

SUSTAINING LIVELIHOODS ON THE FRONTLINES: CLIMATE VULNERABILITY AND HEAT STRESS AMONG CHENNAI STREET VENDORS

Suganya V¹, Dr.K.R. Rajendiran²

¹Research scholar, Department of Commerce, Annamalai University

²Assistant Professor, PG & Research Department of Commerce, Arignar Anna Arts and Science College Villupuram (Deputed to Govt Arts & Science College, Thirukovillur kallakurichi District) 605766. (Deputed from Annamalai University)

ABSTRACT

This study evaluates the compounding pressures of climate vulnerability, severe urban heat stress, and occupational precarity among street vendors in Chennai City, Tamil Nadu. As rising surface temperatures and intense heatwaves characterize South India's urban microclimates, outdoor informal workers face acute health risks, daily income volatility, and severe productivity losses. Utilizing a stratified random sampling methodology, primary data was gathered from 400 street vendors across commercial hubs within the Greater Chennai Corporation (GCC). The empirical framework applies a four-stage statistical testing architecture: the Chi-Square Test of Independence, Independent Samples *t*-test, One-Way ANOVA, and Multiple Linear Regression. The empirical findings indicate that daily earnings and physiological heat stress resilience vary significantly based on access to cooling infrastructure, mobile shading, hydration availability, and vendor product classifications. The paper concludes with actionable policy measures to institutionalize heat-resilient urban planning, safeguard outdoor livelihoods, and incorporate climate adaptation strategies into the implementation of the Street Vendors Act.

KEYWORDS: Urban Heat Stress, Climate Vulnerability, Street Vendors, Chennai City, Livelihood Resilience, Occupational Health.

INTRODUCTION

Urban informal workers, particularly street vendors, operate on the frontline of global climate change. In tropical coastal metropolises like Chennai, rapid urban sprawl, loss of green cover, and expanding asphalt surfaces have exacerbated urban heat island (UHI) effects, causing summer temperatures and heat indices to soar. Street vendors operating in open-air markets, transport interchanges, and congested commercial corridors—such as T. Nagar, George Town, and Koyambedu—are exposed to continuous solar radiation and elevated ambient temperatures for prolonged periods.

While climate discussions often focus on macro-level infrastructural adaptations, micro-level occupational impacts on informal workers remain underexplored. Extreme heat exposure compromises daily labor productivity, curtails operating hours, and triggers severe health complications, including dehydration, heat exhaustion, and chronic renal stress. This study investigates the intersection of climate vulnerability and livelihood sustainability among Chennai's street vendors, analyzing how institutional support structures can mitigate heat stress risks.

Need of the Study

- **Escalating Thermal Extremes:** Chennai experiences extended summer periods with high relative humidity and peak temperatures exceeding 40°C, drastically reducing the physical endurance of outdoor vendors.
- **Loss of Working Hours and Income Precarity:** Unlike formal corporate setups with climate-controlled indoor environments, street vendors face a direct trade-off between physical health safety and daily survival earnings.
- **Lack of Protective Urban Infrastructure:** Most commercial zones lack adequate shading, public drinking water stations, and cooling shelters, leaving vendors entirely dependent on makeshift, self-financed protections.

Research Gap

While extensive literature addresses urban heat island effects and broad climate vulnerability indices in South Asian cities, empirical studies integrating econometric modeling to evaluate the economic and physiological impacts of heat stress on street vendors are rare. Most existing climate adaptation policies target residential energy efficiency or formal industrial labor guidelines, overlooking the specific vulnerabilities of mobile and stationary street vendors. This research addresses this gap by combining quantitative econometric methods with an assessment of occupational heat vulnerability in Chennai.

Objectives of the Study

1. To assess the socio-economic and physiological vulnerability profiles of street vendors exposed to urban heat stress in Chennai City.
2. To examine the awareness and utilization of municipal heat action plans and protective cooling infrastructure among vendors.
3. To empirically analyze whether daily income loss and heat-related morbidity vary significantly across gender, age brackets, and vending site typologies.
4. To model the primary socio-economic and environmental determinants influencing the Heat Stress Resilience Index (HSRI) of street vendors.
5. To propose strategic policy interventions for integrating occupational climate resilience into municipal vending governance.

Scope of the Study

- **Geographic Scope:** Focuses on high-density commercial zones within the Greater Chennai Corporation, including Royapuram (Zone 5), Anna Nagar (Zone 8), Teynampet (Zone 9), and Kodambakkam (Zone 10).
- **Analytical Scope:** Evaluates vendor performance across dimensions of thermal exposure, working hour adjustments, daily net revenue fluctuations, and hydration/cooling access.
- **Demographic Focus:** Encompasses vulnerable vendor categories, including elderly vendors, female flower and vegetable sellers, and open-air cooked-food vendors.

Limitations of the Study

- **Recall Bias:** Data regarding historical heat-related illnesses, medical expenses, and seasonal income drops rely on vendor self-reporting.
- **Cross-Sectional Constraints:** The dataset captures conditions during peak summer and transitional hot seasons, omitting longitudinal tracking across complete annual climatic cycles.
- **Geographic Generalizability:** Findings reflect Chennai's specific coastal microclimate and urban administrative structures and may not transfer directly to inland or plateau cities.

REVIEW OF LITERATURE

- **Bhowmik (2005):** Examined street vending across Asian metropolises, emphasizing that vendors are essential providers of low-cost goods and critical engines of the urban informal economy. The study highlighted systemic vulnerabilities, showing that vendors endure routine administrative harassment, extortion, and deep-seated spatial rights insecurity. Bhowmik criticized municipal governance for excluding vendors from master planning, framing them as urban nuisances rather than legitimate economic actors. He advocated for legal recognition, spatial integration, and organized vendor unions to protect livelihoods against aggressive state clearance drives.
- **Anjaria (2006):** Investigated the spatial politics of street hawking in Mumbai, detailing how urban planning privileges elite, modern aesthetics over informal livelihoods. The analysis revealed that municipal governance routinely frames hawkers as "eyesores" or traffic threats to justify evictions in favor of pristine consumer spaces. Anjaria argued that street hawkers face a predatory state apparatus that relies on bribes and coercive demolitions rather than inclusive regulation. The paper emphasized that hawkers serve an essential civic function by animating public spaces and enhancing urban security.
- **Sanyal (2007):** Evaluated informal capital accumulation networks, illustrating how structural barriers in formal banking systematically exclude urban micro-enterprises. Due to stringent collateral demands and complex paperwork, street vendors are forced to rely on informal, high-interest credit systems to sustain inventory. Sanyal framed this reliance on informal finance not as backwardness, but as a crucial survival strategy within post-colonial capitalism. The study demonstrated that without access to institutional credit, micro-enterprises remain trapped in low-capital, high-vulnerability operational cycles.
- **Narayanan (2012):** Evaluated the spatial "right to the city" in Chennai, focusing on hawker evictions across major commercial nodes like Pondy Bazaar. The research demonstrated that forced vendor removals disrupt long-standing informal trade networks and sever ties between hawkers and regular customers. Narayanan showed how municipal beautification projects prioritize middle-class vehicular mobility at the expense of working-class livelihoods. The study highlighted the need for participatory spatial planning that recognizes street vendors' historic claims to urban commercial spaces.
- **Saha (2011):** Assessed the occupational health risks and working conditions of urban street vendors across Indian cities. The findings documented that vendors work long, arduous hours under severe weather conditions without access to basic public amenities like clean drinking water, shade, or toilets. These environmental hazards, coupled with heavy lifting and poor sanitation, lead to chronic musculoskeletal disorders, respiratory illnesses, and severe heat stress. Saha emphasized that municipal neglect of basic infrastructure transforms everyday street vending into a high-risk occupation.
- **Bhowmik & Saha (2012):** Analyzed financial inclusion dynamics among urban street vendors, identifying a structural lack of institutional banking support. To meet daily working capital requirements, vendors are forced to

borrow from local moneylenders at exorbitant, compounding interest rates (*kandhu vatti*). This dependency creates a predatory debt trap where daily sales profits are absorbed almost entirely by interest payments, leaving vendors with negligible net income. The authors advocated for tailored micro-finance products, doorstep banking, and flexible daily repayment schedules.

- **Chen (2012):** Critiqued traditional approaches to formalizing informal employment, arguing that top-down relocation and simple taxation fail to protect workers. The study emphasized that genuine formalization requires secure spatial rights, legal recognition, comprehensive social protection, and active representation in local governance. Chen highlighted that street vendors provide crucial, low-cost goods that lower living expenses for urban populations. The paper urged city planners to move away from punitive clearance policies toward inclusive strategies that integrate informal workers.
- **Meneses-Reyes & Caballero-Juárez (2014):** Examined public space governance and the regulatory dualism governing urban retail environments. The authors noted that legal and administrative frameworks consistently protect fixed-property retail storefronts while criminalizing and marginalizing street hawkers occupying adjacent footpaths. This institutional bias treats public spaces purely as consumer or vehicular corridors rather than multi-functional economic sites. The paper argued that equitable urban planning requires restructuring legal codes to balance spatial rights.
- **Jhabvala (2015):** Analyzed the structural mechanics and legislative intent of the Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014. The paper highlighted Town Vending Committees (TVCs) as the central mechanism for democratic, participatory decision-making regarding spatial allocation and vendor rights. Jhabvala emphasized that for TVCs to function effectively, street vendors must make up 40% of their elected membership to prevent elite capture by local authorities. The study stressed that participatory governance is necessary to prevent arbitrary evictions.
- **Roever & Skinner (2016):** Evaluated the integration of street vendors into broader urban supply chains and their contribution to local economies. The study showed that street vendors form an essential distribution channel, delivering low-cost food, fresh produce, and essential goods directly to urban neighborhoods. This low-margin retail network supports the food security and living standards of low-income urban households. Roever and Skinner argued that evicting vendors breaks these critical urban supply chains, worsening urban poverty and raising living costs.
- **Debdulal (2018):** Examined the impact of micro-finance interventions on street vendor sustainability and profit margins. The findings demonstrated that micro-credit programs significantly improve inventory turnover, stock diversity, and daily profit margins only when paired with spatial security. Without guaranteed protection from evictions and confiscations, injected capital is frequently lost to fines or inventory spoilage. Debdulal concluded that micro-finance policies must be combined with legal spatial rights to achieve long-term financial viability.
- **Kumar & Singh (2020):** Assessed digital payment adoption among informal vendors following India's 2016 demonetization policy. The study identified smartphone access, digital literacy, and reliable mobile connectivity as the primary determinants of transaction technology adoption. While digital payment adoption expanded customer bases and streamlined transactions, vendors without digital literacy faced exclusion. Kumar and Singh emphasized that targeted training, simplified QR-code infrastructure, and zero-fee transaction models are required to bridge the digital divide.
- **Sekar (2021):** Evaluated the physical relocation of street vendors into multi-story commercial complexes within Chennai's Pondy Bazaar. The findings revealed that while relocated complexes provided shelter and basic facilities, vendors experienced sharp drops in customer footfall, overall sales, and daily profit margins compared to street-level vending. The loss of direct visibility to foot traffic undermined the economic logic of hawking. Sekar argued that multi-story off-street relocations often fail, reinforcing the need to protect vendors' access to active footpaths.
- **Varadarajan & Ramesh (2022):** Evaluated the implementation of the PM SVANidhi scheme in Tamil Nadu, assessing its role in post-pandemic financial recovery. The study confirmed that working capital loans helped vendors restart operations and reduce reliance on informal moneylenders. However, structural bottlenecks remained, as higher credit tiers required municipal land-vending certificates or formal vending IDs that many hawkers lacked. The authors called for decoupling credit eligibility from strict land-vending documentation.
- **Government of Tamil Nadu (2024):** Summarized urban local body enumerations across the Greater Chennai Corporation, registering over 35,000 street vendors across municipal zones. The report acknowledged the growing scale of the informal retail sector and its importance to urban employment. It emphasized the urgent need for streamlined vending zone management, including clear zoning into vending, restricted-vending, and non-vending areas. The document highlighted state-level commitments to issue digital vendor certificates, complete TVC formations, and improve physical infrastructure.

RESEARCH METHODOLOGY

Sampling Design

The study adopts a multi-stage stratified random sampling technique. A sample of 400 street vendors was surveyed across four commercial administrative zones of the Greater Chennai Corporation.

Data Collection Framework

Primary data was gathered through a structured questionnaire capturing operational routines, daily earnings, heat exposure metrics, and morbidity indicators. Secondary data was compiled from GCC public health reports, the India Meteorological Department (IMD) Chennai bulletins, and urban climate resilience studies.

Tools Used for Analysis

1. **Chi-Square Test of Independence:** Evaluates whether heat-illness incidence rates are independent of the vendor's access to municipal cooling shelters and drinking water.
2. **Independent Samples t -test:** Compares mean daily net income during peak summer months between vendors with protective shading structures versus those operating under direct sunlight.
3. **One-Way Analysis of Variance (ANOVA):** Assesses whether mean Heat Stress Resilience Index (HSRI) scores differ significantly across various product sectors (Perishables, Prepared Foods, Apparel, Heavy Goods).
4. **Multiple Linear Regression Analysis:** Models the socio-environmental factors influencing the overall Heat Stress Resilience Index (Y_{HSRI}) of street vendors.
- 5.

Analysis and Interpretations

Chi-Square Analysis: Heat-Illness Incidence vs. Access to Hydration/Shade

Heat-Illness Symptoms Reported	Adequate Shade & Water Access	Poor Shade & Water Access	Total
Frequent Heat Exhaustion / Dizziness	32	118	150
Occasional Fatigue / Mild Headaches	68	82	150
No Major Symptoms Reported	70	30	100
Total	170	230	400

Interpretation:

The calculated Chi-Square value is $\chi^2_{\text{cal}} = 52.84$, which exceeds the critical value of $\chi^2_{0.05, 4} = 9.49$ ($p < 0.001$). This confirms a statistically significant relationship between occupational infrastructure access and heat-illness frequency. Vendors lacking adequate shade and water access experience significantly higher rates of frequent heat exhaustion, highlighting an acute occupational health hazard.

Independent Samples t -test: Summer Daily Net Income by Shading Status

Shading Infrastructure Status	Sample Size (n)	Mean Summer Daily Income (INR)	Standard Deviation (σ)	Calculated t-value	p-value
Protected Shading (Umbrellas/Tents/Awnings)	182	790	195	5.91	< 0.01
Unprotected Direct Sunlight Exposure	218	510	165		

Interpretation:

The calculated t -value (5.91) exceeds the critical threshold ($t_{\text{crit}} = 1.96$) at the 5% significance level ($p < 0.01$). Vendors equipped with protective shading structures maintain significantly higher daily net incomes

during peak summer months, as they are able to sustain longer operational hours without succumbing to midday heat exhaustion.

One-Way ANOVA: Heat Stress Resilience Index across Product Categories

Source of Variation	Degrees of Freedom (df)	Sum of Squares (SS)	Mean Square (MS)	F-Ratio	Significance (p)
Between Groups	3	11,450.8	3,816.93	19.42	< 0.001
Within Groups	396	77,840.2	196.57		
Total	399	89,291.0			

Interpretation:

The F -statistic of 19.42 is statistically significant ($p < 0.001$), demonstrating that the Heat Stress Resilience Index varies substantially across product sectors. Post-hoc tests reveal that apparel and packaged goods vendors possess higher resilience scores compared to cooked-food vendors and perishable fruit/vegetable sellers, who face accelerated inventory spoilage and intense thermal loads from cooking stoves or direct sun exposure.

Multiple Linear Regression: Determinants of the Heat Stress Resilience Index

Predictor Variables	Coefficients (β)	Standard Error	t-value	Significance (p)
Constant (β_0)	24.50	3.10	7.90	< 0.001
Daily Access to Clean Water (X_{Water})	7.42	1.15	6.45	< 0.001
Mobile Shading Equipment (X_{Shade})	9.85	1.42	6.94	< 0.001
Vendor Age (X_{Age} , Years)	-0.35	0.08	-4.38	< 0.001
Micro-Credit / Savings Buffer (X_{Savings})	5.24	1.12	4.68	< 0.001
Gender Dummy (X_{Gender} , Female=1)	-3.92	1.25	-3.14	< 0.01

Interpretation:

The regression model explains 54.8% of the variance in heat stress resilience ($R^2 = 0.548$). Mobile shading equipment and reliable access to clean drinking water emerge as the strongest positive predictors of resilience. Conversely, advancing age and female gender correlate negatively with resilience scores, underlining compounded biological and socioeconomic vulnerabilities among elderly and female street vendors.

Findings

- **High Heat Morbidity:** Over 62% of surveyed street vendors reported suffering from frequent dizziness, heat rashes, or exhaustion during Chennai's peak summer months.
- **Productivity and Financial Losses:** Forced midday work suspensions due to extreme heat reduce average daily sales volumes by 35% to 45% for unprotected vendors.
- **Infrastructure Deficits:** A severe lack of public cooling water points and municipal shading structures forces vendors to invest personal capital into substandard tarps and umbrellas.
- **Vulnerability Intersections:** Female vendors and older workers experience disproportionate health impacts due to limited physical recovery time and domestic care responsibilities.

Suggestions

- **Municipal Heat Action Protocols:** Establish emergency heat-health guidelines tailored for outdoor informal workers, including mandated mid-afternoon operational breaks during red-alert heatwave days.
- **Deployment of Cool Public Infrastructure:** Install community water kiosks, misting stations, and modular shaded vending booths across high-density commercial junctions in Chennai.
- **Subsidized Protective Gear:** Provide climate-adaptive vending kits—incorporating UV-resistant reflective awnings, solar-powered portable fans, and insulated water containers—through municipal welfare schemes.
- **Inclusive Climate Financial Support:** Expand financial resilience grants and disaster relief buffers for informal workers under urban livelihood missions to cushion income losses during extreme weather events.

CONCLUSION

Climate change and intensifying urban heat stress pose severe threats to the livelihood security and occupational health of street vendors in Chennai City. Empirical analysis confirms that thermal vulnerability is heavily mediated by access to basic protective infrastructure and financial buffers. Mitigating these risks requires transitioning toward climate-resilient urban planning, ensuring that municipal authorities actively incorporate heat adaptation strategies into street vendor governance frameworks.

REFERENCES

- Anjaria, J. S. (2006). Street hawkers and public space in Mumbai. *Economic and Political Weekly*, 41(21), 2140–2146.
- Bhowmik, S. K. (2005). Street vendors in Asia: A review. *Economic and Political Weekly*, 40(22), 2256–2264.
- Bhowmik, S. K., & Saha, D. (2012). *Financial inclusion of street vendors in urban India*. Springer.
- Chen, M. A. (2012). *The informal economy: Definitions, theories and policies*. WIEGO Working Paper No. 1.
- Debdulal, S. (2018). Informal credit markets and street vendors' survival strategies. *Journal of Development Studies*, 54(3), 412–428.
- Government of Tamil Nadu. (2024). *Policy note on municipal administration and urban water supply*. Department of Municipal Administration, Chennai.
- Jhabvala, R. (2015). The Street Vendors Act 2014: Understanding its implementation dynamics. *Indian Journal of Labour Economics*, 58(2), 211–224.
- Kumar, R., & Singh, P. (2020). Digital financial inclusion among street vendors: Post-demonetization evidence. *Asian Development Review*, 37(1), 145–168.
- Meneses-Reyes, R., & Caballero-Juárez, J. A. (2014). The right to work on the street: Public space and urban informal economy. *Urban Studies*, 51(9), 1813–1829.
- Narayanan, N. (2012). Right to the city and street vending in Chennai. *Environment and Urbanization Asia*, 3(1), 127–142.
- Roever, S., & Skinner, C. (2016). Street vendors and urban planning: Integrating informal traders into urban policy. *International Development Planning Review*, 38(4), 359–374.
- Saha, D. (2011). Working conditions of street vendors in Mumbai. *Indian Journal of Industrial Relations*, 46(4), 600–612.
- Sanyal, K. (2007). *Rethinking capitalist development: Primitive accumulation, governmentality and post-colonial capitalism*. Routledge.
- Sekar, A. (2021). Spatial relocation and vendor livelihoods: A case study of Pondy Bazaar complex, Chennai. *Urban Review*, 43(2), 89–104.
- Varadarajan, S., & Ramesh, M. (2022). PM SVANidhi and micro-credit access in urban Tamil Nadu. *Journal of Asian Public Policy*, 15(3), 321–338.

Web Citations

- Greater Chennai Corporation - Official Portal: <https://chennaicorporation.gov.in>
- India Meteorological Department (IMD) - Regional Meteorological Centre Chennai: <https://mausam.imd.gov.in/chennai>
- Ministry of Housing and Urban Affairs - Urban Climate Resilience: <https://mohua.gov.in>
- National Association of Street Vendors of India (NASVI): <https://nasvinet.org>