Workshop Report

Extreme Heat and Building Climate Resilience in Assam

Organized by: Assam State Disaster Management Authority (ASDMA) in partnership with the All India Disaster Mitigation Institute (AIDMI)

Venue: Srimanta Sankaradeva International Auditorium, Srimanta Sankaradeva Kalakshetra, Panjabari, Guwahati

Date: March 26, 2025; **Time:** 09:00 - 05:00

Contents

Executive summary

Assam, a region vulnerable to both extreme heat and flooding, faces increasing challenges due to climate change. Rising temperatures, intense heatwaves, and severe flooding exacerbate disaster risks, impacting public health, infrastructure, and livelihoods. To address these growing concerns, the Assam State Disaster Management Authority, in partnership with the All India Disaster Mitigation Institute, organized a workshop on Extreme Heat and Building Climate Resilience in Assam. The workshop, held on March 26, 2025, at the Srimanta Sankaradeva Kalakshetra in Guwahati, brought together key stakeholders to discuss and develop solutions for heat resilience in the region.

The workshop commenced with an inaugural session featuring addresses by Smt. Meenakshi Das Nath, ACS, Secretary & Additional CEO of ASDMA, and Shri Gyanendra Dev Tripathi, IAS Principal Secretary & CEO of ASDMA. Mr. Mihir R. Bhatt, Director of AIDMI, delivered a keynote address, emphasizing key areas of focus. Shri. Keshab Mahanta Hon. Minister of Revenue and Disaster Management Department, GoA inaugurated the workshop, emphasizing the significance of the event and the urgent need to address extreme heat and build resilience in Assam and the Northeast region.

The workshop aimed to achieve specific objectives including understanding heat-related vulnerabilities, identifying best practices, developing a heat action plan, and strengthening collaboration among stakeholders. The diverse group of participants included government officials, experts, NGOs, and community representatives.

Technical sessions at the workshop covered diverse topics. The first session explored the increasing frequency of extreme heat events in India, focusing on health, economic, and environmental consequences and adaptive strategies. The second session examined localized impacts of extreme heat, highlighting vulnerabilities and community responses. A third session concentrated on strengthening early warning systems for extreme heat. The workshop also included sessions on leveraging technology for heat resilience, community-based adaptation and mitigation strategies, the role of media, and action planning.

Throughout the workshop, discussions and presentations focused on various aspects of heat resilience. This included health impacts of extreme heat, early warning systems, community-based adaptation strategies, and the integration of heat mitigation measures into urban planning. Best practices from other regions and countries were also shared, providing valuable insights for Assam's context. The workshop emphasized the need for a multi-faceted approach incorporating immediate actions and long-term planning. Specific recommendations included improving heatwave forecasting, developing community-level preparedness plans, strengthening healthcare infrastructure, and raising public awareness.

The closing session featured a summary of key discussion points and recommendations by Vishal Pathak from AIDMI. Vishal Pathak's summary emphasized urgent action on adaptation and mitigation, integrating heat action plans into urban planning, utilizing NDMA guidelines and lessons from other cities, and community-based early warning systems. He also stressed cool roof campaigns, localized cooling solutions, data-driven decisions, mainstreaming heat resilience across sectors, and leveraging technology for improved information and risk reduction.

Dr. Surajit Baruah, Senior Consultant at ASDMA, delivered the vote of thanks, acknowledging the contributions of all participants and highlighting the importance of the workshop in developing a comprehensive heatwave action plan for Assam.

1. Background

1.1. Introduction

Assam, like much of India and South Asia, is increasingly facing the impacts of climate change, which has manifested in rising temperatures, more intense heatwaves, and severe flooding. The state is vulnerable to both extreme heat and flooding, which exacerbate the region's disaster risks, affect public health, damage infrastructure, and disrupt livelihoods. Extreme heat events have led to widespread discomfort, health issues, and an increased burden on healthcare systems. Meanwhile, Assam's low-lying geography makes it susceptible to flooding, exacerbated by climate change and monsoon unpredictability.

In response and preparedness to this situation, the government of India and relevant organisations including UN and non-government organisations has taken several initiatives at city, state and national levels. In light of these challenges, there is a pressing need for strengthened disaster risk management, better resilience strategies, and effective early warning systems. Acknowledging this and demand of the wide stakeholders, ASDMA and AIDMI have partnered to organize learning workshop, which will bring together key stakeholders to discuss climate resilience and disaster management strategies, with a particular focus on extreme heat, flood risk management, and early warning systems in Assam.

1.2. Workshop objectives

The primary objectives of the workshop were:

1. To share knowledge, good practices, and experiences related to extreme heat and solutions and climate resilience.
2. To explore solutions and strategies for mitigating the impacts of extreme heat in Assam.
3. To strengthen collaboration between stakeholders, including government agencies, disaster management authorities, and civil society organizations.
4. To develop a year-long action plan focused on addressing extreme heat issues in Assam, ensuring that heat resilience is a key component of future disaster risk management strategies.
5. To produce a joint publication based on the learning discussion, recommendations, and outcomes of the workshop for broader dissemination.

1.3. Target audience

The workshop brought together a diverse group of stakeholders, including:

- Representatives from Assam's District Disaster Management Authorities (DDMAs).
- Experts and practitioners from disaster risk management, climate change, and environmental fields including the state departments, IMD.
- Representatives from Assam state offices UN agencies, NGO representatives and CSOs.
- Academics, researchers, and climate experts focused on disaster resilience.

1.4. Workshop agenda

The workshop on Extreme Heat and Building Climate Resilience in Assam, held on March 26, 2025, featured a comprehensive agenda:

- **Inaugural Session (10:15 AM - 11:00 AM):** This session set the stage for discussions on climate extremes, particularly extreme heat, and outlined key focus areas for strengthening

resilience in the Northeast Region. It included addresses by Smt. Meenakshi Das Nath, Gyanendra Dev Tripathi, Shri Mihir R. Bhatt, and Shri. Keshab Mahanta. the workshop *was* inaugurated by Shri. Keshab Mahanta, Hon. Minister of Revenue and Disaster Management Department. The session also marked the launch of southasiadisasters.net.

- **Technical Session 1 (11:00 AM - 12:00 PM):** This session, titled "Understanding Extreme Heat: State and National Perspectives," examined the nature of extreme heat events in India. It focused on the health, economic, and environmental consequences of extreme heat and explored institutional responses and adaptive strategies across vulnerable regions. Speakers included Shri. Mukunda Upadhyay and Dr. P G Dhar Chakraborty.
- **Technical Session 2 (12:00 PM - 1:00 PM):** Titled "Understanding Extreme Heat: Local to Regional Impact and Responses," this session explored the localized impacts of extreme heat, highlighting vulnerabilities, sectoral challenges, and community-driven responses to strengthen resilience. Speakers included Shri. Komkar Dulom, Shri. Suman Deb, and Shri Biprajit Paul Choudhury.
- **Technical Session 3 (2:00 PM - 3:00 PM):** This session focused on "Strengthening Early Warning Systems for Extreme Heat," exploring strategies for enhancing early warning systems and improving communication strategies.
- **Technical Session 4, subsequent sessions, and conclusion:** The workshop continued with a session on leveraging data and technology for extreme heat resilience, followed by sessions on community-based adaptation and mitigation, the role of media, and action planning. It concluded with a synthesis of the key takeaways and a roadmap for future actions.

2. Inaugural session

2.1. Welcome Address by Smt. Meenakshi Das Nath, ACS, Secretary & Additional CEO, ASDMA

Smt. Meenakshi Das Nath's welcome address effectively set the tone for the workshop, emphasizing the urgency of addressing extreme heat in Assam and the Northeast. She shared that extreme heat, in particular, has emerged as a critical issue, not only affecting our environment but also the livelihoods and health of the people living here. It is affecting our future. Her remarks on shared responsibility between government and citizens resonated with the collaborative spirit of the event. By highlighting the workshop's objectives—understanding the complexities of extreme heat, community engagement in adaptation, and collaborative efforts—she underscored the importance of working together to build a more resilient future for the region. “It is through our collective knowledge and concerted efforts that we can hope to create a future where the people of Assam and the Northeast region are not only protected from the harmful effects of extreme heat but can also thrive in harmony with the environment.” Her closing thought, "We don't have a Planet B to live," powerfully conveyed the need for immediate and sustained action.

2.2. Keynote Address by Gyanendra Dev Tripathi, IAS Principal Secretary & CEO, ASDMA

Gyanendra Dev Tripathi, IAS, Principal Secretary & CEO of ASDMA, delivered a keynote address focusing on the long-term effects of climate change. He used the "boiling frog" analogy to explain how climate change is affecting our world. "When you put a frog in boiling water, the frog will try to jump and come out of the water immediately. But if you put a frog in a cold water and slowly, slowly you start heating it. What will be the reaction of the frog? The frog will not come out and slowly what will happen? The water will boil and frog will die." He emphasized that while climate change may not have immediate, drastic consequences as we see in other disasters, its slow-moving impact is evident in declining crop yields, environmental degradation, and deforestation. He stressed the need for

accurate, localized impact assessments, challenging researchers to move beyond global and national models to develop models that predict the specific effects of climate change at the local level, such as in the City of Guwahati. He highlighted a recent competition launched to encourage researchers to develop such models, inviting participation to build local capacity in understanding and addressing climate change's localized impacts. The “Predicting Resilience through Knowledge-driven Research Using Integrative Technological Innovation,” (PRKRITI) competition, launched on ASDMA Foundation Day on March 23, aims to enhance local-level understanding of climate change impacts and encourage young minds and professionals to develop climate models using real-world data.

2.3. Key areas to focus on, by Shri Mihir R. Bhatt, Director, All India Disaster Mitigation Institute

Shri Mihir R. Bhatt, Director of the All India Disaster Mitigation Institute, began by acknowledging the significance of Assam's contributions to disaster management. He emphasized the planetary scale of extreme heat, underscoring the urgent need for collective action. “Extreme heat is not something which is local, it's not even global, but it’s planetary. And that is why we must do something; we can't depend on somebody else”. He commended Assam's proactive approach to disaster preparedness, citing the state's inclusion of the Sendai Framework, SDGs, and the Paris Agreement in its disaster management plan, as well as its pioneering use of intelligent data systems for community-level risk reduction. Mr. Bhatt then outlined five key focus areas for addressing extreme heat, emphasizing practical, cost-effective solutions:

- **Urban planning and green infrastructure:** Recognizing ongoing urban infrastructure development in Assam, he advocated for integrating heat reduction strategies into these projects, empowering citizens to take action.
- **Sustainable agriculture:** He highlighted the need to consider the impact of extreme heat on farmers and the agricultural sector, emphasizing the importance of heat risk reduction in agriculture alongside urban areas. “Farmers feed us, but no one is talking about how heat affects them. We talk a lot about how our cities being affected, which is important but we must also equally focus on how can be reduce heat risks in the agriculture sector.”
- **Water resource management:** Despite the Brahmaputra's abundance, Mr. Bhatt warned of an impending water crisis, urging a proactive approach to water resource management that addresses heat sensitivity and rectifies past mistakes.
- **Public health:** He praised India's innovative work in extreme heat and public health, advocating for leveraging existing cooling solutions across Assam's healthcare system, both public and private. “All the health workers are, so many of them, they are really the torch bearers of taking the existing solutions ahead”.
- **Community engagement and awareness:** Recalling Assam's 2019 award for best state disaster authority, he stressed the importance of engaging every citizen in finding solutions to extreme heat, building on past successes in flood and drought management.

In closing, Mr. Bhatt expressed his hope that Assam could lead India in developing cooling solutions, sharing its expertise with the rest of the country. His call to action, "Let the cool winds come from Assam to the rest of India," encapsulated the potential for Assam to become a model for heat resilience.

2.4. Inaugural Address by Shri. Keshab Mahanta Hon. Minister of Revenue and Disaster Management Department, GoA

In his inaugural address, Shri Keshab Mahanta, the Honorable Minister of Revenue and Disaster Management, and Minister of Science, Technology and Climate Change for the Government of Assam, acknowledged the significance of the event, which brought together diverse stakeholders

committed to tackling the urgent challenge of extreme heat and building resilience in Assam and the Northeast region.

Minister Mahanta highlighted the impacts of climate change, including irregular rainfall, rising temperatures, and increased frequency of extreme weather events like floods and droughts, emphasizing the vulnerability of Assam and the Northeast. “Climate change is making rainfall irregular; temperatures are rising and extreme weather events like floods and droughts are becoming more frequent.” He noted the adverse effects of rising temperatures on agriculture, water resources, public health, and overall quality of life. He stressed that extreme heat events, once rare, are now becoming increasingly common and severe, posing a significant threat to vulnerable communities and ecosystems.

Despite the daunting challenges, Minister Mahanta expressed optimism, emphasizing that through collaboration, knowledge sharing, and unwavering commitment to climate resilience, a brighter and safer future is possible for Assam and its people. He suggested adopting green building codes in schools and colleges to mitigate heat effects and advocated for local-level innovative initiatives. He looked forward to productive discussions, innovative ideas, and strong partnerships, confident that collaborative efforts within Assam and across the Northeast would lead to significant advancements in building climate resilience.

Following Minister Mahanta's address, he and other delegates released a collaborative publication[1] of All India Disaster Mitigation Institute (AIDMI) titled as "Key Action Areas for Addressing Extreme Heat in the Asia-Pacific: Lessons from Regional Platforms."

3. Technical session I: Understanding Extreme Heat: State and National Perspectives

3.1. Context setting by Dr. Surajit Baruah, Senior Consultant SFDRR, ASDMA

Dr. Surajit Baruah, in facilitating the workshop discussion, highlighted how the effects of heat waves cut across multiple sectors, including health, agriculture, labor productivity, water and sanitation, infrastructure, and biodiversity. Within the Indian context, he noted that while heat waves typically occur from March to June, climate change is altering this timeframe. He stressed the importance of studying the intensity, frequency, duration, and spatial distribution of these events due to their slow onset nature, which often leads to them being overlooked compared to more immediate disasters like cyclones or earthquakes. Dr. Baruah highlighted the need for formulating and implementing heat wave action plans, strengthening early warning systems, enhancing understanding of heat wave impacts, establishing appropriate institutional mechanisms, fostering collaborations between government, non-government, and expert agencies, and creating baseline data. He also emphasized the importance of addressing loss and damage frameworks and developing long-term mitigation strategies to combat the deleterious effects of heat waves across various sectors.

[1] Southasiadisasters.net is one of the longest running publications within the disaster risk reduction and climate action communities. Publication Archives - The All India Disaster Mitigation Institute

3.2. Need for Strategic Action: Towards Strengthening Local Systems for Heatwave Management in Assam by Shri. Mukunda Upadhyay

Shri. Mukunda Upadhyay emphasized that while everyone is at risk from heat waves, vulnerable populations such as those living in slums, displaced persons, the homeless, the elderly, and people with special needs experience disproportionately severe impacts. Upadhyay acknowledged the varying definitions of heat waves among stakeholders and experts but stressed the need for convergence and a refined synthesis. He emphasized the importance of understanding heatwave vulnerability in Assam, noting that some districts experience more than 15 consecutive heatwave days. He outlined key areas for consideration: policy formulation and implementation, research and knowledge management, capacity building, improved communication, and overall heatwave management. Specifically, Shri. Upadhyay called for formulating and implementing heatwave action plans, integrating early warning systems for various hazards, and prioritizing communication with vulnerable populations ("last mile becomes the first mile").

He underscores the importance of capacity development in heatwave management, emphasizing training by experts in various fields, including health management and structural measures addressing heat risk, particularly in urban areas. Leveraging technological innovations and AI is also highlighted. He proposed a framework emphasizing understanding risk, implementing structural and non-structural measures, strengthening coordination systems, capacity building, and community engagement. Identifying key hotspots through GIS and advanced data methods is considered fundamental for future preparedness. He also discussed the need for robust interagency coordination, emphasizing the integration of medical preparedness within the response system. Implementing heatwave components into the annual disaster calendar and fostering interstate collaboration were highlighted as crucial preparedness measures.

Shri. Upadhyay stressed the urgency of establishing 24/7 healthcare facilities with necessary medical arrangements, particularly given Assam's increasing vulnerability to heatwaves. Structural measures focusing on urban and infrastructure planning for long-term resilience were also discussed, including implementing the National Building Code, sustainable construction practices, and energy conservation building codes. In his concluding remarks, Shri. Upadhyay emphasized four key components of capacity building for heatwave management: training, awareness and outreach, community engagement, and documentation of experiences. He urged to initiate a discussion focusing on understanding local heat risks, implementing inclusive structural and non-structural measures within a heatwave management framework, leveraging data and technology, fostering community response, and integrating climate change adaptation into heat risk management.

3.3. Understanding Risks of Heatwave: Strategic Approach for Management of Heatwave Risks in Northeast by Dr. P G Dhar Chakraborty

Dr. P G Dhar Chakraborty's presentation addressed preparing heat action plans for the Northeastern states of India. He emphasized a comprehensive approach considering the region's distinct characteristics, including its varied topography and humidity. According to him a successful plan must move beyond temperature-centric definitions by incorporating humidity, drawing on resources like the US National Oceanic and Atmospheric Administration’s heat index. He mentioned that the IMD's development of a similar index is a positive step. Dr. Chakraborty discussed the development of a heat risk index for 640 districts in India, considering various hazard parameters, vulnerability, and exposure. This index utilizes 100 years of temperature and humidity data from weather stations across India.

He highlighted the importance of integrating factors like relative humidity and wet-bulb temperature, especially in the Northeast where humidity is high and temperatures can exceed 40°C. He explained that a high wet-bulb temperature poses significant health risks, especially in high humidity, as the body struggles to cool itself through sweating. He also explained the significant influence of non-meteorological factors on heatwave risk, including settlement patterns, building materials, the presence of water bodies, industrial and vehicular emissions, and working environments. Individual factors such as occupation, working hours, access to ventilation and drinking water, lifestyle, clothing choices, and physiological conditions also play crucial roles. Pre-existing health conditions like respiratory or cardiac issues, coupled with mental stress, further increase vulnerability and can lead to accelerated mortality during heatwaves. Heatwaves also negatively impact the economy through loss of produce, reduced productivity, and infrastructure disruptions.

Referring to the 2019 national heatwave guidelines, revision of the 2016 guidelines, he suggested focusing on readily implementable short-term measures, such as adjusting working hours in the construction sector and ensuring drinking water availability, to reduce heatwave-related mortality. He advised the Assam State Disaster Management Authority to implement these short-term measures during the approaching summer. Dr. Chakraborty recommends a phased approach, starting with immediate actions and progressively addressing long-term strategies outlined in the guidelines.

Dr. Chakraborty noted many heat action plans at state and city levels primarily address short-term impacts and emergency responses, they frequently overlook crucial elements. These include differential spatial and socioeconomic impacts, mitigation and long-term measures, and integration with climate change action plans. He stresses the need for plans tailored to specific local contexts, demographics, and varying vulnerabilities across income and occupational groups. He also advocates connecting HAPs with state-level climate change action plans.

Before concluding his presentation, he discussed the historical heatwave data available for Assam, suggesting users can explore district-wise data to understand historical trends. He highlights the challenges in preparing a heat action plan, including limited weather observation networks and capacity gaps. However, he also points out opportunities, such as learning from other regions' experiences and leveraging new research integrating temperature, humidity, and other meteorological factors. He urges Assam to take a leadership role in developing a flexible, innovative, and community-based heat action plan, recommending starting with Guwahati and Silchar, using existing knowledge for short-term measures this summer, and expanding to mid and long-term plans through stakeholder consultations.

3.4. Strategies for Extreme Heat Resilience in India by Dr. Abhiyant Tiwari, NRDC

Dr. Tiwari highlighted the urgency of addressing extreme heat, referencing the UN Secretary-General's declaration of a "code red for health" due to climate change, now escalating to a state of "global boiling". He emphasizes the stark projection of a 370% increase in heat-related deaths by mid-century, stressing that the severe impacts of extreme heat are already a reality, particularly in Asia. He underscored the critical need to recognize and address the disproportionate risks to vulnerable populations by sharing devastating impact of heatwaves in countries like India and Pakistan in 2015. “Heatwave can also result in situation similar to what saw during the COVID pandemic”.

He shared that the 2010 Ahmedabad heatwave, which resulted in a significant spike in mortality correlated with temperature increases and reflected in ambulance call data, prompted the creation of South Asia's first comprehensive heat action plan in 2013. This plan included early warning systems, interagency coordination, public awareness campaigns, capacity building for medical professionals and stakeholders, and measures to reduce heat exposure and promote adaptation. A key aspect was establishing a governing body to oversee and coordinate activities among various departments and

stakeholders. The plan also focused on targeted outreach to vulnerable groups like slum dwellers and outdoor workers. Capacity building extended beyond healthcare workers to other sectors.

The Ahmedabad Heat Action Plan's success shifted the narrative from heatwave impacts to positive stories of lives saved. “It was published that after the launch of Ahmedabad Heat Action Plan, the city was able to save at least 1100 death every year”. This success has inspired other regions like Telangana, Uttar Pradesh, and Kerala to develop similar policies. Dr. Tiwari's presentation highlighted critical gaps in India's city-level heat action plans, including inadequate local vulnerability assessments, governance structures, and financing. He showcased Jodhpur's innovative community cooling station, where a 12°C temperature difference provided significant relief, demonstrating the potential of targeted interventions.

Dr. Tiwari highlights Assam's vulnerability to rising temperatures, projecting a 1.2 degree Celsius increase annually in a 1.5 degree Celsius warmer world, a threshold already reached. This translates to a greater number of extreme heat days. He suggests leveraging the National and State level Disaster Mitigation Fund, regardless of heatwave's disaster notification status, and encouraged key stakeholders interested in Assam to submit proposals for seed funding from the SDMA for vulnerable cities and districts.

4. Technical session II: Understanding Extreme Heat: Local to Regional Impact and Responses

4.1. Context setting by Dr. Kripal Mazumdar, ASDMA

Dr. Mazumdar opened the second technical session on understanding extreme heat and local responses, emphasizing the session's objective to explore the impacts of extreme heat at a local level, specifically in Assam, Arunachal Pradesh, and Tripura. He highlighted the significant challenges posed by increasing extreme heat events to public health, education, water resources, infrastructure, and other sectors. Dr. Mazumdar noted the unprecedented extreme heat events of 2024, particularly in May and September, which disrupted daily life and even led to school schedule changes due to children's vulnerability. He mentioned that these events underscore the growing need for localized heat action plans and effective adaptation strategies.

4.2. Local impact and responses by Shri. Komkar Dulom, Additional Secretary cum Director of Arunachal Pradesh SDMA

Komkar Dulom, from Arunachal Pradesh SDMA, describes the state's unique vulnerability to heatwaves. Despite a large land area, the small population (1.4 million) and dense forest cover (80%) create a perception that heatwaves are less of a threat. However, Arunachal Pradesh is officially recognized as vulnerable, even with different criteria for hilly areas. Dulom explains that while advisories are issued, other disasters like floods and landslides overshadow heatwave concerns.

He shared that a recent study revealed increasing temperatures in Arunachal Pradesh since 1991, reaching nearly 40°C in some areas in May and September of last year. Reduced rainfall since 1991 is leading to erratic patterns, causing both floods and untimely dry periods, affecting crucial agricultural activities like rice harvesting. This paradoxical situation—experiencing extreme heat when rain is needed and rainfall during sunshine—highlights the complex climate change impacts facing the

region. “So when we need sunshine we receive rainfall and when we need rainfall we face extreme heat situation. That variation we are facing.”

Komkar Dulom outlined Arunachal Pradesh's existing heatwave response measures, which include advisories issued to various departments and local bodies, collaboration with the India Meteorological Department for data, and training of healthcare professionals. Public awareness is raised through IEC activities and social media. Future proposals involve stocking necessary supplies in health facilities and promoting climate-resilient crops and green building practices. While acknowledging a lack of expertise in agriculture, Dulom emphasizes the need for collaboration with technical organizations to develop appropriate strategies.

4.3. Impact and responses by Shri. Suman Deb, Tripura SDMA

Suman Deb from Tripura SDMA explained that Tripura's traditionally six seasons have been reduced to 4-5 due to climate change. He described the current seasons: a transition period from winter to summer with gradually increasing temperatures; summer with average temperatures reaching 35°C; monsoon with heavy rainfall and flood risk; autumn with decreasing rainfall and temperatures; and winter with January being the coldest month. Tripura receives an average of 2000mm of rainfall, mostly during the monsoon, with June being the wettest month. This information provides a valuable overview of Tripura's climate and highlights the changes brought about by climate change.

He explained that sunstroke and sunburn were declared state disasters in 2018, with compensation provided for fatalities. He also clarified that while Tripura is not as flood prone as Assam, it faces significant risks from earthquakes, cyclones originating in the Bay of Bengal, and landslides. Lightning strikes and associated fatalities are also increasing. A heatwave is defined as 40°C in the plains and 30°C in hilly areas, with the highest recorded temperature being 42°C in April 2024. When temperatures reached 39°C, schools were closed for seven days.

Suman Deb added that, fortunately, no official heatwave-related deaths have been recorded in Tripura. The government activates emergency operation centers and response teams during heatwaves, ensures uninterrupted power supply, deploys water tankers, and conducts awareness campaigns. Medical teams are deployed to affected areas, and district authorities are directed to provide drinking water, shade, and medical services. Tripura has a State Action Plan for Climate Change, prepared by the Department of Science, Technology and Environment, and disaster management plans at state, district, and school levels.

5. Technical session III: Strengthening Early Warning Systems for Extreme Heat

5.1. Context setting by Anand P Kanoo, UNICEF Assam

Anand P Kanoo, UNICEF Assam, moderated a technical session on strengthening early warning systems for extreme heat, focusing on enhancing these systems and leveraging expertise from IMD and disaster management authorities. He stressed the importance of last-mile connectivity, especially reaching vulnerable populations. This aligned with the overall workshop goal of improving heatwave preparedness and response. Early warning systems are crucial for timely action, and the emphasis on reaching vulnerable groups is essential for effective heatwave management.

5.2. Strengthening Early Warning Systems for Extreme Heat by Dr. Akhil Shrivastav, Scientist, IMD, Government of India

Dr. Akhil Shrivastav from IMD explained how the agency forecasts and monitors heatwaves across India. IMD uses different temperature thresholds to classify heatwaves based on region: 30°C for hilly stations, 37°C for coastal stations, and 43°C for plains. A heatwave is declared when these thresholds are met and temperatures are 4.5°C to 6.4°C above the 30-year normal for two consecutive days. A severe heatwave is declared when temperatures exceed 45°C or 47°C. Dr. Shrivastav notes that while El Niño years tend to have more heatwave days than La Niña years, heatwaves can occur in both. Data from 1961-2020 reveals an increasing trend of heatwaves in Northeast India. Dr. Shrivastav presented data from 1969-2019 showing heatwave-related deaths concentrated in two regions: western India and eastern India. He explained that Rajasthan experiences dry heatwaves, while the eastern region experiences humid heatwaves, both of which are deadly.

Dr. Shrivastav described IMD's multi-tiered forecasting system for heatwaves. It begins with a seasonal forecast in March, providing a three-month temperature and heatwave outlook. Monthly and weekly forecasts follow, with the latter updated every Thursday for the next four weeks. A medium-range forecast is issued twice daily for the next seven days. Crucially, these forecasts trigger anticipatory actions by stakeholders. The seasonal forecast prompts preparatory actions like drills and refresher courses, while the medium-range forecast necessitates immediate actions by state disaster management authorities based on impact-based, color-coded warnings. IMD also provides impact-based forecasts, detailing the effects of heat on human health, starting in 2017 and expanding to sectors like the Indian Railways in 2024. These forecasts include generalized and sector-specific advice based on a color-coded warning system (e.g., avoiding heat exposure during a yellow warning, taking extreme care for vulnerable populations during a red alert).

Dr. Shrivastav concluded by outlining the various data products and sources used in IMD's forecasting system. This includes the heat index, hot weather hazard analysis using percentile temperatures, and socioeconomic data. He also mentioned the use of GIS maps for visualizing maximum temperature and directed attendees to the IMD website for further information on heatwave guidance. He emphasizes the need for sector-specific data (health, agriculture, forest fire, transport, energy) for impact studies and determining appropriate thresholds.

5.3. The Assam context by Dr. Sunit Das, Scientist, IMD, Assam

Dr. Das points out that while heatwaves are rare in Assam, hot and humid conditions pose a significant challenge. He notes a specific period in September of the previous year (19th-23rd) where temperatures rose significantly above normal but clarifies that this did not meet the IMD criteria for a heatwave. This period was characterized by a lack of rainfall, lower humidity than usual, and clear skies, leading to increased temperatures. While media outlets reported these conditions as a heatwave, Dr. Das emphasizes the distinction between hot and humid weather and actual heatwave conditions as defined by the IMD. He highlighted the increasing vulnerability of Assam to heatwaves, contrasting it with the relatively fortunate position the region has historically held.

Dr. Das explained that "hot and humid conditions" are defined as temperatures 3 degrees or more above normal, combined with above-normal humidity. As a forecaster, he monitors weather patterns in the western parts of the region for potential heatwave conditions that could impact Assam due to westerly winds. He emphasizes that multiple factors contribute to heatwaves, including humidity, wind, and cloud cover. Ideal conditions for heatwaves include dry, warm regions with favorable wind patterns, low upper-air moisture, and clear skies. While heatwaves in Assam are infrequent, they occasionally occur in the western districts, parts of Meghalaya and Tripura, and sometimes southern districts.

Dr. Das discusses the alarming rise in maximum, minimum, and mean temperatures across all seven northeastern states, particularly since 2010. He notes a significant increasing trend, with maximum temperatures rising faster than the other parameters. Arunachal Pradesh, for example, experiences a mean temperature increase of 0.87°C per century, while its maximum temperature rises by 1.14°C. This trend is consistent across the region, with maximum temperature increases exceeding 1°C per century in most states, except Meghalaya (0.88°C). To monitor heatwaves and heat-like conditions, IMD utilizes data from around 30 surface observatories, part-time observatories, automatic weather stations, and approximately 400 automatic rain gauges with temperature sensors across Northeast India. Heatwave declarations are based on departures from the normal temperature calculated for each station.

Dr. Das also described a robust dissemination system for weather products, utilizing various channels like email, websites (both central and regional), print and electronic media, Common Alerting Protocol, social media, and a dedicated warning cell. Information is provided to various stakeholders including SDMA, state government officials, district and departmental officials, NGOs, and the media. This multi-pronged approach ensures that vital weather information, including heatwave warnings, reaches a wide audience, enabling timely responses and preparedness measures.

6. Technical session IV: Leveraging Data and Technology for Extreme Heat Resilience

6.1. Context setting by Shri Akash Yadav, Data Science Expert, AIDMI

Akash Yadav discussed the role of data and technology, especially data science and predictive analytics, in building resilience to extreme heat. He highlighted the ongoing "big data revolution" and its impact on disaster forecasting and emergency logistics. Yadav points to Assam's leading role in utilizing data science and predictive analytics, citing their flood reports and community-based early warning systems as prime examples. He emphasizes how actionable data platforms can be grounded in local knowledge, and with increasing data accuracy and availability (both public and private), data science offers expanding possibilities for improving service delivery and strengthening preparedness for extreme heat events.

6.2. Assam State Heat Action Planning by Dr. Amrit Goswami, All India Peoples Science Network, AIPSN

Amrit Goswami, of the All India Peoples Science Network, detailed the organization's efforts to combat the growing threat of heatwaves in Assam. AIPSN developed a comprehensive heat action plan, drafted in consultation with experts, and presented it to the state government. The plan's urgency is underscored by the 11 heatwave-related fatalities recorded in September 2024 and the unseasonably warm winter that followed. Key recommendations of the plan include: Early warning systems with targeted communication strategies for stakeholders; protective measures for vulnerable populations, including access to cooling centers; regulated work hours for outdoor workers, especially during peak heat periods (11:30 AM - 3:30 PM); urban heat mitigation through increased green spaces, shaded areas, and urban forestry initiatives to combat the urban heat island effect and improve air quality; enhanced healthcare preparedness with training for medical professionals on heat illness diagnosis and treatment, plus ensuring adequate facilities and resources; energy conservation measures,

including promoting responsible air conditioner usage and immediate interventions such as providing drinking water and shaded rest areas for outdoor workers, and offering financial aid to families of heatstroke victims.

6.3. Leveraging Data and Technology for Extreme Heat by Dr. Gouri Sankar Bhunia, Geo-spatial Expert, Vassar Labs

Dr. Gouri Sankar Bhunia from Vassar Labs discussed how data and technology can be utilized for weather forecasting and decision-making, particularly concerning climate change. His organization focuses on water, agriculture, and disaster information systems. They have worked on projects related to water information support, agricultural production, climate risk management, smart cities, and disaster impact assessment. Their deployments include systems for flood, cyclone, heatwave, and drought risk assessment.

Dr. Gouri Sankar Bhunia described a four-layered disaster information system platform. The first layer involves data integration from various sources, including sensors, remote sensing, models, and historical data. This data is then processed to generate information relevant to disaster mitigation, such as inundation, infrastructure, citizen information, agricultural details, health, and topological data. A disaster index is created using this information and cutting-edge technologies, covering heatwaves, droughts, floods, forest fires, and landscapes. This facilitates disaster mapping and other systems, aiming to reach the last mile.

The platform uses IMD and European meteorological department data for weather forecasting, employing spatial and temporal analysis for detailed insights at district, block, and even village levels. Threshold values and probabilities are visualized through interpolation, and future predictions are generated. Temperature analyses are validated with local weather stations for accuracy. Heatwave analysis utilizes established definitions and color-coded alert systems. Two indices, heat wave and heat index, are calculated, considering humidity and air temperature, respectively.

Dr. Bhunia showcased a system using IMD and ECMWF data to provide heatwave information. The system analyzes data from the past seven days and forecasts for the next 24 hours, displaying the number of districts severely affected by heatwaves, experiencing heatwave conditions, or under normal conditions. It also validates the information against observed global patterns and calculates accuracy. The platform provides detailed statistics at the state, district, and block levels, visualizing the information through maps and displaying projected conditions for the next 7-10 days. It allows for generating reports and analyzing them for decision-making. Dr. Bhunia also mentioned a heat advisory system, which processes downloaded data and applies rules based on different hierarchies to update GIS and image-based decision systems. The system uses live data to monitor events, issue advisories, and enables different stakeholders to access information for post-event analysis.

6.4. Expanding the coverage of existing platform to include extreme heat by Shri. Gaurav Godhwani, Director, Civic Data Labs

Gaurav Godhwani pointed out the increasing trend of heatwaves in India, particularly in the Northeastern region, including Assam. He notes a significant temperature deviation in cities like Guwahati Dibrugarh, Tezpur, Jorhat, and others. His analysis reveals a concerning rise in both minimum and mean land surface temperatures in Assam, indicating a likely increase in future heatwave incidents. He highlighted the alarming impact of heatwaves on various sectors in Assam, based on analysis from the Directorate of Economics and Statistics and other sources. He noted an 8% decrease in agricultural production, a 15% increase in healthcare system overload, a 20% rise in energy demand, and a 40% increase in reported water scarcity over the past five years.

He discussed Assam State Disaster Management Authority's progressive use of data and AI in disaster

management. He mentioned their recent collaboration with Civic Data Labs on intelligent data solution for flood preparedness and response. This solution provides comprehensive risk assessments at district and sub-district levels, and Godhwani proposes extending it to heatwave preparedness as well. He also highlighted ASDMA and UNICEF's joint effort in creating a platform called Disaster Reporting and Information Management System (DRIMS) to collect losses and damages data. This platform provides daily reports, accessible to the public, detailing community impacts of disasters at various administrative levels. Godhwani suggests incorporating a heatwave module into DRIMS to better understand and address the impacts of extreme heat.

Gaurav Godhwani, explained their analysis of recent temperature data in Assam. Comparing the average monthly temperature from 2004-2020 with the observed mean temperature over the last four years, they identified districts experiencing the most significant temperature increases. South Salmara-Mankachar, Dhubri, and Kamrup Metropolitan districts showed the highest deviations, with South Salmara-Mankachar experiencing an average monthly temperature increase of 0.67°C. Godhwani also discussed the urban heat island effect in Guwahati, focusing on areas like Paltan Bazaar, areas near the Kamakhya Temple, and the Railway Colony, which experienced significant temperature rises during the heat period of March-June 2024. He advocated for establishing localized heat thresholds at the district, city, and ward levels to improve preparedness. He also stresses the importance of considering both ambient and apparent temperatures in heat early warning systems and recommends conducting sectoral impact studies to understand the effects of heat on public health, agriculture, economy, social and ecological systems, and infrastructure.

Gaurav Godhwani emphasized the importance of citizen engagement in heatwave management. He suggested leveraging existing platforms like DRIMS to create a reporting mechanism for both heat exhaustion and heat stroke, allowing citizens to anonymously share their experiences with ASDMA through an LLM-based chatbot integrated with popular social media platforms. This two-way communication system would enable citizens to report their heat-related symptoms and receive personalized alerts on high-heat days. Godhwani also highlighted the potential of Assam's Aapda Mitra volunteer group and NSS student volunteers to collect this information and create a heat volunteer network. Utilizing this platform and the existing volunteer networks, Godhwani suggested collecting data on various heat disorders, including heat rash, cramps, exhaustion, and stroke, to inform localized alerts developed in collaboration with ASDMA.

In his concluding remarks, Gaurav Godhwani proposed a data-driven Heat Action Plan for Assam, built on analyzing existing and new heat-related datasets. He suggested establishing localized heat thresholds, empowering district-level authorities to activate heat-related protocols as needed. A key element is the creation of a heat early warning system using SMS and LLM-based chatbots, disseminating timely alerts to citizens. Godhwani also recommended mapping urban heat islands in major cities like Guwahati, Dibrugarh, Tezpur, and Silchar to understand and address localized heat stress. He calls for multi-sectoral heat vulnerability case studies to define protocols and responsibilities for different government departments, along with dedicated budget allocations to track progress. Citizen engagement is paramount, achieved through enabling alerts and reports and activating a heat volunteer network, potentially expanding the existing Apada Mitra network. Finally, he stresses the importance of timely heat loss and damage reports, integrating heat data into existing systems like DRIMS.

7. Closing Session

7.1. Summary highlights by Vishal Pathak, AIDMI

Vishal Pathak's summary of the workshop highlighted several key takeaways regarding heat action plans and building climate resilience:

- Urgency: Immediate action on both adaptation and mitigation is crucial.
- Urban planning: Integrating heat action plans into city planning is essential, particularly for Assam and Northeast India.
- Key elements: Utilizing key elements of heat action plans from NDMA guidelines and lessons from other Indian cities and states is vital.
- Early warning systems: Community-based approaches are highly effective for heat preparedness and response.
- Cooling strategies: Implementing cool roof campaigns and exploring local cooling solutions are important steps.
- Context-specific approaches: Recognizing the unique local contexts of different states, regions, and even districts is crucial for effective interventions.
- Data-driven decisions: Strengthening data collection and analysis is essential, as is stakeholder engagement throughout the process.
- Mainstreaming heat resilience: Integrating heat mitigation measures into city, district, departmental, hospital, and school plans is necessary.
- Technology: Utilizing AI, big data, and metadata can significantly improve information dissemination, risk reduction, and early warning systems.

Pathak's summary provides a concise overview of the key discussion points and recommendations from the workshop, emphasizing a multi-faceted approach that incorporates both immediate actions and long-term planning for heat resilience in the region.

7.2. Vote of Thanks by Dr. Surajit Baruah, Senior Consultant - SFDRR, ASDMA

Dr. Surajit Baruah, representing ASDMA, thanked participants at the workshop on extreme heat and climate resilience. He highlighted Assam and Northeast India's dedication to disaster management and climate resilience, expressing gratitude to Minister Keshab Mahanta for his guidance, government officials (including ASDMA leadership), speakers, experts, panelists, district representatives, the ASDMA and AIDMI team. Baruah emphasized the workshop's importance as a platform for discussion and collaboration to address extreme heat challenges, confident that the resulting ideas and solutions would contribute to a heatwave action plan for Assam.