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Climate Extremes: Pathways for Preparedness and Anticipatory Action

Co-Editors: Shilpi Srivastava, and Mihir R. Bhatt
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Drought, May 2022. Photo credit: Megha Sheth.

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INTRODUCTION

Overview

By ***Shilpi Srivastava,*** *Research Fellow, Institute of Development Studies (IDS), UK*

In recent years, we have seen a rapid acceleration in the pace of climate change with extreme weather events becoming more frequent and intense across the world. In many instances, some of these events exceeded historical norms and/or model projections (UNDRR 2024).

In South Asia, floods devastated regions across Afghanistan, India, Nepal, Pakistan and Bangladesh during the 2024 monsoon period. In some places, these events were interspersed by cyclones and storms. For example, several parts of North-Western India were in the grip of extreme rainfall and floods. The impact was further compounded by the incidence of cyclone Asna which scientists described as 'rare' since cyclones are not typical of the monsoon period (Choudhury 2024).

This is the 'new normal' of our global climate system as it becomes more variable and volatile with the incidence of climate extremes. However, there remain considerable uncertainties about the impact of such complex events (Mishra et al. 2024), especially when they strike in areas with no prior historical record of occurrence (such as floods in drought-prone areas) or at a time when they have not occurred before (early onset of heatwaves during spring in South Asia) (Srivastava et al. forthcoming).

In parallel, we are also witnessing a co-occurrence of multiple extremes (which are increasingly becoming co-located by way of being closely timed (such as droughts followed by floods) or co-occurring (such as droughts, heatwaves and wildfires). This is what we have called **co-located hazards** in the "Anticipating Futures: Forecasting and Climate Preparedness for Co-located Hazards in India" project (ANTICIPATE, funded by the British Academy) which hosts this Special Issue in collaboration with AIDMI. The project examined how different actors forecast and prepare for such co-located hazards under conditions of climatic uncertainty, and whether and how these practices can be integrated for building preparedness.

These extreme events indicate a shift away from what we may be familiar with towards uncertainty where the incidence, impact and scale of these events are difficult to predict accurately. Unlike risk where we know the odds and the probabilities can be calculated (cf. Wynne 1992), uncertainty is where one does not know the odds and probabilities cannot be calculated.

In our project, we argue that climate extremes have ushered us into a world of **radical uncertainty** where the past is no longer a good guide for the future (Srivastava et al. 2021). In the project, we have conceptualised this radical uncertainty in two ways: first, the lack of prior knowledge which limits coping/adaptation; second, the experience of high volatility which is just not ecological (caused by hazards or extremes) but its integration with other drivers including social arrangements (caste, class, gender, sexuality, ethnicity, ability) and political drivers (market forces, governance arrangements, etc.), which often tend to make the outcomes more uncertain for vulnerable communities on the frontline (Mehta et al. 2022).

The contributions in this volume bring out the multiple ways in which climate extremes shape uncertainties for various actors from climate scientists to the local communities on the ground. The first few articles highlight the complexities of forecasting such extremes and their communication. These are followed by a set of articles from different parts of the country which bring out the every day and socially differentiated experiences of local communities with floods, droughts, heatwaves and landslides. They underline how the most vulnerable groups (women and landless communities) are bearing the brunt of these climate shocks and stressors and how the slow impacts generally remain hidden from the policy gaze. The contributions raise important questions about anticipation and limits to anticipation in the context of climate extremes.

In diverse ways, the articles highlight how the extremes are displacing assumptions of 'known' risks and stationarity and are compounding vulnerability across temporal, spatial and social scales. As such, extreme events become more pervasive globally, new and agile ways of thinking about preparedness are required which acknowledge local experiences and plural knowledges and are well aligned with local needs to build trust and reliability in anticipatory action and response. ■

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CLIMATE SCIENCE PERSPECTIVE

Anticipatory Actions: Three Observations from Climate Science

*By **Krishna AchutaRao**, Professor, Centre for Atmospheric Sciences, Affiliate Faculty, School of Public Policy, Indian Institute of Technology Delhi, India*

Recent years have seen dramatic increases in extreme weather and climate events across the world. Such events include heat waves, droughts, tropical cyclones, extreme rainfall and floods. These increases have been predicted to occur by climate scientists warning about the consequences of climate change brought on by human activities. The science of event attribution has enabled scientists to quantify the contribution of climate change in making such events more extreme than they would have been without human activities. As a climate scientist who has worked to improve our understanding of the climate system, I have watched with alarm how dramatically climate change has unfolded.

Uncertainty is Not Your Friend

There have always been uncertainties in estimates of future climate change. While not the only source of uncertainty, our incomplete understanding of the climate system is the primary reason as far as climate scientists are concerned. Lately, we are seeing that some variable of consequence or other has completely overshot the uncertainty range we had predicted just a couple of years ago and in a direction with adverse consequences for the climate and society. The dramatic increases in sea surface temperatures in parts of the Atlantic Ocean or the large decreases in sea-ice extent around Antarctica in the last couple of years have led to concerns that what we know less than we thought we did, and that the climate system is perhaps more sensitive to our activities than we had estimated.

What Does it Mean to Forecast?

Our plans for adaptation to climate change seem to hinge on mitigating disaster risk by forecasting weather and climate hazards well enough in advance. One such hazard in India is heatwaves for which many Heat Action Plans are in place. India is no stranger to hot summers and heatwaves have occurred here well before human-caused climate change happened. A recent study by Arulalan et al. (2023) suggests that the future heatwaves over India will be more widespread geographically and last for longer durations - perhaps as long as a couple of months. The last couple of years have witnessed heatwaves across the Indian subcontinent and Southeast Asia that have lasted for weeks. If future summer seasons are essentially one long heatwave, what is the value added from forecasting?

Acting in the Face of Uncertainty

Science is currently better at forecasting temperatures than heavy rainfall or flooding and we will always be chasing the better forecast to take better actions. But knowing that we will never be able to make a perfect forecast, what is a good enough forecast to act? The answer to this question could benefit adaptation actions. The details of everyday weather forecasting cannot become our strategy guiding adaptation actions. We need to take a longer-term view of the changing statistics of weather to inform our decisions that reduce exposure and vulnerability.

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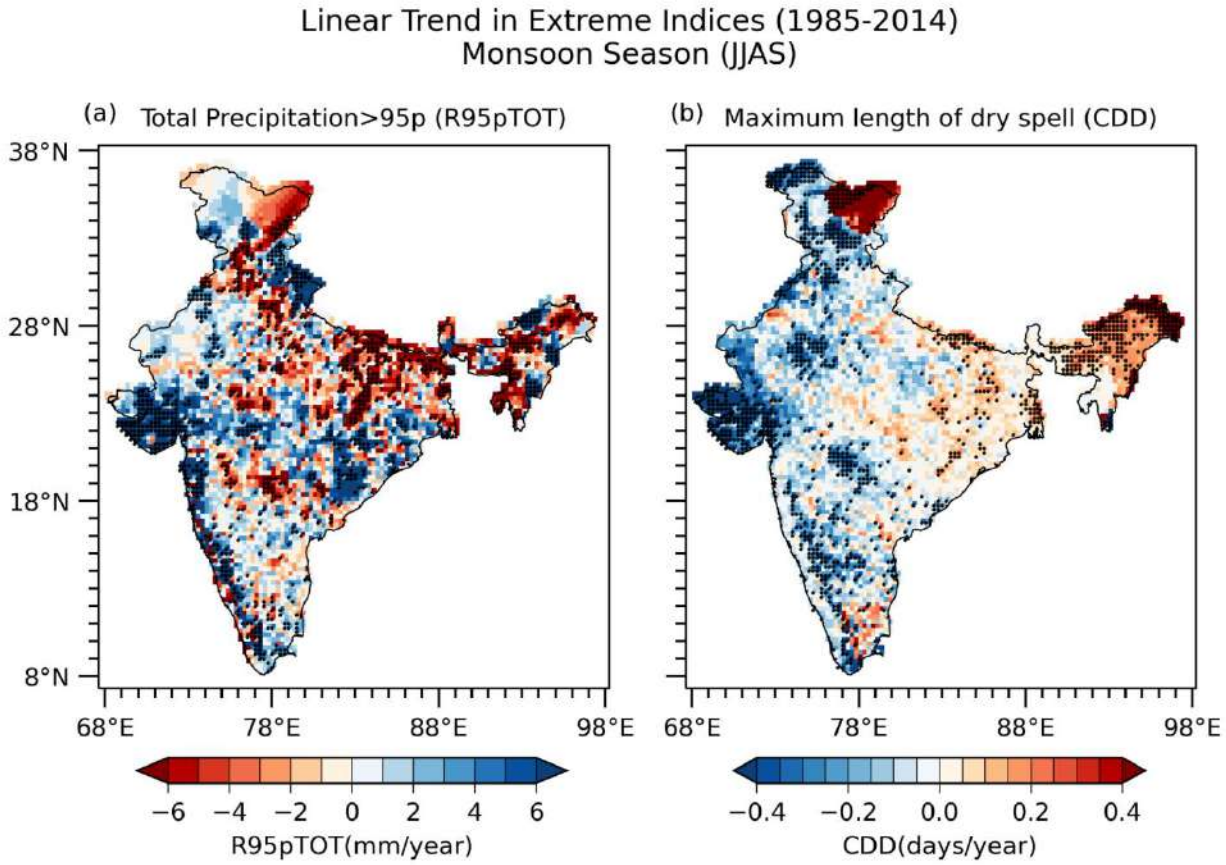
CLIMATE SCIENCE PERSPECTIVE

Shifting Extreme Precipitation Patterns in a Warming World

*By **Chaithra ST,** PhD Student, Indian Institute of Technology Delhi, India*

Human activities, particularly greenhouse gas (GHG) emissions dominated by CO2, are the primary drivers of climate change, leading to rising global temperatures and changing weather patterns (IPCC 2021). While natural factors like the El-Niño-Southern Oscillation (ENSO) and volcanic activity also affect global mean temperatures, their impacts are smaller compared to human contributions (Fischer and Knutti 2015; Gillett et al. 2021). Human-induced climate change has increased the frequency, intensity, and duration of extreme weather events, necessitating better understanding, monitoring, and mitigation efforts (IPCC 2021).

Global surface temperatures have risen by 1.1°C above pre-industrial levels in 2011-2020, primarily due to GHG emissions, with ongoing increases driven by unsustainable energy use, land use, and consumption patterns (IPCC 2023). Rising temperatures have led to increased heatwaves and extreme heat events (Bindoff et al. 2014; Perkins-Kirkpatrick and Lewis 2020), while human influence on precipitation changes is less clear. Studies suggest increasing trends in extreme precipitation events globally, albeit with significant regional variability (Seneviratne et al. 2021). Extreme precipitation events are also increasing in various parts of India, leading to devastating floods in recent years, including the 2013 Uttarakhand, 2014 Srinagar, 2015 Chennai, 2017 Gujarat, 2018 Kerala, and 2023 Himalayan floods. These events caused significant human and economic losses, with rising trends in extreme rainfall intensity identified in various parts of India including central India, the



Source: Chaithra ST, ongoing PhD research on 'Precipitation Extremes over India: Detection & Attribution Study' Department: Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi (India).

Western Himalayas, and the upper Indus basin (Goswami et al. 2006; Mishra and Liu 2014; Roxy et al. 2017), highlighting the urgent need for climate change attribution studies.

India typically experiences its heaviest rainfall along the west coast, followed by the central and northeastern parts of the country. Recent observations suggest a noteworthy increase in extreme precipitation intensity (represented by the index 'R95pTOT' which is the total precipitation when rainfall > 95p) over the northwestern region, particularly Gujarat, from 1985 to 2014 (shown in the figure above). Concurrently, there has been a reduction in the maximum length of consecutive dry days (CDD) over the northwest indicating more frequent and intense rainfall events and fewer prolonged dry periods. Conversely, the northeastern regions have seen a decrease in extreme rainfall intensity and an increase in CDD implying a shift towards drier conditions.

In the twenty-first century, GHGs and aerosols are the primary anthropogenic forcing factors. However, aerosol levels are anticipated to decline (Lamarque et al. 2011; Wang et al. 2015) may amplify climate warming and exacerbate extreme weather events driven by GHGs (Rotstayn et al. 2013; Lin et al. 2018). Globally, anthropogenic GHG emissions have significantly contributed to the intensification of extreme precipitation events (Min et al. 2011; Madakumbura et al. 2021). The contribution is expected to rise nonlinearly with further temperature increases, reaching about 40per cent with a 2°C temperature rise (Fischer and Knutti 2015). Detecting human influence on regional extreme precipitation is challenging due to natural variability masking anthropogenic signals, although regional-scale detection of anthropogenic signals may occur earlier (Martel et al. 2018).

Evidence underscores changes in extreme precipitation patterns globally. With rising temperatures, the frequency and intensity of extreme weather events are projected to increase, posing significant challenges to human and natural systems. However, detecting human influence on regional extreme precipitation changes remains complex due to natural variability. Nonetheless, the urgency of understanding and mitigating the impacts of these changes cannot be overstated, particularly for a country like India. This highlights the need for concerted efforts in climate change attribution studies and the development of effective adaptation and mitigation strategies to address the growing risks posed by extreme events.

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Is Extreme Rainfall Leading to 'Green Drought' in Western India?

For the last two years, the ANTICIPATE project team has been exploring how local communities in Banaskantha (North Gujarat) experience and cope with the extremes of drought and floods, which have become more frequent in the past decade. While exploring the lived experiences and impacts of these hydrological extremes, we were struck by the framing of *'leelo dukaal'* (translated into English as 'green drought'). This was reported to us as the fall out of an untimely and 'strange' pattern of monsoon rains (July to September), which were leading to water-inundated farms and crop devastation.

Green droughts are characterised by stunted plant growth and reduced crop yields, making them challenging to detect and diagnose. Contributing factors include uneven rainfall patterns, high temperatures, shallow-rooted plants, and soil compaction, which hinders water reaching down to the root zone. At the outset, this description fits well with the local experiences of green drought in Gujarat.

In rural Banaskantha, memories of the 1986-87 drought are often invoked, where people speak of a *dukaal* (hard time) where there was "no water, no food to eat and the pervasive loss of livestock". Green drought, however, presents a contrasting situation where *dukaal* is triggered not by water scarcity but by the abundance of water. There is green cover in the field with weeds and grass but limited to no crops left to harvest. As with slow onset events, the impacts of green drought also evolve over a longer period, leading to slow depletion livelihoods

In these parts of the country, green drought is a new phenomenon, and its impacts are slowly emerging and becoming visible as wet days intensify in the region. For example, in 2024, Gujarat has experienced widespread flooding and heavy rainfall during the monsoon period. More investigation is needed to understand this phenomenon as both a social, ecological and hydrological condition. Understanding these increases in extreme rainfall and dry spell patterns is crucial for developing adaptive strategies to mitigate the impacts of climate variability on agriculture and water resources, in Gujarat and beyond.

Excerpt from the IDS Blog: https://www.ids.ac.uk/opinions/is-extreme-rainfall-leading-to-green-drought-in-western-india/ . *Read the full blog in Gujarati on page no. 8.*

શું ભારે વરસાદ પશ્ચિમ ભારતને 'લીલા દુકાળ' તરફ દોરી જાય છે?

શિલ્પી શ્રીવાસ્તવ, રિસોર્સ પોલિટિકસ અને એન્વાયર્નમેન્ટલ ચેન્જ ક્લસ્ટર લીડ અને રિસર્ચ ફેલો; મેધા શેઠ, ANTICIPATE રિસર્ચ ઓફિસર; ચૈથરા એસ.ટી., પીએચડી સ્ટુડન્ટ, સેન્ટર ફોર એટમોસ્ફેરીક સાયન્સ, ઈન્ડિયન ઈન્સ્ટિટ્યૂટ ઓફ ટેકનોલોજી, દિલ્હી; અને વિનીતા બચીના, ANTICIPATE રિસર્ચ ઓફિસર

આબોહવા પરિવર્તન સમગ્ર વિશ્વમાં વરસાદની પેટર્નમાં ફેરફારનું કારણ બની રહ્યું છે, કૃષિ અને આજીવિકાને નુકસાન પહોંચાડે છે અને વૈશ્વિક સ્તરે લાખો જીવનને અસર કરે છે. ભારતમાં, ગ્રામીણ ગુજરાતના ખેડૂતો દુકાળ અને પૂરના ચક્રમાં ફસાયેલા છે અને તેની 'સહ-સ્થિત જોખમો'ની અસરને 'લીલો દુકાળ'ના રૂપમાં જોવા મળે છે.

ANTICIPATEના સંશોધકો આ પ્રોજેક્ટ વૈજ્ઞાનિક સમજણ અને સ્થાનિક અનુભવોનો ઉપયોગ કરીને આ ઘટનાને ઊંડાણપૂર્વક સમજવાનો પ્રયાસ કરે છે. તેઓ દલીલ કરે છે કે જ્યારે મોટા ભાગનું ધ્યાન એ 'તીવ્રતા' પર રહે છે, તે ધીમી શરૂઆત અથવા ધીમા જોખમો છે જેના પર આપણું ધ્યાન જરૂરી છે.

છેલ્લાં બે વર્ષથી, અમારી સંશોધન ટીમ બનાસકાંઠા (ઉત્તર ગુજરાત)માં સ્થાનિક સમુદાયો દુકાળ અને પૂરની અસરોનો કેવી રીતે અનુભવ કરે છે અને તેનો સામનો કેવી રીતે કરે છે તેની શોધ કરી રહી છે, જે છેલ્લા એક દાયકામાં વધુ વારંવાર બની છે. આ હાઇડ્રોલોજિકલ તીવ્રતાઓના જીવંત અનુભવો અને અસરોનું અભ્યાસ કરતી વખતે, અમને લીલા દુકાળની રચના દ્વારા આશ્ચર્ય થયું. ચોમાસાના વરસાદ (જુલાઈથી સપ્ટેમ્બર)ના

Credit: Megha Sheth.

'અણધાર્યા' અને 'વિચિત્ર' પેટર્નના પરિણામે અમને આની જાણ કરવામાં આવી હતી, જે ખેતરોમાં પાણીમાં ડૂબેલા અને પાકના વિનાશ તરફ દોરી જતા હતા.

જો કે ભારતીય ચોમાસું કૃષિને ટકાવી રાખવામાં અને ખાદ્ય સુરક્ષા સુનિશ્ચિત કરવામાં મહત્વની ભૂમિકા ભજવે છે, તેમ છતાં વરસાદનો સમય અને જથ્થાનો મોટો ભય હંમેશા ખેડૂતો માટે મહત્વનો રહ્યો છે. તાજેતરના વર્ષોમાં ગુજરાતના ખેડૂતો પાસેથી જાણવા મળ્યું કે પૂરના પ્રકારમાં વધારો અને પાણીનો ભરાવો, જે ટૂંકા ગાળામાં ઉભા પાકને નુકસાન પહોંચાડે છે અને લાંબા ગાળે જમીનનું ધોવાણ અને જમીનની ગુણવત્તામાં ઘટાડો કરે છે.

અમારા સંશોધનમાં જાણવા મળ્યું છે કે સ્થાનિક સમુદાયો દુકાળ અને પુરની પરસ્પર અસરોનો સામનો કરવા માટે સંઘર્ષ કરી રહ્યા છે. પરંપરાગત મોસમી હવામાન પેટર્નમાં પરિવર્તન સાથે, આ રાજ્યના ઘણા પ્રદેશો હવે મે થી જુલાઈ સુધી તીવ્ર ગરમી અને દુકાળનો અનુભવ કરી રહ્યા છે, ત્યારબાદ ઓગસ્ટથી સપ્ટેમ્બર દરમિયાન ભારે વરસાદ અને પૂર આવે છે. અમે અમારા આ સંશોધનમાં 'સહ-સ્થિત જોખમો'ને અવકાશી અને સમયના અતિસંયોજન તરીકે વર્ણન કર્યું છે.

બનાસકાંઠા, ગુજરાતમાં દુકાળ - એક ઐતિહાસિક ઝાંખી

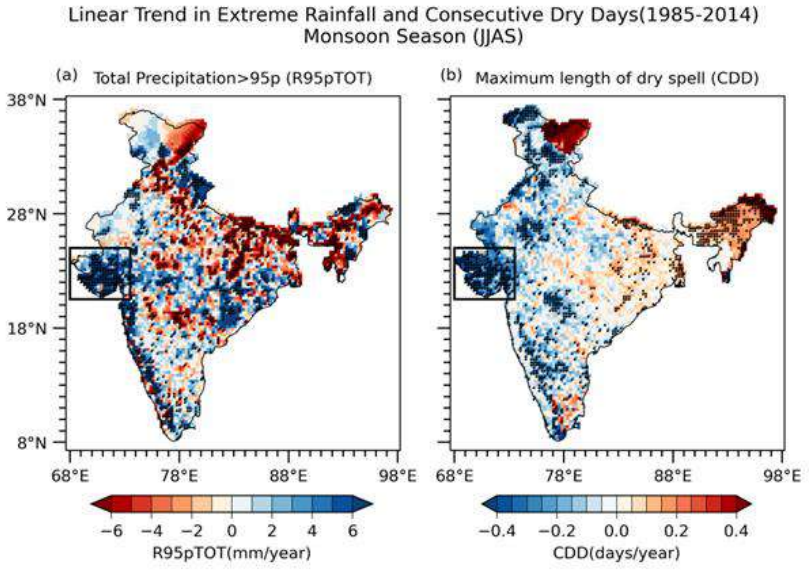
ગુજરાત રાજ્ય ઉત્તર પશ્ચિમ ભારતના શુષ્કથી અર્ધ શુષ્ક પ્રદેશો હેઠળ આવે છે. વર્ષ 2019થી જોવા મળ્યું છે કે સૌથી વિનાશક દુકાળ ગુજરાત રાજ્યમાં જ્યાં જાન્યુઆરી અને જુલાઈ વચ્ચે માત્ર 196

મીમી વરસાદ નોંધાયો હતો, જે તેના સામાન્ય 816 મીમી (86 ટકા નીચે)નો માત્ર એક ભાગ છે અને બનાસકાંઠામાં સમાન સમયગાળામાં વરસાદ 81 ટકા ઓછો હતો. આબોહવાની રીતે, ભારત પશ્ચિમ કિનારે ભારે વરસાદના ઉચ્ચતમ સ્તરનો અનુભવ કરે છે, પરંતુ તાજેતરના અવલોકનો (1985-2014) નીચેની આકૃતિ-1 દ્વારા દર્શાવ્યા મુજબ ભારે વરસાદમાં વધારો સૂચવે છે.

બનાસકાંઠામાં 2012-13, 2015-16 અને 2018-19માં દુકાળને સત્તાવાર રીતે જાહેર કર્યો હતો. સરકારે જિલ્લાને દુષ્કાળગ્રસ્ત જાહેર કર્યો છે કે કેમ તે ધ્યાનમાં લીધા વિના, જિલ્લામાં વર્ષ દરમિયાન ચોમાસાની નોંધપાત્ર ખાધનો અનુભવ થયો છે, જેની અસરો વધુ જટિલ છે. દુકાળ રાહતના પગલાં અને વળતરનો અભાવને લીધે જ્યારે પૂર જેવા જોખમો આવે છે ત્યારે સમુદાયોને વધુ મુશ્કેલીમાં મૂકે છે.

'લીલા' દુકાળ વિશે અભ્યાસ

દુકાળના વિવિધ વર્ગીકરણો, જેમ કે હવામાનશાસ્ત્ર અથવા હાઇડ્રોલોજિકલ દુકાળ, લીલો દુકાળ એ એક ભ્રામક દૃશ્ય છે જ્યાં વનસ્પતિ અને ઘાસ લીલાછમ દેખાય છે. લીલા દુકાળ અંતર્ગત પાણીની તાણ મૂળ પર છોડની વૃદ્ધિ અટકવી અને પાકની ઉપજમાં ઘટાડો દ્વારા વર્ગીકૃત થયેલ છે, તેમને શોધવા અને નિદાન કરવા માટે પડકારરૂપ બનાવે છે. આ પરિબળોમાં અસમાન વરસાદની પેટર્ન, ઉચ્ચ તાપમાન, છીછરા મૂળવાળા છોડ અને માટી ઘનીકરણ, જે મૂળીયા સુધી પાણી પહોંચવામાં અવરોધે છે. શરૂઆતમાં, આ વર્ણન ગુજરાતમાં લીલા દુકાળના સ્થાનિક અનુભવો સાથે સારી રીતે બંધબેસે છે. જો કે, જટિલ અભ્યાસ તરીકે દુકાળ અને પાણીની અછત જણાવે છે કે સામાજિક તફાવત અને નબળાઈના પ્રકારના આધારે અસરો અલગ રીતે અનુભવાય છે.



Source: Chaithra ST, ongoing PhD research on 'Precipitation Extremes over India: Detection & Attribution Study' Department: Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi (India).

'લીલો દુકાળ' અને તેની આંતરછેદ અસરોના જીવંત અનુભવો

ગ્રામીણ બનાસકાંઠામાં, 1986-87ના દુકાળની યાદોને વારંવાર યાદ કરવામાં આવે છે, જ્યાં લોકો દુકાળ (મુશ્કેલ સમય) "પાણી નથી, ખાવા માટે ખોરાક નથી, અને પશુધનનું વ્યાપક નુકસાન" કહેતા હતા. હવે લીલો દુકાળ, એક વિરોધાભાસી પરિસ્થિતિ રજૂ કરે છે. જ્યાં દુકાળ એ પાણીની અછતથી નહીં પરંતુ પાણીના વધારાથી સર્જાય છે. ખેતરમાં નીંદણ અને ઘાસ સાથે લીલું આવરણ હોય છે પરંતુ લણણી માટે કોઈ પાક હોતો નથી. આ ધીમી શરૂઆતની ઘટનાઓની જેમ, લીલા દુકાળની અસરો પણ લાંબા ગાળામાં વિકસિત થાય છે, જે ધીમી આજીવિકા તરફ દોરી જાય છે.

લીલા દુકાળની વિભેદક અસર

અમારી ફિલ્ડ સાઇટના ખેડૂતોના જણાવ્યા અનુસાર, લીલો દુકાળ ખેતીના તમામ તબક્કાઓને અસર કરે છે. પ્રારંભિક ચોમાસા દરમિયાન સતત વરસાદ જમીનને સંતૃપ્ત કરે છે, પાકની વાવણીમાં વિલંબ અથવા અટકાવે છે (કપાસ, એરંડા, ચારો અને બાજરી). જો પાકની વાવણી સમયસર કરવામાં આવે તો પણ, સતત વરસાદથી તેની વૃદ્ધિને અવરોધે છે, જેના કારણે પાણી ભરાઈ જાય છે અને પાક બગડે છે. ઉદાહરણ તરીકે, 2022ના ચોમાસાના સમયગાળા દરમિયાન, કપાસના પાકમાં કુલ પાકની નિષ્ફળતાથી માંડીને એરંડામાં પાકમાં ઘટાડો અને પાકની નબળી ઉપજ સુધીની અસરો હતી. આ નુકસાન માત્ર ઘરની ખાદ્ય સુરક્ષાને અસર કરતું નથી પરંતુ આખા વર્ષ માટે આર્થિક અસ્થિરતાનું કારણ બને છે અને

નબળા પરિવારો કે જેમના ખેતરોને નુકસાન થયું હતું તે ગામથી સ્થળાંતર કરવા માટેનું કારણ બને છે.

જમીનનો પ્રકાર લીલા દુકાળની અસર નક્કી કરે છે

કેટલાક ખેડૂતોએ ઉલ્લેખ કર્યો છે કે લીલો દુકાળની અસરો જમીનની પાણીને શોષવાની અથવા ચોખ્ખી કરવાની ક્ષમતાના આધારે અલગ પડે છે. ગામમાં મોટાભાગના ખેતરો રેતાળથી ચીકણી માટી (રેતાળ લોમ) જમીનના છે. ખેડૂતો અને કૃષિ નિષ્ણાતના મતે, રેતાળ જમીન પાણીને વધુ સરળતાથી શોષી લેતી હોવા છતાં, રેતાળ જમીનમાં પાકની નિષ્ફળતા વધુ જોવા મળે છે. તે બાજરી માટે સારી છે પરંતુ નફાકારક કપાસ અને એરંડાના પાક માટે નહીં. સફળ સિઝનમાં પણ, રેતાળ જમીનમાંથી લણાયેલા પાકનું વજન રેતાળ લોમ કરતા ઓછું હોય છે. તેમ છતાં, રેતાળ જમીનમાં ઉગાડવામાં આવતા પાકો રેતાળ લોમની સરખામણીમાં દૈનિક વરસાદ દરમિયાન વધુ સ્થિતિસ્થાપક હોય છે. આનો અર્થ એ છે કે મુખ્યત્વે રેતાળ લોમ જમીન ધરાવતા ખેડૂતોને નુકસાનનો સામનો કરવો પડે છે. જો કે, ખેત મજૂરો અને જમીન વિહોણા મજૂરો માટે પરિસ્થિતિ વિકટ છે જ્યાં એક સીઝનનું નુકસાન વિનાશક બની શકે છે કારણ કે તેમની પાસે આઘાત અને તણાવ માટે મર્યાદિત સ્થિતિસ્થાપકતા છે.

મહિલાઓ માટે કામનું ભારણ વધે છે

ચોમાસાની ઋતુમાં વાવણી અને નુકસાનનું ચક્ર ચાલુ રહેતા હોવાથી મોટાભાગની મજૂરીકામ સ્ત્રીઓ પર પડે છે. તેઓને માત્ર ઘરના કામકાજ કરવામાં જ મુશ્કેલીઓનો સામનો કરવો પડતો નથી, પરંતુ સારી ગુણવત્તાના પાણી માટે લાંબા અંતર સુધી ચાલવું પણ પડે છે . સાથેસાથે જ્યારે પાક નિષ્ફળ જાય ત્યારે ઘાસચારો એકત્રિત કરવાની વધારાની જવાબદારીઓ પણ સોંપવામાં આવે છે. ચોમાસાની ઋતુમાં મહિલાઓ દિવસના સૌથી વધુ કલાકો કામ કરતી જોવા મળે છે. ખેતરની કટોકટીઓ સાથે (જેમ કે એક જ સિઝનમાં વાવણીના એકથી વધુ રાઉન્ડ હાથ ધરવા, વનસ્પતિનું વ્યાપક નિંદણ અને નિષ્ફળ ગયેલા પાકનું વર્ગીકરણ) આ‘ કામમાં અણધાર્યો વધારો ’રહે છે અને યોગ્ય વેતન મળતું નથી.

આગળ શું કરવું

દેશના આ ભાગોમાં, લીલો દુકાળ એ એક નવી ઘટના છે, અને તેની અસરો ધીમે ધીમે વધતી રહી છે અને આ વિસ્તારોમાં ભીના દિવસોની વધુ તીવ્રતા સાથે દેખાઈ રહી છે. ઉદાહરણ તરીકે, 2024માં, ગુજરાતમાં ચોમાસાના સમયગાળા દરમિયાન વ્યાપક પૂર અને ભારે વરસાદનો અનુભવ થયો છે. આ ઘટનાને સામાજિક, ઇકોલોજીકલ અને હાઇડ્રોલોજિકલ બંને સ્થિતિ તરીકે સમજવા માટે વધુ તપાસની જરૂર છે. ગુજરાતમાં અને તેનાથી આગળના વિસ્તારોમાં, કૃષિ અને જળ સંસાધનો પર આબોહવાની પરિવર્તનશીલતાની અસરોને ઘટાડવા માટે અનુકૂલન વ્યૂહરચના વિકસાવવા માટે અત્યંત વરસાદ અને શુષ્ક જોડણીની પેટર્નમાં આ વધારાને સમજવું મહત્વપૂર્ણ છે. ■

Published on October 24, 2024. Gujarati translation from https://www.ids.ac.uk/opinions/is-extreme-rainfall-leading-to-green-drought-in-western-india/

ઉપરોક્ત બંને ફોટા ઓગસ્ટ 2022 માં ક્ષેત્રની મુલાકાત દરમિયાન લેવામાં આવ્યા હતા જ્યાં ચોમાસાની ઋતુ દરમિયાન કપાસની ખેતી કરવામાં આવી રહી હતી. ડાબી બાજુનું ખેતર વરસાદથી પ્રભાવિત થયું ન હતું, જ્યારે જમણી બાજુના ખેતરમાં પાણી ભરાઈ ગયું હતું. (ફોટો ક્રેડિટ: મેઘા શેઠ).

Role of IMD in Anticipatory Action: Recent Initiatives with Respect to Heatwaves

*By **Akhil Srivastava,** Scientist - D, India Meteorological Department, Delhi, India*

The India Meteorological Department (IMD) follows a unified seamless system for monitoring and predicting heatwaves. This system spans from seasonal-range forecasts (three months in advance), followed by monthly forecasts (one month in advance) issued on the first day of the month, to extended-range forecasts (with a lead time of one to two- weeks) issued every Thursday, and medium range to short-range forecasts (with a lead time of seven days) issued daily and updated four times a day. The impact-based heatwave warning is issued twice daily (morning and evening) with validity for the next five days at the meteorological sub-division to district and station level. It contains observed heatwave conditions, warm nights, relative humidity, winds, percentile analysis, etc., and a warning for heatwaves, warm nights, and hot & humid weather conditions. The heatwave warnings are distributed to numerous stakeholders, including the Ministry of Home Affairs, National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA), Chief Secretaries, State Emergency Operation Centres (SEOC), district authorities, health and agriculture departments, power sector, Indian Railways, road transport authorities, as well as press and electronic media. Additionally, and Heat Action Plan (HAP) authorities at city, district, and state levels receive these warnings through websites, email, Common Alert Protocol & social media platforms such as WhatsApp, Facebook, X (formerly Twitter), and other channels. The heatwave forecast and warning services are used at the highest level of the government for anticipatory actions to mitigate the impact of heatwaves.

The forecast issued by IMD for different lead times invokes different anticipatory actions within IMD and with different stakeholders. The seasonal and monthly outlook issued by IMD anticipates preparatory and stock-taking actions from different stakeholders. The meetings are conducted by NDMA and different state governments for preparedness measures. The activation of HAPs, which are local government-based actions to tackle heatwaves, is anticipated upon the issuance of seasonal/monthly forecasts of increased temperatures and heatwaves. Within IMD, the issuance of seasonal and monthly outlook of increased temperatures and heatwaves initiates the meeting, and discussions among different forecasting offices of the region concerned for more rigorous monitoring and forecasting services aspects. Capacity-building measures are undertaken to update the officials for ensuing weather conditions which includes pre-season exercises and refresher courses. This also provides an opportunity to revisit the climatological dataset of extreme heat conditions. There could be mock drills by the concerned state and central authorities to ensure early action based on early warnings.

The extended range forecast further highlights the main regions for heatwaves during the coming two weeks along with the duration of the heatwave spell. This forecast anticipates on-ground actions with respect to making the arrangements required for interventions from different stakeholders for mitigating heatwave impacts. It triggers a pre-heatwave spell exercise for the region. The HAPs are activated. Within IMD extensive monitoring of the current state of temperatures, Numerical Weather Prediction (NWP) model analysis and their consensus, video conferencing among forecasters etc. continues to ensure the timely forecast of heatwaves and its dissemination to different stakeholders based on sectorial requirements.

The short to medium-range forecast (lead time up to seven days) with impact-based colour-coded warnings (for the next five days) at the district level are issued by IMD twice daily. These district-wise colour-coded impact-based warnings anticipate the immediate commencement of actions at the district level by different stakeholders as per the guidelines issued by the NDMA. The colour-coded warnings issued by IMD are GREEN COLOUR (**No warning),** YELLOW COLOUR **(Be Updated**), ORANGE COLOUR (**Be Prepared**) & RED COLOUR (**Take Action**). The daily dedicated sectorial bulletins with impact information are issued for anticipatory actions on the ground, for example, IMD issues a daily Heatwave Bulletin for Indian Railways and IMD also issues daily weather forecast bulletins constituency-wise with respect to the Lok Sabha elections of 2024. ■

Water and Extreme Weather Events

By ***Lyla Mehta,*** *Professorial Fellow, Institute of Development Studies (IDS), UK*

"What energy is to mitigation, water is to adaptation." These wise words were said by the late Professor Saleemul Huq, Director of the International Centre for Climate Change and Development in Dhaka, Bangladesh (cited in WaterAid, n.d.). Huq was a global voice on climate justice, especially for the countries and people most vulnerable to climate change (but responsible for less than five per cent of global emissions). As our planet is increasingly confronted by floods, droughts, sea-level rise and melting glaciers, it is clear that most of these extreme weather events are around water. In 2023 alone, Asia witnessed 79 disasters, that killed over 2000 people and affected nine million people. Over 80 per cent of these extreme events were water-related namely floods and storms (Indian Express, 2023) Furthermore, there are also growing uncertainties due to co-located water-related hazards, e.g. droughts followed by floods, even in areas such as North Gujarat in India normally considered to be drought-prone.

All this makes water lie at the heart of climate action and adaptation. The problem is compounded by the fact that despite decades of global programmes and actions around water and sanitation, around 2 billion people (26 per cent of the population) lack safe drinking water, while 3.6 billion (46 per cent) lack access to safely managed sanitation. Added to which only 56 per cent of domestic wastewater is safely treated. These water and sanitation insecurities significantly undermine the adaptive capacity of poor and vulnerable people in coastal cities, deltas, drylands, urban informal settlements and remote rural areas to deal with increasing climate shock and stresses. When disasters strike, they affect water and sanitation systems, increasing water-borne diseases and malnutrition, especially for children. This makes water a key contributor to climate risks and uncertainties and also a key factor in climate adaptation (Rahman et al., 2023).

Narmada Canal - Amrapur Distributar. Photo credit: Megha Sheth (January 2023)

Yet, until recently water largely remained invisible in global climate debates and agreements. In part, this has to do with the nature of water, resources with mostly local, national or regional attributes. Even though about 80 per cent of countries that signed up to the Paris Agreement mentioned water as a key adaptation priority in 2015, water was rarely mentioned in the annual COPs. It was only in COP28 that all parties and stakeholders were called to "significantly reduce climate-related water scarcity, enhance resilience to water-related hazards, and realise a climate-resilient water supply" (Michel, 2023).

Yet there remain many challenges in ensuring that these actions are actually implemented on the ground, and in ways that will actually benefit poor, vulnerable and marginalised groups. Often planned interventions are narrowly framed around either too little water (scarcity) or too much water (floods) with 'solutions' that predominantly focus on top-down, capital-intensive infrastructure development or market-based solutions for optimising water-use efficiency (Srivastava et al., 2023).

In reality, water is a contested resource where physical availability doesn't necessarily translate to access. Instead, access is more determined by caste, class, gender,

race, public policy, institutional arrangements (both formal and customary), power and politics. Moreover, diverse sectoral needs, competing policies, interests, and political and economic actors tend to determine who gets water, when and where, and thus affect water distribution in all its dimensions (availability, access, quality and stability of supply) (Mehta et al., 2019). There are also risks of maladaptation that can inadvertently increase vulnerability to climate change. For example, in the Indian Sundarbans, embankments and engineered flood control have been implemented without recognising their impacts on poor and marginalised islanders, their ability to maintain structures and also ways in which vulnerability may be transferred to other locations thus leading to 'cascading' maladaptation that can reinforce or worsen current vulnerabilities. Many climate and water interventions often ignore local and Indigenous concerns and knowledge which must be the focus of adaptation responses. It is also important not to blame all water-related disasters on climate change. For example, so many recent flooding disasters in the Himalayas are more due to poor water management and development strategies in an ecologically fragile area than unexpected heavy rainfall.

In conclusion, it is important to recognise and embrace perspectives from 'below' and recognise the inherent uncertainty and its political nature as we seek to anticipate and respond to water-related extreme events. Decontextualised and top-down policies will invariably hamper appropriate adaptation processes (Mehta et al., 2022). This necessitates the need to embrace hybrid perspectives and knowledge and find ways to create convergences between water and climate policies and adaptation strategies that are locally led and rooted and push for inclusion, social justice and equity. ■

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Banas with Borewell. Photo credit: Megha Sheth

Practices of Anticipation in North Gujarat: Some Key Observations

*By **Vinitha Bachina,** ANTICIPATE Research Officer, Institute of Development Studies (IDS), UK*

Increasing incidence of climate extremes is becoming a key concern for local communities especially as they are experiencing a shift from traditional seasonal patterns. Extreme variability has pushed communities to the limit of coping and has placed an even greater burden of anticipation on women and landless people. Although women carry the burden of care during shocks and stressors, the gendered impacts of such climate events are largely invisible and undocumented. During our fieldwork in North Gujarat (2022-2024), several women spoke of their intensive daily routines which included milking their animals, walking to and from their fields at least five kilometres away, bringing back fodder and feeding livestock multiple times a day.

A woman takes buffaloes through the monsoon mud to graze. Photo credit: Megha Sheth (August 2022)

Gendered Impacts

A woman farmer in North Gujarat narrated how in the event of extreme rainfall: "It is very difficult to conserve dry firewood and get water to cook for the family, as at that time we do not have access to Panchayat or borewell water. Since the cattle are moved to shelters this only adds to the workload because we are responsible for feeding the animals". Despite the unequal burden of work, many women do not have a legal claim to the land they labour on, affecting their access to relief and crop insurance.

Shifting Practices and Unequal Access to Water Resources

Access to irrigation through dams and canals act as a buffer for communities dealing with delayed or erratic rainfall and heatwaves. In the ANTICIPATE research site, farmers with larger landholdings have installed private pipelines from the main and distributary canals at their own expense. This has altered perceptions around water scarcity and security and has caused prevailing practices to shift to cash crop cultivation, moving away from previously rain-dependent farming.

However, these water arrangements have intensified vulnerabilities for smaller landholders and landless farmers. Socio-economic hierarchies are further widening the gap not only between beneficiaries and non-beneficiaries of canal water, but they also decreasing water security for landless farmers as they are forced to depend on larger landholders and borewell owners. Anticipatory decision-making in such cases is challenged as intersectional vulnerabilities affect the extent to which communities are able to prepare.

Emerging Lessons for Preparedness

Anticipatory measures need to go beyond the household and require institutional support. For example, in Gujarat, there have been situations of unplanned dam opening schedules that have caused flooding in some areas. Large volumes of water were released when the dam reached its peak. Had the water been released with adequate warning, loss to crops, animals, and homes could have been avoided. Anticipatory decision-making at the household level is complex as not only does it intensify unpaid care responsibilities for women, but it is also affected by socio-economic vulnerabilities. Access to irrigation sources may act as a buffer during periods of extreme dryness and allows some farmers to engage in cash-cropping. However, the extent of household anticipation is limited and requires institutional support in the form of relevant and actionable forecasting information and planned dam operations. A socially inclusive view of preparedness that centres the experiences and perspectives of local communities is essential for bottom-up preparedness. ■

The Value of Visual Methods in Studying Extremes: What We Know Now?

By ***Shibaji Bose,*** *PhD Researcher, National Institute of Technology Durgapur, India*

To unveil the photo and narratives through participatory visual methods by co-producing with a population that is in the throes of climate uncertainty is a challenge. But when the same population is faced with an unprecedented phenomenon of drought and flood, it has its psychological traps as we tend to focus more on the dramatic unfolding of the extreme heat, hailstorms, floods, and pestilence than on the everyday stressors.

In the ANTICIPATE project, we aimed to capture the spectrum of voices and experiences of shocks and stressors amidst hierarchies of caste, ethnicity, religion, and gender through the visual methods of photovoice, an embedded researcher photography and photo elicitation method.

By deliberately slowing down the pace of the research for a long time, we were able to follow and work together with the local communities as their lives, livelihoods, uncertainties, and windows of opportunity unfolded from one season to the other. The visual co-production techniques enabled us to unpack the multidimensional experiences of variability (which turned out to be the *daily* challenges rather than the extremes), capturing the hidden, latent, and visible aspects of change.

Through engaged documentary photography (a form of photography where the research team critically engaged with all social intersections, including gender, caste, class, age and religion in the village), we developed extended photo stories that reflect the daily lives of the local communities. This covers the spectrum of weather variability, including heatwaves, droughts, and erratic rainfall patterns experienced during the monsoon and, more recently, in the winter and spring seasons.

Our learning from the decentralised nature of embedding visual methods is as follows:

Photo elicitation – A booklet discussion with one of the villagers. Photo credit: Megha Sheth (April 2023)

Photovoice launch meeting in the village. Photo credit: Shibaji Bose (September 2022)

1. Photos taken by the researcher, who had spent considerable time in the village, captured important moments shared by the women and elderly who did not have a smartphone or did not have time to engage due to their unending daily chores and preparations for the next extreme. These photos served as an entry point for initiating conversations about the community's experiences with all the intersecting social locations in the village.

2. The embedded visual methods unpacked hidden narratives like challenges, importance, and needs, particularly in the face of climate uncertainty and the corresponding strategies critical to sustaining our livelihoods and preparing for the future.

In the ANTICIPATE project, we aimed to capture the spectrum of voices and experiences of shocks and stressors amidst hierarchies of caste, ethnicity, religion, and gender through the visual methods of photovoice, an embedded researcher photography and photo elicitation method.

Our learning through visual methods research, which complemented the social science research, is conveyed by the journey of realisation. We started with unpacking extremes – using both floods and drought as our entry points of conversation. However, we soon realised that even these terms were too homogenous and abstract for the local communities. In many ways, the photo-elicitation process challenged the researcher's gaze and nudged us to rethink our vocabularies of inquiry and exploration (Bose et al., 2023). This process made us recognise the importance of the everyday life of extremes, and what happens between them is as essential to unpack as the episode itself. We were able to unpack the social constructions of extremes to think about preparedness from the ground up. ■

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"Photos used during the exercise serve as an entry point for initiating conversations about the community's experiences, challenges, importance, and needs, particularly in the face of climate uncertainty. For me and my community, this is critical to sustaining our livelihoods and preparing for the future." (Interview May 2023)

"I have observed through all these photographs that different communities anticipate and prepare [for summer and monsoons] and this is shaped by the availability of resources, their traditional customs and their recognition and status within the society" (Interview, May 2023)

"Co-located hazards have impacts that range from the visibly immediate (loss of life and livelihoods) to sustained long-term effects on land, resource quality and access, livelihood options, and quality of life. While relief and compensatory measures are important to help smooth over the initial shock, we need a socially inclusive view of preparedness that centres on the experiences and perspectives of local communities on the frontline. This must focus on the power inequities and knowledge hierarchies that shape the effects of and response to co-located hazards"

Excerpt from IDS Blog: 'Living between droughts and floods: Differentiated impacts of co-located hazards in Gujarat, India' https://www.ids.ac.uk/opinions/living-between-droughts-and-floods-differentiated-impacts-of-co-located-hazards-in-gujarat-india/

Women on the Frontlines: Leading Climate Action through Anticipatory Practices

*By **Megha Sheth,** ANTICIPATE Research Officer, Institute of Development Studies (IDS), UK*

The impacts of the climate crisis are vast, touching every corner of the globe, but its effects on grassroots communities are particularly pronounced. Women's reliance on natural resources makes them especially vulnerable to the impacts of climate change. However, this same connection also positions women as pivotal actors in climate action, particularly in the realm of anticipatory preparedness.

Women preparing the floor with river sand before the arrival of monsoons (pagthi khundine lipan) by trampling the surface barefoot, which helps to restrict insects emerging from the floor during the monsoon. Photo credit: Megha Sheth (May 2022)

During fieldwork on the ANTICIPATE project in North Gujarat, it was observed that women undertake nearly 70 per cent of farming activities. Their roles extend beyond agricultural tasks; they collect water for their families, procure fodder, maintain paddocks, and perform other livestock-related tasks. Additionally, gathering dry wood fuel for cooking is a routine activity. These daily responsibilities expose them not only to the brunt of hydrological extremes like floods and droughts but also to the increasing frequency of unpredictable events such as unseasonal rains called *mavtha*, continuous and erratic monsoon rains, heatwaves, cyclonic conditions, and hailstorms (during the winter season).

A woman covers a clay stove with plastic after preparing a meal, considering the forecast of unseasonal rains. Photo credit: Megha Sheth (May 2022)

A woman community leader mentioned: "As we see clouds in the sky pre-monsoon, we procure flour to make meals for the family, shift dry wood, fodder, and harvested crops to places with proper roofs, and cover them with plastics in case of sudden emergencies." This statement underscores the proactive measures women take in response to even the slightest changes in weather patterns. Their knowledge and quick, sensible actions are crucial and need to be recognised and not remain hidden as unpaid care.

Women play a crucial role in providing short-term preparedness

Anticipatory action in the field – A woman covers fodder and harvested castor with plastic during a hailstorm forecast. Photo credit: Megha Sheth (April 2023)

Collecting rainwater for drinking and household chores. Photo credit: Megha Sheth (August 2022)

and anticipatory action at the grassroots level.

Women are at the frontline of climate action through their everyday anticipatory preparedness efforts. Their roles in grassroots communities make them indispensable in both short-term and long-term climate resilience strategies. By acknowledging and supporting their contributions, and by addressing the structural barriers that limit their participation, we can ensure more effective and inclusive climate action. Women's involvement is not merely beneficial; it is essential for crafting comprehensive strategies to combat the climate crisis. ■

"Preparedness and response plans focusing on extreme events can only truly be inclusive if they account for the gendered impacts that multiple climate hazards pose. Positioning women's perspectives within narratives to build responses to extreme climate events is essential."

Excerpt from IDS Blog: 'Living between droughts and floods: Differentiated impacts of co-located hazards in Gujarat, India'
https://www.ids.ac.uk/opinions/living-between-droughts-and-floods-differentiated-impacts-of-co-located-hazards-in-gujarat-india/

A cumin field was rendered uncultivable due to the 2017 floods in Banaskantha. Photo credit: Vinitha Bachina.

"Preparedness is often seen from the vantage point of decision-makers and managed within geopolitical borders that often do not relate to the physical realities of the communities and villages on the ground. These disparities further complicate the challenges of 'being prepared', especially for vulnerable communities such as migrants, farmers, pastoralists, disabled people, etc."

Excerpt from IDS Blog: 'Living with co-located hazards: reimagining preparedness under climate extremes' https://www.ids.ac.uk/opinions/living-with-co-located-hazards-reimagining-preparedness-under-climate-extremes/

ANTICIPATORY ACTION

Co-location and Anticipatory Action: What is Needed to Address Extreme Heat Acceleration

*By **Mihir R. Bhatt,** All India Disaster Mitigation Institute (AIDMI), India*

The extreme heat of 2024 is unprecedented and it is only going to accelerate in the coming years. Extreme heat will also cascade and will be co-located with other extreme events such as floods cyclones, or both, as it happened in the summer of 2023 in Gujarat.

Co-location in this context means the impact of extreme heat on a single location, either in conjunction with other hazards such as floods or cyclones or as repeated extreme heat events within a short spell of summer.

Anticipatory action in this context refers to any action taken at any level in anticipation of extreme heat before the extreme heat strikes.

Let me draw from the recent panel on "Anticipating Futures: Forecasting and Climate Preparedness for Co-located Hazards in India (ANTICIPATE)" Final Project Meeting at the Institute of Development Studies, Brighton, UK on June 4-6, 2024, supported by the British Academy.

I also draw on the findings from the field in the ANTICIPATE project, and more importantly, the validation workshop which was conducted in our field site (in June 2024), where the impact of extreme heat was repeatedly highlighted. During the three years of the project, the co-location of heat and floods, heat and hailstorms, and heat and heavy rains occurred for two years, causing the loss of livelihoods, income, assets, and a future.

Co-located hazards in Gujarat. Photo credit: AIDMI

So, what did we find that is more broadly useful for further research and action to address extreme heat acceleration in the village as well as across India?

One, in such an emerging landscape of extreme heat risk, what are key anticipatory actions we must take?

Two, how do co-creations around co-locations happen across sciences, the economic sector, and people in a settlement facing extreme heat?

Three, what can be done to support and nurture future leadership for co-locations across subjects and individuals relevant to extreme heat and extremes more widely?

Four, how do we collect and use textual, numerical, and visual evidence on co-location for climate action and anticipatory climate justice, especially for those affected?

Five, what anticipatory agenda do we need to support local co-created research and mutual learning around the co-location of extreme heat?

Six, are there common strategies for extreme heat preparedness and anticipatory action, and how to define and develop them for greater and long-term cooling goals?

Seven, does co-location make solidarity for anticipatory action among populations affected by extreme heat- more possible?

The seven questions raised above are needed for further research and innovation to better address the co-location of extreme heat and extreme events more broadly for anticipatory action in India. ■

Anticipation, Relocation, and Saving Lives: Understanding Landslide and Disaster Risk in Wayanad, Kerala

*By **Hariprasad VM**, Doctoral Candidate, IIT Bombay, India*

The Wayanad district experienced the biggest landslides in the history of Kerala on July 30, 2024, a disaster that highlights the devastating impact of extreme climate events (Rajendran, 2024). The high-intensity rainfall that triggered this landslide is becoming increasingly common due to the accelerating effects of climate change, and it warrants a much more effective disaster response. The majority of the victims were socially and economically marginalised, including private tea estate workers and their families, many of whom lost their lives or were severely injured (Express News Service, 2024)

Experts suggest that similar incidents could occur every fifty years, given the 1.3-degree increase in global temperature (World Weather Attribution, 2024). Despite the increasing risk and acknowledging the risk over the years by the state government, anticipation and preparedness in Wayanad were noticeably inadequate (Kumar, 2023). Early warning systems, relocation plans, lessons from past experiences, and local observations, including those from tribal communities, were either ignored or inadequately addressed. This failure to act on available information and warnings led to catastrophic consequences.

Challenges of Anticipatory Action

Kerala has become the epicentre of landslides in India. From 2015 to 2022, Kerala accounted for 59.2per cent of all reported landslides in the country, underscoring the state's acute vulnerability to this natural hazard (Business Today Desk, 2024). However, Kerala's ongoing financial

Local women guide the rescue team to the sites where houses stood before the landslide. The origin of the landslide can be seen in the background. Photo credit: Prasoon Kiran

crisis would make it difficult for the state to invest in disaster management (Livemint, 2023). In the absence of adequate resources, investing in a low-cost, localised early warning system with the highest accuracy should be an immediate priority. The challenge lies in selecting the most effective anticipatory actions and taking the help of local-level agencies.

Science and technology will continue to improve, and future advancements may help society better manage climate risks. However, the slow pace of fixing an early warning system for landslides by the state and union governments, along with not accurately predicting rainfall led to this disaster (Unnikrishnan, 2024; Surya, 2024). While the union government says that the early warning was given to the state on time, the chief minister countered the argument (Perinchery, 2024). Although government agencies like the Indian Meteorological Department (IMD) or Geological Survey of India (GSI) did not issue red alerts for rainfall or landslides, reports from Wayanad indicate that the Hume Centre for Ecology and Wildlife Biology located in Wayanad had warned the district administration about a potential landslide in Mundakkai and surrounding areas 16 hours before the event (Unnikrishnan, 2024; Abraham, 2024).

In India, disaster warnings are not typically based on predictions from local agencies alone due to the lack of standardised protocols and credibility issues. For example, while local knowledge and data, such as rainfall measurements by local organisations, are valuable, official disaster warnings often rely on centralised government agencies like the IMD (IMD n.d). This centralised approach is as per the standard operating procedure and to provide consistency and reliability in data and the government's mandate to issue such warnings (ibid). This highlights a significant issue in our disaster governance, where local insights are often undervalued in the decision-making process.

Need for Convergence of Different Disciplines

Anticipatory action in disaster management is a forward-thinking approach designed to mitigate impacts before a disaster occurs (Haque and Schneider, 2024). Yet, various disciplines, such as geology, hydrology, ecology, and soil conservation, often fail to collaborate effectively. Each discipline uses different parameters and has its perspective, making it difficult to develop a comprehensive early warning system. According to the World Disaster Report 2020, landslides can be categorised as either geophysical or hydro-meteorological events (IFRC, 2020). So, developing a localised early warning system requires input from all relevant disciplines and local communities.

In 2019, a symposium on landslides in Kerala was held in Munnar, where experts discussed possible ways to prevent landslides, focusing on low-cost warning systems and comprehensive data on landslides in the state. Despite previous discussions, GSI launched its first regional early warning system for rain-induced landslides on July 19, 2024, just two weeks before the Wayanad incident, but errors in the modelled data resulted in the system's failure to accurately predict the landslide (DTE Staff, 2024).

Long-term Structural and Non-Structural Solutions

Kerala's disaster preparedness should include long-term mitigation and adaptation plans rather than merely relocating residents to relief camps each year. The state needs land use based structural measures, and the immediate changes or reversals are required to conserve the risky terrains. Chenan, who belongs to the Indigenous *Adivasi* community, regularly walks through the areas affected by the landslide. He observed cracks and gaps in the land and informed some officials a few months ago (News Malayalam, 2024). This highlights the need to incorporate community knowledge and experience into the mitigation and preparedness efforts.

Reflecting on the 2013 Uttarakhand flood, which claimed over 6,000 lives, geologist K.S. Valdiya described the disaster as "man-made" and attributed it to the "criminal oversight" of the state's geological features and water channels over several decades (Bhattacharya, 2013). We must not overlook the lives of people living in difficult terrains, and future incidents should not be attributed solely to extreme weather events.

In conclusion, investing in long-term resilience projects—both structural and non-structural—by utilising local data is essential for timely action. This approach requires dedicated transdisciplinary expertise teams in each district to develop long-term strategies, integrate local knowledge, improve anticipation, and effectively respond to such events. ■

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Managing Research Projects: A View on Adaptive Management amidst Uncertainty

*By **Natalie Lovell,** ANTICIPATE Project Manager, Institute of Development Studies (IDS), UK*

Managing projects amidst the Covid-19 pandemic and its cascading impacts provided valuable lessons for adaptive management. While all projects undergo a risk assessment during the conception phase, we seldom plan for the type of uncertainties experienced in the past few years due to the pandemic.

Collaborating with dryland communities in Gujarat, ANTICIPATE examined how different actors forecast and prepare for co-located hazards under conditions of climatic uncertainty, and whether and how these practices can be integrated for building preparedness. Originally conceived to be a two-year project starting in April 2020 and concluding in March 2022, the disruption of the Covid-19 pandemic resulted in several unavoidable delays, stretching ANTICIPATE and its limited budget into a four-year project ending in June 2024. Indeed, managing an international project while navigating the Covid-19 pandemic has been a formidable challenge, requiring adaptability, innovation and collaboration. Here I trace the timeline of ANTICIPATE and reflect on what it means to manage a project in the face of uncertainty.

Inception

Although the project officially began in April 2020, the Covid-19 pandemic caused significant delays during the inception period (April to September 2020). Logistical delays to contracting as well as nationwide lockdown measures imposed by the UK and Indian governments to curb the spread of the virus forced a revision of fieldwork schedules, resulting in the research team missing the crucial drought and monsoon periods in Western India.

Implementation

From September 2020 to December 2021, the research team adopted remote data collection methods in a bid to ensure research activities could continue. Relying predominantly on literature reviews to build a conceptual foundation and phone-based interviews with local communities provided some progress but had its limitations. Despite restrictions on movement being lifted, plans for face-to-face fieldwork from March to July 2021 were hindered by the severity of the second wave of the Covid-19 pandemic in India. Additionally, a duty of care and the need to minimise the risk of infection to communities, team members and collaborators added another layer of complexity. And while substantial progress resumed with the easing of restrictions and fieldwork from September 2022, new challenges soon emerged: team members felt the personal effects of the pandemic, administrative barriers arose at partner institutions, local and state elections paused or delayed project activities.

Dissemination and Synthesis

Despite the numerous challenges encountered by ANTICIPATE, significant progress has been achieved and synthesis is underway. The project has gained visibility through impactful events such as the World Climate Research Programme (WRCP), Adaptation Futures, and COP28-related activities alongside the final dissemination event held at the Institute of Development Studies. Moreover, the project's findings are proving to be of critical importance given the rise in extreme and erratic weather events, and India's ongoing struggle with severe heatwaves and hydrological extremes.

Several factors contributed to the success of ANTICIPATE. These include: i) an adaptive management approach; ii) factoring in risk as well as uncertainties which required the continuous reassessment of project plans, timelines and objectives; iii) ongoing communication and collaboration between the internationally dispersed research team; and iv) flexibility from the funder. These strategies enabled ANTICIPATE to navigate the immediate challenges presented by the pandemic, to adapt and respond to changing project conditions, and to ensure that project activities remained relevant and effective. ANTICIPATE exemplifies that through careful planning and adaptability, an opportunities for experimentation may arise from unprecedented uncertainty. ■

CONTENTS

ALL INDIA DISASTER MITIGATION INSTITUTE
411 Sakar Five, Behind Old Natraj Cinema, Ashram Road, Ahmedabad–380 009 India.
Tele/Fax: +91-79-2658 2962
E-mail: bestteam@aidmi.org, Website: http://www.aidmi.org, www.southasiadisasters.net
Follow us on: @AIDMI_ORG AIDMI.ORG aidmi_org All India Disaster Mitigation Institute