ACCRA METROPOLITAN ASSEMBLY

URBAN HEAT STRESS AND RELATED HEALTH RISKS IN THE METROPOLIS: DRAFT VULNERABILITY ASSESSMENT REPORT

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1. Introduction

Accra is experiencing unprecedented levels of extreme heat due to accelerating climate change, rapid urbanization, land-use change, and the intensification of the Urban Heat Island (UHI) effect. The heat situation is no longer a seasonal inconvenience but a major public health, socio-economic, and environmental threat in AMA. Vulnerability is shaped by exposure to heat, underlying sensitivity, and the adaptive capacity of individuals, communities, and institutions.

Vulnerability to heat is not distributed evenly across Accra's population. The VEA framework offers a structured lens for identifying groups and localities most susceptible to the adverse effects of heat. It assumes that an individual or community's vulnerability arises from three interacting dimensions (i.e., exposure to the hazard, sensitivity to its effects, and the capacity to adapt or respond).

In AMA, vulnerability to extreme heat is shaped by multiple, overlapping factors. Age is a key determinant, as older adults and young children are less able to regulate body temperature, making them more susceptible to heat exhaustion, dehydration, and other heat-related illnesses. Gender also influences vulnerability. Women, particularly those working in the informal sector, such as market vending and street hawking, often spend long hours outdoors and face restricted access to cooling, hydration, and rest facilities. Their domestic and caregiving responsibilities also expose them to cumulative heat burdens both at work and at home.

Occupational exposure is another major factor. Outdoor workers, including waste collectors, transport operators, construction laborers, and food vendors, operate in poorly shaded or highly reflective environments that trap radiant heat. For these workers, prolonged exposure to extreme temperatures poses not only health risks but also productivity losses and income insecurity. Socio-economic status compounds this exposure. Low-income households in densely populated neighborhoods often occupy poorly ventilated housing with limited access to electricity, fans, or air conditioning in some cases. The absence of green space, insulation, and a reliable water supply further heightens their exposure.

Individuals with pre-existing health conditions such as cardiovascular disease, respiratory illnesses, diabetes, or renal disorders are particularly at risk. Heat stress exacerbates these conditions, while limited access to healthcare services or medications increases the likelihood of adverse outcomes. These factors, taken together, illustrate how heat vulnerability in AMA is multidimensional and embedded in broader patterns of social inequality and urban form. Understanding these dynamics provides the foundation for identifying high-risk populations and tailoring interventions to their specific needs. This report synthesizes vulnerabilities across demographic, environmental, socio-economic, and institutional dimensions.

2. Climate and Environmental Vulnerabilities

Over the past 30 years (1990–2025), Accra's mean temperatures and daily maximums have risen significantly, with frequent exceedance of 32°C and humidity above 70%. Projections indicate a further 1.5–2.5°C rise by 2050, increasing the frequency of dangerously hot days and nights. Key contributors include impervious surfaces, vegetation loss, compact settlements, and asphalt-dominated environments. Core districts are several degrees hotter than peri-urban surroundings.

Heat–Health Vulnerability Modelling

The Composite Heat Risk Index (HRI) was developed by integrating three key components, **Exposure, Sensitivity**, and **Adaptive Capacity,** using a weighted overlay approach in ArcGIS PRO informed by the Analytic Hierarchy Process (AHP) and expert scoring. Exposure was derived from LST and UHI intensity, representing the physical heat burden across Accra. Sensitivity captured population characteristics, including population density, the proportion of adults aged 65 years and older, and the distribution of chronic disease hotspots. Adaptive Capacity reflected communities' ability to cope with extreme heat, as measured by indicators such as access to green spaces, housing quality, and potential for ventilation. These standardized and weighted inputs were combined to produce an HRI surface that highlights neighbourhoods where high heat exposure intersects with vulnerable populations and limited adaptive capacity, thereby identifying priority zones for heat-health interventions (see Table 2) for the determination of the variables for the Composite Heat Risk Index.

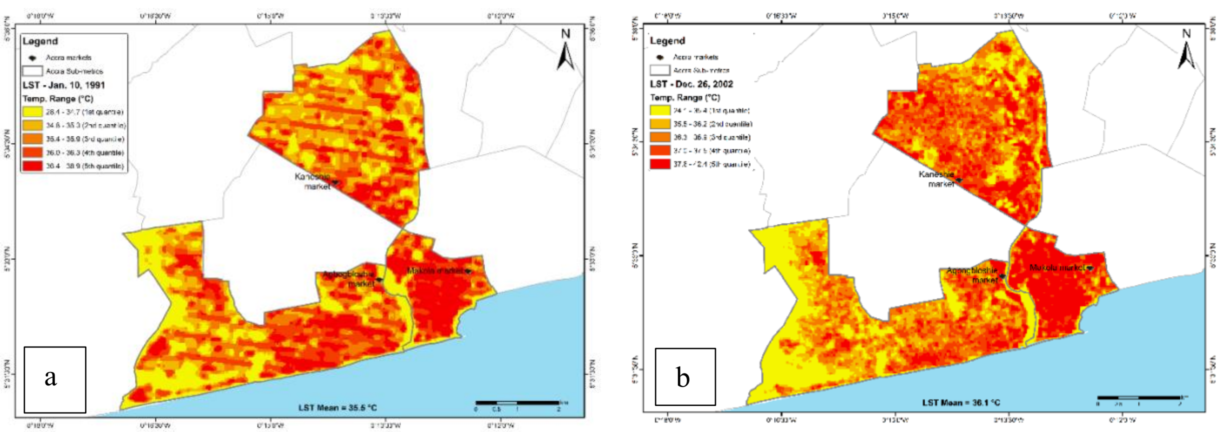
Table 1: Variables used and the range of values resulting from reclassification

	Exposure		Sensitivity		Adaptive Capacity	
Levels	LST	UHI intensity	population density	age >65	Green space (i.e. NDVI)	WDPA
Very High	0.0 - 0.10	0.0 – 0.10	0.00 – 0.25	0.00 – 0.19	0.22 - 0.41	0.00 - 0.24
High	0.10 - 0.84	0.1 – 0.37	0.25 – 0.53	0.19 – 0.39	0.16 - 0.22	0.24 - 0.40
Moderate	0.84 – 0.89	0.37-0.56	0.53 – 0.70	0.39 – 0.56	0.12 - 0.16	0.40 - 0.59
Very Low	0.89 - 0.92	0.56- 0.68	0.70 – 0.84	0.56 – 0.76	0.08 - 0.12	0.59 - 0.78
Low	0.92 – 1.00	0.68-1.00	0.84 – 1.00	0.76 – 1.00	0.00 - 0.08	0.78 – 1.00

*WDPA implies Walking Distance to Protected Areas

Land Surface Temperature (LST) Patterns

Spatio-temporal trends of Dry Season Land Surface Temperature (LST) Patterns in the three AMA sub-metros.



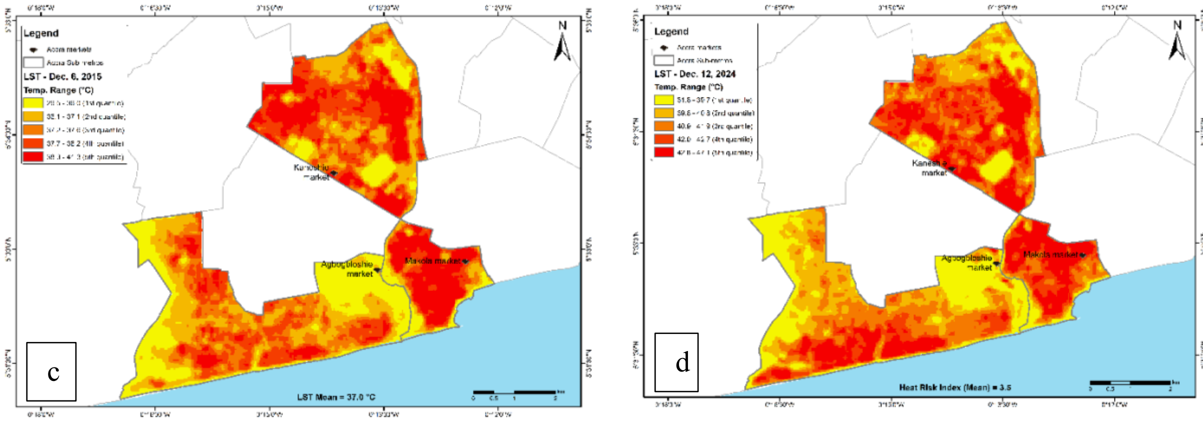


Figure 1: Land Surface Temperature (LST) distribution across the Accra Metropolitan Area for four time periods.

**These time periods include (a) 10 January 1991, (b) 26 December 2002, (c) 6 December 2015, and (d) 12 December 2024. Temperature ranges are classified using quartiles for each respective year. Yellow tones indicate cooler surfaces, while orange to red areas represent progressively warmer to hottest zones. The maps illustrate spatial and temporal variations in surface heating across Accra, revealing an apparent intensification of high-temperature zones over the study period.*

LST patterns across the selected Accra Metropolitan Area show a consistent upward trend from 1991 to 2024. In 1991, the mean LST was **35.5°C**, with moderate temperatures and localized hotspots primarily concentrated near dense residential and commercial districts. By 2002, the mean temperature rose slightly to **36.1°C**, accompanied by a noticeable expansion of high-temperature patches across central and coastal zones. The 2015 map shows a further increase in mean LST to **37.0°C**, reflecting more widespread and continuous hotspots, especially around Kaneshie, Agbogbloshie, and the coastal corridor. By 2024, the mean LST sharply increases to **40.0 °C**, with intense red-coded hotspots dominating much of the metropolitan region. Cooler areas become increasingly restricted to sparsely built or vegetated pockets. The progression across the four years highlights a significant intensification of surface heating within Accra (Figure 2).

Urban Heat Island Intensity

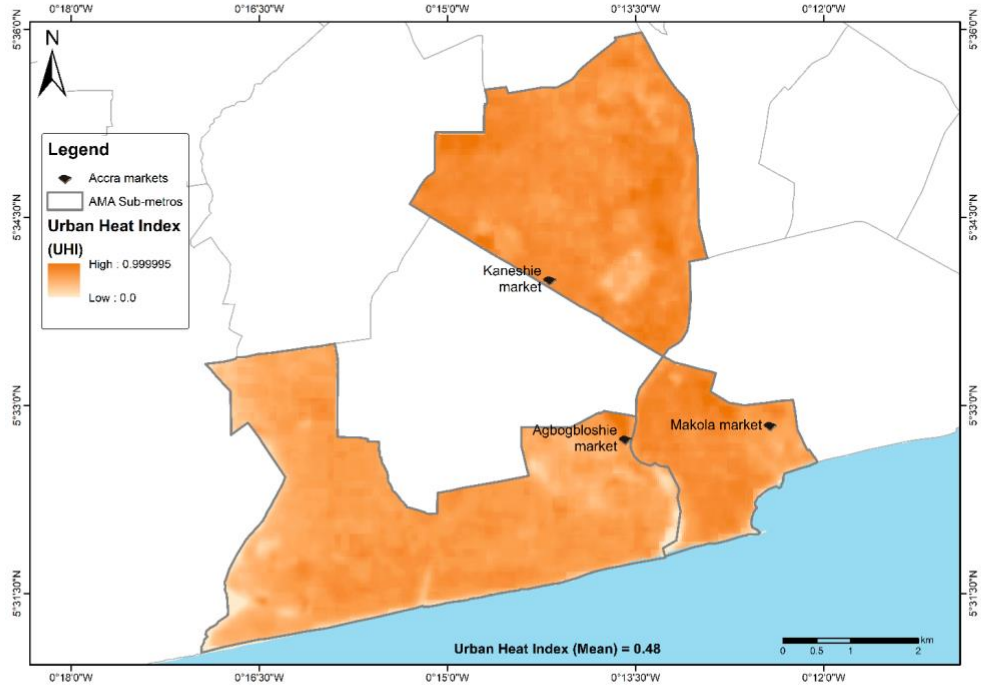
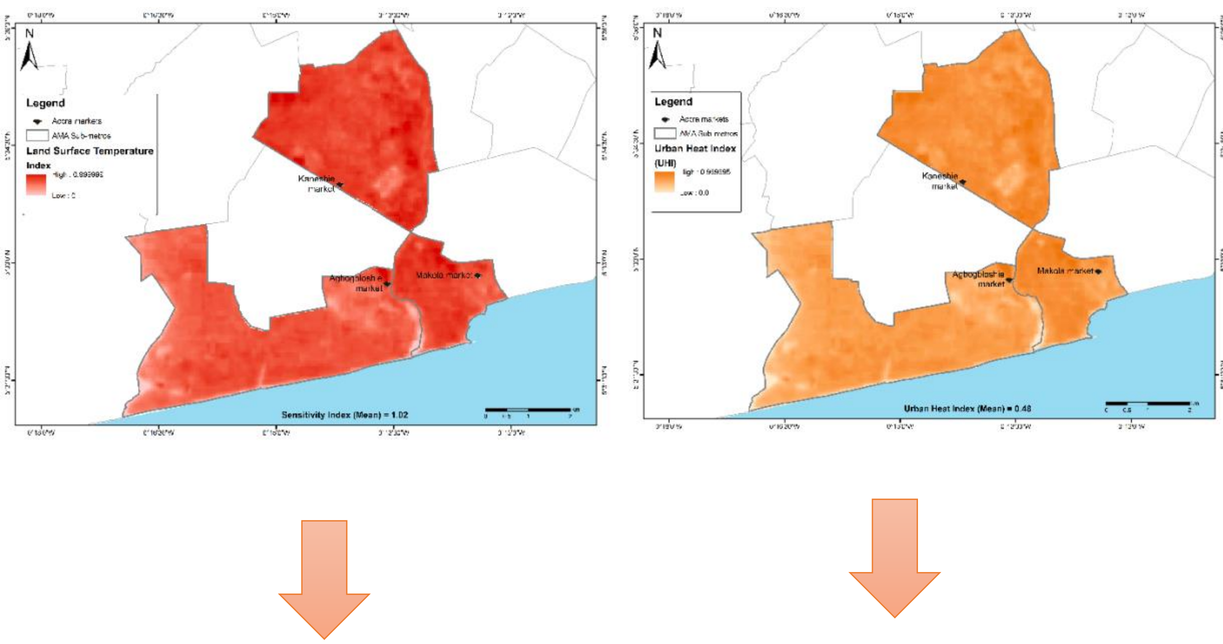


Figure 2: Urban Heat Index calculated based on the difference between LST values between the Urban areas and surrounding rural areas

Heat Risk Map Interpretation and Heat–Health Vulnerability Modelling

Adaptive Capacity Mapping



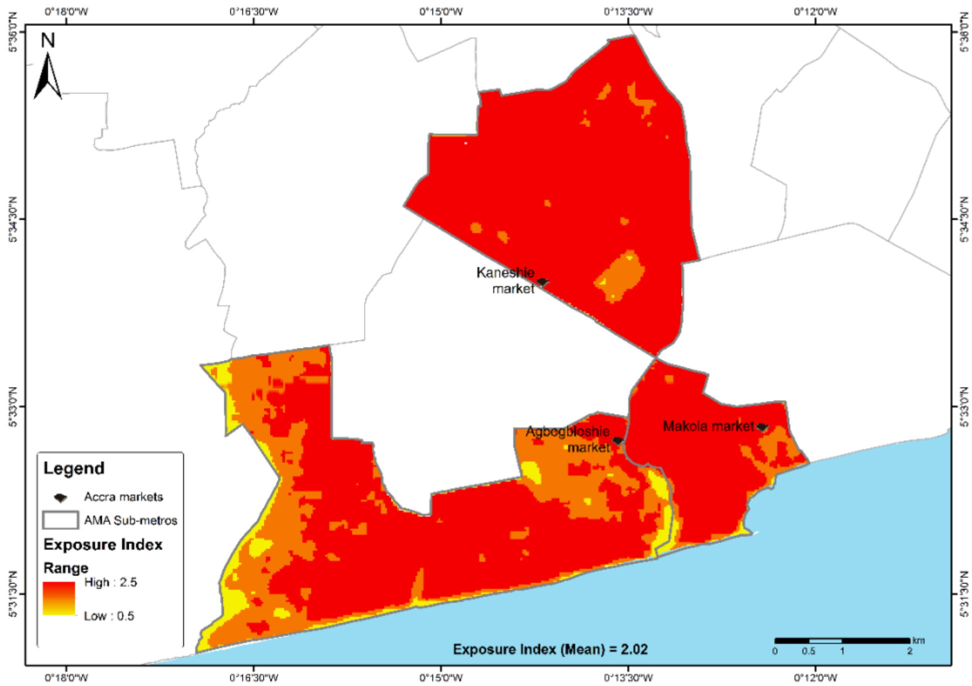
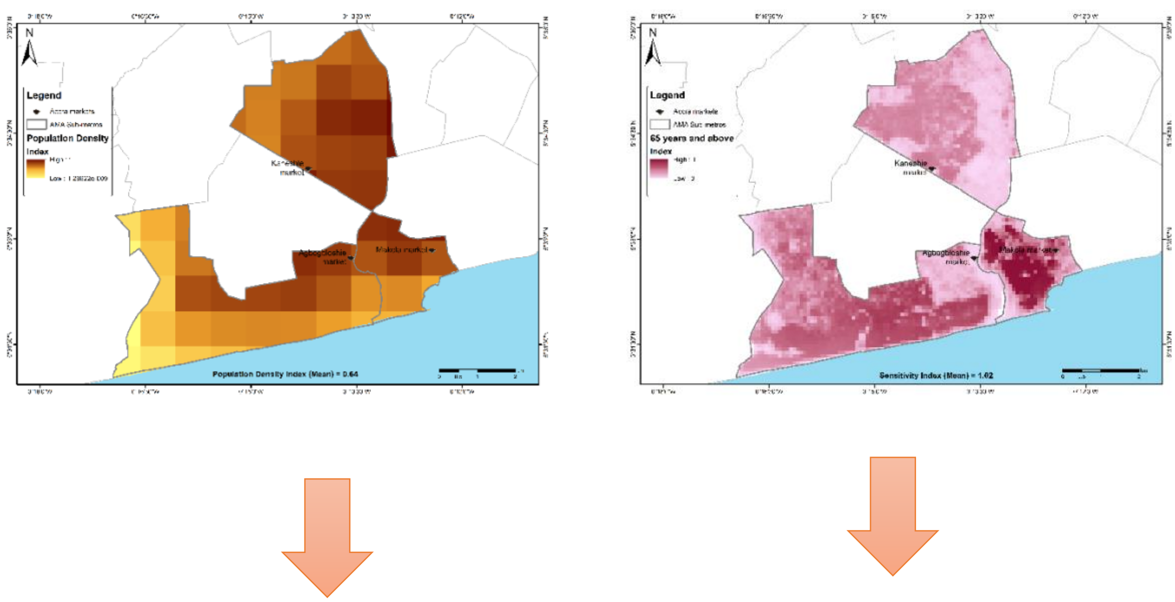


Figure 3: Exposure Index map (determined from LST and UHI intensity)

Sensitivity Index Map



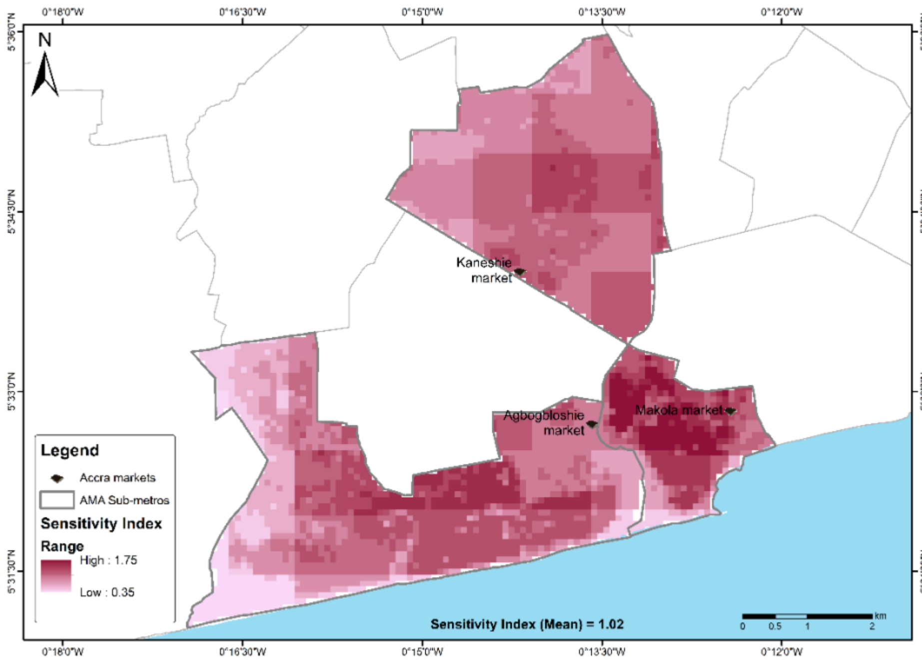


Figure 4: Sensitivity Index map (determined from population density and population of 65 years and above)

Adaptive Capacity Index

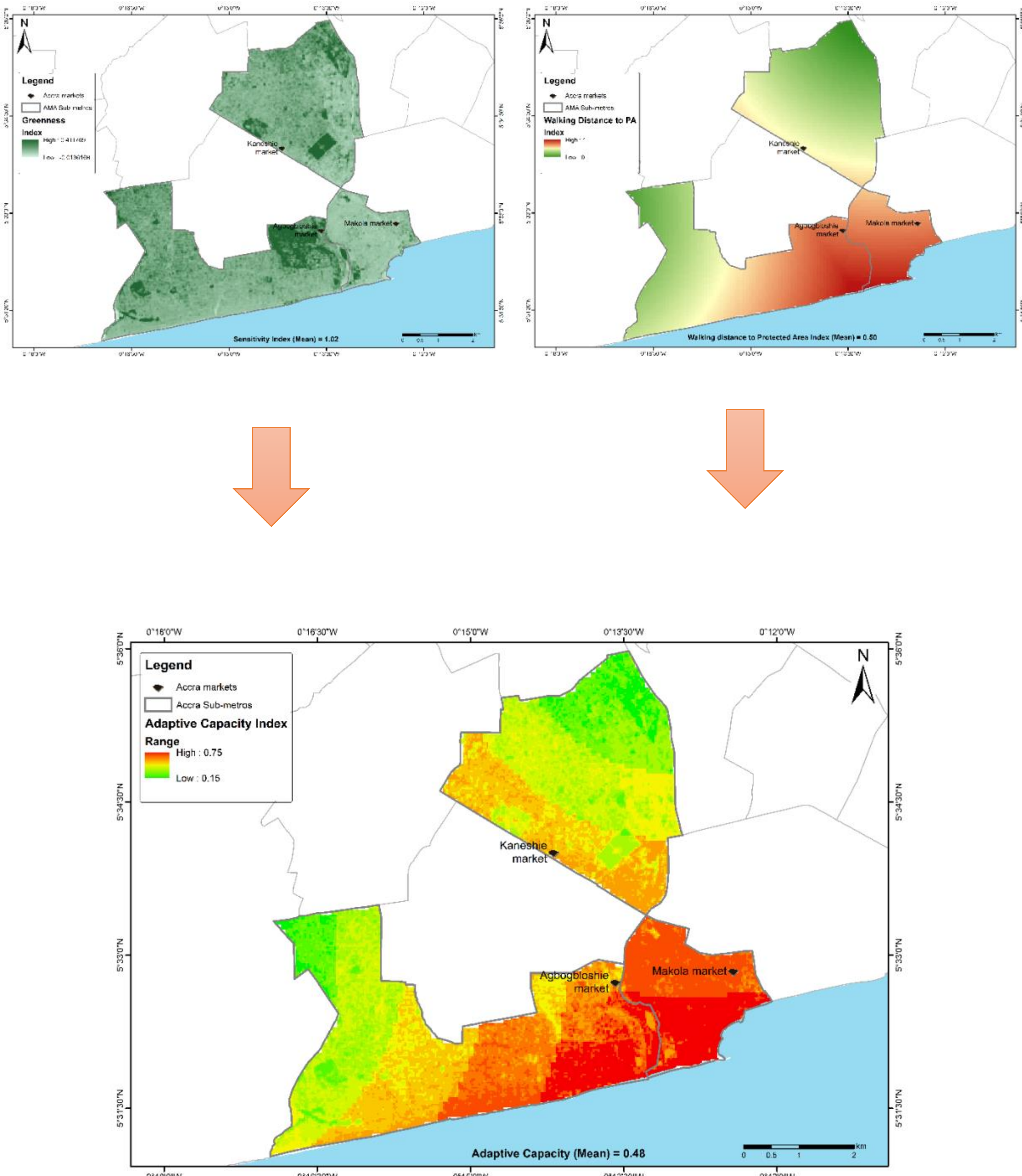


Figure 5: Adaptive Capacity Index map (determined from Green-space and the Walking Distance to Protected Areas variables)

Composite Heat Risk Index (HRI)

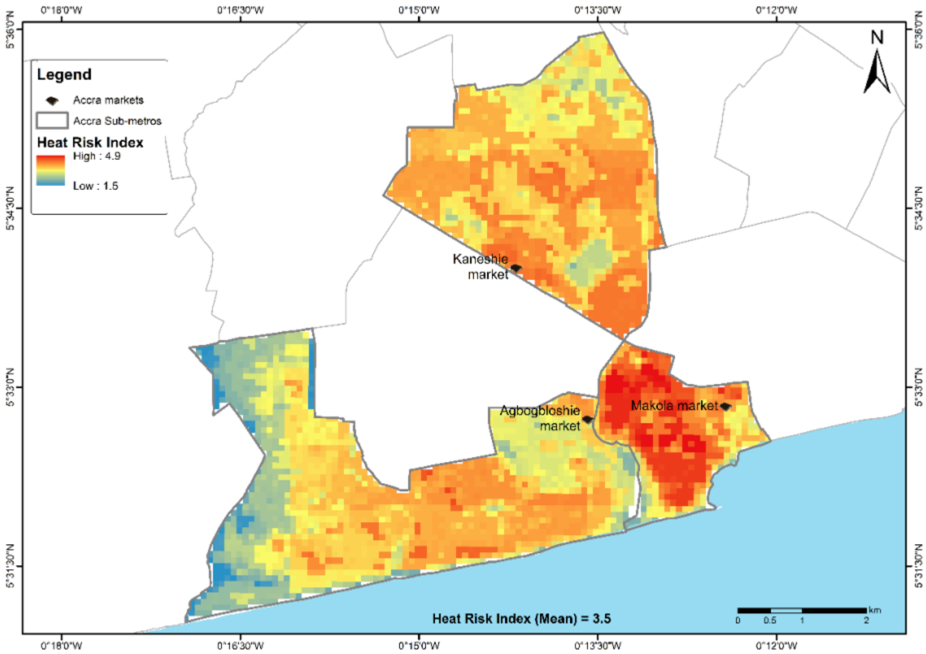


Figure 6: The final Heat Risk Map (determined from Exposure, Sensitivity, and Adaptive Capacity indices)

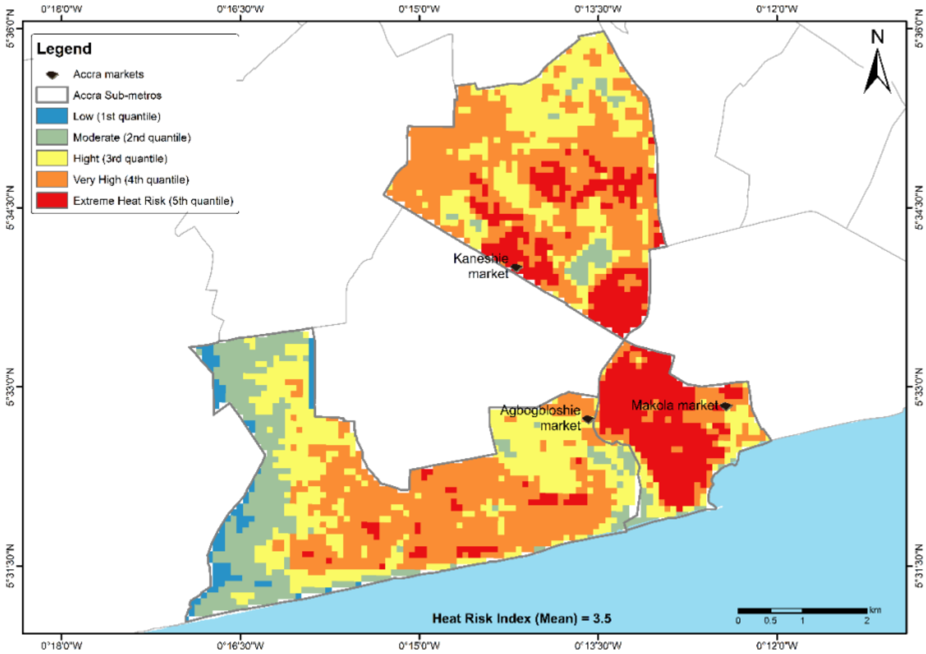


Figure 7: The final Heat Risk Map (Reclassified using natural breaks)

Health Risk Hotspots

Low Risk Zones

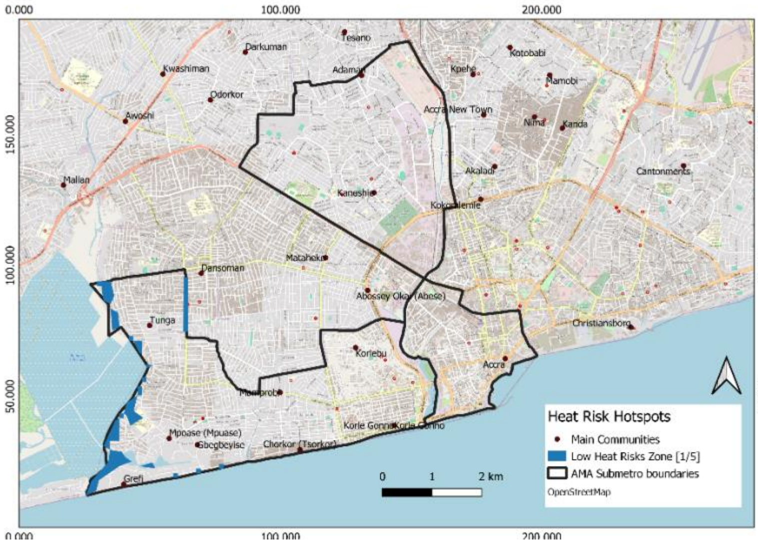


Figure 8: Low Risk Zones in the three submetros

The Low-Risk Heat zone includes Glefe, and part of Ebenezer Senior High School (SHS), as well as areas adjacent to the Pambros salt ponds, all of which are found in the Ashiedu-Keteke sub-metro.

Moderate-Risk Zones

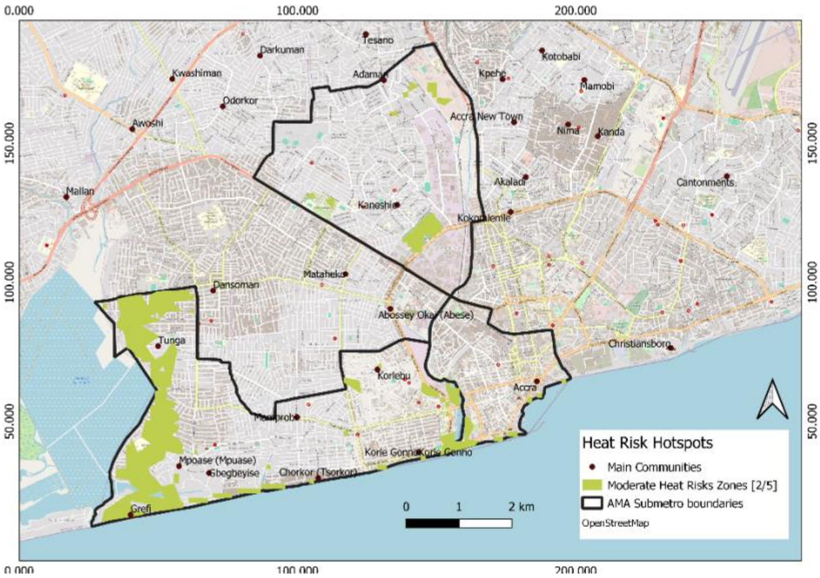


Figure 9: Moderate Risk Heat Zones in the three submetros

The moderate heat risk zones are mainly James Town and Victoriaborg, both in Ashiedu-Keteke sub-metro; Grefi, Ebenezer SHS, and Tunga localities in Ablekuma South sub-metro; and thirdly, Awudome cemetery and Accra Academy, both in Okaikoi South sub-metro.

High-Risk Zones

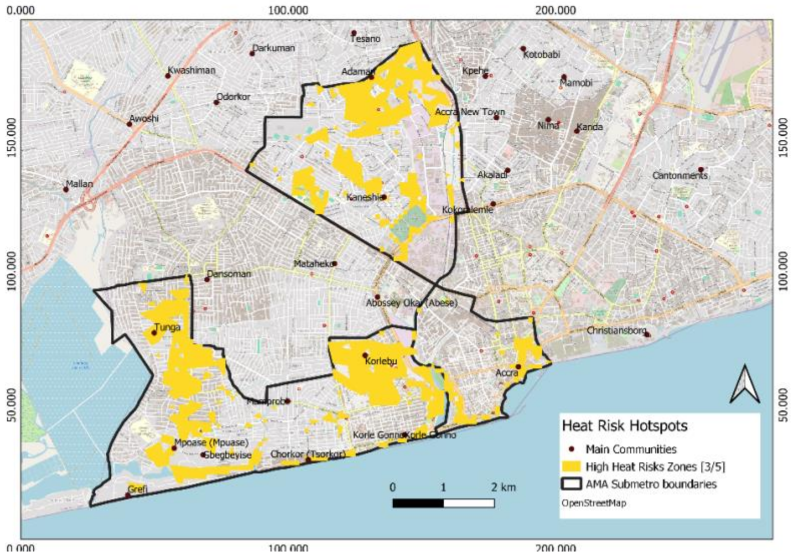


Figure 10: High Risk Heat Zones in the three submetros

High-risk heat maps cover most parts of Accra Central in the Ashiedu-Keteke sub-metro, as well as Tunga, Korle Bu, Mpoase, and Dansoman North in the Ablekuma South sub-metro; and thirdly, Kaneshie, including Kaneshie market, located in the Okaikoi South sub-metro.

Very High Heat Risk Zones

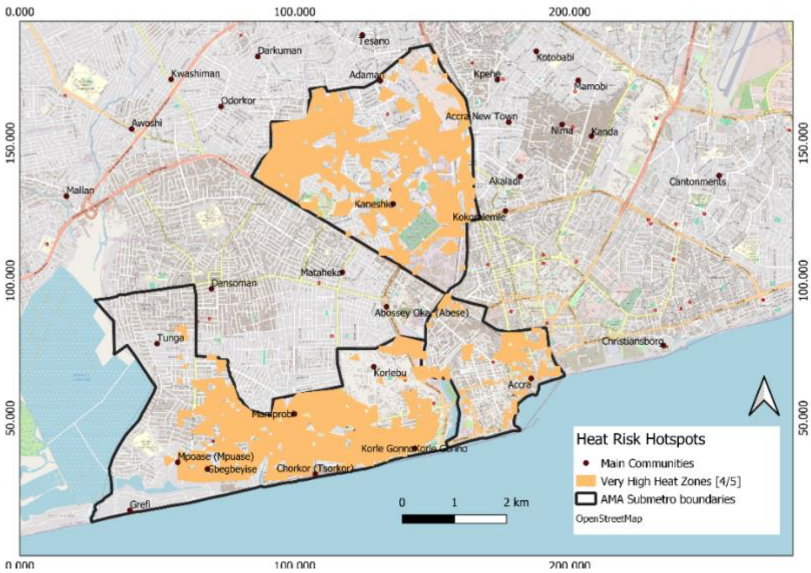


Figure 11: Very High-Risk Zones in the three submetros

The Very High Heat Risk Zones consist of Accra Central in the Ashiedu-Keteke sub-metro. In contrast, the Ablekuma South sub-metro comprises Mpoase, Mamprobi, Korle Gonno, Aborgwe, Old Dansoman, Lantemame, and Opetekwe localities. Finally, Okaikoi South sub-metro includes Kaneshie, North Industrial Area, Bubuashie, Kokompe, Masalatsi, Quarters, and Awudome.

Extreme Heat Risk Zones

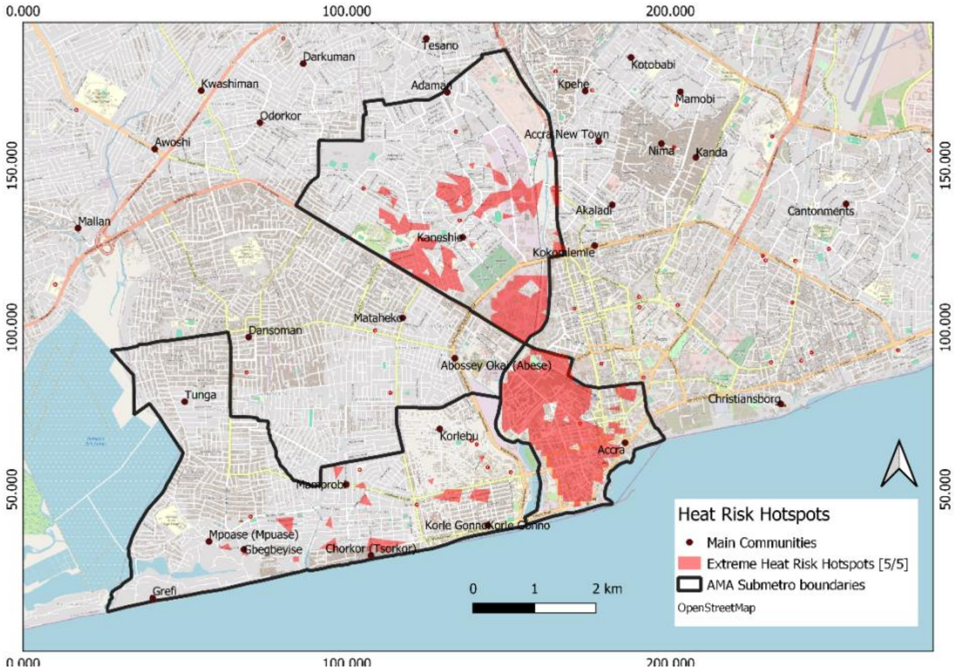


Figure 12: Extreme Heat Risk Zones

The Extreme Heat Risk zones in Ashiedu-Keteke sub-metro are James Town, Ussher Town, Dudor, Old Fadama, Bukom, Adedenkpo, Agbogbloshie, and Kantamantu market. Whereas in Ablekuma South sub-metro, these conditions are experienced in Gbegbeyise, Chorkor (Old Winneba Road), Mamprobi (Mpetemaku street), Agege (Gbegbe Road), and Camara (1st Tsokorme Link). The Extreme Heat Risk conditions are mainly found in the South Industrial Area, the North Industrial Area, the Kaneshie market, and the Kaneshie last stop, in the Okaikoi South sub-metro.

Compounding Environmental Hazards

Heat interacts synergistically with poor air quality (ozone formation, particulate resuspension), flooding, which worsens thermal exposure due to displacement into crowded shelters, and energy stress affecting cooling. These interactions amplify health risk and reduce community resilience.

Health Vulnerabilities

Heat exposure increases risks of, heat exhaustion, heat stroke, dehydration, cardiovascular and respiratory complications, and sleep disruption and chronic stress epidemiological evidence is influenced by lack of dedicated heat-related illness coding in DHIMS-2 in the Metro health data. Proxy indicators show rising trends such as: Asthma cases increasing significantly between 2020–2025, cases rising from 1,174 (2020) to a peak of 2,112 (2022) before settling to 1,226 (as of October 2025); a post-COVID spike that suggests changes in exposure, health-seeking or reporting patterns. These temporal changes are plausibly linked to environmental drivers. Total COPD case reported by the Accra Metro Health Directorate are higher in 2022 (68 cases) and 2023 (42 cases), with smaller counts in 2024 (10) and 2025 (22 cases as of October), suggesting episodic peaks rather than a steady. The number of skin-disease presentations with a 2021 peak (6,426 cases) and declines to 4,939 (2024) and 3,996 as of October 2025 is also proxy evidence (Accra Metro Health Directorate dataset, 2020–2025). Dermatological conditions such as miliaria (heat rash), sweat-related dermatitis, fungal intertrigo and secondary infections increase during hot, humid weather when sweating, occlusion and skin-barrier breakdown are common. Dermatology literature documents the seasonality and heat/humidity sensitivity of these conditions (Guerra, 2021)

Socio-Economic Vulnerabilities

AMA's population density exceeds 12,000 persons/km²—one of the highest in Africa. Informal settlements such as Agbogbloshie, Old Fadama, and Chorkor exhibit: Overcrowding, aluminum or metal roofing, poor ventilation, limited green cover, and inadequate access to water and electricity

These factors intensify heat exposure and limit adaptive capacity. Urban poor rely heavily on heat-exposed informal employment. Reduced productivity due to heat threatens daily income security, worsening socio-economic vulnerability.

Housing and Infrastructure Vulnerability

Houses with metal roofs and uninsulated walls trap heat day and night. Infrastructure deterioration (roads, buildings, markets) accelerates under prolonged heat, raising maintenance costs and reducing the resilience of livelihoods and businesses. Within AMA, vulnerability interplay with socio-economic and infrastructure are clear from:

- **Energy**: High ambient temperatures increase electricity demand (cooling loads) and may reduce the efficiency of power generation/transformers. The use of artificial cooling systems like the air-conditions contributes to greenhouse emissions as most of the energy sources rely on fossil fuels, contributing to creating a vicious cycle. The projected increase in extreme heat days is expected to escalate energy loads, potentially leading to outages and limiting access to electric cooling for vulnerable populations, exacerbating poverty among the urban poor.
- **Water**: Many cooling strategies depend on water for evaporation, storage, and bathing. Declining rainfall reliability and infrastructure stress mean water supply may become less dependable during hot periods. Longer dry spells reduce the availability of water for cooling and bathing, while higher evaporation and demand add pressure on storage and distribution systems. Also, high temperatures increase evaporation losses, affecting reservoirs and household storage.
- **Transport**: Transport infrastructure and housing likewise amplify exposure. Major roads and terminals absorb and re-emit heat, exposing commuters and informal workers. Road surfaces and built transport infrastructure absorb and radiate heat; exposure for passengers/walkers increases during heat events. Public transport stops, shelters and informal transit (e.g., trotro stations) provide inadequate shade.
- **Housing and shelters**: Many housing units in Accra, particularly in informal settlements/slums, have metal roofs, little insulation, minimal ventilation, and limited shading, retaining heat overnight and reducing physiological recovery. These conditions enhance indoor heat retention, prolonging exposure beyond daylight hours, and increasing night-time physiological stress. Infrastructure densification, insufficient green space and poorly ventilated market stalls further raise vulnerability.

Occupational Vulnerabilities

Outdoor and informal-sector workers—including vendors, transport operators, waste pickers, sanitation workers, and construction laborers—experience continuous exposure to radiant heat from buildings, pavements, and roadways. Productivity losses and increased risks of dehydration, respiratory distress, and injuries are widespread.

Food System Vulnerability

Heat reduces yields in urban agriculture and increases spoilage of perishable goods, affecting food security and income for urban farmers and market vendors.

Demographic Vulnerabilities

Children: physiologically limited thermoregulation, elderly (5.5% of AMA population) are at highest risk of heat morbidity and mortality, pregnant women compounded cardiovascular and metabolic strain, women in informal jobs experiences prolonged exposure and lower access to cooling. From the field survey, 57% of AMA residents are under 30 years of which many are engaged in informal or outdoor work, increasing their daily exposure. Limited access to cooling, healthcare, and occupational protections exacerbates their vulnerability to urban heat. Although only 5.5% of residents are elderly, they represent the highest physiological vulnerability due to chronic illnesses, mobility constraints, and limited ability to thermoregulate. Migrants settling in unplanned and flood-prone areas face poor housing, limited-service access and higher exposure to heat and other compounding hazards.

Institutional Vulnerabilities

Institutions such as AMA, GMet, GHS, EPA, NADMO, and LUSPA operate without an integrated heat-health strategy, resulting in No standardized heatwave definition, weak inter-agency coordination, limited surveillance of heat-related illnesses, and slow emergency response mechanisms.

Overall Vulnerability Summary

Vulnerability Domain	Key Findings
Environmental	Intensifying UHI; rising temperatures; spatial heat hotspots
Health	Increased heat-related illnesses; respiratory and cardiovascular risks; weak surveillance
Socio-economic	Poverty, informal work exposure, food system impacts, energy stress
Demographic	High youth exposure; elderly sensitivity; vulnerable settlements
Community	Low awareness; inadequate coping capacity; limited cooling access

Institutional	Fragmented governance; no HEWS; insufficient heat-health protocols

Community-Level Vulnerabilities and Coping Mechanisms

As many communities' experiences urban heat, they adopt different coping mechanisms based on their knowledge and available support. Community knowledge of heat-risk management and coping mechanisms is variable with many relying on informal strategies such as staying indoors, increasing water intake, and seeking shade. However, these methods are not sufficient during extreme heat events, particularly in settlements lacking green cover and proper ventilation.

Some members of the communities have limited access to cooling facilities at the household level as most of the most affected people are in low-income households including air conditioning, electric fans, reliable electricity, and cool public spaces. These challenged and constraints heighten nighttime heat stress among the vulnerable groups.

Gender dimensions of heat exposure and coping mechanisms

Gender shapes heat exposure and coping capacity in Accra. Women dominate informal trading and petty commerce, particularly in open-air markets such as Makola, Kaneshie, and Agbogbloshie, where daytime temperatures exceed 35°C inside zinc-roofed stalls. Surveys of traders in AMA (48% males and 62% females) reported experiencing dizziness or dehydration at work during a heat episode. Coping strategies are constrained by both economic and cultural factors. Many women use handheld fans, water sachets, or temporary shade cloths as improvised cooling mechanisms.

Men's vulnerability arises from occupational patterns such as construction, transport driving, and waste handling expose them to extreme heat for long hours, often without regulated rest breaks.

Gendered differences in exposure and resources mean that heat-health policy must integrate gender equity, providing targeted support, including cooling shelters in markets, subsidized fans, and health messaging tailored to women's networks, while addressing the occupational exposure of men in outdoor labour.

Informal sector adaptations

As shown in section 4.4 above, the informal sector, comprising market traders, street vendors, transport operators, and artisans, represents the majority of Accra's outdoor workforce and is among the most heat-exposed population groups. Overall, the informal sector's adaptations remain vulnerable to systemic shocks (e.g., fuel price hikes, electricity outages, market relocations). Formal integration of occupational heat protection into labor regulations and market design remains minimal. Adaptation in this sector reflects pragmatic, low-cost, and often collective responses:

- **Shading and temporary shelters:** Traders at markets such as Makola, Agbogbloshie, and Kaneshie construct makeshift shades using tarpaulins, umbrellas, or corrugated sheets (see Annex 2). These reduce direct sun exposure but trap heat underneath due to poor ventilation. Some markets have begun experimenting with lightweight reflective covers introduced by NGOs and AMA's Markets Department.
- **Work-hour adjustments:** From the survey, 14% of outdoor workers shifted their operating hours to early morning (5–10 a.m.) or evening (4–8 p.m.) to avoid peak heat. These respondents are part of the 41% that spend 6-8 hours a day outdoors working as shown in section 4.4. However, this group of workers indicated that they sold their products from 10-4 pm, depending on the weather on the day. This means that they could work up to or more than 10 hours a day, depending on the weather (temperature on that day). Majority (86%) of outdoor workers did not shift their working hours and worked during extreme heat conditions. Construction workers and waste collectors modify work schedules where supervisors permit. However, income insecurity and informal employment arrangements often limit the feasibility of rest breaks during heatwaves.
- **Use of public and green spaces for cooling:** Observations from the field showed that workers gather under trees, in bus terminals, or near coastal areas such as Independence Square and Osu beaches during extreme heat events. These *informal cooling nodes* highlight the social importance of shade trees and public spaces in the city's adaptive landscape. Providing cooling systems in public spaces as part of the adaptation mechanism is amplified by these practices.
- **Collective resource pooling:** Interaction with informal workers in markets such as Agbogbloshie and Kaneshie during the survey revealed that groups of traders purchase fans or rent generator-powered cooling devices. Others share costs for water storage

tanks used for drinking and bathing. Such collective strategies demonstrate social cohesion but are limited in coverage and depend on daily income fluctuations.

Conclusion

AMA faces high and multi-dimensional heat vulnerability driven by climate change, urbanization, poverty, and weak institutional systems. Vulnerability is most severe among, informal workers, residents of informal settlements, elderly persons, women and children, migrant and low-income households, and communities in known heat hotspots (James Town, Chorkor, Kaneshie, Agbogbloshie). There can be decisive measures to address these vulnerabilities which will require an integrated heat-health governance, strengthened early-warning systems, urban greening and cooling infrastructure, improved housing and settlement planning, targeted support for high-risk groups, and enhanced public awareness and community participation. Accra has a unique opportunity to build resilience through evidence-based and equity-driven action.

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