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ECONOMICS OF CLIMATE EXTREMES: EVIDENCE FROM INDIA

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ABSTRACT

This paper explores the links among natural disasters, climate change in the context of India. It is clear that the Climate change and increasing disasters have positive relation. The paper summarizes the limited knowledge of the long-term economic impact of natural disasters. It is necessary to draw links among disasters, conflicts, resource management, and other transmission channels to develop an appropriate response to natural disasters. This paper express the economic consequences of climate extremes, and It also argues for more work on the links between climate change and disasters and a new way of looking at disaster resilience as a continuum to development strategies. This paper studies the policy implications and the need for reforms. This paper discusses the imperativeness of coordination among the centre and the state the challenges that have to be overcome in order to achieve sustainable development.

INTRODUCTION

According to the United Nations Intergovernmental Panel on Climate Change (IPCC), Climate change is the long-term change in average weather conditions, including temperature, rainfall and wind. Sufficient scientific evidence has now been generated to make climatic changes the prime agenda for the planners of the world economies. Warnings from the scientific community are becoming louder. An increasing body of literature is pointing towards the possible current and future dangers from such climatic changes. Although, there have been debates about the possible reasons for climate changes, the general consensus among the scientific community points to anthropogenic origins. The phenomenon of climate change is an irrefutable fact in the contemporary world. The fourth assessment report of IPCC (2010) states that globally there has been change in long term mean temperatures. Global surface temperatures, alone, have increased by roughly 0.74°C between 1906 and 2006. The report also states that the mean sea levels have increased at an average rate of 1.8 mm per year between 1961 and 2003 and by 3.1mm between 1993-2003. According to the IPCC these trends are set to continue and even accelerate into the 21st century and will be accompanied by new changes such as increases in extreme weather events. In fact, according to the IPCC's latest findings, global average temperatures will probably rise a further 1.1—6.4°C this century, depending on the extent of continued greenhouse gas emissions. There are majorly four concerned aspects of climate change, which are as follows:

(1) How much global warming and climate change will occur?
(2) How worse it will get?
(3) When will all this occur?
(4) What should be done about it?

Climate change and disasters are fast emerging as the most defining challenges of the 21st century. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC); IPCC AR4 has provided compelling evidence that climate change is advancing rapidly as a global risk with impacts far beyond just the environment. Recent projections and analytical studies indicate that the increasing global temperatures, arctic and glacial melt down, sea level rise and other climate change induced environmental degradation will give rise to extreme weather events and overstretch many societies' adaptive capacities within the coming decades thus increasing societal vulnerabilities. Until now disasters were linked to climate change through short term natural variability manifesting in extreme weather events such as cyclones, storms, floods, droughts, heat waves, windstorms and other natural hazards with potential for catastrophic loss of human lives, damages to infrastructure and environment. However, with the climate change manifesting at

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an unprecedented rate with increased variability and frequency of extreme events, long term implications and possibility of abrupt change, fuelled largely through human activity, these two processes have the potential to coalesce generating destructive forces which could cause mega disasters unless urgent, radical and resolute mitigation actions are not implemented.

For India, tackling the challenge of climate change and increase in disaster risks posits particular significance. Valuable time and resources would be consumed in handling the increasing risks, which would impinge on geo-strategic imperatives, unless appropriate mitigation measures and mechanisms are not put in place now, and policies redefined to address the challenge. 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 .Future projections indicate that there is increased confidence that some weather events and extremes will become more frequent, more widespread and/or more intense during the 21st century and impacts due to altered frequencies and intensities of extreme weather, climate and sea level events are very likely to change (IPCC, 2007c). A few examples of possible impacts of climate change due to changes in extreme weather and climate events to the mid- to late 21st century are:

- Warmer and fewer cold days and nights, warmer and more frequent hot days and nights over most land areas - virtually certain (greater than 99% chance)
- Heat waves frequency increases over most areas - very likely (90–99% chance).
- Heavy precipitation events frequency increases over most areas- likely (90– 99% chance).
- Area affected by drought increases- likely (66–90% chance).
- Intense tropical cyclone activity increases- likely (66–90% chance).
- Increased incidence of extreme high sea level (excludes tsunamis)-likely (66–90% chance).

Climate Change and Disasters

The United Nations defines 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 linked with disasters, hitherto, through climate variability manifesting in extreme weather events such as cyclones, storms, floods, droughts, heat waves, 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.

Climate Change and Increasing Disasters- Is there a Link?

A number of experts link these current trends in extreme weather events with the increase in the global mean temperature. The Centre for Research on the Epidemiology of Disasters (CRED) report states that there '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). CRED report also surmises that the current trends are consistent with the predictions of IPCC AR4, in that Asia, and also West Africa are already suffering from more severe and frequent floods (Sapir, 2008). The future projections by IPCC AR4 also indicates that there is 'increased confidence that some weather events and extremes will become more frequent, more widespread and/or more intense during the 21st century and impacts due to altered frequencies and intensities of extreme weather, climate and sea level events are very likely to change' (IPCC, 2007c; Parry *et al*., 2007). Although the predictions of IPCC AR4, supported by CRED through trend analysis of rising climate disasters, a direct attribution to climate change is not possible as every weather event is the product of random forces and systemic factors. However, climate change will steadily increase the exposure of the poor and vulnerable to climate shocks and place increased pressure on coping strategies and adaptive capacities of societies by resource and environment degradation. Current evidence points very clearly that climate change is creating systemic conditions for extreme weather events and will increase the risk of exposure to climate disasters through increasing societal vulnerabilities. Also, there is evidence now that climate change, with present developmental trends, will not express itself in through slow shifts in average conditions, but will manifest at an unprecedented rate with increased variability, frequency of extreme events, long term implications and possibility of abrupt change.

Climate Change in India

For the Indian subcontinent, the projected changes by IPCC based on the General Circulation Model (GCM), project warming of 2-4.7 °C, with the most probable level being around 3.3 °C by the year 2100. Warming is expected to be more marked in the winter half of the year (3.6 °C) than in summer (2.7 °C), and stronger in the north than in the south. Most scenarios project a decrease in precipitation during the inter dry period and an increase for the rest of the year. At the same time, an increase in heavy rain events is probable, particularly in the north of India. The global sea level rise of 0.1 to 0.9 meters is particularly expected to be high in the Indian Ocean, especially on the west coast. Assessments by Indian Scientist using the Hadley Centre Regional Model (HadRM2) climate models show similar outputs and indicate that over the Indian region the temperatures will increase by 3 to 4°C towards the end of the 21st century. The warming may be about 2.1 to 2.6 º C in the 2050s and 3.3 to 3.8 º C in the 2080s. The different models/experiments generally indicate the increase of temperature to be of the order of 2-5°C across the country. In case of mean annual temperature, the increase is of the order of 3 to 6ºC. The warming is projected to be widespread over the country, and relatively more pronounced over northern parts of India. While the rainfall is projected to increase, there would be variations in the spatial pattern, with some pockets showing increase and others experiencing decline in rainfall. Most models project an increase in rainfall between 10 and 40% from the baseline period (1961–90) to the end of 21st century, with the maximum expected increase in rainfall over northwestern and central India. There is very little or no change noted in the monsoon rainfall over a major

part of peninsular India. The climate change would cause global sea to rise between 0.09 to 0.88 mm by 2100 and enhance extreme events like excessive rain, flash flood, droughts, cyclones and forest fires. The projected climate change will affect India particularly severely. Its consequences include a rise in sea level, threatening areas such as the densely populated Ganges delta, changes in the monsoon rains, the melting of the glaciers in the Hindukush-Karakorum-Himalaya region(crucial for the water supply in the dry seasons), and the foreseeable increase in heavy rain events and intensity of tropical cyclones.

Likely Impact of Climate Change on Disasters in India

India is among the world's most disaster prone areas. India support 1/6th of the world's population on just 2 % of it landmass. History shows that the India is exposed to natural disaster, cyclones; floods, earthquakes, droughts and floods are major threats. About 60 percent of the landmass is prone to earthquakes of various intensities, over 40 million hectares is prone to floods and the 68 percent of the area is prone to drought. This not only results in loss of lives but also in terms of loss in private community and public assets. The Indian Subcontinent is highly vulnerable to cyclones, droughts, earthquakes and floods. Avalanches forest fire and landslides occur frequently in the Himalayan Region of Northern India. Among the 35 total states/Union territories in the country, 25 are disaster prone. On an average, about 50 million people in the country are affected by one or the other disaster every year, besides loss of property worth several million is shown in Table 1.

years. The period from 2001 to 2011 has been associated with a large number of earthquakes in Asia that have a relatively high injury to death ratio. Floods, droughts, cyclones, earthquakes, landslides and avalanches are some of the major natural disasters that repeatedly and increasingly affect India, it shown in Table 2. The natural disasters directly impact, the economies, agriculture, food security, water, sanitation, the environment and the health each year. Therefore it is the single largest concern of the developing nations. Different natural hazards because varying levels of physical damage to infrastructure and agriculture with implications for their indirect and the secondary impacts. Droughts cause heavy crop and livestock losses over wide areas of land but typically leave infrastructure and the productive capacity unaffected.

Challenges in the Disaster management

Good governance and responsive administration have to be seen as non negotiable features of a dynamic process of effective links with the communities at risk from the devastating impact of disasters. This process must be driven by transparency and accountability of public functionaries and their ownership of the transition to paradigm shift. The challenges in the disaster management are due to the following bottleneck:

Fragile Institution

The National policy envisaged paradigm shift from the reactive postdisaster relief centric regime to more proactive and enabling environment of strengthened disaster preparedness, mitigation and improved emergency response

Table 1. People affected, lives lost and economic damage due to Disasters in India during 1980 to 2010

Year	Type of Disasters	People affected	Life lost	Economic damage (USD * 1000)
1980	Floods	30,000,023		
1982	Drought	100,000,000		
	Floods	33,500,000		
1984	Epidemic		3290	
1987	Drought	300,000,000		
1988	Epidemic		3000	
1990	Storm			2,200,000
1993	Floods	128,000,000		7,000,000
	Earthquake		9748	
1994	Floods		2001	
1995	Floods	32,704,000		
1996	Storm			1,500,300
1998	Storm		2871	
	Extreme Temp		2541	
	Floods		1811	
1999	Storm		9843	2,500,000
2000	Drought	50,000,000		
2001	Earthquake		20,005	2,263,000
2002	Drought	300,000,000		
	Floods	42,000,000		
2004	Floods	33,000,000		2,500,000
	Earthquake		16,389	
2005	Floods			3,330,000
	Floods			2,300,000
2006	Floods			3,390,000
2009	Floods			2,150,000

Source: "EM-DAT: The OFDA/CRED International Disaster Database

In the 1970s and the 80s droughts and famines were the biggest killers in India, the situation stand altered today. It is probably a combination of factors like better recourses management and food security measures that has greatly reduced the deaths caused by droughts and famines. Floods, high winds and earthquakes dominate (98 percent) the reported injuries, with ever increasing numbers in the last 10

capacities of all stakeholder groups. For this the govt. of India enacted Disaster management act of 2005 and set up national management disaster authority charred by prime minister of India. The national policy and disaster management act are still in educate and inefficient as they lack the effective implementation by the concerned authorities whom it has been delegated.

Table 2. Year-wise damage caused due to floods, cyclonic, storms, landslides etc. During last ten years in India

Year	Live lost human (In Number)	Cattle Lost (In Number)	Houses damaged (In Number)	Cropped areas affected (In Lakhs hectares)
2001-02	834	21,269	3,46,878	18.72
2002-03	898	3,729	4,62,700	21.00
2003-04	1992	25,393	6,82,209	31.98
2004-05	1995	12,389	16,03,300	32.53
2005-06	2689	1,10,997	21,20.012	35.52
2006-07	2402	4,55,619	19,34,680	70.87
2007-08	3764	1,19,218	35,27,041	85.13
2008-09	3405	53,833	16,46,905	35.36
2009-10	1677	1,28,452	13,59,736	47.13
2010-11	2310	48,778	13,38,619	46.25

Source: Ministry of Home Affairs (MHA)

Table 3. Natural Disasters in India from 1980-2010

No of Events	431
No of people killed	143,039
Average killed per year	4,614
No of people affected	1,521,726,127
Average affected per year	49,087,940
Economic Damage(US$*1000)	48,063,830
Economic Damages per year	1,550,446

Source: Preventionveb

Need to adopt innovative system, techniques and technologies

Most modern nation has adopted innovative system to improve the effectiveness of the post climate disaster management. As India is highly populated country and being high growth economy, the chances of emitting greenhouse gases more. India needs to adopt eco-friendly technology in order to reduce the emissions.

The problem of financing post disaster immediate and long term recovery

The responsibility for disaster funding in the aftermath of a natural catastrophe has been shared by the state and central governments. While the affected state manages the relief work and reconstruction efforts, the central government provides financial support but due the lack of coordination among the centre and the state governments, these policies are not implemented.

Policy Recommendation

Both climate change and increasing disasters will play out in future against the back drop 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. The Global Risk Network, an initiative of the World Economic Forum, in its Global Risk 2007 Report, identified 23 core global risks to international community over the next ten years. A total of 9 of these 23 risks (39 %), pertain to risks related to natural, health and climate related disasters in the environmental and societal domains (WEF, 2007). 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. Clearly, the forecast places managing these growing risks as a frontrunner imperative for any aspiring global power. The challenge of climate change and increasing disasters will have to be addressed in the back drop of the key drivers of change, viz, economic growth, population rise, resource competition, changing demographics, increasing diseases, mass displacement and environmental impacts. Given the lack of resources, and access to technology and finances India has limited capacity to develop an adopt strategies to reduce its vulnerability to changes in climate. To manage the climate change-disasters-security nexus, the country needs to have improved scientific understanding, capacity building, networking and broad consultation processes across every section of the society. A few important policy recommendations are enumerated in the succeeding paragraphs.

Integrated Risk Management Framework

The possibility of climate change and natural disaster imposes a comprehensive integrated risk management framework. In India disaster management is being addressed by the National Disaster Management Authority (NDMA) as the apex body for addressing policy issues and for laying guidelines. Climate change is being addressed at various levels, by the Ministry of Environment and Forests, the Ministry of Science and Technology, the Ministry of External Affairs well as by the Prime Minister's Office. There is wide divergence among these entities. There is an urgent need to bring climate change and disaster communities on a commonplat form, and develop an integrated risks management framework or model for the challenges of climate change and increasing disasters. An integrated approach would mean:

- Better coordination among the climate change, disasters and development communities,
- Even-handed attention to the reduction of greenhouse gases and of the risks associated with climate change, including through enhanced disaster management.
- Improved conceptual and methodological approaches to understand and respond to local manifestations of disasters while simultaneously addressing underlying the complex global processes.

Adaptation and Mitigation

Both adaptation and mitigation have been key levers in disaster risk reduction and climate change strategies. An integrated risk management framework needs to build on these two vial strategies. However adaptation, in comparison to mitigation has been the neglected stepchild in both disaster risk reduction and global negotiations and debates over

climate change, mainly due to the complexity of separating adaptation from other socio economic, environment and development issues. Mitigation (structural, reduction of green house gases etc) with clear visible manifestation of actions has been the easier chosen option. India has many mitigation projects for disasters, viz, earthquake, flood, drought mitigation, etc, but adaptation is largely spoken about only in discussions. This must change. The key levers of adaptation include poverty reduction, progressive change in economic structures, shifting away from primary (agriculture) livelihoods into (secondary and tertiary) knowledge based forms of economic activity that are less vulnerable to direct impacts of risks, changes in land use and cropping patterns etc and enhancing the resilience of people. Adaptation will involve coping with climate change in the context of several factors that influence vulnerability. The Government of India has many polices in place that are directed to enhancing the adaptive capacity. However, implementation of these at the local level has been poor, as manifest in the slow eradication of poverty, inequity etc and low human development index.

New Approach to Vulnerability

There have been changes in the concept of vulnerability recently, and this requires a new approach. India has a unique vulnerability profile and each disaster affects the other. The poor are the most affected as they are unable to break the cycle. Extreme weather events occur more often and are becoming more severe, and vulnerability will increase. Trends in India show that rescue and rehabilitation do not solve problems, prevention and planning are required. Communities must be made more resilient. Strategies and policies must cope with climate change and adaptability and increasing vulnerability. The top-down approach has been left with very minimal impact.

Development as a Tool for Reducing Risk

Climate change and disasters interface with diverse social and natural processes and consequently with the developmental process. The conventional view has been to consider disasters and climate change as a barrier to development and simultaneously developments as a threat to climate change. However development can be the driving force to overcome challenges and risks of climate change.

International Cooperation

Climate change and disasters have no boundaries, and will spread across geographical divides. We need to broaden and deepen the nature and scope of on-going dialogues to encompass the entire subcontinent. Ironically, climate change offers humanity an opportunity for a quantum leap in sustainable development and in peace making. If international cooperation, as opposed to competition, is strengthened in response to the threat of climate change and increasing disasters, international stability, governance, and development could also benefit. As quoted by UNDP regarding MDG 8: "Climate change, a global phenomenon, calls for a collective response in the form of global partnerships" (UNDP, 2007c).

Conclusion

It is clear that the Climate change and increasing disasters have positive relation. The paper explores the climate extremes due to climate change or global warming have negative impact on the India economies, agriculture, food security, water, sanitation, the environment and the health each year. There is an urgent need to look into the other new funding options which may further enhance the process for disasters risk reductions and sustainable development in a more integrated format. In the short term the post-disaster period can offer opportunities for acquiring foreign capital through reinsurance payments, remittances, international emergency relief and development aid. However, more usually this period of opportunity is short lived and insufficient to compensate for all losses, especially those systemic and secondary disaster impacts that may only be felt some time after the initial disaster shock. With better planning, preparedness and awareness and mitigation measures we can significantly reduce the impact of disasters for our people in the near future. Good governance and the response administration have to be seen as non-negotiable features of a dynamic process of effective interface with the communities at risk from the devastating impact of disaster. The approach to disaster management has been undergoing a change from a relief centric to more proactive approach encompassing all phases of disaster management without limiting it to relief.

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