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POLICY BRIEF

Large income losses and negative health impacts from summer heat stress on informal workers in Delhi

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Introduction

Delhi is witnessing severe heat waves and over time the severity is increasing in terms of intensity as well as duration. The year 2024 saw record-breaking temperatures when the National Capital Region and the surrounding areas experienced the maximum temperature crossing 49°C and the gruelling heat prevailed for one and half months without any temporary respite. The nights also remained equally gruelling, with a minimum temperature around 36°C. This prevented people from cooling down effectively or getting some quality sleep, and they suffered the consequent health impacts.

The urban centres in India are getting the brunt of high temperature due to the add on urban heat island effects. In 2024, the Indian Meteorological Department reported some 37 cities in the country to have suffered from heat waves and faced temperature above 45°C. The country suffered 41000 cases of heat strokes and 116 human casualties in 2024.

What are the economic consequences of such phenomenon for poor slum dwellers who work in informal sector and are not covered by any government protection policy?

Our recent publication in *Environmental Research Letters* (Das and Somanathan, 2024) studies the slum dwellers of Delhi during peak heat of 2019 and brings out the economic and health impacts of high temperature. We studied 396 workers from Zakhira and Kirti Nagar slums of Delhi for a period of one month, 21st May 2019 till 21st June 2019

Findings: Heat impact on informal workers

We find strong negative correspondence between temperature and daily average income (average of workers) of workers (Figure 1).

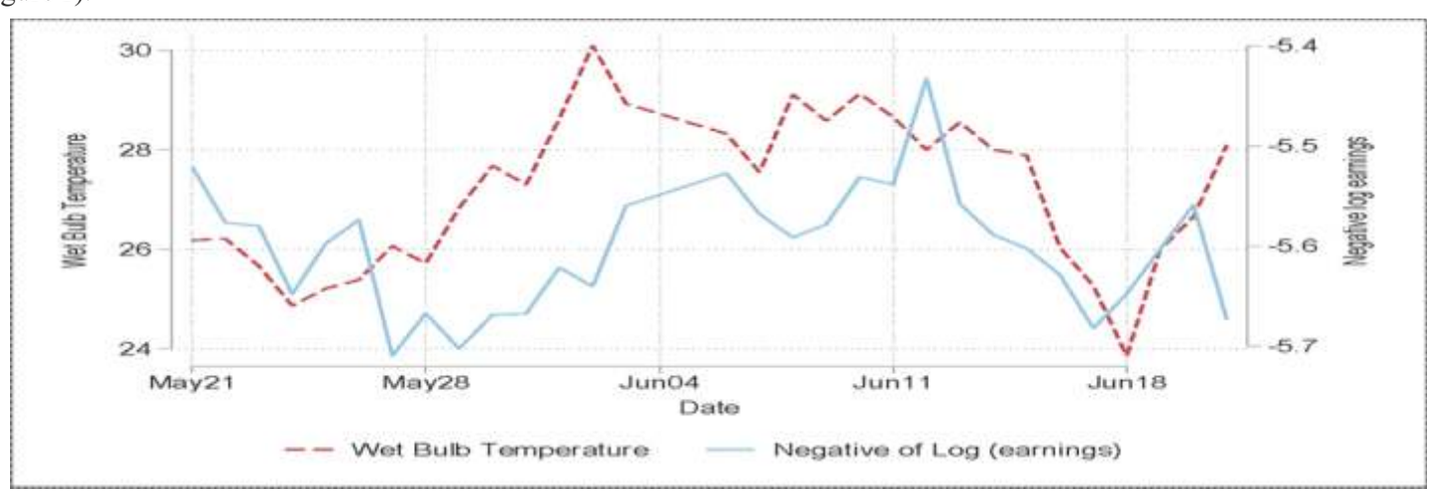

Figure 1: Wet Bulb Temperature and Negative of log of average earning (inverse of average earning). This correspondence indicates the average income to have gone down when the temperature increased.

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Effects on different wellbeing indicators

We measured the impact of heat on different welfare indicators using econometric models and used four different measures of daily temperature, the maximum, the minimum, the average, and the wet bulb temperature alternatively to see the robustness of results. The models controlled for humidity, days of the week dummy, and Eid holiday dummy. The results were very similar with a little variation in the magnitude of the impact coefficients. Table 1 shows the percentage change in the welfare indicators for one degree increase in temperature over the averages in the study period. The averages for different temperatures were the following: max42.8°C, min27.96°C, ave35.38°C, and wbt27.35°C, during the study period.

Table 1: Percentage change in welfare indicators for one degree increase in temperature over the average

Type of welfare	Welfare Indicators	Maximum Temperature	Minimum Temperature	Average Temperature	Wet Bulb Temperature
Income	Daily Gross Income	- 10%	- 9%	-12%	-13%
	Daily Net Income	- 14%	- 12%	- 16%	- 19%
Expenditure	Total expenditure	+5%	+4%	+6%	No significant impact
	Medical expenditure	+11%	+11%	+14%	+14%
	Expenditure on Ice	+6%	+5%	+7%	+7%
	Expenditure on Water	+4%	+3%	+4%	+4%
	Expenditure on both ice and water	+10%	+8%	+11%	+11%
Health effects	Did you get good Sleep?	- 1%	- 1%	- 2%	- 2%
	Hours slept	- 17%	- 16%	- 22%	- 20%
	Whether went to work	- 2%	- 1%	- 2%	- 2%
	Not working due to heat	+5%	+5%	+7%	+8%
	Sick due to heat	+5%	+5%	+7%	+6%

Table 1 shows income going down, expenditures going up, and health status and earning related work getting negatively impacted with a rise in temperature. A 1°C rise in maximum temperature results in a14% drop in net earnings with the same rise in minimum temperature resulting in a 12% drop. For every 1°C increase in wet bulb temperature—an indicator that combines heat and humidity—net income declines by 19%. During the two heat waves that occurred in the study period, workers' earnings were 40% lower than on the other days. Workers earning an average of ₹268 per day lost over ₹100 in earnings per day during the heat waves. These losses are much greater than those reported in some earlier studies (Dell *et al.,* 2012; Burke *et al.,* 2015; Somanathan *et al.,* 2021).

It is usually argued that people do not work during peak heat due to demand constraint as no work is available. We examine this question using workers responses on reasons for not working and found the cause of not working to be 'due to heat', not unavailability. Thus, income losses are primarily due to not working because of strong heat and need to be addressed by policy makers.

The informal-sector workers work outdoors, do hard physical work, and have less insulated housing than their formal-sector counterparts, and thus, are more vulnerable to the adverse effects of heat. Such findings are a mirror of the hard-future consequences because of climate change and need policy makers urgent attention.

Possible interventions to enable slum dwellers to cope with the heat stress

- Cool roof, shaded walls, well ventilated rooms, surrounding green cover can be strong mediators. Research based on Ahmedabad shows cool-roof technology reducing indoor temperature by 1.2°C and easing heat related discomfort (Mahadeviya, 2024)
- Painting roof white: Research on efficacy of Cool-roof paint interventions in Anganwadis and schools in India shows white-painted roofs to lower indoor temperatures by 1.3°C, leading to improved thermal comfort and better cognitive performance in children (Benston et al., ongoing study; Garg et al., 2016)
- Agro-bio panels in slum houses: Interventions by NGO Indo-Global Social Service Society shows slum dwellers who had adopted these panels, are full of praise for such panels in reducing indoor temperatures and improving their body comfort. (Ghosh,2024)

However most of these interventions have limitations in terms of cost efficiency, durability, wear and tear especially during heavy rain, being able to show results within a temperature threshold, etc. These interventions need to be studied well before suggesting upscaling.

Recommendations of the high-level policy panel on heat waves adaptation for informal sector

The panel having policy makers from Delhi Development Authority, the National Disaster Management Authority, Delhi Urban Shelter Improvement Board, Ministry of Environment, Forests and Climate Change, and Centre for Social and Economic Progress.

The panelists emphasized the importance of harnessing human capital while addressing climate risks, particularly heat stress. They stressed the necessity of community-driven solutions, collaboration, and the need for effective disaster mitigation.

Key takeaways included:

- Expanding shelters with cooling facilities like fans, coolers, and cold water in urban areas.
- Strengthening local governance by financially empowering local authorities to rehabilitate slums and promote

sustainable mobility.

- Creating green and blue spaces near slums to mitigate urban heat island effects.
- Enhancing heat action plans through continuous coordination and disaster preparedness.
- Encouraging private sector investment in scalable solutions like cool roofs and bio-panels.
- Leveraging international climate finance through mechanisms like the Green Climate Fund and Adaptation Fund.

The workshop reinforced the need for urgent, coordinated efforts to address heat stress in India's urban slums. The insights and solutions discussed serve as a foundation for future research, policy development, and targeted interventions. Moving forward, translating these research findings into scalable, actionable policies will be crucial in building climate resilience for the most vulnerable populations.

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