International Journal of Humanities and Social Science Research
www.socialsciencejournal.in
ISSN: 2455-2070
Received: 17-11-2021, Accepted: 03-12-2021, Published: 20-12-2021
Volume 7, Issue 6, 2021, Page No. 88-92

Climate change and natural disasters: The India context

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Abstract
Climate change and disasters are fast emerging as the most defining challenges of the 21st century. Global Risk 2021 Report indicated that climate change - to which no one is immune-continues to be a catastrophic risk. Although lockdowns worldwide caused global emissions to fall in the first half of 2020, evidence from the 2008-2009 financial crises warns that emissions could bounce back. A shift towards greener economies cannot be delayed until the shocks of the pandemic subside. Global Risks Perception Survey and Methodology identified that climate action failure is the most impactful and second most likely long-term risk. The paper tried to examine the nexus between climate change and disaster in the context of India, the future projections of the IPCC and other regional assessments, along the disaster profile of the country.

Keywords: climate change, disasters, adaptation, mitigation, global temperature

Introduction

Climate change and natural disasters are fast emerging as the most significant challenges of the 21st century. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) has offered persuasive evidence that climate change is advancing rapidly as a global risk with impacts far beyond just the environment. According to recent projections and analytical studies, increasing global temperatures, arctic and glacial meltdown, sea-level rise and other climate change-related environmental degradation will result in extreme weather events and overstretch many societies' adaptive capacities within the coming decades. At the same time, a global review on the statistics of disasters by the Centre for Research on the Epidemiology of Diseases (CRED) says that natural disasters are increasing in terms of frequency, complexity, scope and destructive capacity. Previously, disasters were linked to climate change through short term natural variability manifested in extreme weather events such as cyclones, storms, floods, droughts, heat waves, windstorms and other natural hazards with the potential for catastrophic loss of human lives, damages to infrastructure and the environment. However, with the climate change manifesting at an unprecedented rate with increased variability and frequency of extreme events, long term implications and the possibility of abrupt change, fuelled largely through anthropogenic cause, these two processes have the potential to coalesce generating destructive forces that could cause mega-disasters unless immediate, radical and resolute mitigation actions are not implemented.

For India, tackling the challenge of climate change and increase in disaster risks posits particular significance, presently poised as she in becoming a major global power. Unless appropriate mitigation measures and mechanisms are not put in place now, and policies redefined to address the challenge, India would face a greater risk. The subsequent arguments analyze the impact of climate change on the risk of natural hazards in India and implications for security and propose preparedness strategies and emergent policy imperatives.

Global Temperature

Results from a wide range of climate model simulations suggest that our planet's average temperature could be between 2 and 9.7°F (1.1 to 5.4°C) warmer in 2100 than it is today. The main reason for this temperature increase is carbon dioxide and other heat-trapping "greenhouse" gases that human activities produce. The biggest source of added carbon dioxide is from people burning coal and other fossil fuels. As per the IPCC Fifth Assessment Report, global average surface temperature has been warmed by 0.85°C between 1880 and 2012 (IPCC, 2013b). Many regions of the world have already greater regional-scale warming, with 20-40 per cent of the global population has experienced over 1.5°C of warming in at least one season (IPCC, 2018) [7]. The impact of this warming is visible in the form of extreme weather events, rising sea levels and diminishing Arctic sea ice. This year alone, various parts of the world was battered by extreme weather events - be it heat waves and drought in Europe and China, forest fires in the US, dust storms and unprecedented rainfall in India (including the historical floods in Kerala) and high precipitation in Japan and other island nations. With a further 0.5°C warming, the effects would be more pronounced than what scientists had previously predicted (Shreeshan Venkatesh, 2018).

Disaster Classification

The United Nations defines a disaster as *a serious disruption of the functioning of the community or society, causing widespread human, material, or environmental losses which exceed the ability of the affected community or society to cope using its resources* (UNDHA, 1992) [13]. Climate has always been linked with disasters, hitherto, through climate variability manifesting in extreme weather events such as cyclones, storms, floods, droughts, heatwaves, windstorms etc, with potential for catastrophic

loss of human lives, damage to infrastructure and environment. These short term climate fluctuations and extreme weather events have been the most frequently occurring hazards and in combination with social vulnerability have been responsible for the vast majority of disaster losses worldwide. The CRED categorizes these disasters resulting from climatic variability and other climatic and meteorological causes as *hydro-meteorological disasters* (floods, landslides, mudflows, avalanches, tidal waves, windstorms, including typhoons, cyclones, hurricanes, storms, winter storms, tropical storms and tornadoes, droughts, extreme temperatures, and complex disasters associated with drought) as distinct from *geological disasters* (earthquakes, volcanic eruptions and tsunamis) (CRED, 2007). The hydro-meteorological disasters resulting from climate variability and other climatic and meteorological causes are also commonly referred to as 'climate disasters' in disaster studies.

Nexus between Climate Change and Increasing Disasters

Several experts argue that there exists a nexus between the current trends in extreme weather events with the increase in the global mean temperature. The CRED report states that '*there is increasingly conclusive evidence which confirms that global climate change will have an impact on the occurrence and magnitude of extreme events. These impacts are envisaged to increase human vulnerability to natural disasters, thus emphasizing the need for improved measures of preparedness in every part of the world'* (UN/ISDR, 2008/01). The UNDRR report points that there was a rise in climate-related disasters including extreme weather events: from 3,656 climate-related events (1980-1999) to 6,681 climate-related disasters in the period 2000-2019 (UNDRR, 2020/08). Report from the Emergency Events Database (EM-DAT) maintained by the CRED indicates that Asia faced the highest number of disaster events. In total, between 2000 and 2019, there were 3,068 disaster events in Asia, followed by 1,756 events in the Americas and 1,192 events in Africa. In terms of affected countries globally, China (577 events) and the USA (467 events) reported the highest number of disaster events, followed by India (321 events), the Philippines (304 events), and Indonesia (278 events). These countries all have large and heterogeneous landmasses and relatively high population densities in at-risk areas (UNDRR, 2020/08).

Impact of Climate Change on Disasters in India

The Indian subcontinent is vulnerable to droughts, floods, cyclones and earthquakes. Landslides, avalanche and forest fires also occur frequently Table 1).

Table 1: Major Disasters in India

Disaster	Place	Death	Date, Time and Year	Magnitude	Epicenter
Most powerful Earthquake	Assam	1,500	17:11, June 12, 1897	8.1	Exact location not known
	Kangra	> 20,000	06:10, April 4, 1905	7.8	Himalayas
	Bihar and Nepal	> 30,000	14:13, January 15, 1934	8.7	South of Mount Everest
	Assam	1,526	19:39, August 15, 1950	8.6	Rima, Tibet
	Koynanagar	180	04:21, December 11, 1967	6.5	Koyna
	Uttarkashi	>1,000	Unknown time, October 20, 1991	6.8	Garhwal, Uttarakhand
	Latur	> 9,748	22:25, September 30, 1993	6.4	Killari, Latur
	Gujarat	20,000	08:50:00, January 26, 2001	7.7	Kutch, Gujarat
	Indian Ocean	> 283,106	08:50, December 26, 2004	9.1- 9.3	West coast of Sumatra, Indonesia
	Kashmir	130,000	08:50:38, October 8, 2005	7.6	Muzaffarabad, Pakistan-administered Kashmir
Cyclone and tidal waves	Date and Place			Impact	
	29 October 1971 in Orissa			10,000 people were killed	
	19 November 1977 in Andhra Pradesh			20,000 people were killed	
	29 and 30 October 1999 in Orissa			9,000 were killed and 18 million people affected	
Landslide	July 1991 in Assam			300 people were killed and heavy loss to roads and infrastructure	
	August 1993 in Nagaland			500 killed and more than 200 houses destroyed	
	18 August 1998 in Malpa, Uttarakhand			210 people killed and villages were washed away	
Floods	1978 Floods in North East India			3,800 people killed and heavy loss to property	
	1994 Floods in Assam, Arunachal Pradesh, Jammu and Kashmir, Himachal Pradesh, Punjab, Uttar Pradesh, Goa, Kerala and Gujarat			More than 2000 people killed and thousands affected	
	Kosi Flood in Bihar, 2005			527 people were killed	
	Mumbai Flood in 2005			1094 people were killed and property loss was estimated at Rs. 550 crore.	
	Bihar Flood in 2007			Affected an estimated 10 million people	
	Bihar Flood in 2008			Affected over 2.3 million people, killed 250 people.	
	Assam Flood in 2012			Over 124 people, including 70 children, died in the floods and about 2.2 million people were affected.	
	Uttarakhand Flood in 2013			More than 100,000 people trapped in landslides, an estimated 4,094 were killed and over 5,700 were missed.	
	Kashmir Flood in 2014			The economic value of the damage was estimated to be between Rs.5000 to Rs. 6000 crore	
	Assam Flood in 2015			Caused numerous landslides and the region is possibly India's most flood-prone region.	
	Gujarat Flood in 2015			Amreli district was badly affected. Gir Forest National Park was severely affected.	
	Chennai Flood in 2015			More than 500 people died, over 50,000 homes were structurally damaged, and over 1.8 million people were displaced	
	Assam Flood in 2016			Affected 1.8 million people in India as well as wildlife of Kaziranga National Park and Pobitora Wildlife Sanctuary	
	Bihar Flood in 2017			Affected 19 districts of North Bihar causing the death of 514 people. Around 1.71 crores (17.1 million) people were hit by the floods.	
	West Bengal Flood in July 2017			Property damage of ₹14,000 crores (US$2.18 billion)	

	Gujarat Flood in 2017	224 deaths between 1 June and 31 July. 16 people had died in neighbouring Rajasthan state by 31 July.
	Mumbai Flood in 2017	7 people have died after a building collapse in the Bhendi Bazaar area of Mumbai
	Kerala Flood in 2018	More than 445 people were killed, lakhs displaced from their homes and estimated economic losses of Rs.30,000 crore
	Bihar Flood in July 2019	Affected a total of 88.46 lakh people in 1269 panchayats across 13 districts
	Odisha Flood in August 2019	1.3 lakh people were affected in 1012 villages
	Kerala Flood in August 2019	121 people were killed and 40 injured in several flood-related incidents. A further 21 were reported missing
	Maharashtra Flood in August 2019	35 people were killed across the state. As many as 761 villages were affected, and more than 4 lakh people were displaced.
	Karnataka Flood in August 2019	61 were deaths, while 14 people remained missing across 22 districts. Close to 7 lakh people were evacuated from their homes and close to 60,000 houses damaged partially or completely.
	Uttarakhand flood in February 2021	58 people were killed and over 150 missing due to glacier breakdown

Source: Compiled from the internet.

The United Nations Environment Programme included India among the 27 countries that are most vulnerable to a sea-level rise. India has a vast coastal line and the rising sea levels caused by global warming would cause an ecological disaster. In India, 2.7 million families depend on coastal resources. The megacities of Mumbai and Chennai with large and growing populations and huge investments in infrastructure are located on the coast.

A significant fraction of sea-level rise is due to thermal expansion of warming ocean (as much as 0.3 to 0.8 m over the past century) and an influx of freshwater from melting of mountain glaciers and polar ice caps (IPCC, 2007). Geographic patterns of sea-level rise are due mainly to changes in the distribution of heat and salinity in the ocean, resulting in changes in ocean circulation. Precise satellite measurements since 1993 show that the largest sea-level rise since 1992 has taken place in the western Pacific and eastern Indian Oceans, with the potential for significant impacts on the east coast of India. The Indian National Communication to the UNFCCC states that sea-level rise is highest in the Gulf of Kutch (Gujarat) and on the coast of West Bengal. Sea level is projected to rise between the present (1980-1999) and the end of this century (2090-2099) by 0.35 m (0.23 to 0.47 m). Due to ocean density and circulation changes, the distribution will not be uniform.

Unnikrishnan, a scientist of the National Institute of Oceanography indicated that the Indian Ocean is rising by 0.13 meter per year and also that the sea level along the coast of Mumbai, Kochi and Visakhapatnam were rising by 0.08, 0.11 and 0.75 meters respectively, per year. A study conducted by Jawaharlal Nehru University indicated that if the sea level rose by just 1 meter as many 7 million people would be displaced and 5,764 sq km of land and 4,200 km of roads would be lost. Besides, much of the coastal region has fertile agricultural land. The two islands in the Sunderbans, an area that India shares with Bangladesh, have already submerged.

Low-level areas, such as those in Orissa, West Bengal, and Lakshadweep islands would be vulnerable to inundation. In Tamil Nadu, 13 districts namely Chennai, Tiruvallur, Kanchipuram, Villupuram, Cuddalore, Thoothukkudi, Tirunelveli, Kanniyakumari, Nagapattinam, Tiruvarur, Thanjavur, Pudukkottai, and Ramanathapuram were already 5 to 10 meter below the sea. If the sea level rose by just 1 meter, as many as 4 lakh people would be displaced and 1091 sq km of land would be lost.

An increase in sea level would also lead to saltwater entering the groundwater aquifers on which people depend for drinking water and irrigating their fields. Valuable marine and coastal ecosystem including mangrove forests, coral reefs, and seagrasses would also get adversely affected by sea-level rise. Coral would generally grow fast enough to keep pace with sea-level rise but might be damaged by warmer sea temperature.

The second impact would be the melting of mountain glaciers. As per the glacial inventory of Space Applications Centre (ISRO), there are 32,392 glaciers distributed over three main glacier basins of the Indus, the Ganga and the Brahmaputra. These three basins have 16,049; 6,237 and 10,106 glaciers that occupy an area of 32,246; 18,393 and 20,543 sq km respectively. The 76 km (47 m) long Siachin glacier located in the Karakoram, is the longest glacier in the Indian Himalayas and the second-longest in the world's non-polar areas. It lies immediately south of the great drainage divide that separates the Eurasian Plate from the Indian subcontinent and has an altitude of 5,753 m (18,875 ft) above sea level at its head at Indira Col.

Table 2: Largest Glaciers of the Himalaya in terms of Length

Sl. No.	Name of the Glacier	Length in km
1	Siachen	75
2	Hispar	59
3	Biafo	58
4	Baltoro	58
5	Chogo Lungma	50
6	Lolofond	40
7	Godwin Austen	30
8	Gangotri	30
9	Bara Shigri	28
10	Kanchenjunga	21
11	Milam	20

Source: ENVIS

Maharaj K Pandit, professor in the Department of Environmental Studies and Director of the Centre for Interdisciplinary Studies of Mountain & Hill Environment, University of Delhi, said “the Himalayas are warming faster than other mountain ranges and the increased use of reinforced concrete in building construction, replacing the traditional wood and stone masonry there, is likely to create a heat-island effect and thus add to regional warming” (Ishan Kukreti, 2021) [9]. Furthermore, recent research has discovered that glaciers melting in the Himalayas, in particular, is dramatic and accelerating, with the pace of change much faster in the 21st century than in the 20th.

Landslides and floods are more likely to occur due to melting ice and expanding glacial lakes.

Productive agricultural regions in the North depend on the spring snowmelt to replenish regional water supplies. Climate models predict earlier snowmelt, which could have a significant effect on agricultural production, especially if the levels of moisture in the soils are reduced during the growing season. The retreat of snow and ice cover in and around the Himalayas is already having a drying effect on these regions. A recent study of the melting Naimona'ny glacier in the Himalayas, which provides water to the Indus, and Brahmaputra Rivers shows that the glacier has melted so much that the exposed surface of the glacier dated to 1944 (Thompson, 2006) [12].

A study of glaciers in the region shows that they are now receding at an average rate of 10-15 meters per year (WWF, 2005) [16]. Himalayan glaciers collect water during the monsoon season and release it during the dry season, providing irrigation water for crops. If the rate of glacial melt increases, flooding is likely to occur in the river valleys fed by the glaciers. Later, as the river flows decrease to below previous rates, many people may be left without sufficient drinking water or water for irrigating crops.

Anil Kulkarni of the Space Applications Centre in Ahmadabad along with other scientists examined the data for 466 glaciers in the Himalayas and found that their surface area has shrunk by about 21 per cent since 1962. As the glaciers retreated, they became more fragmented. The smaller glaciers were more sensitive to climate change. Similarly, a study conducted by the geology and geophysics department of Kashmir University found that the Kolahoi glacier, the biggest in the Indian portion of divided Kashmir, has shrunk to about 4.44 square miles (11.5 square kilometres) from about 5.0 square miles (13 square kilometres) in the past 40 years. This would have a profound effect on future water availability.

On February 7, 2021, a glacial lake outburst flood was occurred by a portion of the Nanda Devi glacier breaking off that brought devastation in the Chamoli districts of Uttarakhand. The Nanda Devi group of glaciers consists of seven glaciers. Among these, Nanda Devi North and Nanda Devi South each about 19 km in length originate from the Nanda Devi peak at an elevation of 7,108 metres above sea level. Streams originating from these glaciers join to form the Rishiganga River. The Rishiganga River drains into Dhauliganga River, which finally joins the Alaknanda River at Vishunprayag. The Alaknanda River and Bhagirathi River join at Devprayag to form the holy river Ganga (Dhruv Sen Singh, 2021) [2]. The prominent Uttari Nanda Devi glacier is retreating at 72 feet per year.

The third impact would be the flooding due to notably recorded rainfalls, overflow of rivers and dams. Deadly floods are common in some parts of India, particularly during the monsoon season that runs from July to September each year. Floods that devastated India includes the Bihar flood in 1987, Mumbai and Gujarat flood in 2005, Bihar flood in 2008, Assam flood in July 2012, Uttarakhand flood in 2013, Jammu & Kashmir flood in September 2014, Chennai flood in November 2015, Kerala flood in August 2018. According to India's Disaster Management Division, as of 17, May 2021 Tropical Cyclone Tauktae lead as many as 23 people had died in the storm, mostly as a result of wind damage but also flooding and rough seas. It also reported a total of 197 houses have been destroyed and almost 7,000 homes damaged including 3,534 in Maharashtra and 2,427 in Kerala, but also in the states/territories of Lakshadweep, Goa, Karnataka and Gujarat. As many as 217,458 people have evacuated their homes, mostly in Gujarat, where 203,509 were displaced.

Regional climate model projections indicate that besides the occurrence of floods, rise in sea level and melting of mountain glaciers, global warming would also lead to arise powerful cyclones, hurricanes, droughts, heatwaves, storms, heavy rainfall and many other natural disasters which would occur more frequently in many parts of India.

Conclusion

Both climate change and increasing disasters will play out in future against the backdrop of other global trends and developments. Both climate change and disasters are largely anthropogenic processes, fuelled largely through development. Development processes are currently largely associated with *risk accumulation* and not *risk reduction.* During the next 20-30 years, every aspect of human life will change at an unprecedented rate, throwing up new features, challenges and opportunities. Global Risk 2021 Report prepared by World Economic Forum indicated that among the highest likelihood risks of the next ten years are extreme weather, climate action failure and human-led environmental damage. Among the highest impact risks of the next decade, infectious diseases are in the top spot, followed by climate action failure and other environmental risks. Consequently, a nations' ability to prevent, mitigate, respond and recover from catastrophic events is increasingly being recognized as a prime driver for national security and strategic growth. The challenge of climate change and increasing disasters will have to be addressed in the backdrop of the key drivers of change, viz, economic growth, population rise, resource competition, changing demographics, increasing diseases, mass displacement and environmental impacts.

Reference

1. The Global Risks Report, 16th Edition, World Economic Forum, 2021, 7
2. Dhruv Sen Singh. Climate Change has led to a rise in natural disasters' frequency. Time of India, 2021. Retrieved from
3. https://timesofindia.indiatimes.com/city/lucknow/climate-change-has-led-to-rise-in-natural-disasters-frequency-/articleshow/80740437.cms
4. ENVIS Jammu & Kashmir. Data from ENVIS Jammu & Kashmir, 2018. Retrieved from http://jkenvis.nic.in
5. ENVIS Uttarakhand. Data from ENVIS Uttarakhand, 2018. Retrieved from http:/utrenvis.nic.in
6. IPCC. Summary for Policymakers. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2013, 3-29.
7. IPCC. Special Report: Global Warming of 1.5ºC, 2018. Retrieved from
8. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_Chapter1_Low_Res.pdf

9. Ishan Kukreti. Glacier breaks in Chamoli, Experts Blame Low Snowfall. *DownToEarth, 2021.* Retrieved from https://www.downtoearth.org. in/news/natural-disasters/glacier-breaks-in-chamoli-experts-blame-low-snowfall-75417
10. Sharma AK, Singh SK, Kulkarni AV, Ajai. Glacier Inventory in Indus, Ganga and Brahmaputra Basins of the Himalaya. *National Academy Science Letter*,2013:36(5):497-505.
11. Shreeshan Venkatesh. There is no safe level of global warming: IPCC Report. *DownToEarth, 2018.* Retrieved from https://www.downtoearth.org.in/news/climate-change/there-is-no-safe-level-of-global-warming-ipcc-report-61871
12. Thompson LG, Yao T, Mosley-Thompson E, Davis, ME, Henderson KA, Lin PN. A High-Resolution Millennial Record of the South Asian Monsoon from Himalayan Ice Cores," Science,2006:289:1916-1919.
13. UNDHA. *Internationally Agreed Glossary of Basic Terms Related to Disaster Management*. United Nations Department of Humanitarian Affairs Publication–DHA Geneva (DHA/93/36), 1992.
14. UN/ISDR. *Disaster Figures for 2007.* Press release prepared by CRED, 2008. Retrieved from https://www.emdat.be/sites/default/files/presereleasecred_jan_2008.pdf
15. UNDRR. Dramatic Rise in Climate Disasters over Last Twenty Years. Press release dated 12 October 2020 prepared by CRED and UNDRR, 2020. Retrieved from https://cred.be/sites/default/files/2020_UNDRR-CRED.pdf
16. WWF. An Overview of Glaciers, Glacier Retreat and Subsequent Impacts in Nepal, India and China, World Wildlife Fund WWF Nepal Programme, 2005.