Understanding the increasing and intensifying Disaster Impacts in view of Climate change

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Abstract

Climate change has become a pressing global concern, with significant implications for the frequency and severity of natural disasters. This research paper aims to explore the relationship between climate change and the increasing and intensifying impacts of disasters. By examining scientific evidences, this paper provides a comprehensive analysis of the key mechanisms through which climate change influences disaster occurrences and their consequences. Additionally, it discusses the socio-economic and environmental implications of these changing dynamics. The findings highlight the urgent need for climate change mitigation and adaptation strategies to minimize the adverse impacts of disasters and foster resilience in vulnerable communities.

Keywords: socio-economic, environmental implications, disaster impacts, climate change

1. Introduction

Disasters are increasing at a more alarming rate than ever since last decade, being more severe and catastrophic in nature. According to the 2020 Ecological Threat Register (ETR), the number of natural disasters has increased tenfold since the 1960s. The Global Disaster Alert and Coordination System (GDACS) has identified 22 major natural disasters worldwide for the first two months of 2023 alone, with most damaging events being associated with climate change. These included-the series of earthquakes in Turkey and Syria 2023, the forest fires in Chile 2023, the tropical cyclone "Freddy" in Madagascar and Mozambique 2023, the floods in Brazil 2023, Hurricane Gabriel in New Zealand 2023, and the most recent being Cyclone Biparjoy 2023 in north Indian states. Climate change can increase disaster risk in a variety of ways - by altering the frequency and intensity of hazard events, affecting vulnerability to hazards, and changing exposure patterns (Climate change drives disaster risk 2021). Not only this climate change' differential variability across the globe leading to uneven spatial distribution of weather-related hazards could result in new

risk patterns (Climate change drives disaster risk 2021). Figure 1 indicates the variability distribution of global warming and precipitation patterns due to climate change.

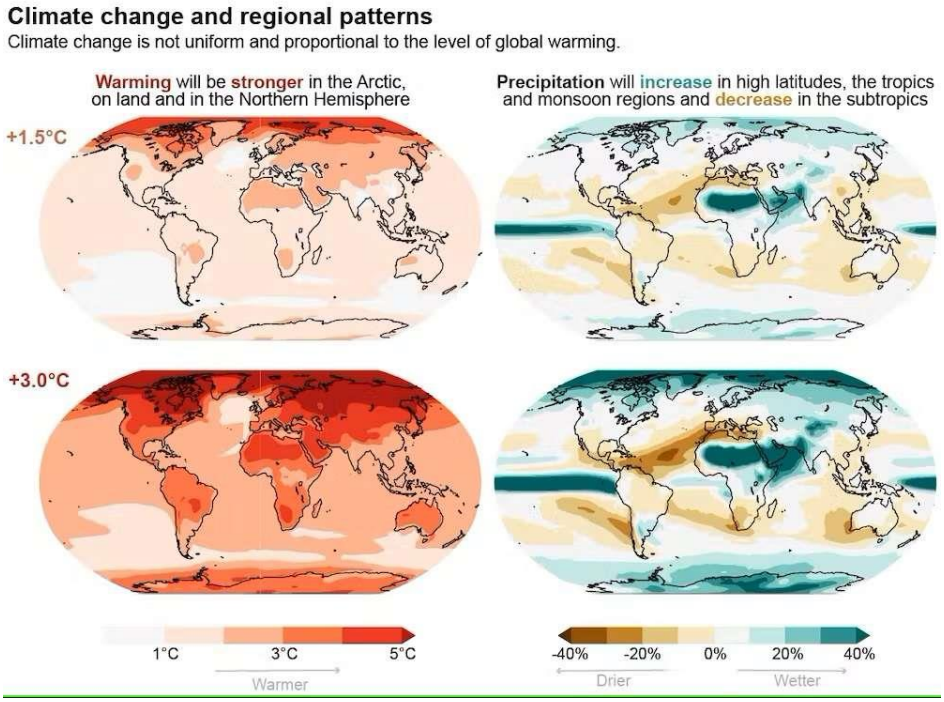

Figure 1 : variability distribution of global warming and precipitation patterns due to climate change. IPCC sixth assessment report

Although the specific impact of climate change is unknown, it is important to note anticipated climate change consequences. Mostly these can result in increase in – increase in Droughts-The number of people suffering extreme droughts across the world(Sendai Framework 2021) could double in less than 80 years, which has major implications for the livelihoods of the rural poor; Sea level rise-Coastal flooding events could threaten assets worth up to 20 % of the global GDP by 2100, with Global "hotspots" for flooding are projected to be in north western Europe and Asia(Projections of global-scale extreme sea levels and resulting episodic coastal flooding over the 21st Century 2020); Rise in Wildfires-By 2030, fire season could be three months longer in areas already exposed to wildfires and Cyclones- Under 2.5°C of global warming(Climate change and wildfires: Projecting future wildfire potential 2020); the most devastating storms are projected to occur up to twice as often as today (Briefing note on tropical cyclones: Impacts, the link to climate change and adaptation 2017). It is thus important to access the underlying factors of increasing disaster events in advent of climate change. Thus the next section discusses the impact of disasters in cities, relationship between climate change and increasing disasters, and mitigation strategies.

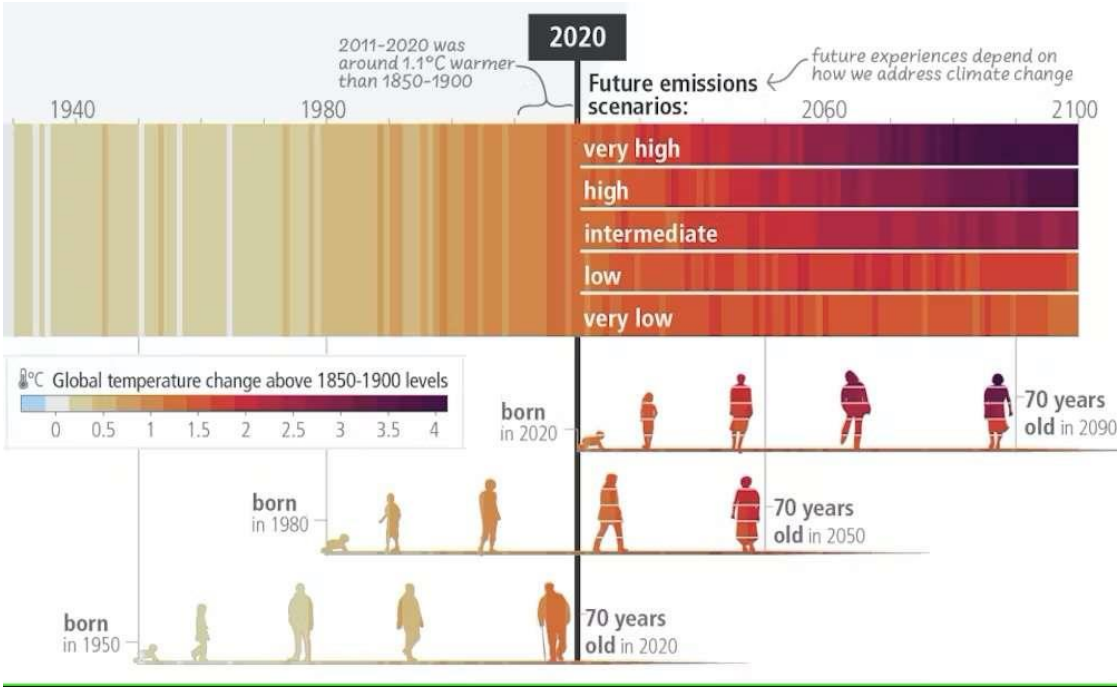

Figure 2- The scenarios show expected differences in temperature in future depending on how high emissions are going forward as per IPCC sixth assessment report (*Ar6 synthesis report: Climate change 2023*)

2. Increasing and Intensifying Impacts Of Disasters

The increasing and intensifying impacts of disasters can be associated with various factors-:

1. *Increase in Economic Losses***:** According to the United Nations Office for Disaster Risk Reduction (UNDRR), from 2000 to 2019, climate-related disasters caused an estimated $2.98 trillion in economic losses globally. (UNDRR, 2020). The number of weather-related disasters has more than tripled over the past 50 years. (World Meteorological Organization, 2020).
2. ***Loss of Lives:*** According to the Centre for Research on the Epidemiology of Disasters (CRED), climate-related disasters led to over 410,000 deaths globally between 2000 and 2019. (CRED, 2020). Heatwaves have become a significant cause of weather-related mortality. European heatwave 2003 resulted in an estimated 70,000 excess deaths. (Robine et al., 2008).
3. *Displacement and Migration:* In 2020, an estimated 30 million people were displaced by climate and weather-related events, such as storms, floods, and wildfires. (Internal Displacement Monitoring Centre, 2021). Rising sea levels and coastal flooding pose a significant threat to communities, especially in low-lying areas and small island nations. It is projected that by 2050, up to 280 million people could be displaced due to coastal flooding. (World Bank, 2020)

4. *Frequency and Intensity of Extreme Events*: The frequency and intensity of extreme weather events are increasing. The World Meteorological Organization reports that in the past four decades, the number of recorded weather-related disasters has doubled. (World Meteorological Organization, 2020). The IPCC's Fifth Assessment Report stated that it is very likely that heatwaves will occur more frequently and last longer due to climate change.

3. Climate Change and Extreme Weather Events

Climate change has been altering global weather patterns, leading to changes in the frequency, intensity, and duration of extreme weather events. Rising global temperatures are causing shifts in atmospheric circulation patterns, resulting in changes in precipitation patterns, wind patterns, and the occurrence of extreme events. For instance, increased evaporation rates due to warmer temperatures contribute to more intense rainfall events, while higher temperatures also increase the likelihood of heatwaves and droughts.

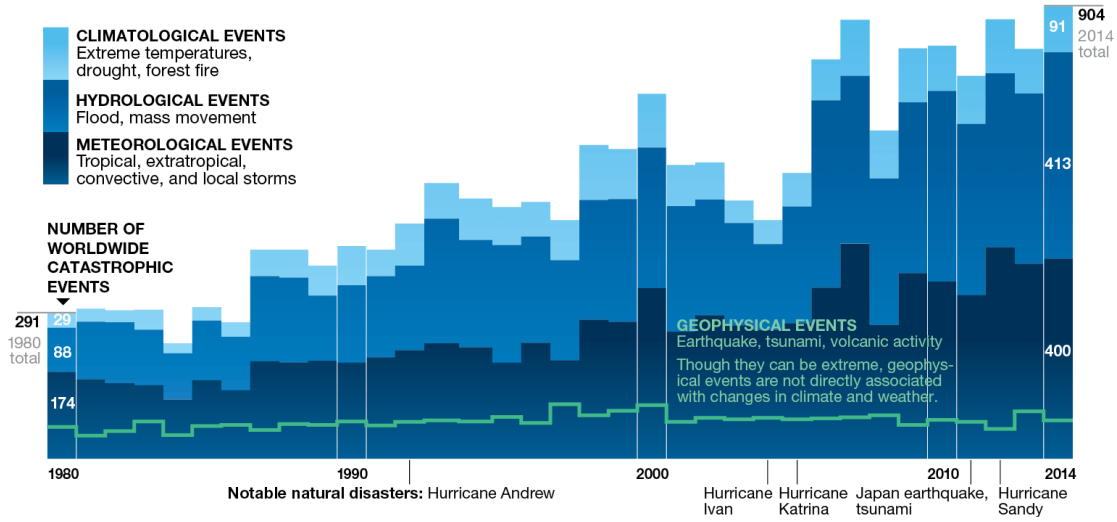

Figure3: Meteorological records show a rise in weather-related disasters since 1980

Numerous scientific studies have provided compelling evidence linking climate change to the occurrence and severity of extreme weather events. The Intergovernmental Panel on Climate Change (IPCC) reports have consistently highlighted the connection between climate change and events such as heatwaves, heavy precipitation, and tropical cyclones Bloor & Bardgett (2012). Through sophisticated climate modelling and analysis of historical data, scientists can attribute the increased likelihood or intensity of certain events to human-induced climate change (Vautard et al., 2019). For example, studies have shown that rising global temperatures have contributed to the intensification of heatwaves (Wouters, 2023). Increased atmospheric moisture, driven by climate change, has also been linked to more intense rainfall and flooding (Ghanian et al., 2020). Additionally, warmer ocean

temperatures have been associated with the increased frequency and intensity of tropical cyclones (Hoang et al., 2022). These findings underscore the urgent need for mitigation and adaptation strategies to address the impacts of climate change on extreme weather events (Kunawotor et al., 2021). Figure 3 indicate the severity of disasters over the time associated with climate change (National Geographic, 2015)

4. **Socio Economic Disruption**

Climate change-related disasters have profound economic and social implications, leading to significant disruption across various sectors. The following aspects illustrate the economic costs, infrastructure damage, impacts on livelihoods, social inequalities, and vulnerable communities:

4.1 *Economic Costs of Climate Change-Related Disasters*: The economic costs of climate change-related disasters have been substantial and are expected to rise. The Global Climate Risk Index reports that from 2000 to 2019, the direct economic losses from weather-related disasters amounted to approximately $2.98 trillion globally (*Global climate risk index 2021 - World* 2021). Disasters result in the destruction of physical assets, loss of productivity, and disruptions to business operations, leading to long-term economic setbacks. These costs encompass not only immediate damages but also long-term recovery and rebuilding efforts. Figure 3 Indicates economic losses over the years have increased many times.

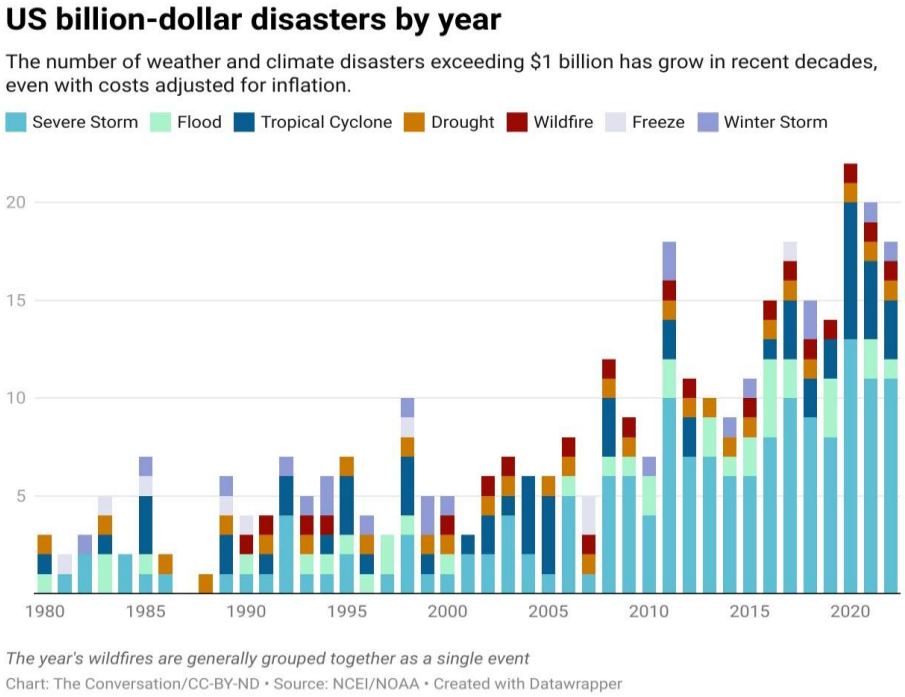

Figure 3 -economic losses due to different disasters (Morford, 2023)

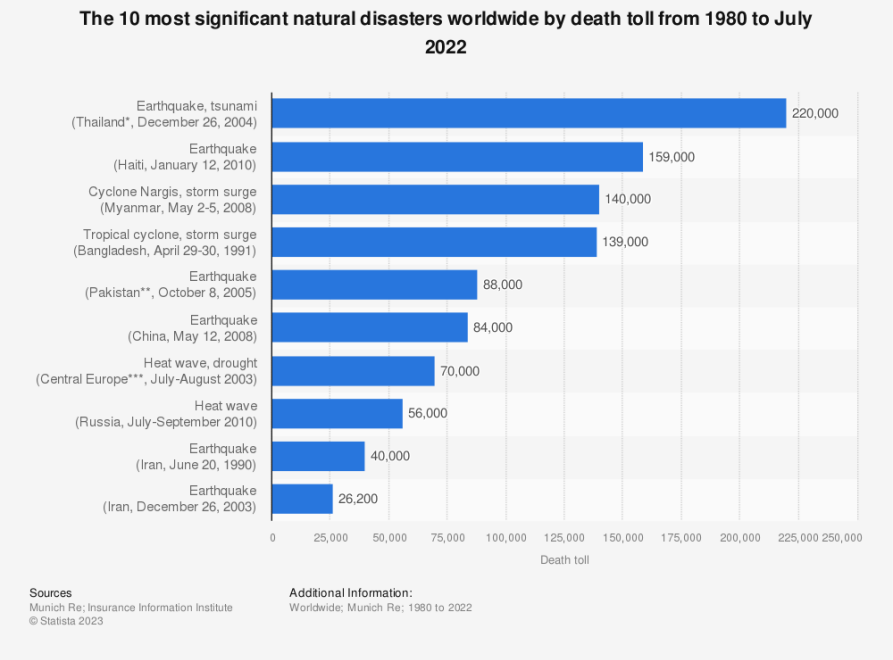

Figure4: social loss in terms of number of death due to disasters

4.2 *Infrastructure Damage and Rebuilding Efforts:* Climate-related disasters often cause severe damage to critical infrastructure such as roads, bridges, power grids, and water supply systems. Rebuilding and repairing infrastructure are a significant financial burden for affected regions. For instance, the destruction caused by Hurricane Katrina in 2005 required substantial investments in rebuilding New Orleans' infrastructure, costing approximately $135 billion. (Diaz et.al 2020)

4.3 *Impacts on Livelihoods:* Climate change-related disasters can devastate livelihoods, particularly in sectors such as agriculture, fisheries, and tourism that are highly dependent on natural resources. Crop failures, reduced agricultural productivity, and disruption of supply chains due to extreme weather events lead to income losses and food insecurity. For example, the drought in the Horn of Africa in 2011 caused significant crop failures and widespread food shortages.

4.4 *Social Inequalities and Vulnerable Communities:* Climate change exacerbates existing social inequalities and disproportionately affects vulnerable communities, including marginalized populations, low-income groups, and indigenous communities. These communities often lack access to resources and infrastructure necessary for disaster preparedness and resilience, making them more susceptible to the impacts of climate-related disasters. For example, the impacts of Hurricane Katrina in the United States were disproportionately felt by marginalized communities, highlighting social disparities in

disaster response and recovery. Figure 4, indicates the significant natural disasters worldwide by death toll from 1980- 2022 July.

4.5 *Implications for Social Justice and Equity:* Climate change-related disasters can deepen social inequalities and exacerbate existing injustices. Vulnerable communities face challenges in accessing resources, healthcare, and essential services during and after disasters. Indigenous peoples, for instance, often face significant challenges in preserving their cultural heritage and traditional livelihoods due to the loss of ecosystems and displacement caused by climate change-related disasters.

5. Disaster Risk Reduction, Adaptation, and Resilience-Building

Various strategies are employed in Disaster Risk Reduction (DRR), Adaptation, and Resilience-Building to effectively address the challenges posed by disasters. These strategies include improved surveillance systems and risk mitigation strategies (Garbern et al., 2016), collaborative work between disaster risk reduction (DRR) and climate change adaptation (CCA) groups (Dwirahmadi et al., 2019), recognition and utilization of indigenous knowledge for disaster risk reduction (Iloka, 2016), partnerships between practitioners and scientists to develop legitimate and relevant disaster risk reduction strategies (Weir, 2023), community adaptation strategies (Aksa & Afrian, 2022), regular communication of disaster risk reduction knowledge to communities by local officials (Sangat, 2023), embracing effective disaster risk reduction practices (Okunola, 2021), integrating climate change and disaster adaptations in regional sustainable development and risk reduction strategies (Jia et al., 2021), evaluation of farmers' livelihood adaptive capacity and identification of factors influencing adaptation strategies (Liu et al., 2022), disaster education on risk, mitigation, and preparedness strategies (Dwiningrum et al., 2020), construction of affordable and climate resilient houses (Moyo, 2020), understanding localized social vulnerability and response capacity limitations (Chakma & Matsui, 2022), the concept of Build Back Better (BBB) to increase resilience through integrating DRR measures (Moatty, 2020), investigating obstacles and determinants of adaptation strategy choice (Peng et al., 2020), prioritizing resilience building, disaster prevention, and mitigation activities (Agrawal et al., 2020).

Collaborative work between DRR and CCA groups is recommended to achieve a comprehensive and robust strategy for building community resilience for climate-related disasters (Dwirahmadi et al., 2019). Recognizing and utilizing indigenous knowledge is important in disaster risk reduction, as it provides valuable insights and adaptive strategies from local communities (Iloka, 2016). Partnerships between practitioners and scientists are essential in developing legitimate and relevant disaster risk reduction strategies that address

the complex challenges of disasters (Weir, 2023). The concept of Build Back Better (BBB) emphasizes the use of recovery, rehabilitation, and reconstruction phases after a disaster to increase the resilience of nations and communities through integrating DRR measures (Moatty, 2020). Investigating obstacles and determinants of adaptation strategy choice provides insights into the challenges and factors influencing the resilience of different farming strategies (Peng et al., 2020). Prioritizing resilience building, disaster prevention, and mitigation activities is recommended to enhance disaster resilience in disaster-prone regions (Agrawal et al., 2020).

In addition to these other strategies include- Hazard identification involves understanding the nature and characteristics of different hazards, such as earthquakes, floods, or hurricanes (Oh & Oetzel, 2022); Vulnerability analysis involves assessing the social, economic, and physical vulnerabilities that can exacerbate the impacts of disasters (Arifin et al., 2021); Emergency response planning involves developing comprehensive plans and protocols to guide the response to disasters. It includes establishing communication systems, mobilizing resources, and coordinating the efforts of various stakeholders (Grothe-Hammer & Berthod, 2016). Multi-sector partnerships and alternative supply chains can help multinational enterprises manage the threat of natural disasters (Oh & Oetzel, 2022). Knowledge management strategies, such as mentorship programs and communities of practice, can facilitate the translation of research findings into policy and practice (Généreux et al., 2019). Regulatory analysis can ensure that disaster risk reduction policies incorporate the involvement of communities in the recovery process (Arifin et al., 2021).

These strategies contribute to the overall goal of reducing disaster risks, enhancing community resilience, and promoting sustainable development in the face of increasing climate-related disasters. By implementing these strategies, stakeholders can work together to effectively address the challenges posed by disasters and build a more resilient future.

5. Conclusion:

This review paper has provided an in-depth analysis of Disaster Risk Reduction (DRR), Adaptation, and Resilience-Building strategies in the context of disaster management. The key points discussed include the concept and importance of these strategies, the relationship between climate change and extreme weather events, the increasing and intensifying impacts of disasters, economic and social disruptions caused by climate change-related disasters, and the evolution of DRR, adaptation, and resilience-building strategies over time

The paper highlighted the challenges faced in implementing these strategies, such as limited awareness, insufficient resources, institutional fragmentation, socio-political factors, and data gaps. It also identified opportunities for improvement, including mainstreaming DRR and adaptation, enhancing international cooperation and partnerships, leveraging technology and innovation, community engagement and empowerment, policy and institutional reforms, and long-term planning and financing. The recommendations for future research and practice in Disaster Risk Reduction (DRR), adaptation, and resilience-building include: enhancing multi-disciplinary and cross-sectoral collaboration, improving data collection and analysis, strengthening community participation and ownership, promoting gender-sensitive approaches, integrating traditional knowledge and practices, enhancing capacity building and training, and fostering innovation and learning

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