digital land records using modern technologies such as CORS (Continuously Operating Reference Stations), drone technology, and GIS (Geographic Information System) is revolutionizing land governance. This approach ensures accurate land ownership details, efficient land use planning, and reduces disputes over land boundaries by providing precise and up-to-date land records. Here's an in-depth look at how these technologies work together to create digital land records.

Since Traditional land records often suffer from inaccuracies due to outdated or poorly maintained data, leading to land disputes, inefficiencies in land transactions, and challenges in governance. Digital land records address these issues by providing accurate, real-time data that is easily accessible, transparent, and reliable. They allow governments, landowners, and other stakeholders to manage land ownership, transactions, and disputes more effectively.

D- Develop and implement national and regional land governance frameworks that are climate-responsive and disaster-resilient.

E Prioritize the protection of vulnerable communities by recognizing and formalizing land rights, especially in disaster-prone areas.

D Leverage geospatial technologies to improve land-use planning and disaster risk management.

E Strengthen legal frameworks to ensure transparent, equitable, and accountable land governance.

F Establishing a Local Land Use Monitoring Group: Planning Land Use with Advanced Recommendations

The establishment of a Land Use Monitoring Group at the local level is essential for ensuring sustainable, equitable, and climate-responsive land use. This group would be responsible for implementing recommendations based on modern geospatial technologies like CORS, drone surveys, and GIS platforms, alongside promoting sustainable practices that address climate change, disaster resilience, and reducing land disputes.

G Foster multi-stakeholder collaboration to enhance knowledge-sharing, capacity-building, and technology transfer at the regional level.

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