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Integrating Sustainable Practices in Disaster Management: Strengthening Disaster Resilience and Disaster Risk Reduction

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ABSTRACT

Disasters, both natural and human-induced, pose significant threats to communities worldwide, leading to loss of life, property damage, and disruption of essential services. Building disaster resilience and reducing disaster risk are vital for sustainable development. Sustainable practices include eco-friendly actions, strategies, and behaviours that meet current needs without compromising the ability of future generations to meet theirs. These practices incorporate environmental conservation, social well-being, and economic stability, ensuring a balanced and long-term approach to resource management and development. Disaster resilience refers to a community's ability to withstand, adapt to, and recover from disasters with minimal external assistance. Disaster risk reduction (DRR) involves systematic efforts to identify, analyse, and address the factors that contribute to disasters. This conceptual research paper explores how sustainable practices promote disaster resilience and disaster risk reduction in disaster management. It highlights key sustainable strategies, such as eco-friendly infrastructure, resource-efficient planning, and community-based resilience programs, which collectively improve preparedness and response. It also examines various sustainable practices across

sectors like infrastructure, agriculture, and community development, emphasising their role in enhancing resilience and reducing disaster impacts. The paper further discusses the challenges and opportunities in implementing these practices, stressing the importance of integrated approaches, stakeholder engagement, and policy frameworks that prioritise sustainability in DRR strategies.

INTRODUCTION

In the face of climate change, extreme weather, and geological events, governments increasingly recognise the need to improve risk management. Climate change has intensified natural disasters such as floods, droughts, hurricanes, wildfires, and rising sea levels. Kerala is particularly vulnerable to natural disasters because of its climate and topography, and it has experienced countless floods, landslides, cyclones and other types of disasters. These disasters cause economic losses, environmental degradation, and loss of human lives. Sustainable practices in disaster management are essential to mitigate risks, enhance resilience, and ensure long-term environmental balance. However, integrating sustainable practices into disaster management enhances resilience, reduces vulnerability, and minimizes environmental degradation. Sustainable disaster management incorporates eco-friendly infrastructure, renewable energy, resource conservation, and community engagement to create a holistic approach to risk reduction and recovery.

Disaster Resilience examines the processes and circumstances that improve or limit a population's ability to resist, adapt to, and recover from a shock or perturbation in the shortest time possible, with little or no outside assistance (Ranjan and Abenayake, 2014). Communities with disaster resilience traits will be better prepared to plan for, cope with, absorb, and adapt to natural disasters (Cutter et al., 2008). Disaster risk reduction (DRR) is the concept and practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters. Reducing exposure to hazards, lessening vulnerability of people and property, wise management of land and the environment, and improving preparedness and early warning for adverse events are all examples of disaster risk reduction (UNDRR).

Integrating disaster risk reduction into sustainable development strategies by strengthening risk assessment, disaster prevention and humanitarian responses will be critical to protecting development gains, particularly among those most deprived (United Nations Task Team, 2015). Development cannot be sustainable if the disaster risk reduction approach is not fully integrated into development planning

and investments. Development investment that does not consider disaster risk will accumulate more risk (UN Secretary-General,2024). Disaster risk reduction and building of resilience to disasters are to be addressed with a renewed sense of urgency in the context of sustainable development and poverty eradication, and, as appropriate, to be integrated into policies, plans, programmes, and budgets at all levels and considered within relevant future frameworks. (UN General Assembly Resolution on Sustainable Development,2012).

Disasters, both natural and human-induced, pose significant threats to communities worldwide. The integration of sustainable practices into disaster resilience and DRR strategies is crucial for mitigating risks and ensuring long-term environmental and social stability.

SUSTAINABLE PRACTICES IN DISASTER MANAGEMENT

Sustainable practices in disaster management play a crucial role in both disaster resilience (the ability to recover from disasters) and disaster risk reduction (DRR) (measures to prevent or minimise disaster impact). These practices integrate environmental, social, and economic sustainability, ensuring that communities can withstand, adapt to, and recover from disasters while reducing future risks.

DISASTER RESILIENCE AND SUSTAINABLE PRACTICES

Disaster resilience refers to a community's ability to absorb, adapt, and recover from hazards while maintaining essential functions. Sustainable practices enhance resilience by incorporating eco-friendly infrastructure, nature-based solutions, and community-based strategies.

1. **Sustainable Infrastructure**

- **Resilient Construction:** Building codes and standards that incorporate disaster-resistant design principles are crucial. This includes using appropriate materials, ensuring structural integrity, and considering local hazard risks (UNISDR, 2015).
- **Disaster Resilient Infrastructure:** Disaster resilient infrastructure includes vital buildings, public communal facilities, transit systems, telecommunications, and power systems that are strategically designed to withstand the impact of a natural disaster like a flood, earthquake, or wildfire.
- **Earthquake-Resilient Building:** An earthquake-resilient building is a structure designed to withstand seismic forces, preventing collapse and minimising damage during an earthquake. These buildings incorporate flexible materials, advanced engineering techniques, and innovative

design to ensure safety and stability in earthquake-prone areas. The need for Disaster resilient infrastructure is also included in the SDGs goal for 2030.

2. **Green Infrastructure**

Utilising natural systems, such as wetlands, forests, and green roofs, can provide natural buffers against floods, storms, and other hazards. Green infrastructure also offers co-benefits, such as improved air quality and biodiversity.

- **Green roofs and Green gardens:** Planting small trees on rooftops can help reduce flooding in crowded cities. A study by CEPT University and IIT Bombay highlights that green roofs can absorb rainwater, keeping buildings cooler and aiding rainwater harvesting. Green roofs are vegetative layers installed on building rooftops, consisting of a growing medium, plants, and a drainage system. They provide several advantages, such as insulating buildings, improving air quality, and reducing the urban heat island effect. Crucially, they also retain rainfall, reducing the volume of water that flows into drainage systems during storms.

3. **Sustainable Transportation**

Investing in resilient transportation networks, including roads, bridges, and railways, is essential for ensuring access to essential services and facilitating evacuation during disasters.

DISASTER RISK REDUCTION (DRR) AND SUSTAINABLE PRACTICES

Disaster risk reduction (DRR) focuses on minimising vulnerabilities and hazards through long-term strategies. Sustainable disaster management ensures that ecosystems and infrastructure are designed to reduce disaster risks before they occur.

1. **Sustainable Land Use Planning**

- **Hazard Mapping and Zoning**: Identifying areas prone to hazards and implementing land use regulations that restrict development in high-risk zones is essential for minimising disaster impacts.
- **Geobag seawall construction:** A geobag seawall is a barrier made of geobags that protects the shore from erosion and waves. The construction of seawalls using geo bags will start at Kannamali, Cheriyakadavu and Kattipparam areas of Chellanam grama panchayat. Once the sea walls are constructed, they will solve the issue of seawater incursion in the coastal areas during the rainy season. The geo-bag seawalls are being built in areas that were not covered under the tetrapod seawall project.

- **Bio Fencing Plants**: Bio fencings are the lines of trees planted on farm and field boundaries that give protection against cattle, wildlife and soil erosion, act as windbreaks, enrich the soil, and control dust. They are less expensive and useful than fences made of wood, barbed wire or stone masonry. Various species have been tested to discover their suitability for use as bio fencing plant species have been widely used. Kodungallur's Sree Narayanapuram Panchayat has set up a coastal biofence model project, a nature-based measure for coastal protection to prevent sea erosion.

2. **Ecosystem-based Adaptation:** Protecting and restoring natural ecosystems, such as mangroves and coral reefs, can provide natural defences against coastal hazards.

- **Mangrove Forest Promotes Ecosystem-Based Disaster Risk Reduction (Eco-DRR):** Kerala Biodiversity Board promotes Ecosystem-based approaches, such as restoring wetlands, mangroves, and forests, to help reduce the impact of natural disasters like floods, landslides, and storms. Mangrove forests act as natural barriers against coastal flooding, storm surges, and erosion while supporting a rich diversity of marine life. Protecting and restoring mangroves is essential for both disaster risk reduction and biodiversity conservation. These ecosystems protect biodiversity and provide natural disaster mitigation benefits.
- **Participatory Land Use Planning:** Engaging communities in land use planning processes can ensure that development decisions consider local knowledge and priorities, promoting more sustainable and resilient land management.

3. **Sustainable Water Management**

- **Integrated Water Resources Management:** Managing water resources holistically and sustainably is crucial for reducing flood and drought risks. This includes promoting water conservation, investing in water storage infrastructure, and managing watersheds effectively.
- **Rainwater Harvesting**: Collecting and storing rainwater can supplement water supplies and reduce reliance on centralised water systems, enhancing resilience to droughts.
- **Soil and Water Conservation on Watershed Basis**: The Department of Soil Survey and Soil Conservation has been implementing watershed projects/ Drainage and Flood protection schemes under the Rural Infrastructure Development Project with NABARD assistance. The main objective of the scheme is to bring in improved and sustainable agricultural production and productivity in the identified watershed area by adopting soil and water conservation activities. These land development works aim to improve the local production environment by providing the required basic infrastructure for controlling soil erosion, regulating water flow, promoting in situ conservation of water, moderating floods and related damage, controlling saline intrusion in drainage lines, etc, for facilitating increased agricultural production and productivity.

- **Water Shed Management:** Watershed management to enhance water conservation and reduce flood risks. Investing in Eco-DRR strengthens environmental resilience while providing multiple benefits, such as carbon sequestration and biodiversity conservation.

  Haritha Keralam Mission, which spearheads the water budget project, is a sub-mission under the NKP focusing on eco-friendly development initiatives in agriculture, water conservation and climate-resilient disaster management practices.
- **Wastewater Treatment and Reuse:** Treating and reusing wastewater can reduce water scarcity and minimise pollution, contributing to a more sustainable and resilient water system.
- **Sustainable drainage systems**: To prevent waterlogging and reduce flood damage. These measures ensure water security during disasters and promote efficient water use in the long term.

COMMUNITY BASED DISASTER RISK REDUCTION AND EDUCATION SUSTAINABILITY- DRR TRAINING

Community-Based Disaster Preparedness (CBDP) in India, particularly in Kerala, focuses on local participation, sustainable solutions, and disaster resilience. Given Kerala's vulnerability to floods, landslides, cyclones, and coastal erosion, disaster risk reduction (DRR) training integrates sustainable practices, eco-friendly infrastructure, and community-driven initiatives to ensure long-term resilience. In Kerala, sustainability-focused DRR training includes nature-based solutions, renewable energy use, and disaster education to enhance community resilience. Educate communities on eco-friendly disaster risk management strategies.

Sustainable practices bridge the gap between disaster resilience and risk reduction by ensuring that disaster responses are eco-friendly, long-term, and community-driven. These practices not only mitigate disasters but also strengthen ecosystems and human settlements, ensuring a sustainable and disaster-resilient future.

Challenges and Opportunities

Implementing sustainable practices for Disaster Resilience and Disaster Risk Reduction faces several challenges:

- ✓ **Lack of Awareness and Capacity**: Many communities and policymakers lack awareness of the benefits of sustainable practices for DRR. Building capacity through education and training is essential.

- ✓ **Financial Constraints**: Investing in sustainable infrastructure and other DRR measures requires significant financial resources. Access to funding and innovative financing mechanisms is crucial.
- ✓ **Institutional Barriers:** Inadequate policy frameworks and institutional coordination can hinder the implementation of sustainable DRR practices.
- ✓ **Data and Information Gaps:** Lack of reliable data and information on hazard risks and vulnerabilities can make it difficult to develop effective DRR strategies.

CONCLUSION

Sustainable practices in disaster management are essential for reducing risks, enhancing resilience, and promoting long-term environmental and economic stability. By addressing the root causes of vulnerability, enhancing capacity, and building resilience, sustainable practices offer a powerful tool for creating a safer and more sustainable future. By integrating green infrastructure, renewable energy, ecosystem-based DRR, and sustainable waste management, communities can build resilience while mitigating climate change impacts. Governments, organisations, and individuals must collaborate to implement sustainable strategies and ensure a safer, more sustainable future. Overcoming the challenges and seizing the opportunities outlined in this paper requires a concerted effort from governments, communities, and all stakeholders. Integrating sustainability into DRR strategies is not just a matter of good practice; it is a fundamental requirement for building a world where all communities are resilient to the impacts of disasters.

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