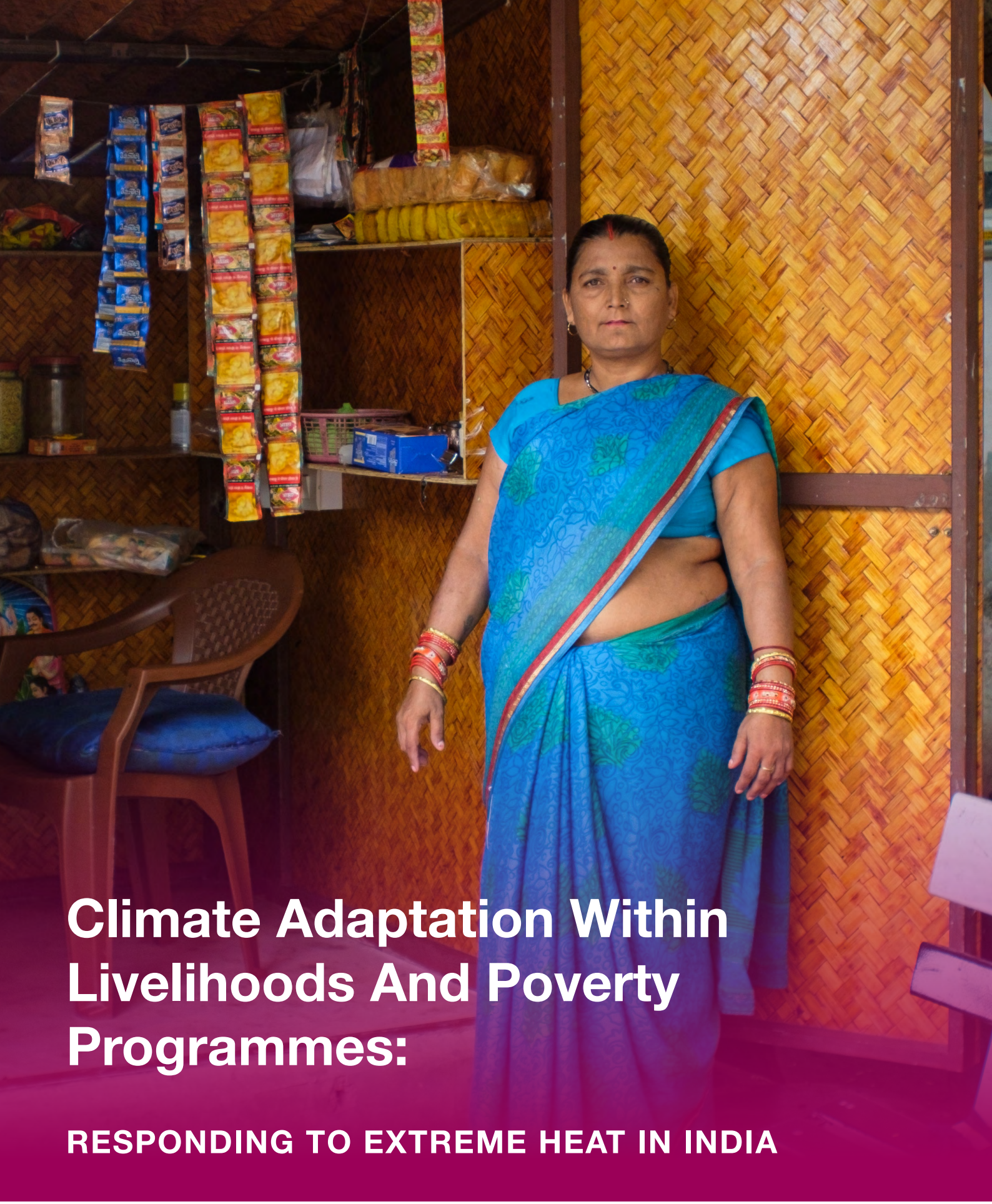


Climate Adaptation Within Livelihoods And Poverty Programmes:

RESPONDING TO EXTREME HEAT IN INDIA

brac

MAHILA HOUSING TRUST
Towards Responsible Urban Development
MHT

Table of Contents

India is experiencing the effects of the current 1°C global warming. Heat waves, floods, and droughts are affecting the lives of communities across the region.[1] At this present moment, a disproportionate amount of attention is paid to climate mitigation. One of the reasons is that it attracts the lion's share of global climate finance, eight times as much funding as climate adaptation.[2] Adaptation efforts are needed as some estimate that climate shocks could push 50 million more people into poverty by 2040.[3] This paper presents how to integrate adaptive measures within rural and urban livelihoods programmes, especially programmes that are designed for the most vulnerable populations. This paper has been co-written by BRAC International and Mahila Housing Trust[4] to invite further discussion on the topic by key stakeholders like the government, civil society, and private sector.

Introduction

Many cities in India are reporting temperatures above 48°C.[5] Currently, wet-bulb temperatures in India are generally below 32°C, but research shows that by 2030 many areas in India will experience wet-bulb temperatures of 34°C, one of the highest in the world.[6] With global temperatures rising further, these effects will only increase in severity and frequency, disproportionately affecting populations without resources to cope.

Heatwaves and wet-bulb temperature

The World Health Organization defines a heatwave when the temperature is above 40°C on flat areas or above 30°C on hilly areas and is more than 4.5°C above the normal temperature.[7] Besides heatwaves, India reports the highest wet-bulb temperatures in the world. Wet-bulb temperatures are measured by combining the air temperature and relative humidity levels. With higher wet-bulb temperatures, the human body is less able to cool itself through evaporation of sweat. When wet-bulb temperatures increase, people can face fatigue in order to prevent overheating of the body, or organs can start failing.[8] 35°C of wet-bulb temperature is defined as the maximum humans can survive.

The health impacts of excessive heat exposure are well known - including heat rash, edema, dizziness, dehydration, heat exhaustion, heatstroke, and even death.[9] In addition to their effects on human health and well-being, heatwaves can also result in disruptions to water and energy supplies. This is significant since water and electricity are essential resources for staying cool and remaining adequately hydrated during heatwaves.

However, heat exposure can also directly impact livelihoods by limiting the number of productive hours and the productivity of the livelihoods themselves. Most of India's workforce is engaged in sectors that are impacted by heatwaves. The main outdoor occupations include agriculture, mining, and quarrying. Indoor occupations include home-based work, transportation work, and manufacturing. Often, this work takes place in heat retaining construction areas or work spaces that lack access to proper ventilation and air conditioning.[10]

This results in reduced incomes of people living in poverty who typically lack access to cooling facilities or other resources, which can mitigate some of the effects of heat on their livelihood and health.[11]

Climate adaptation, resilience, and mitigation

In dealing with the impacts of climate change, policymakers distinguish between climate change adaptation, mitigation, and resilience. Climate mitigation refers to addressing the root causes of climate change, such as reducing fossil fuel dependence, while adaptation refers to changes that address the adverse effects of climate change. Climate resilience is a more comprehensive and systemic approach that combines building coping, adaptive, and transformative capacities for people to prepare for and recover from the effects of climate change. Renewable and green energy solutions are generally related to climate mitigation approaches, whereas switching to drought resistant crops is an example of climate adaptation. At this present moment in India, a disproportionate amount of attention is paid to climate mitigation, which is attracting the lion's share of global climate finance, eight times as much funding as climate adaptation.[12] Despite this disparity, investments in climate adaptation yield net economic benefits and reduce loss and damages.[13] Adaptation measures with a resilience lens are critical to addressing the impacts of climate change that are already happening, disproportionately affecting vulnerable populations.

The impact of heat stress is socially, economically, and geographically differentiated and magnifies existing vulnerabilities and inequalities. While extreme heat poses a risk to all segments of society, certain groups are more vulnerable than others. These disparities arise due to variations in factors such as exposure and sensitivity to heat, adaptability, and access to basic services. Heatwaves are most dangerous for the elderly, children, pregnant women, people with pre-existing chronic health conditions, people with disabilities, people living alone or those dealing with mental health issues. Also at risk are marginalised and indigenous communities, and the homeless.[14,15]

Heatwaves also disproportionately impact women living in poverty, particularly those belonging to scheduled castes, scheduled tribes, and indigenous communities. Women are often tasked with additional labour including fetching water, domestic work, childcare,

caregiving, and other household work.[16] It is estimated that women spend an additional 4.9 hours every day on unpaid household work compared to men. These burdens are exacerbated by rising temperatures in various ways - additional caregiving for family members affected by heat-related illness, or support services such as creches shutting down due to a lack of cooling equipment. In a scenario where only 24 percent of women in India are part of the labour force, earn 35 percent less than men, and form a large percentage of the informal workforce, this wage gap widens further due to increased heatwaves.[17]

The increased intensity and duration of extreme heatwaves in recent years are adversely impacting India's efforts to reduce poverty, income inequalities, food insecurity, and gender inequalities.[18] In 2023, there were heatwaves for 49 days across 20 States and Union Territories. The frequency of heatwaves and their duration has risen over the last 30 years and over the course of the next few decades, the number of heatwaves will increase by two per season and their duration will increase by about 12-18 days (compared to 2-4 days at present).[19] We expect this to worsen in the years and decades to come.

India's economy heavily relies on a heat-exposed workforce, contributing to half of the country's Gross Domestic Product (GDP) and driving approximately 30 percent of GDP growth. As of 2017, around 75 percent of India's labour force, approximately 380 million people, were exposed to heat stress, sometimes facing temperatures that could be life-threatening.[20,21] By 2030, it is projected that out of the estimated 80 million global job losses resulting from productivity declines related to heat stress, approximately 34 million will occur in India.[22]

A considerable number of studies describe how floods and droughts affect the lives of people living in poverty and policymakers have started addressing the issues. However, climate adaptation to heatwaves is still in its early stages and therefore the focus of this paper is to integrate adaptive measures for heat into livelihoods and poverty programmes which are key to empower people to escape poverty.

Climate Adaptive Livelihoods

High temperatures in general and heatwaves specifically are negatively impacting the livelihoods of people living in poverty. Heat stress further erodes the livelihoods of people living in poverty, undoing development gains made in the livelihood and poverty programmes in the past.

For every degree above 25°C, household productivity decreases by 2 percent,[23] which means reduced income for home-based enterprises. Home-based workers experience hot, dingy, and stuffy working conditions affecting their productivity, profit, health, and well-being.

Moreover, heatwaves make outdoor work during the hottest hours of the day impossible, leading to a 20 percent loss of working hours. This impacts people engaged in manual outdoor labour, such as construction workers, rickshaw pullers, and street vendors by reducing the hours of productive work. Another high-risk group includes people who work in close proximity to heat sources, such as bakers, welders, blacksmiths, and people cooking and selling food over open fire.[24]

Extreme heat conditions particularly impact the agricultural sector. Heat stress amplifies drought conditions and worsens the problem of water scarcity for irrigation. In rural Odisha, tribal women's livelihood depends on the collection of leaves, flowers, and tamarind in the forests. Because of heatwaves, they are not able to work in the forest during the hottest hours of the day and the overall quality of products deteriorates because of the lack of pre-monsoon rains.[25]

Micro entrepreneurs and vocational traders are unable to undertake work during extreme heat episodes. Additionally, vegetable or food vendors find their produce damaged or spoiling faster than usual. These are daily wage earners, and losing a day of work amounts to less food, and lesser savings. For example, in Patna, one of the participants in Jeevika's Satat Jeevikoparjan Yojana (SJY) was not able to work during the hottest hours of the day, which lowered her income. Additionally, the eggs she normally sells at her shop were rotting too quickly in the heat, so she had to stop selling them.

Workers may also be exposed to extreme heat while travelling to workplaces. They may find themselves commuting long distances on foot, by bicycle, or on overcrowded public transportation systems. Engaging in these journeys is a key period of exposure to extreme heat, especially for populations in poverty who rely on the cheapest and often less comfortable modes of transportation.[26]

Existing solutions and their limitations

Governments in India are responding to the increasing frequency and intensity of heatwaves by introducing Heat Action Plans (HAPs). The first HAP was developed in Ahmedabad in 2013, after which the government of India through the National Disaster Management Authority (NDMA) released national guidelines in the paper Preparation of Action Plan - Prevention and Management of Heat Wave in April 2016 and revised these in 2017 and 2019.[27] These guidelines provide a framework for implementing, coordinating, and evaluating extreme heat response activities in India. However, these HAPs were implemented top-down without considering the local context. In addition, reaching the people who are most vulnerable has been challenging; capacity building of civil servants has been done in silos; and limited funding has been available to implement the plans.[28] Moreover, the responsibility for delivering these interventions has been assigned to Disaster Risk Management Departments who have limited influence when it comes to implementation of long-term solutions.

In these HAPs, governments have formulated guidelines that help communities make the necessary preparations, cope with effects, and recover from heatwaves. Some HAPs recommend employers and communities shift working hours to early morning or evening/night hours to escape extreme heat during the hottest months.[29] They suggest that nighttime lighting be installed at construction and other labour sites so people can work in the early morning or during the evening. While a potentially effective solution, shifting working hours could lead to economic and cultural challenges, such as adaptation to altered commute timings, and changes needed for working hours in schools and shops.[30]

Some companies have offered extra health breaks and provided work site-adjacent cooling stations and cooling mist sprays[31] for labourers and stations near informal housing communities with prioritised access for children, the elderly, and pregnant women.

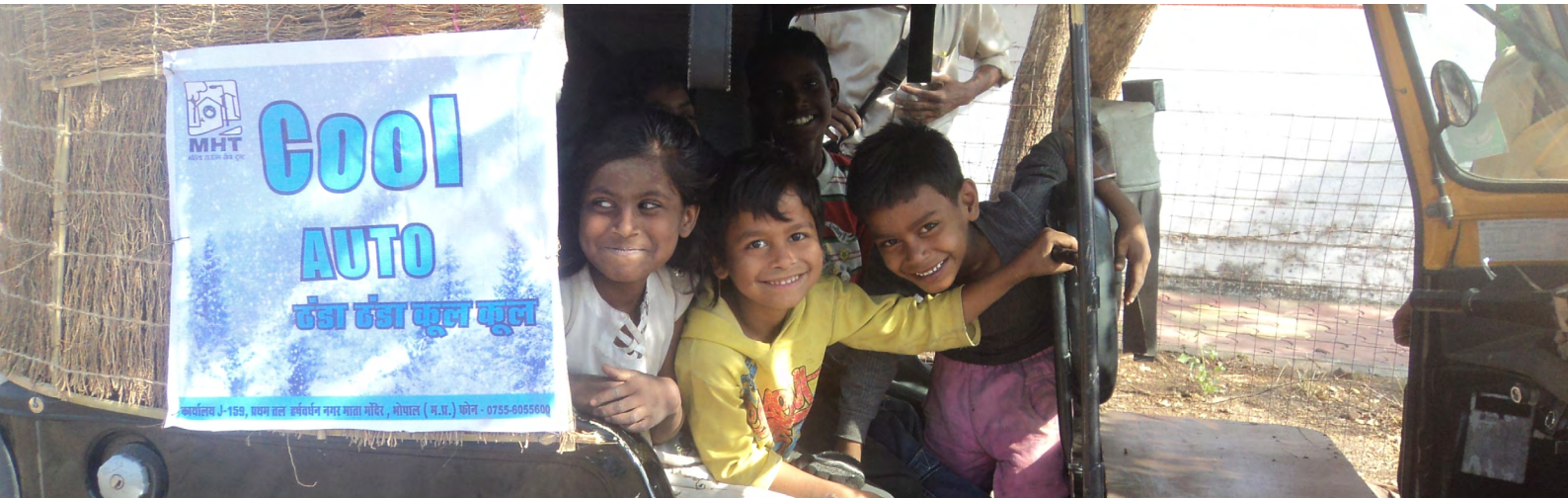
Case Study I: Livelihood Adaptations in BRAC's Ultra-Poor Graduation Programme in Rural Bangladesh

In the northwestern Barind region of Bangladesh, communities face worsening heatwaves and droughts which threaten to kill their livestock and crops. Traditional tin roofs which shelter livestock are overheating, so BRAC works with Graduation programme participants to improve their livestock infrastructure in cost-effective, locally adapted ways such as using banana and palm leaves to construct sheds, or layering straw and bamboo underneath their tin roofs. Graduation coaches will offer guidance to help animals survive, encouraging participants to spray them with water and bring them into the shade around midday. Staff promote awareness around heat resistant grass and crop varieties that require minimal water consumption and are experimenting with mulching to retain moisture, save water, and reduce weed growth.

In agricultural communities, heat shelters have been created for livestock to prevent heat-related asset losses.[32] Crop cycles were adjusted and heat-resistant crop varieties and effective post harvest management tried. Weather-indexed crop insurance and livestock insurance have also been used to combat low yields caused by heat. Livelihood diversification also reduces the risk to households depending on a single income source.[33] .

Some new cooling technologies and innovations have been explored to mitigate the impacts of extreme heat on livelihoods. For example, RuKart's Subjee Cooler is a portable, zero-energy cooling chamber that can keep vegetables fresh for up to five days without any energy input, relying on just twenty litres of water per day. The Subjee Cooler has played a crucial role in reducing losses for farmers and perishable goods vendors in India.[34,35] Similarly, Coolcrop is collaborating with farmers and Farmer Producer Organisations (FPOs) and establishing micro-cold storage units to offer cold storage as a service to small farmers.[36]

Fig. 1 - Cool Auto Rickshaw [Photo credit: Mahila Housing Trust]



Cooling Solutions for Low-Income Settlements

A significant portion of people living in urban poverty reside in temporary or self-constructed houses that are typically small with a single room that serves as a combined living, cooking,[37] sleeping, and toilet area. Often, these homes are poorly situated and made of materials such as tarpaulins, tin, asbestos, cement sheets, plastic, and plywood scraps. Such materials increase indoor temperatures and make indoor environments hotter than outdoors.[38] Therefore, during heatwaves, staying at home becomes an exhausting and inhumane ordeal.

Numerous local factors contribute to the vulnerability to heat stress, including having cooking stoves located indoors, overcrowding, inadequate ventilation, the lack of green spaces and tree shade surrounding the residences, and running businesses within the homes. Most homes lack access to water and electricity, which are two essential resources for staying cool and adequately hydrated during heatwaves. Consequently, indoor heat becomes a persistent issue not only during the daytime but also at night. In some instances, efforts to escape the heat, such as sleeping outdoors and engaging in nighttime activities, can give rise to other issues like exposure to malaria-causing mosquitoes.[39]

For those who spend a significant amount of time at home, an overheated house can subject them to continuous heat stress. Especially lower-income women often find themselves spending more time indoors doing household tasks, running home-based businesses, or caring for children. They are disproportionately affected by the indoor heat of the house.

Existing solutions and their limitations

At the household level, people spray their mattresses with water to dispel the heat and paint roofs white. This reduces indoor temperature, improves sleep quality, and enables programme participants with small shops to keep working during the hottest hours of the day.

At the policy level, HAPs include heatwave warning systems and a coordination approach between government departments, articulating long-term investments in infrastructure including cool roofs and water harvesting bodies.

Cool roofs appear to be the most practical solution for reducing heat inside the houses of the people in urban poverty. They are more cost-effective compared to insulation and are feasible for both new constructions and retrofitting efforts. Cool roofs are the outer layer or exterior roof surface that acts as a reflective surface. Painting white vinyl or other white surface materials increases a building's ability to reflect light to 60 percent, compared to 10-20 percent on a traditional asphalt roof. This reduces heat absorption and cools the interior.[40] Other household-level cooling solutions include the use of Khus or grass curtains (humid area) sprayed with water to cover doors and windows.[41] Placing half clay pots on roofs to increase space and buffer direct sunlight (as promoted by the government via National Disaster Management Authority - NDMA), especially in dry areas, is a low-cost solution that can reduce indoor temperatures by 2 to 5°C (3.6 - 9°F).[42] At the community level, constructing community cooling spaces or painting community buildings with white 'cool roofs' may reduce the heat stress on people in poverty. They could use the places to stay, work, and study during the hottest months of the year. However, the effectiveness of these technologies still need to be explored at scale.

Case Study II: Enhancing Heat Resilience in Jodhpur: A Holistic Approach to Community Engagement

Mahila Housing Trust's (MHT) recent experience in Jodhpur, Rajasthan, reveals a critical gap in access to early warning systems for heat. The current dissemination methods, primarily through print media, pose a challenge for those who are not literate, which constitutes a significant portion of people living in urban poverty. Furthermore, those who can access information through print media often lack awareness regarding actionable steps at the individual and workplace levels to mitigate heat exposure. Bridging this awareness gap is vital for the effective implementation of early warning systems at the grassroots level. In response, MHT has undertaken an innovative approach by collaborating with women-led Community Action Groups for the last-mile delivery of the heat early warning system in Jodhpur. This initiative involves strategically placing hoardings in informal settlement areas with colour-coded warnings. Women leaders from the community play a pivotal role in educating families through group meetings and household visits, ensuring that vital information reaches every corner of the community. This holistic approach not only addresses the accessibility issue, but also empowers the community, especially women, to take proactive measures in response to early warnings.

Adapting to extreme heat within the context of housing requires a combination of technical innovations in building materials and layout, and community-driven initiatives. Recognizing that people living in urban poverty typically reside in informal, temporary, or self-constructed housing, adaptation measures need to be simple, practical, cost-efficient, and aspirational. It is equally important to engage local communities, particularly women, in the process. This ensures that solutions are not only tailored to local and cultural contexts but are also sustainable and can be maintained by households in poverty.[43]

Climate Adaptation, Finance, and Cash Transfers

Climate funding often doesn't get to the people who need it the most. Only 10 percent of current climate finance has reached the intended, most vulnerable communities.[44] BRAC supported the creation of the eight principles of locally-led adaptation, endorsed by over 100 governments, global institutions, and NGOs. In this approach, decision-making is devolved to the lowest possible level, and investments are made in local capabilities, which ensures a robust understanding of local knowledge.[45]

Existing solutions and their limitations

Finance needs to enable local actors to build capacity. However, private investment in adaptive tools and services has been slow to develop because of a lack of a clear profit incentive. There have been recent attempts at a global level, like Cool Capital,[46] that tries to mobilise capital investment towards adaptation investment. But the efforts are too few to translate into real gains for the sheer volume of affected people. This profit gap needs to be filled by public sector investment and donor funds to enable the private investment towards adaptation and in particular, adaptive livelihoods.

This investment needs to occur at three levels (a) adaptive technologies at the micro level, for example, small and affordable cool boxes that can protect new born chicks during extreme heat, (b) settlement level infrastructure like cooling shade for street vendors or communal refrigeration options, and (c) systemic tools like financial infrastructure that can underwrite heat insurance at scale.

Unlike floods, cyclones, and other extreme climate episodes, multiple heatwaves are expected to occur in the Indian subcontinent between March and June. That certainty provides room for planning and designing innovative financial products.[47] The Self-Employed Women's Association (SEWA) has launched a pilot for 21,000 of their members who are employed in a range of hazardous professions like waste management, street vending, and construction workers. SEWA and the Rockefeller Foundation will test parametric insurance,[48] which will offer wages to members during extreme heat episodes. If certain levels of meteorological triggers, like day and night temperatures and humidity are reached, then an automatic payment is made into the worker's bank account. There is a need to explore different types of climate risk funds that can provide financial assistance to people living in poverty during episodes of extreme heat. Mahila Housing Trust is also starting a pilot in collaboration with Global Parametrics to launch a heat insurance product for 27,000 women entrepreneurs through their cooperatives in Gujarat. These pilots are promising examples of heat risk insurance, which can be used to incorporate successful insurance products at governments.

Within livelihood and poverty programmes that aim to reach those furthest behind, there is a small cash transfer provided to families worth INR 1000 for approximately the first seven months of entering the programme. These cash transfers can be used to support income during extreme heat episodes. However, these amounts are dedicated to meeting basic needs and are insufficient to use them to cope with heat stress.

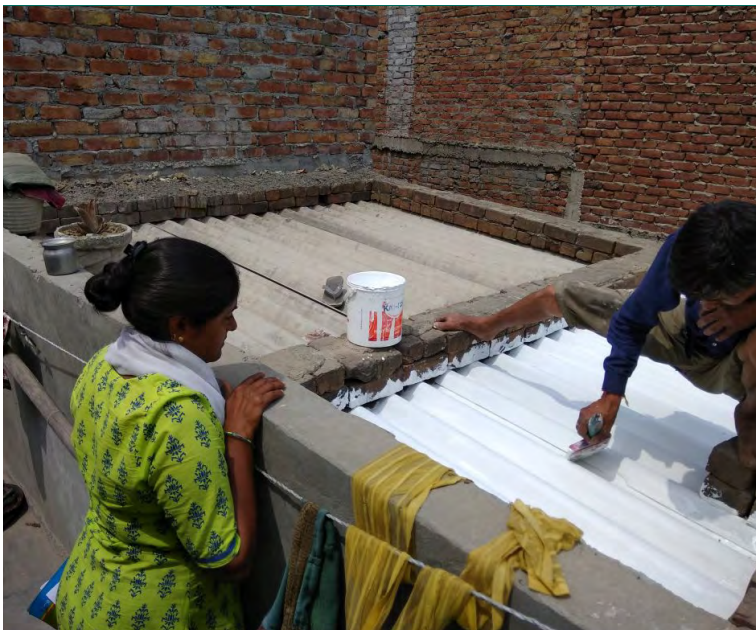


Fig. 2 - Residents of an informal settlement in Bapalal Kadia, Ahmedabad city, India, painting their roof with solar-reflective white paint. [Photo credit: Mahila Housing Trust]

Policy Recommendations

Holistic and systematic approaches that leverage community institutions to design locally-led adaptation solutions are required to enable communities to adapt to heat stress. Based on the current challenges people in poverty face and the emerging solutions that are developed, we propose seven policy recommendations. The first three recommendations are key to ensure government-led climate adaptation and can be mainstreamed through NRLM and SRLMs' work. The other four recommendations specifically address key areas to improve climate adaptation.

1. Leverage community institutions:

India has a vast network of community institutions in rural and urban areas. These institutions, Self-Help Groups, Village Organisations, Cluster and Area Level Federations, and City Level Federations need to be leveraged to craft a more effective heat response strategy. Micro plans on livelihood options need to incorporate risks and measures for extreme heat episodes. Addressing climate stress needs vernacularisation of the language in which vulnerability and solutions are communicated by state and civil society. The National Rural Livelihood Mission and State Rural Livelihood Missions, along with the National Urban Livelihood Mission and their state counterparts, with municipal bodies can play a central role in cultivating locally-led adaptation.

2. Empower communities by following the locally-led adaptation principles:

Where the HAPs are generally too generic formulated and top-down implemented, locally-led adaptation could empower communities to develop context specific and bottom-up solutions to heat stress. Locally-led adaptation approaches can be developed through already existing community institutions. These community institutions could create awareness and educate households on the impacts of heat stress and proactive measures to reduce the effects of extreme heat on their livelihoods and health. The staff of State Rural Livelihood Missions (SRLMs), State Urban Livelihood Missions (SULMs), and community cadres must undergo comprehensive training to enhance their capabilities in heat adaptation and resilience-building within vulnerable communities. To facilitate these initiatives, SRLMs/SULMs may need to allocate additional funds and resources, particularly in urban areas where community institutions often face limitations in funding for supplementary social initiatives.

3. Leverage existing government resources:

India has several rural and urban livelihood missions at the state level that can leverage existing government programmes and schemes from other departments like the Disaster Risk Management Department or Smart Cities Initiative for funding to build community capacity.

4. Change policies to support climate adaptation:

Learning from Ahmedabad, new policies could be drafted to prohibit work for urban wage and rural day labourers on days that approach or surpass fatal wet-bulb temperatures in which the body cannot cool itself. Alternatively, governments can shift working hours during the hottest months of the year. For both policy options, income losses can be mitigated by heatwave labour insurance schemes.

5. Build climate-adaptive public and private infrastructure:

Many urban communities living in poverty are involved in home-based work. Therefore, new houses constructed under Pradhan Mantri Awas Yojana should prioritise thermal comfort features, including insulation, passive solar design, energy-efficient windows and doors, ventilation, and cool roofing. This will enhance living conditions, reduce energy bills, and contribute to the well-being of urban communities living in poverty, and it is aligned to India's sustainability goals. Additionally, government health centres could stock oral rehydration solution (ORS) packages.[49]

6. Design cash transfer and climate risk insurance products:

Some livelihood and poverty programmes already offer cash transfers during initial stages of their programmes. We recommend increasing the cash transfer amount when it's overlapping with extreme heat episodes. Additionally, low-cost financial products that can help support households that are dependent on daily wage labour, small enterprises, and high intensity manual jobs need to be developed and offered at no cost or subsidised rates. Public sector guarantees or investments can help drive innovation from both private and public sector entities. Public sector finance can be leveraged to establish a national climate risk fund that could guarantee insurance payouts to low-income households. This would incentivise private and public sector innovation in financial products that address extreme heat.

7. Include heatwave modules into livelihood and poverty programmes:

Livelihood and poverty programmes need to create awareness among programme participants on the consequences of heatwaves and inform them about adaptive solutions. Two components have to be integrated into the life skill curriculum: health risks and livelihood adaptations. These two components of life skills can be incorporated into existing coaching curriculums. However, coaches need to be trained on these elements so that they can share these insights with programme participants.

Fig. 3 - Lakshmiben sits outside her newly renovated shop-cum-house, with a bamboo door and bamboo roofing replacing the older structure at Rajiv Nagar, Ahmedabad city, India. [Photo credit: Mahila Housing Trust]

Conclusion

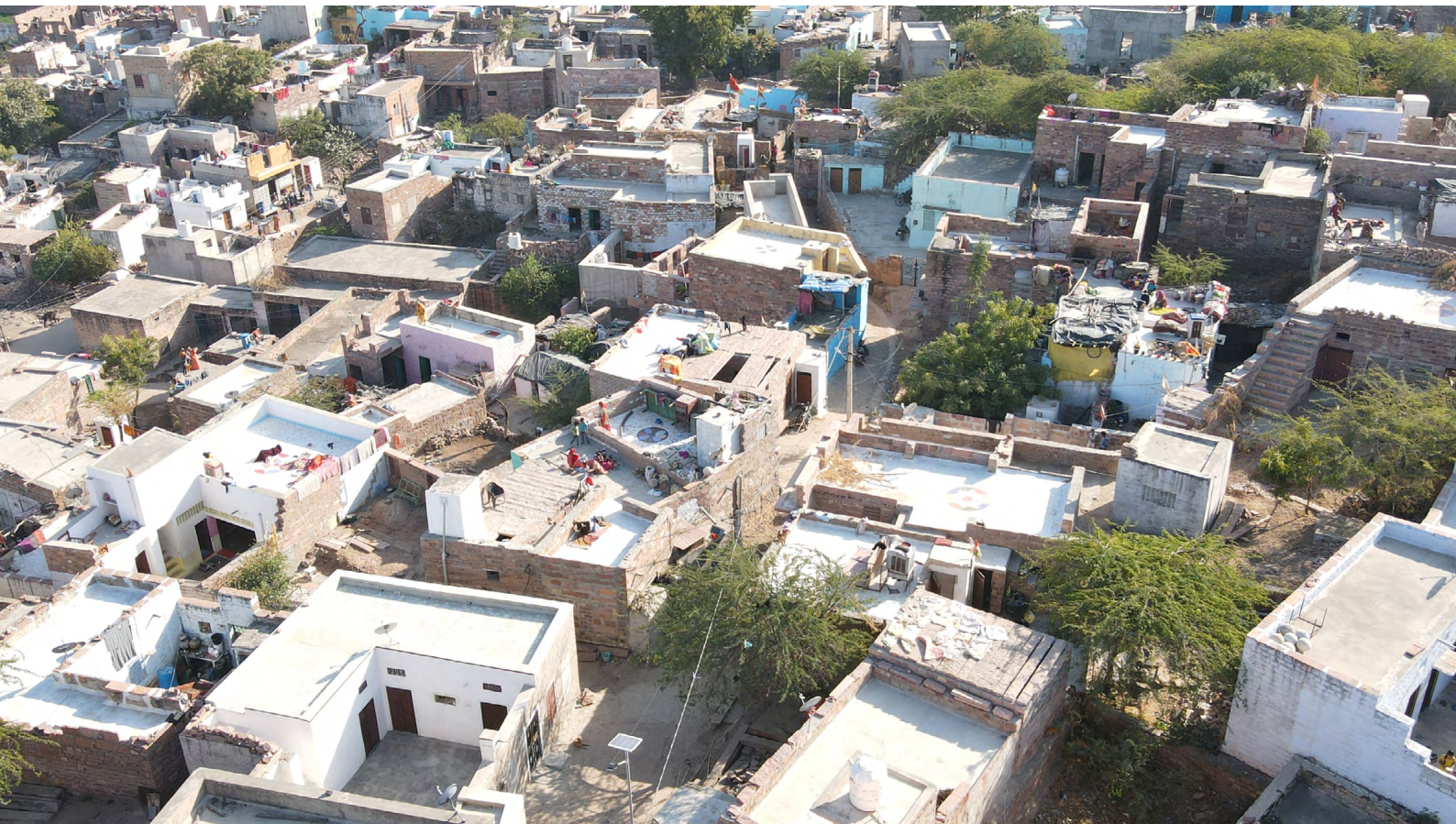
Extreme heat episodes are negatively affecting the health and livelihoods of communities across India. As with any other climate shock, those living in poverty will be least equipped and most impacted by heat stress.

We have to act now to develop solutions to enable people living in poverty to cope with the adverse effect heat stress has on their lives. If we do not take action now, we risk losing the gains made in reducing poverty in the past and any we make in the future.

Currently, the bulk of climate financing goes to climate mitigation efforts as it receives eight times more funding than climate adaptation initiatives. More funds need to be allocated to climate adaptation to develop suitable solutions for people living in poverty so that they become resilient towards the effects of climate change in general and heat stress in particular.

This paper showcases some initial solutions developed by and for communities to adapt to extreme heat. We invite further deliberation on possible pathways to help address this problem that is affecting all of humanity.

Fig. 4 - Solar reflective white paint on houses in Jodhpur, India. [Photo credit: Mahila Housing Trust]



References

[1] Picciariello, Angela, Sarah Colenbrander, Amir Bazaz, and Rathin Roy. “The costs of climate change in India.” A review of the climate-related risks facing India, and their economic and social costs. ODI Literature review. London: ODI (2021), https://odi.org/en/publications/the-costs-of-climate-change-in-india-a-review-of-the-climate-related-risks-facing-india-and-their-e conomic-and-social-costs/.

[2] Sharma Kabir. “Climate change adaptation is the need of the hour.” (2023). Accessed August 23, 2023, https://idronline.org/article/climate-emergency/climate-change-adaptation-is-the-need-of-the-hour/

[3] Picciariello, et al (2021).

[4] Mahila Housing Trust is headquartered in Ahmedabad and works on urban habitats and climate resilience in many parts of India. BRAC International is headquartered in the Netherlands and is working to support governments across the world on designing and implementing livelihood and poverty programmes.

[5] Picciariello, et al (2021).

[6] Woetzel, Jonathan, Dickon Pinner, Hamid Samandari, Rajat Gupta, Hauke Engel, Mekala Krishnan, and Carter Powis. “Will India get too hot to work.” (2021).

[7] World Health Organization. Heat Waves. (2023). Accessed on August 15, 2023 https://www.who.int/india/heat-waves.

[8] Timperley, Jocelyn . Why you need to worry about the “wet-bulb temperature”. Accessed on December 14, 2023. https://www.theguardian.com/science/2022/jul/31/why-you-need-to-worry-about-the-wet-bulb-temperature

[9] World Meteorological Organization (WMO) and World Health Organization (WHO) (2015). Heatwaves and Health: Guidance on Warning-System Development

[10] Hussain Zoya Ada. Can India’s Heat Action Plans cope with the heat? (2023). Accessed on July 26, 2023, https://idronline.org/article/climate-emergency/can-indias-heat-action-plans-cope-with-the-heat/.

[11] Turek-Hankins, Lynée L., Erin Coughlan de Perez, Giulia Scarpa, Raquel Ruiz-Diaz, Patricia Nayna Schwerdtle, Elphin Tom Joe, Eranga K. Galappaththi et al. “Climate change adaptation to extreme heat: a global systematic review of implemented action.” Oxford Open Climate Change 1, no. 1 (2021): kgab005.

[12] Sharma Kabir” (2023) https://idronline.org/article/climate-emergency/climate-change-adaptation-is-the-need-of-the-hour/

[13] Lankes, Soubeyran, and Stern. Acting on climate and poverty: if we fail on one, we fail on the other. (2022). Accessed December 28, 2023, https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/04/Acting-on-climate-and-poverty_if-we-fail-on-one-we-fail-on -the-other.pdf

[14] UNICEF. Protecting children from heat stress. (2023). Accessed on August 8, 2023, https://www.unicef.org/parenting/heat-wave-safety-tips.

[15] Asian Development Bank (2022). Beating the Heat: Investing in Pro-Poor Solutions for Urban Resilience.

[16] Suchitra. ‘It’s all our burden’: Poorest women hardest hit by heatwaves in India (2023). Accessed on September 6, 2023, https://www.thenewhumanitarian.org/news-feature/2023/07/20/its-all-our-burden-poorest-women-hardest-hit-heatwaves-india?u tm_content=buffer395fc&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer

[17] Adrienne Arsht-Rockefeller Foundation Resilience Center. The scorching divide: How extreme heat inflames gender inequalities in health and income. (2023). Accessed on July 28, 2023, https://onebillionresilient.org/extreme-heat-inflames-gender-inequalities/.

[18] Debnath, Ramit, Ronita Bardhan, and Michelle L. Bell. “Lethal heatwaves are challenging India’s sustainable development.” PLOS Climate 2, no. 4 (2023): e0000156.

[19] Climate India 2023: An assessment of extreme weather events. (n.d.). https://www.cseindia.org/india-2023-extreme-weather-events-11973 Accessed on December 20, 2023

[20] The World Bank. Climate Investment Opportunities in India’s Cooling Sector (2022).

[21] McKinsey Global Institute. Will India get too hot to work? (2020).

[22] International Labour Office. Working on a warmer planet: The impact of heat stress on labour productivity and decent work (2019)

[23] Vellingiri, Selvakumar, Priya Dutta, Srishti Singh, L. M. Sathish, Shyam Pingle, and Bijal Brahmbhatt. “Combating climate change-induced heat stress: assessing cool roofs and its impact on the indoor ambient temperature of the households in the urban slums of Ahmedabad.” Indian Journal of Occupational and Environmental Medicine 24, no. 1 (2020): 25.

[24] Gough, K. V. et al. (2019). Vulnerability to extreme weather events in cities: implications for infrastructure and livelihoods. Journal of the British Academy

[25] Mohanti, Hrusikesh. 16 heatwaves in Odisha this summer rob its tribal women of livelihood. (2023). Accessed on July 26, 2023, https://www.downtoearth.org.in/news/climate-change/16-heatwaves-in-odisha-this-summer-rob-its-tribal-women-of-livelihood-90 200.

[26] Esson, James, Katherine Gough, David Simon, Ebenchief Amankwaa, Olivier Ninot, and Paul W.K. Yankson. (2019). ‘Livelihoods in Motion: Linking Transport, Mobility and Income-generating Activities’

[27] National Disaster Management Authority. Heat Wave A5 Book: Beating the Heat, How India Successfully Reduced Mortality Due to Heat Waves. (2020). Accessed on August 16, 2023, https://ndma.gov.in/sites/default/files/IEC/Booklets/HeatWave%20A5%20BOOK%20Final.pdf.

[28] Aditya Valiathan Pillai and Tamanna Dalal. How is India adapting to heatwaves?: An assessment of heat action plans with insights for transformative climate action. CPR report. (2023). Accessed August 16, 2023, https://cprindia.org/briefsreports/how-is-india-adapting-to-heatwaves-an-assessment-of-heat-action-plans-with-insights-for-trans formative-climate-action/

[29] Woetzel et al (2021).

[30] Woetzel et al (2021).

[31] Suter, Ivo, Saskia Drossaart van Dusseldorp, and Julien G. Anet. “From observations to modeling: Investigating the heat mitigation potential of public spray mist cooling in Zurich.” In EGU General Assembly Conference Abstracts, pp. EGU-13652. 2023.

[32] National Disaster Management Authority. (2020).

[33] Jones, Lindsey, Susanne Jaspars, Sara Pavanello, Eva Ludi, Rachel Slater, Natasha Grist, and Sobona Mtisi. “Responding to a changing climate: Exploring how disaster risk reduction, social protection and livelihoods approaches promote features of adaptive capacity.” (2010).

[34] Rukart Website. Accessed their webpage on October 25, 2023. https://www.rukart.org/pages/subjee_cooler.html.

[35] World Economic Forum (2022) 9 youth-led innovations that are protecting the planet. Accessed on October 26, 2023,

https://www.weforum.org/agenda/2022/04/9-youth-led-innovations-are-protecting-the-planet.
Accessed their webpage on October 25, 2023. https://www.rukart.org/pages/subjee_cooler.html.
36
Dipti. On the Farm: Micro Cold storage for Small Farmers. Accessed on October 26, 2023, http://dipti.sustainabilityoutlook.in/perspectivenew/42.
37 In an internal survey from Mahila Housing Trust, 43% of the 4525 of the interviewed informal settlement households in Ranchi, Jharkhand report to not have a separate kitchen. This means that heat and smoke generated from cooking is affecting all members in those households.
38 Natural Resources Defense Council (NRDC) (2013). Rising Temperatures, Deadly Threat: Recommendations for Slum Communities in Ahmedabad. Accessed on October 25, 2023, https://www.nrdc.org/sites/default/files/india-heat-slum-communities-IB.pdf.
39 Wilby, R.L. et al. (2021). 'Monitoring and Moderating Extreme Indoor Temperatures in Low-Income Urban Communities'. Environmental Research Letters
40 Environmental and Energy Studies Institute. 2012. Cool Roofs Factsheet. Accessed on October 25, 2023, https://www.eesi.org/papers/view/fact-sheet-cool-roofs#:~:text=Energy%20Savings%3A%20Typical%20roofs%20can,painted%20roofs%20or%20steel%20roofs.
41 Azhar, Gulrez Shah. Life hacks from India on how to stay cool (without an air conditioner). (2023). Accessed on August 16, 2023, https://www.npr.org/sections/goatsandsoda/2022/08/02/1114354904/opinion-life-hacks-from-india-on-how-to-stay-cool-without-a n-air-conditioner.
42 Jaiswal, Anjali. Heat Action Plans 2021: Cool Roofs Challenge. (2021). Accessed on August 17, 2023, https://www.nrdc.org/bio/anjali-jaiswal/heat-action-plans-2021-cool-roofs-challenge.
43 Asian Development Bank (2022). Beating the Heat: Investing in Pro-Poor Solutions for Urban Resilience.
44 International Institute for Environment and Development. Climate finance not reaching the local level. Accessed December 19, 2023. https://www.iied.org/climate-finance-not-reaching-local-level.
45 Soanes, Marek, Aditya Bahadur, Clare Shakya, Barry Smith, Sejal Patel, Cristina Rumbaitis del Rio, Tamara Coger et al. "Principles for locally led adaptation." International Institute for Environment and Development, London, UK (2021).
46 The Rockefeller Foundation. The cool capital stack. Accessed December 19, 2023, https://onebillionresilient.org/project/cool-capital-stacK/.
47 Chandrashekar, Nirmita. Rising temperature, falling income: Heat stress in the informal sector. (2024). Accessed on February 2, 2024, https://idronline.org/article/climate-emergency/rising-temperature-falling-income-heat-stress-in-the-informal-sector/
48 The Rockefeller Foundation. Fighting extreme heat with parametric insurance. Accessed December 19, 2023, https://onebillionresilient.org/2023/03/07/fighting-extreme-heat-with-parametric-insurance/.
49 National Disaster Management Authority. (2020).

BRAC International
Zuid-Hollandlaan 7 2596 AL
The Hague
The Netherlands
info@bracinternational.nl

701-702, 7th floor, Sakar – 4,
Opp. M.J. Library, Ashram
Road, Ellisbridge, Ahmedabad
380006, Gujarat, India
info@mahilahsg.org

Authors

Shweta S. Banerjee
Country Lead India
BRAC International

Siraz Hirani
Senior Programme
Management Specialist
Mahila Housing Trust

Boudewijn Weijermars
Technical Advisor
BRAC International

Ramesh Veluru
India Programme Officer
BRAC International