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Highlights

Empirical evidence shows that greenhouse gas (GHG) emission from agricultural sector causes to rise heat stress in Bangladesh.

Projections suggest that Bangladesh will face a significant rise in the number of days with temperatures exceeding 35°C, continuing through 2035.

Strategic climate-smart approaches are required for reducing emissions from agricultural sector in Bangladesh.

Strengthening urban planning plays a critical role in addressing the intensifying Urban Heat Island (UHI) effect in Bangladesh's major cities, particularly Dhaka and Chattogram.

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cpdbangladesh CPDBangladesh

Centre for Policy Dialogue (CPD)
House 40/C, Road 11 (new), Dhanmondi
Dhaka-1209, Bangladesh
Telephone: (+88 02) 41021780 - 2
Fax: (+88 02) 41021783
E-mail: info@cpd.org.bd

Managing Urban Heat Stress and GHG Emissions

Strategies for Sustainable Cities in Bangladesh

Fahmida Khatun, Foqoruddin Al Kabir and ***Md. Takrim Hossain***

1. Introduction

Heat stress has become one of the most urgent climate issues of the 21st century. Worldwide, extreme heat events are increasing frequently with extended period and intensity, primarily due to anthropogenic climate change and increased urbanisation (Wang et al., 2021; Ren et al., 2022). These conditions intensify environmental deterioration and have adverse impact on socioeconomic conditions in densely populated and low-income countries. Bangladesh, being one of the most climate vulnerable countries in the world, is not an exception. Its geographical location, elevated population density, and rapid urban expansion make it extremely vulnerable to the effects of heat stress and associated risks (World Bank, 2025).

Rapid urbanisation has worsened the Urban Heat Island (UHI) effect in Dhaka city, causing local land surface temperatures to rise by as much as 3°C relative to the surrounding areas (Uddin et al., 2022). Studies find that heat stress has serious and multifaceted effects on public health and working hours (Rahman et al., 2024; Patwary et al., 2025). For instance, in 2024, heat stress related impact on physical and mental health conditions led to a loss of 250 million workdays. This cost the economy up to USD 1.78 billion, which is equivalent to around 0.4 per cent of GDP in 2024 (World Bank, 2025). Heat stress also significantly impacts agricultural productivity across the regions of Bangladesh and extreme heat above 32°C causes substantial productivity loss in wet seasons (Li, 2023). Research shows that electricity demand during summer days increases due to increased cooling load which have further impact on heat stress (Islam et al., 2025). These trends collectively demonstrate that heat stress is a systemic issue that affects labour, agriculture, energy, urban growth, and health.

The primary reason behind this rising heat stress is the emission from various sectors such as power, transport, industry, agriculture, etc. Previously, Wang and Zhang (2019) showed that increased emissions from various sectors contribute to rising temperatures, which intensified heat stress. In Bangladesh, the energy sector (including power, transport, industry, buildings, agriculture-related energy use) accounts for 48.81 per cent of total greenhouse gas (GHG) emission, whilst agriculture and Industrial Processes and Product

Use (IPPU) contributes 17.04 per cent and 2.67 per cent of GHG emission respectively (Ministry of Environment, Forest and Climate Change, 2025). These figures clearly identify energy, transport, agriculture and industrial processes as the country's major emitting sectors, and therefore central to any discussion of rising heat stress.

Against this backdrop, this policy brief analyses the long-run relationship between heat stress and GHG emission from various sectors. To carry out the analysis, annual data for Bangladesh from 1990 to 2020 on extreme heat days, sectoral emissions from agriculture, manufacturing and construction, industrial processes, transport, and renewable energy use have been used. Augmented Dickey-Fuller (ADF) unit root test, Johansen cointegration test, and Dynamic Ordinary Least Squares (DOLS) were also employed to estimate the cointegrating factors. The results show a strong and statistically significant long-run association between agricultural emissions and extreme heat, a modest but meaningful relationship between extreme heat and emission from industrial processes. Based on the findings, this policy brief also proposes a set of recommendations to mitigate the heat stress in the country.

The rest of the policy brief is structured as follows. Section 2 points out recent evidence on heat stress and its socioeconomic impacts in Bangladesh, section 3 describes the data and econometric methodology in detail, section 4 presents the empirical findings and forecasting results, and section 5 outlines a set of policy recommendations, and finally section 6 draws the conclusion.

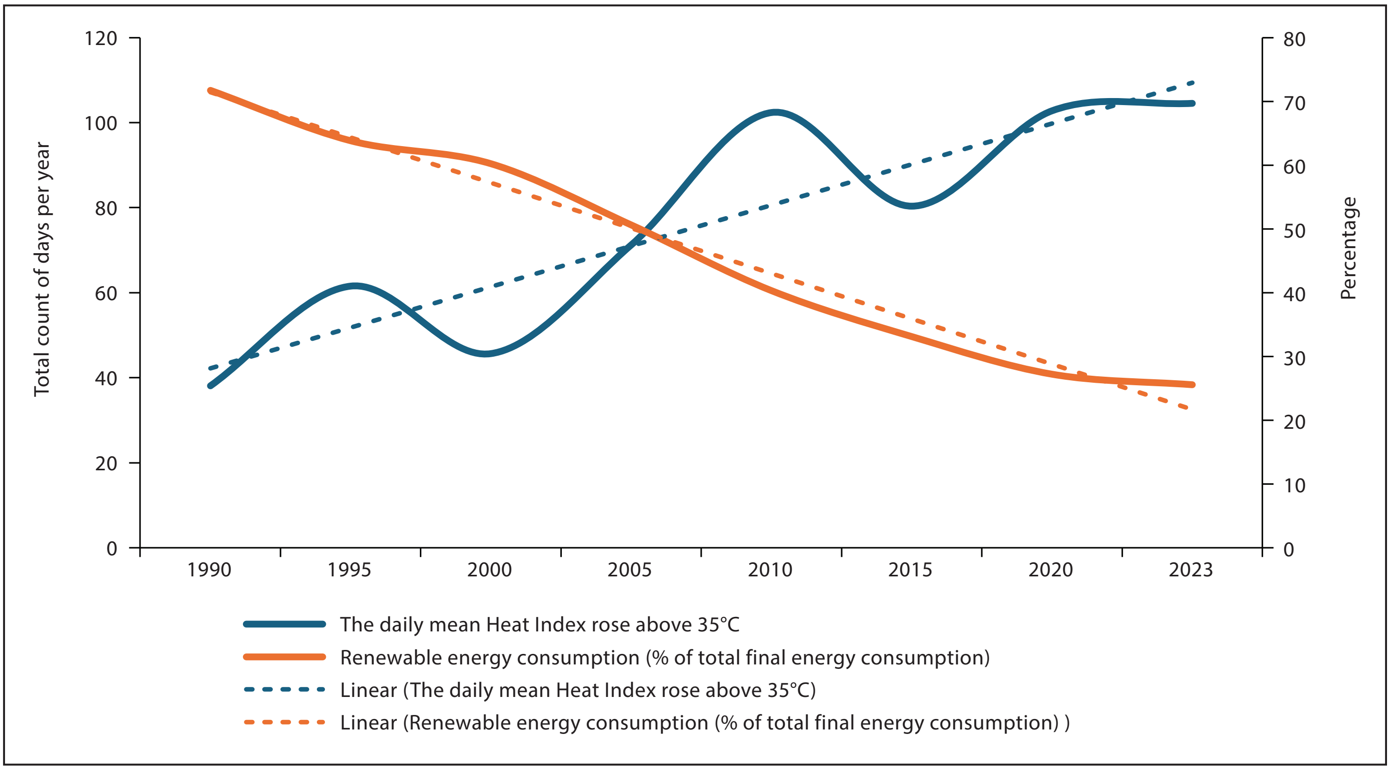
2. Heat Stress and Its Impact on Public Health and Economy

For the overall development of Bangladesh, heat stress is turning into a critical concern , particularly in dense and rapidly expanding urban areas. Higher temperatures and increasingly humid conditions are already affecting how people live and work, with implications for health, productivity and economic activity. The effects are uneven, often falling hardest on those who work outdoors, rely on daily wages or live in overcrowded neighbourhoods with limited access to cooling and green space. This section provides an overview of recent intensification of heat stress in Bangladesh, its impacts on health and productivity, the linkages with sectoral emissions and increasing temperature, and the overarching policy framework guiding the national response.

2.1 Growing Heat Stress Due to Urban Expansion: A National Concern

Urban heat stress, defined by increased land surface temperatures (LST) and heat index values, has emerged as a significant concern for cities globally. Bangladesh is not an exception in this case. The UHI effect exacerbates urban heat stress, as developed areas retain more heat than adjacent rural

Figure 1: Trend of Heat Index Above 35°C and Renewable Energy Consumption



Source: Authors' calculation based on data from World Bank (2025).

regions. The UHI impact has intensified in Bangladesh, especially in Dhaka and Chattogram, due to substantial urban expansion. World Bank (2025) data suggests that between 1990 and 2020, the frequency of such days has nearly tripled, signifying a substantial escalation of heat stress (Figure 1). Meanwhile, the proportion of renewable energy in final energy consumption has decreased from roughly 72 per cent to 27 per cent. This transition signifies a movement from conventional biomass to fossil fuels, resulting in heightened greenhouse gas emissions and intensified heat stress.

Research indicates that Dhaka's land surface area expanded by 25.33 per cent from 2001 to 2017 (Uddin et al., 2022), while urban areas expanded by 249.77 per cent between 1991 and 2015 (Hussain et al., 2023). This expansion has resulted in increased urban population. The dense population in urban areas leads to rising temperatures. For instance, metropolitan areas with certain areas of Dhaka are witnessing an increase of up to 3°C compared to its outskirts (Uddin et al., 2022). An examination of the heat vulnerability index (HVI) in Dhaka by Abrar et al. (2022) indicated that 17 of the 41 thanas are located in high or extremely high-risk zones. These findings indicate an immediate necessity for climate-responsive urban development and investment in green infrastructure.

2.2 Heat Stress and Public Health Hazards

The health implications of increasing temperatures go beyond just discomfort; they include increased morbidity and mortality rates. Heat stress elevates the likelihood of cardiovascular and respiratory diseases, dehydration, and heatstroke (Haque et al., 2024). Moreover, it exacerbates the spread of certain diseases. For example, the heat index has significant associations with diarrheal disorders, with elevated heat index conditions resulting in an overall increase in hospitalisations by 8-9 per cent and up to 18.3 per cent in children under five years (Haque et al., 2024). These health crises result in increased healthcare expenditures. For instance, Raihan et al. (2022) find that a 1 per cent rise in CO_2 emissions increases health expenditures by 0.95 per cent, whereas fossil fuel energy use increases it by 2.67 per cent. Raihan et al. (2022) further illustrate that the adoption of renewable energy may decrease health expenditures by 1.44 per cent, underscoring the significance of sustainable energy transitions for environmental and public health outcomes in Bangladesh.

2.3 An Emerging Concern for Productivity Loss Due to Heat Stress

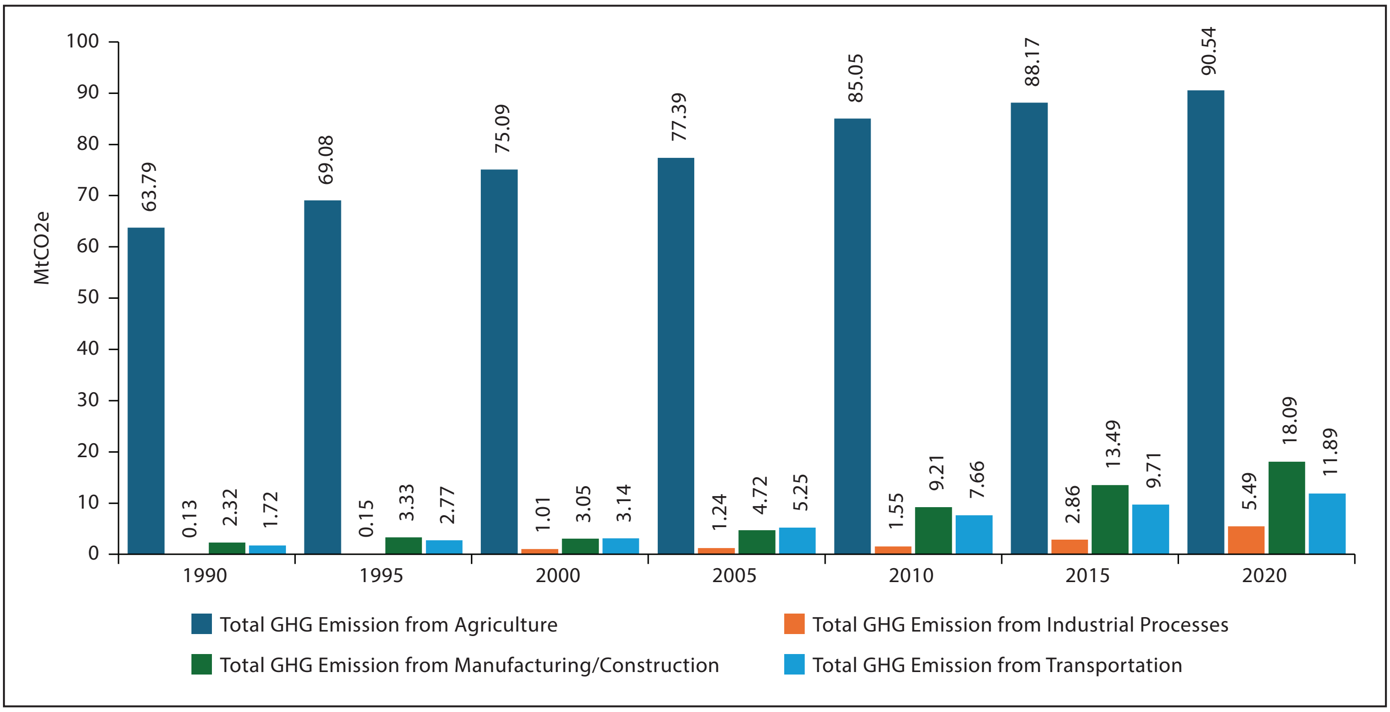
Heat stress severely impacts working hours and productivity in Bangladesh, resulting in serious economic consequences. An assessment of South Asian megacities from 1990 to 2019 indicated that Dhaka and Chattogram endure heightened 'danger' levels of heat stress, causing populations at risk to reduce their annual work hours by 0.25-860.6 hours for light labour, 43-1595.9 hours for moderate labour, and 291-2402 hours for heavy labour (Debnath et al., 2023). The decline in productivity is especially alarming in Bangladesh's crucial readymade garment (RMG) sector, which constitutes a significant portion of employment and exports. Heat exposure in RMG factories induces health symptoms such as headaches, dizziness, and exhaustion, whilst simultaneously hindering productivity and elevating summer absenteeism (Yeasmin et al., 2025). Workers cannot maintain productivity for over 6 hours when temperatures surpass 35°C, significantly diminishing working hours and production (Obaidullah et al., 2023).

The economic burden of heat stress is not unavoidable; adaptive strategies could mitigate its effects. Passive cooling retrofits, including green roofs and cool roofs, can lower indoor temperatures by roughly 2°C and diminish excessive heat exposure by up to 603 workhours each year, which is comparable to 75 working days (Bach et al., 2023). These findings underscore that incorporating climate-sensitive architectural solutions into industrial and commercial infrastructure is essential for maintaining productivity amid increasing temperatures.

2.4 Sectoral Emissions and Heat Intensification

Increasing GHG emissions continue to be an important contributor in temperature increase and heat stress in Bangladesh. Research demonstrates that emissions substantially contribute to warming via multiple pathways. Agricultural activities significantly contribute to GHG emissions, with energy use in agriculture boosting emissions by 1.81 per cent for each 1 per cent increase (Raihan et al., 2023). Economic expansion, industrialisation, and urbanisation exacerbate CO_2 emissions, but renewable energy and forested areas contribute to their mitigation (Raihan et al., 2022).

Figure 2: Trend of GHG Emissions From Selected Sectors



Source: Authors' calculation based on data from Climate Watch (2025).

Considering the sectoral emission (Figure 2), agriculture continues to be the primary source of emissions. Emissions from manufacturing and construction have risen consistently, indicating ongoing industrial growth and expansion. Over the time, transport emissions have also increased, reflecting the growing scale of mobility. Industrial processes account for a smaller share but follow a steady upward trend. These sectoral patterns underscore the necessity for focused mitigation initiatives, particularly in agriculture and transport, to address urban heat stress.

2.5 Policy Context and Challenges

Although Bangladesh has very low per capita emissions, it encounters considerable difficulties in fulfilling its Nationally Determined Contributions (NDCs) whilst maintaining economic growth (Rahman & Rao, 2020). The country has pledged to decrease greenhouse gas emissions by 20.31 per cent from projected business-as-usual levels by 2035. However, attaining these objectives requires overcoming obstacles in funding, improving capacity, and incorporating clean energy goals into comprehensive development strategies (Das et al., 2024).

Heat stress in Bangladesh constitutes not just an environmental concern but also a multifaceted developmental challenge. It intersects health, energy, infrastructure, and economic productivity. Addressing urban heat stress needs a cohesive policy framework that integrates emission reduction initiatives, the promotion of renewable energy, and climate-resilient urbanisation. Investing in green spaces, implementing heat-sensitive building standards, and enhancing low-emission transportation systems can yield simultaneous advantages for health and climate. Furthermore, aligning these initiatives with Bangladesh's NDC commitments would be essential for fostering sustainable urban growth and safeguarding vulnerable populations from the increasing effects of heat stress.

3. Data and Methodology

Following previous research that demonstrated significant relationships between emissions and heat stress across multiple domains (Wang & Zhang, 2019; Zhang et al., 2024), the following model in this policy brief was developed to assess the impact of sectoral emission on heat stress in Bangaldesh.

LNHI35 = f (LNGHGA, LNGHGMC, LNGHGT, LNGHGIP, RENC)……..............................….........................(i)

The description of the variables in equation (i) is provided in the table 1 below.

Table 1: Data Description and Sources

Variable	Description	Sources
LNHI35	Log of Heat Index 35, total count of days per year where the daily mean Heat Index rose above 35°C	World Development Indicators
LNGHGA	Log of Total GHG Emissions from Agriculture (MtCO2 eq)	Climatewatch
LNGHGMC	Log of Total GHG Emissions from Manufacturing & Construction (MtCO2 eq)	Climatewatch
LNGHGIP	Log of Total GHG Emissions from Industrial Processes (MtCO2 eq)	Climatewatch
LNGHGT	Log of Total GHG Emissions from Transport (MtCO2 eq)	Climatewatch
RENC	Renewable energy consumption (per cent of total final energy consumption)	World Development Indicators

Source: Authors' compilation.

The model stated in equation (i) was transformed into the DOLS estimating equation.

Let $X_t = [LNGHGA_t + LNGHGMC_t + LNGHGIP_t + LNGHGT_t + RENC_t]'$……………………..………..*(ii)*

Now,

$LNHI35_t = \alpha + \delta T + \beta' X_t + \sum_{j=-q}^{q} \Gamma_j \; \Delta X_{t+j} + u_t$……………………………………………………..(iii)

Here, $\Delta X_{t+j} \equiv X_{t+j} - X_{t+j-1}$

Replacing equation (ii) into equation (iii) we find equation (iv)

$LNHI35_t = \alpha + \delta T + \beta_1 LNGHGA_t + \beta_2 LNGHGMC_t + \beta_3 LNGHGIP_t + \beta_4 LNGHGT_t + \beta_5 RENC_t + \sum_{j=-q}^{q} \sum_{j=1}^{5} \gamma_{ij} \Delta X_{i,t+j} + u_t$………………………………*(iv)*

The study used time-series data from 1990 to 2020 for empirical analysis. All the variables were transformed into logarithmic form except for RENC.

The ADF test by Dickey and Fuller (1979) was used to test the stationarity property of the variables. Then, the Johansen cointegration test was used to determine whether a long-run equilibrium relationship exists between the variables. Johansen and Juselius (1990) derived two Cointegration tests and these are the trace test and the maximum Eigenvalue test. The trace statistic evaluates the null hypothesis that there are at most r cointegrating vectors whereas the maximum Eigenvalue test, evaluates the null hypothesis that there are exactly cointegrating vectors in dependant variables.

To estimate the long-run coefficients, the study employed the DOLS method which was introduced by Stock and Watson (1993). The DOLS is a robust approach which accounts for endogeneity by including leads and lags of the differenced independent variables.

Finally, Cumulative SUM (CUSUM) test was used to check stability of the model. This is a hypothesis testing through which we understand whether the model is stable or not by rejecting of accepting the null hypothesis (Farhani, 2012). The CUSUM test is used to detect systematic changes or shifts in coefficient values that may indicate structural instability in the model.

4. Result Analysis

Time-series data frequently display trends. If a series is non-stationary (exhibits a unit root), conventional regression of levels may yield misleading results. Thus, it was examined whether each variable is stationary at its levels or achieves stationarity after first difference. The result shows that all variables (heat index LNHI35 and the sectoral emission series) exhibit non-stationarity in levels but attain stationarity after first differencing. The unit root test result is given in Table 2.

The unit root test result revealed that the data is stationary at first difference. Hence, we proceed to cointegration test. Johansen Cointegration test was carried next to determine whether the variables exhibit parallel movement across time, indicating the existence of a stable linear relationship among them. If yes, then that signifies a long-run equilibrium. The test confirmed the presence of at least one cointegrating equation. Both the Trace test and the Maximum Eigen value tests revealed the existence of at least one cointegrating equation (Table 3).

As the study finds a long run cointegration among the variables in the model, the DOLS method was used to estimate the long-run coefficient of the independent variables in the model. The DOLS result (Table 4) revealed that coefficient for LNGHGA to be 0.75 and positive. It indicates that 1 per cent increase in GHG emission from agriculture sector increases the heat index by 0.75

Table 2: Augmented Dickey-Fuller Unit Root Test Result

Levels			
Variable	**ADF Statistics (Only Constant)**	**ADF Statistics (Constant & Trend)**	**Decision**
LNHI35	-2.01 (0.28)	-1.04 (0.92)	Non-stationary
LNGHGA	-1.39 (0.58)	-1.89 (0.64)	Non-stationary
LNGHGMC	-0.45 (0.89)	-5.40 (0.00)	Stationary at constant & trend
LNGHGT	-1.35 (0.59)	-2.47 (0.34)	Non-stationary
LNGHGIP	-1.15 (0.68)	-1.15 (0.68)	Non-stationary
RENC	-1.83 (0.35)	-2.77 (0.21)	Non-stationary
First Differences			
Variable	**ADF Statistics (Only Constant)**	**ADF Statistics (Constant & Trend)**	**Decision**
LNHI35	-5.47 (0.01)	-6.50 (0.01)	Stationary
LNGHGA	-6.36 (0.00)	-3.86 (0.03)	Stationary
LNGHGMC	-6.58 (0.00)	-6.88 (0.00)	Stationary
LNGHGT	-5.64 (0.00)	-5.81 (0.00)	Stationary
LNGHGIP	-4.72 (0.00)	-4.51 (0.00)	Stationary
RENC	-4.16 (0.00)	-3.99 (0.02)	Stationary

Source: Software generated result compiled by authors.

Table 3: Johansen Cointegration Test Results

Trace Test				
Null	**Alternative**	**Trace Statistic**	**95% Critical Value**	**Conclusion**
r=0	r=1	115.06	95.75	1 Cointegrating equations at 5% level
r<=1	r=2	67.88	69.82	
Maximum Eigen value Tests				
Null	**Alternative**	**Max-Eigen Statistic**	**95% Critical Value**	**Conclusion**
r=0	r=1	47.18	40.08	1 Cointegrating equation at 5% Level
r<= 1	r=2	0.68	36.28	

Source: Software generated result compiled by authors.

per cent. This is a significant and substantial influence, indicating that agriculture is a primary long-term contributor to excessive hot days. On the other hand, 1 per cent increase in GHG emission from manufacturing and construction sector decreases the heat stress index by 0.08 per cent as the coefficient for LNGHGMC is found to be negative and significant. A possible explanation of the negative coefficient in emissions from manufacturing and construction is the existence of aerosols in emissions from this sector, which may have a temporary cooling impact by reflecting sunlight or influencing cloud characteristics. Such a phenomenon referred to as aerosol dimming (Folini & Wild, 2011; Dar et al., 2021). Although GHGs raise atmospheric temperatures, aerosols can reduce some warming, potentially explaining the observed negative coefficient. This does not imply that these

Table 4: Result of DOLS Estimation (Long Run)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGHGA	0.75	0.01	86.84	0.00
LNGHGMC	-0.08	0.01	-8.53	0.00
LNGHGIP	0.03	0.02	1.93	0.07
LNGHGT	0.03	0.02	1.62	0.13
RENC	0.04	0.00	64.01	0.00
R^2	0.92			
Adjusted R^2	0.79			

Source: Software generated result compiled by authors.

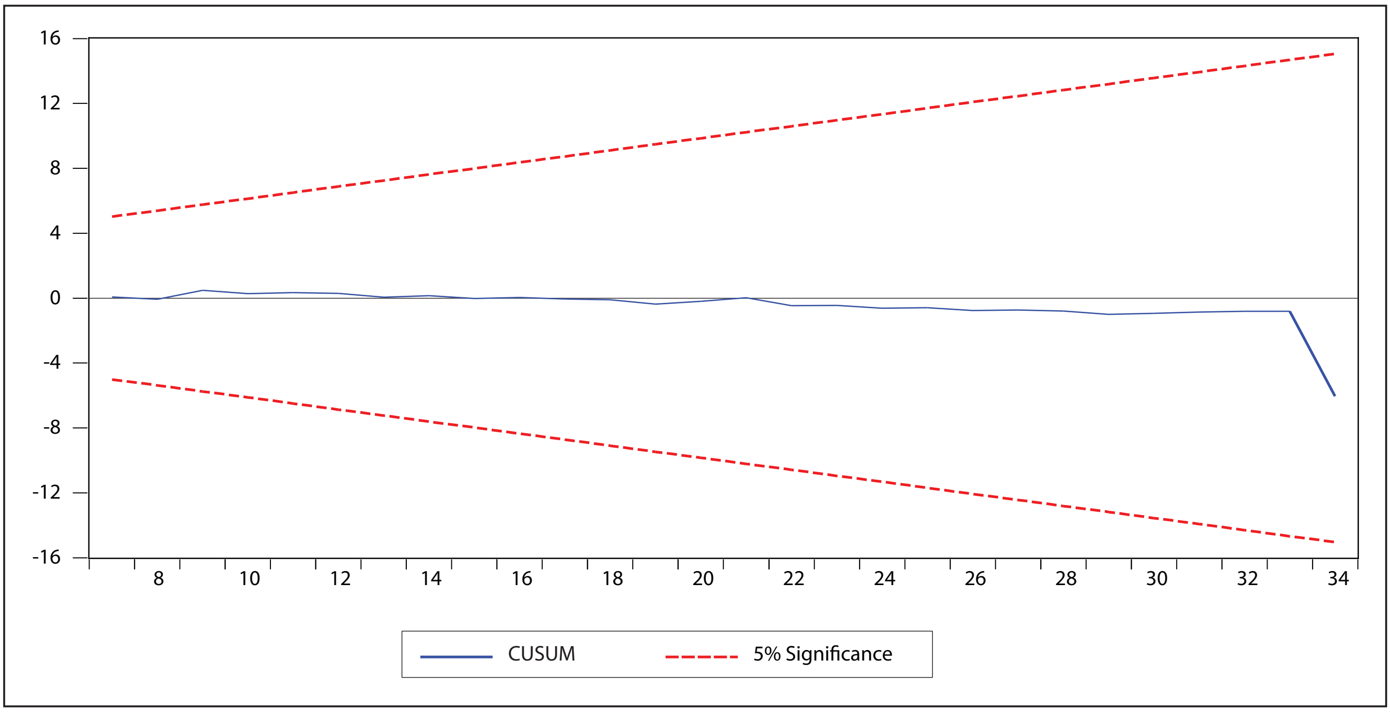
emissions are desirable; aerosols inflict significant health and environmental damage, and their cooling effect is temporary (Kennedy, 2007; Arfin et al., 2023).

Emissions from Industrial processes have slightly positive coefficient. The marginal significance indicates a modest long-run contribution to excessive hot days. Emissions from Transport has slightly positive coefficient but that is not statistically significant in the long run. On the other hand, emissions from renewable energy have a highly significant positive coefficient. A 1 per cent increase in renewable energy usage is associated with a 0.04 per cent increase in the number of extreme heat days. Agriculture is the sector most significantly associated with extreme heat in the long run. Thus, mitigation strategies from agriculture should be given priority.

The CUSUM plot (Figure 3) indicates that the test line consistently stays under the 5 per cent limit corridor. This suggests the absence of significant structural instability in the long-run relationship which indicates that the calculated DOLS estimation is stable in the long-run.

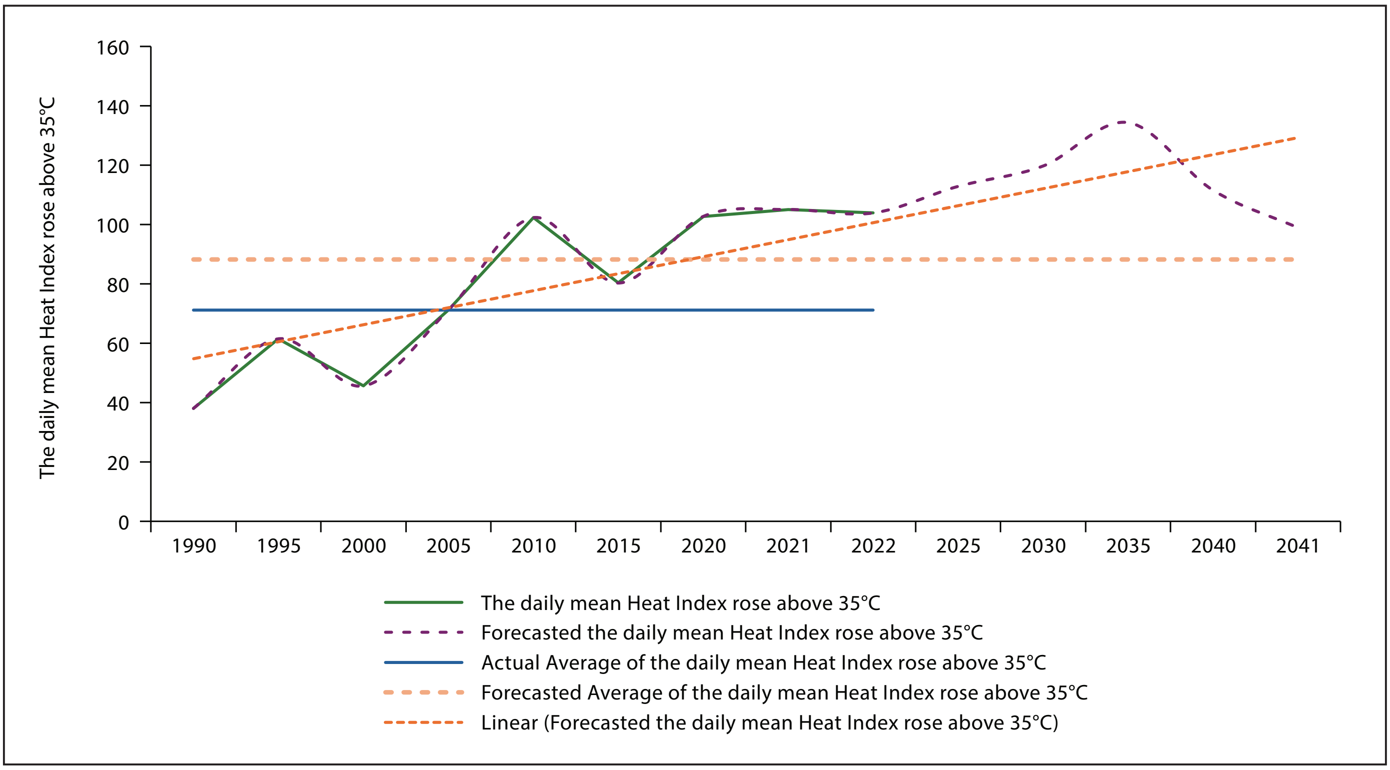
The study further conducted a simple linear forecasting exercise using the daily heat index data from 1990 to 2022 compiled form the World Bank. Figure 4 illustrates an overview of historical and projected trends in the number of days in a year with temperature above 35°C in Bangladesh, indicating severe levels of heat stress in coming days. Historical data from 1990 to 2022 indicates an evident upward trend, with a considerable increase in the number of extreme heat days over time. The average of observed data from 1990 to 2022 for the daily mean Heat

Figure 3: CUSUM Test for Residual Stability



Source: Software generated result compiled by authors.

Figure 4: Trend of Actual and Projected Average of the Daily Heat Index Rose Above 35°C



Source: Authors' calculation.

Index rose above 35°C is around 71 days. The study finds that the average number for the daily mean Heat Index increases to 88 days when forecasted data was used. The growing degree of heat stress is anticipated to continue, with predictions extending until 2041. The model predicts that the number of days in a year with temperature above 35°C in Bangladesh would reach a maximum of almost 140 days in a year by 2035 and then it will start to fall.

5. Recommendations

The empirical evidence in this study shows a strong long-run relationship between rising heat stress and GHG emissions, particularly from agriculture and industrial processing sectors in Bangladesh. Hence, reducing long-run warming factors and short-run exposure as well as vulnerability in cities are the two critical approaches needed to address urban heat stress. Hence, this policy brief proposes a set of recommendations that include reducing emission from agriculture, improving industrial processing and transport system in the country, improving urban planning and designing, addressing the impact of heat stress on public health, and strengthening inter-ministerial coordination.

5.1 Reducing Agricultural Emissions by Implementing Climate-smart Approaches

Strategic approaches are required for reducing emissions from agriculture sector in Bangladesh. The econometric analysis in this study finds that emissions from agriculture sector contributes significantly to increasing heat stress in the long run. Studies also find that rice cultivation, use of fertilisers, and livestock largely contribute to Methane (CH_4) and Nitrous Oxide (N_2O) emissions (Begum et al., 2019; Ahmed et al., 2022).

To address the issue, the following interventions should be prioritised to reduce emissions from agriculture sector in Bangladesh:

- *Promote Alternate Wetting and Drying (AWD) in Rice Cultivation:* AWD reduces Methane (CH_4) emissions by avoiding continuous flooding of rice fields, whilst also conserving water and maintaining yields.
- *Enhance Fertiliser Efficiency:* Implement soil testing and precision application techniques to minimise Nitrous Oxide (N_2O) emissions without compromising agricultural productivity.

- *Improve Livestock Management:* Introduce better feed practices and manure management systems, such as covered digesters, to reduce methane emissions from livestock.
- *Encourage Agroforestry and Crop Diversification:* Agroforestry and crop diversification practices sequester carbon and these also improve farm resilience and income stability.

The proposed strategies are technically feasible and economically beneficial for farmers. Integrating such climate-smart agriculture practices can simultaneously advance food security, improve rural livelihoods, and environmental sustainability.

5.2 Improving Transport System and Increasing Industrial Efficiency to Mitigate Emissions

Although the study finds that agriculture remains the dominant contributor to heat stress, emissions from transport and industrial sectors are steadily increasing and requires targeted interventions. The econometric analysis in this study does not find significant evidence that emissions from transport sector contribute to heat stress. However, studies find that rapid urbanisation and increased vehicle usage have intensified fossil fuel consumption, worsening air quality and contributing to localised heat stress (Fattah et al., 2022).

To address the challenges, the following strategies are recommended:

- *Modernise Urban Transport Systems:* Expand Mass Rapid Transit (MRT) networks to reduce reliance on private vehicles. Prioritising public transport can significantly lower emissions and improve urban mobility.
- *Promote Emission Free Transport:* Invest in pedestrian-friendly infrastructure and dedicated cycling lanes to encourage low-emission commuting options near MRT stations.
- *Upgrade Industrial Processes and Implement Emission Standards and Monitoring:* Encourage cleaner production technologies and energy-efficient machinery in manufacturing sectors. Incentivising industrial retrofits can reduce emissions and improve operational sustainability. Strengthen regulatory frameworks to enforce emission limits for vehicles and industrial facilities. Establish real-time monitoring systems to ensure compliance and transparency.

Aligned with these measures, a coordinated approach integrating transport reform and industrial efficiency is essential for mitigating urban heat stress and supporting Bangladesh's climate commitments.

5.3 Strengthening Urban Planning to Mitigate Heat Stress

Urban planning plays a critical role in addressing the intensifying Urban Heat Island (UHI) effect in Bangladesh's major cities, particularly Dhaka and Chattogram. Rapid urbanisation, loss of green spaces, and poor building design have contributed to rising land surface temperatures, increasing health risks and reducing liveability. To reduce urban heat stress, the following strategies should be prioritised:

- *Expand Urban Greening Initiatives:* increase investment in green initiatives such as tree planting, green corridors, and restoration of urban wetlands to lower surface temperatures, improve air quality, and enhance flood resilience.
- *Implement Passive Cooling Solutions:* Promote green roofs and cool roofs in industrial and public buildings. These cost-effective retrofits can reduce indoor temperatures by up to 2°C and recover significant labour hours annually (Bach et al., 2023).
- *Revise Building Codes for Climate Resilience:* Update construction standards to include heat-sensitive design features such as reflective materials, natural ventilation, and shaded structures.
- *Develop City-Level Heat Action Plans:* Establish early warning systems, temporary cooling centres, and targeted outreach for vulnerable groups including children, the elderly, and outdoor workers.

These interventions will help to cities that are more resilient to heat stress and better equipped to protect public health and productivity.

5.4 Advancing a People-Centred and Coordinated Response to Urban Heat Stress

Communication and equity must be central to the response. Public awareness initiatives about heat safety, emphasising hydration and rest, and protection for those most vulnerable, can preserve lives during severe heat waves. To ensure a people-centred approach, the following strategies are essential:

- *Raise Public Awareness and Promote Heat Safety:* Launch targeted campaigns to sensitise communities on hydration, rest, and protective measures during heatwaves. Public messaging should be accessible and culturally sensitive.
- *Engage Communities in Planning:* Involve local residents in the design and placement of cooling centres, shaded areas, and water access points to ensure interventions meet real needs and foster ownership.
- *Prioritise Equity in Policy Design:* Ensure that heat mitigation policies explicitly address the needs of the most vulnerable groups, promoting fairness and social inclusion.
- *Improve Data Systems and Monitoring:* Enhance meteorological tracking of temperature, humidity, and develop city-level heat vulnerability maps. Introduce an annual Heat and Emissions Scorecard to monitor progress on key indicators such as extreme heat days, sectoral emissions, renewable energy adoption, and heat-related hospitalisations.

By placing people at the centre of climate adaptation and ensuring institutional coordination can ensure build a resilient urban future that protects lives, promotes equity, and supports sustainable development.

6. Conclusion

Heat stress in Bangladesh has grown into an everyday event with significant consequences. According to the findings in this policy brief, the number of extreme hot days is rapidly increasing, primarily due to emissions from agriculture, but also aided by advances in transportation, industrialisation, and a reduction in the usage of renewable energy. These factors increase risks to public health, decrease worker productivity, and put stress on the entire country, especially on its cities.

The analysis highlights the necessity of addressing both the causes of emissions and the vulnerability of populations affected by heat. The most pressing issue is agricultural mitigation, but other crucial issues include urban greening, transportation reform, the growth of renewable energy use, and the construction of heat-sensitive buildings. Governance and financial systems must ensure the effective, equitable implementation of these actions in accordance with national commitments under the Paris Agreement.

The way forward requires a dual approach—reduce long-term emissions to minimise future warming, whilst concurrently adjusting urban areas, workplaces, and healthcare systems to safeguard individuals from existing and imminent threats. If executed well, these initiatives can produce simultaneous advantages for health, employment, and environmental quality. Bangladesh possesses a distinctive chance to address heat stress not merely as a climatic concern but as a developmental opportunity that enhances resilience, protects vulnerable communities, and sustains economic growth in an increasingly warm world.

References

Abrar, R., Sarkar, S., Nishtha, K., Talukdar, S., Shahfahad, Rahman, A., . . . Mosavi, A. (2022). Assessing the Spatial Mapping of Heat Vulnerability under Urban Heat Island (UHI) Effect in the Dhaka Metropolitan Area. *Sustainability, 14*(9). https://doi.org/10.3390/su14094945

Ahmed, Z., Gui, D., Qi, Z., Liu, J., Ali, A., Murtaza, G., . . . Ahmad, S. (2022). Greenhouse Gas Emissions and Mitigation Strategies in Rice Production Systems. In M. Ahmed, *Global Agricultural Production: Resilience to Climate Change* (pp. 237–265). Switzerland: Springer Nature. https://doi.org/10.1007/978-3-031-14973-3_8

Arfin, T., Pillai, A., Mathew, N., Tirpude, A., Bang, R., & Mondal, P. (2023). An Overview of Atmospheric Aerosol and Their Effects on Human Health. *Environmental Science and Pollution Research, 30*, 125347–125369. https://doi.org/10.1007/s11356-023-29652-w

Bach, A., Palutikof, J., Tonmoy, F., Smallcombe, J., Rutherford, S., Joarder, A., . . . Jay, O. (2023). Retrofitting Passive Cooling Strategies to Combat Heat Stress in the Face of Climate change: A Case Study of a Ready-made Garment Factory in Dhaka, Bangladesh. *Energy and Buildings*. https://doi.org/10.1016/j.enbuild.2023.112954

Begum, K., Kuhnert, M., Yeluripati, J., Ogle, S., Parton, W., Williams, S., . . . Smith, P. (2019). Modelling Greenhouse Gas Emissions and Mitigation Potentials in Fertilized Paddy Rice Fields in Bangladesh. *Geoderma, 341*(1), 206-215. https://doi.org/10.1016/j.geoderma.2019.01.047

Climate Watch. (2025). *Data Explorer Climate Watch*. Retrieved 2025, from climatewatchdata.org/data-explorer/historical-emissions?page=1

Dar, I., Rouf, Z., Javaid, M., & Dar, M. (2021). Atmospheric Emissions from Construction Sector. In J. Malik, & S. Marathe, *Ecological and Health Effects of Building Materials* (pp. 13-31). Switzerland: Springer Cham. https://doi.org/10.1007/978-3-030-76073-1

Das, A., Shuvo, R., Mukarram, M., & Sharno, M. (2024). Navigating the Energy Policy Landscape of Bangladesh: A Stern Review and Meta-analysis. *Energy Strategy Reviews, 52*. https://doi.org/10.1016/j.esr.2024.101336

Debnath, K., Jenkins, D., Patidar, S., Peacock, A., & Bridgens, B. (2023). Climate Change, Extreme Heat, and South Asian Megacities: Impact of Heat Stress on Inhabitants and Their Productivity. *ASME Journal of Engineering for Sustainable Buildings and Cities, 4*(4). https://doi.org/10.1115/1.4064021

Dickey, D., & Fuller, W. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 74*(366a), 427-431. https://doi.org/10.1080/01621459.1979.10482531

Farhani, S. (2012). Tests of Parameters Instability: Theoretical Study and Empirical Analysis on TwoTypes of Models (ARMA Model and Market Model). *International Journal of Economics and Financial Issues, 2*(3), 246-266. Retrieved from https://www.econjournals.com/index.php/ijefi/article/view/173

Fattah, M., Zannat, M.-U., Morshed, S., & Roni, A. (2022). Modeling the Impact of Motorized Vehicles' Activities on Emissions and Economic Losses in a Fast-growing Developing City, Dhaka, Bangladesh. *Journal of Transport & Health, 25*(2022). https://doi.org/10.1016/j.jth.2022.101377

Folini, D., & Wild, M. (2011). Aerosol Emissions and Dimming/Brightening in Europe: Sensitivity Studies with ECHAM5-HAM. *Journal of Geophysical Research: Atmospheres, 116*(D21). https://doi.org/10.1029/2011JD016227

Haque, F., Lampe, F., Hajat, S., Stavrianaki, K., Hasan, S., Faruque, A., . . . Kelman, K. (2024). Heat Index: An Alternative Indicator for Measuring the Impacts of Meteorological Factors on Diarrhoea in the Climate Change Era: A Time Series Study in Dhaka, Bangladesh. *International Journal of Environmental Research and Public Health, 21*(11). https://doi.org/10.3390/ijerph21111481

Hussain, N., Ahmed, S., & Shumi, A. (2023). Remote Sensing-based Geostatistical Hot Spot Analysis of Urban Heat Islands in Dhaka, Bangladesh. *Singapore Journal of Tropical Geography, 44*(3), 438-458. https://doi.org/10.1111/sjtg.12507

Islam, M., Turja, S., & Habib, A. (2025). Enhanced Power Demand Forecasting for Bangladesh: Using Feature Engineering Associated with Environmental and Economic Impact. *Journal of Data, Information and Management, 7*, 1–19. https://doi.org/10.1007/s42488-025-00140-9

Johansen, S., & Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Coinegration — With Applications to the Demand for Money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210. https://doi.org/10.1111%2Fj.1468-0084.1990.mp52002003.x

Kennedy, I. (2007). The Health Effects of Combustion-generated Aerosols. *Proceedings of the Combustion Institute, 31*(2), 2757-2770. https://doi.org/10.1016/j.proci.2006.08.116

Li, M. (2023). Adaptation to Expected and Unexpected Weather Fluctuations: Evidence from Bangladeshi Smallholder Farmers. *World Development, 161*. https://doi.org/10.1016/j.worlddev.2022.106066

Ministry of Environment, Forest and Climate Change. (2025). *Bangladesh's Third Nationally Determined Contribution (NDC 3.0)*. Retrieved from chttps://unfccc.int/sites/default/files/2025-09/Bangladesh%20Third%20Nationally%20Determined%20Contribution%20%28NDC%203.0%29.pdf

Obaidullah, M., Jamil, S., Mohammad Ali, H., & Akhter, A. (2023). Burning Up: How Heatwaves Pose a Threat to Public Health. *IJS Short Reports, 8*(3). https://doi.org/10.1097/SR9.0000000000000067

Patwary, M., Disha, A., Sikder, D., Hasan, S., Hossan, J., Bardhan, M., . . . Salahuddin , M. (2025). Urban Heat Stress and Perceived Health Impacts in Major Cities of Bangladesh. *International Journal of Disaster Risk Reduction, 116*. https://doi.org/10.1016/j.ijdrr.2024.105066

Rahman, D., & Rao, A. (2020). Electricity Planning for Bangladesh Under Various Scenarios. In S. Singh, & V. Ramadesigan (Eds.), *Advances in Energy Research, Vol. 1* (pp. 543-553). Springer Singapore. Retrieved from http://link.springer.com/10.1007/978-981-15-2666-4_52

Rahman, M., Afridi, S., Hossain, M., Rana, M., Masum, A., Rahman, M., & Al-Maruf, A. (2024). Nexus Between Heat Wave, Food Security and Human Health (HFH): Developing a Framework for Livelihood Resilience in Bangladesh. *Environmental Challenges, 14*(2024).https://doi.org/10.1016/j.envc.2023.100802

Raihan, A., Farhana, S., Muhtasim, D., Hasan, M., Paul, A., & Faruk, O. (2022). The Nexus Between Carbon Emission, Energy Use, and Health Expenditure: Empirical Evidence from Bangladesh. *Carbon Research*. https://doi.org/10.1007/s44246-022-00030-4

Raihan, A., Muhtasim, D., Farhana, S., Hasan, M., Pavel, M., Faruk, O., . . . Mahmood, A. (2023). An Econometric Analysis of Greenhouse Gas Emissions from Different Agricultural Factors in Bangladesh. *Energy Nexus, 9*. https://doi.org/10.1016/j.nexus.2023.100179

Raihan, A., Muhtasim, D., Farhana, S., Pavel, M., Faruk, O., Rahman, M., & Mahmood, A. (2022). Nexus Between Carbon Emissions, Economic Growth, Renewable Energy Use, Urbanization, Industrialization, Technological Innovation, and Forest Area Towards Achieving Environmental Sustainability in Bangladesh. *Energy and Climate Change, 3*. https://doi.org/10.1016/j.egycc.2022.100080

Ren, Z., Fu, Y., Dong, Y., Zhang, P., & He, X. (2022). Rapid Urbanization and Climate Change Significantly Contribute to Worsening Urban Human Thermal Comfort: A National 183-city, 26-year Study in China. *Urban Climate, 43*(2022). https://doi.org/10.1016/j.uclim.2022.101154

Stock, J., & Watson, M. (1993). A Simple Estimator of Cointegrating Vectors in Higher Order Integrated Systems. E*conometrica*, 783-820.

Uddin, A., Khan, N., Islam, A., Kamruzzaman, M., & Shahid, S. (2022). Changes in Urbanization and Urban Heat Island Effect in Dhaka City. *Theoretical and Applied Climatology, 147*(3-4), 891-907. https://doi.org/10.1007/s00704-021-03872-x

Wang, F., & Zhang, J. (2019). *Heat Stress Response to National-Committed Emission Reductions under the Paris Agreement* (12 ed., Vol. 16). *International Journal of Environmental Research and Public Health*. https://doi.org/10.3390/ijerph16122202

Wang, J., Chen, Y., Liao, W., He, G., Tett, S., Yan, Z., . . . Hu, Y. (2021). Anthropogenic Emissions and Urbanization Increase Risk of Compound Hot Extremes in Cities. *Nature Climate Change, 11*(2021), 1084–1089. https://doi.org/10.1038/s41558-021-01196-2

World Bank. (2025). *Bangladesh Faces Health and Economic Risks from Rising Temperature:* Retrieved from World Bank Group: https://www.worldbank.org/en/news/press-release/2025/09/16/bangladesh-faces-health-and-economic-risks-from-rising-temperature-world-bank

World Bank. (2025). D*ataBank World Development Indicator*. Retrieved 2025, from https://databank.worldbank.org/source/world-development-indicators

Yeasmin, F., Bach, A., Palutikof, J., Tonmoy, F., Tofail, F., Rahman, M., & Rutherford, S. (2025). Heat Impacts on Health and Productivity: The Case of two Ready-made Garment Factories in Tropical Bangladesh. *Environmental and Occupational Health Practice, 1*. https://doi.org/10.1539/eohp.2024-0009

Zhang, D., Raghupathi, W., & Raghupathi, V. (2024). Exploring the Effects of Greenhouse Gases and Particulate Emissions on Quality of Life: A Country-Level Empirical Study. *Climate, 12*(11). https://doi.org/10.3390/cli12110176

This policy brief examines how rising urban heat stress in Bangladesh is linked to greenhouse gas (GHG) emissions from key sectors, especially agriculture and industry. The objective is to understand the long-run relationship between sectoral emissions and heat stress, and to recommend solutions for building climate-resilient and sustainable cities in Bangladesh.

The study uses time-series data from 1990–2020 and employs econometric methodologies such as the Augmented Dickey-Fuller (ADF) unit root test, Johansen cointegration test, and Dynamic Ordinary Least Squares (DOLS) estimation test to assess how emissions from agriculture, manufacturing, transport, and industrial processes influence the number of extreme heat days.

The analysis reveals a long-run association between agricultural emissions and rising heat stress, while emissions from industrial processes show modest positive effects. Projections suggest that Bangladesh is going to experience extremely hot days in coming days, with serious implications for health, productivity and urban welfare.

The policy brief recommends promoting climate-smart agriculture, improving industrial efficiency and transport systems, investing in urban greening and heat-sensitive building design, and strengthening public health and early warning systems. It argues that managing heat stress is central to both climate action and sustainable urban development in Bangladesh.

Authors

Dr Fahmida Khatun is the Executive Director of the Centre for Policy Dialogue (CPD), Dhaka, Bangladesh. She can be reached at: fahmida@cpd.org.bd

Mr Foqoruddin Al Kabir is a Senior Research Associate at the CPD. He can be reached at: kabir@cpd.org.bd

Mr Md. Takrim Hossain is a Programme Associate at the CPD. He can be reached at: takrim@cpd.org.bd

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