

2018

A review of heat stress policies in the context of climate change and its impacts on outdoor workers: Evidence from Zimbabwe

Bigboy Ngwenya

Edith Cowan University, b.ngwenya@ecu.edu.au

Jacques Oosthuizen

Edith Cowan University, j.oosthuizen@ecu.edu.au

Martyn Cross

Edith Cowan University, m.cross@ecu.edu.au

Kwasi Frimpong

Edith Cowan University, k.frimpong@ecu.edu.au

Cynthia N. Chaibva

[10.4018/IJSESD.2018010101](https://ro.ecu.edu.au/ecuworkspost2013/3988)

This is an Author's Accepted Manuscript of: Ngwenya, B., Oosthuizen, J., Cross, M., Frimpong, K., & Chaibva, C. N. (2018). A Review of Heat Stress Policies in the Context of Climate Change and Its Impacts on Outdoor Workers: Evidence From Zimbabwe. *International Journal of Social Ecology and Sustainable Development (IJSESD)*, 9(1), 1-11. Original article available [here](#).

This Journal Article is posted at Research Online.

<https://ro.ecu.edu.au/ecuworkspost2013/3988>

A review of heat stress policies in the context of climate change and its impacts on outdoor workers: Evidence from Zimbabwe

**Bigboy Ngwenya, Edith Cowan University, Perth, Australia*

Jacques Oosthuizen, Edith Cowan University, Perth, Australia

Martyn Cross, Edith Cowan University, Perth, Australia

Kwasi Frimpong, Edith Cowan University, Perth, Australia

Cynthia Nombulelo Chaibva, National University of Science and Technology, Bulawayo, Zimbabwe

ABSTRACT

Record breaking summer heat events are increasing in frequency in Zimbabwe and 2016 was a particularly hot year with the country experiencing its worst heat wave event in decades. Currently, Zimbabwe has no coordinated public health response to deal with heat wave events and no specific data on heat-related morbidity and mortality. The country has no legislation for protecting workers against environmental heat exposure, particularly those most vulnerable who are employed in the informal sector. These workers are also at risk due to their outdoor work environments. The study outlines the state of climate and heat stress in Zimbabwe as benchmarked against other African countries and France. It further summaries outdoor workers' susceptibility to heat exposure and the need for the Zimbabwean Government to develop policies to ensure the health and safety of an increasing population of outdoor workers in Zimbabwe.

Keywords: *Climate Change, Climate Policy, Outdoor Informal Sector Workers, Street Hawkers, Heat Stress, Zimbabwe*

INTRODUCTION

Climate change has been impacting global climatic and environmental conditions over the last few decades and many countries are experiencing extreme high temperatures, which have caused a serious public health issue. Extreme temperatures, particularly in occupational environments, have impacted negatively on humans, increasing their susceptibility to disease and heat-related mortality.

Susceptibility among human populations depends on various factors which include social, cultural and /or physical status. Current studies show that the effects of climate change are progressively affecting the cultural and socioeconomic lives of communities (Frimpong, Van Etten, Oosthuizen, & Fannam, 2015). It has been shown that many people throughout the world are frequently exposed to environmental conditions that exceed the capacity of normal human physiological coping mechanisms, placing such individuals at risk of suffering heat-related illnesses (Kjellstrom, 2009).

Heat is one of the naturally occurring hazards associated with climate change, and heat waves account for a significant proportion of human mortality (WHO, 2014). Globally morbidity and mortality trends associated with heat wave events have been published in a number of developed countries. The heat waves that occurred in Western Europe in August 2003 exposed flaws in the management of environmental public health risks (Kovats & Hajat, 2008). The extreme heat event that struck Europe in 2003 resulted in 15,000 deaths (Rey et al., 2009). Russia experienced 1,100 deaths in 2011 (Grumm, 2011) and the Chicago heat waves had a reported mortality of 800 in 2010 (Hayhoe, Sheridan, Kalkstein, & Greene, 2010). Research has shown that a lack of intervention plans and coordination between health agencies and social services impacted negatively on the management of these events (Kovats & Hajat, 2008). However, there is a gap in data for Africa, which is particularly vulnerable to the effects of climate change and heat waves. Global average surface temperatures are estimated to increase further by between 1.8 – 4.0°C by the year 2100 (Intergovernmental Panel on Climate Change (IPCC), 2007). Current literature concurs that heat-related illnesses will emerge as major public health issues in the future, particularly in developing countries, including Zimbabwe. Studies have shown that heat waves occur more frequently than any other natural hazard, yet are not

generally recognized as a significant cause of mortality, particularly in developing countries (Koppe, Kovats, Jendritzky, & Menne, 2004). Contemporary global economic changes and urbanization in poor countries has further exposed populations to environmental health hazards, including heat waves, with there being very limited policies on heat prevention and adaptation strategies in place. Zimbabwe and the whole of the Southern African Development Community (SADC) region, is facing an increase in the frequency of hot summer days and extremely dry cold winter days caused by climate change. These changes are being experienced in Zimbabwe, greater parts of South Africa, Botswana and Namibia with an increase of between 0.2°C to 0.5°C per decade (Young et al., 2010). Since 1980, Zimbabwe's average annual temperatures have also been increasing. The issue has been compounded by changes in rainfall patterns that have resulted in rainfall becoming increasingly uncertain (United Nations Framework Convention on Climate Change (UNFCCC zimnc2, 2013)). In recent years increasing heat wave episodes have also been experienced in the region. Although people may adapt to higher temperatures, their physiological capacity to cope with sporadic heat events is uncertain (Patz et al., 2000). According to Zimbabwe's National Climate Change Response Strategy (2014), there has been an increase in daytime temperatures between the months of September and November with an average minimum of between 15°C, average maximum of 29°C and a potential peak of above 35°C. During the wet season, the average minimum temperature is 12°C, and the average maximum is 30°C, potentially peaking as high as 35°C. This is coupled with high humidity events. Being a landlocked country, it is predicted that Zimbabwe will also warm more rapidly in the future than the global average (UNFCCC zimnc2, 2013).

In the context of climate change and the assumption that heat waves will be a significant environmental hazard associated with climate change in the future, this article reviews heat stress policies and outdoor occupational health sustainability in the context of climate change in Zimbabwe. Furthermore, the article explores heat exposure and adaptation strategies of a particularly vulnerable group of outdoor informal sector workers, also known as street hawkers/vendors, in urban Bulawayo – Zimbabwe. The City of Bulawayo is the second largest city in Zimbabwe and was the country's

industrial hub in the 1980s. The population of Bulawayo is 653,337 (303,346 males and 349,991 females) according to the Zimbabwe 2012 Census. Unemployment in this city has escalated to a point where approximately 80% of the people are working in the streets as hawkers. This is slightly better than the country's national unemployment rate, which is 85% (Mpofu, 2010). Adaptation is viewed as the most effective way to reduce susceptibility of these workers to climate change effects (Frimpong et al., 2015). In assessing their adaptation, coping capabilities and awareness, this article will analyse and inform the development of appropriate government policies aimed at heat stress prevention.

SUSCEPTIBILITY TO HEAT STRESS AND CLIMATE CHANGE IMPACT ON STREET HAWKERS IN ZIMBABWE

Heat waves, which have been experienced globally, present specific public health challenges, particularly for certain sectors of society and different occupational groups, yet there is inadequate research on this phenomenon, particularly in developing countries such as Zimbabwe (Gubernot, Anderson, & Hunting, 2014). The groups most vulnerable to heat exposure include the elderly, children, displaced individuals, those with chronic diseases, low socio economic status and those in outdoor occupations (Kovats & Hajat, 2008). The population in Africa is also recognized as susceptible due to the high prevalence of poverty and inadequate coping strategies to manage climate change effects (Madzwamuse, 2011). In Bulawayo, street hawkers are unlikely to gain employment in the formal sector due to economic conditions that have resulted in the closure of industries in the city, the previous industrial hub city of Zimbabwe. Through personal observation and informal communication with local residents it appears as if the situation has been further complicated by the influx of rural people into the cities due to the collapse of the commercial agricultural sector, erratic rainfall patterns and recurrent droughts. Street hawkers are exposed to the effects of heat waves as they operate their businesses on street pavements for long hours and with minimal protection from the sun. Most common heat management strategies recommend taking regular short breaks, however, this is hard to enforce as these workers spend long hours in the open, with limited knowledge of the

effects on heat on their health. This cohort also has limited choices as open street vending is their major source of income and livelihood.

Figure 1: Street vendors (hawkers) in Bulawayo



The combined exposure to high temperatures, humidity and radiant heat from direct sunlight, as well as the lack of ready access to potable water, means that this sector of the population are at a much greater risk of suffering the effects of heat stress and its related illnesses which can cause death and other chronic conditions such as renal disease. Heat stress can also exacerbate other underlying conditions (Coco et al., 2016). In this article, susceptibility is described as the state of vulnerability of a group of people (street hawkers) who are exposed to the impacts of climate change. Street hawkers in developing countries are particularly vulnerable as they have less capacity to adapt and there are no heat wave health-related policies that would apply to them (Frimpong et al., 2015).

Studies have shown that extremely high temperatures coupled with air pollution and high humidity contributes to higher morbidity and mortality rates as well as an increase in more general chronic health concerns (Kjellstrom, Butler, Lucas, & Bonita, 2010). The situation is further exacerbated by rapid urbanization that contributes to the urban heat island effect (Corburn, 2009). With the increasing impacts of global warming, these workers are becoming more vulnerable. It has been estimated that outdoor workers have a 20-fold increased risk of suffering heat-related mortality as compared to other occupational groups and this trend is likely to be more pronounced in developing countries with no public health response to heat wave events (Centers for Disease Control, 2008). Heat exposure is likely to impair the physiology, health status and work performance of this group of individuals (Parsons, 2003). Preparing for future heat wave events of increasing severity and duration poses a difficult challenge to governments in developing countries such as Zimbabwe. As a result of economic decline, there are a growing number of hawkers on the streets who make ends meet under the exposure of extreme heat, working with no shade for cooling or resting. The health and livelihood security of this population is at risk as global climate change is intensifying (Mpofu, 2010; Rusvingo, 2015). As temperature is a key driver of climate change in Africa, the susceptibility of outdoor workers is at stake. In the context of climate change and socioeconomic development there is a gap in the protection of this large and vulnerable sector of society and there is a need to develop appropriate policies to ensure the security of this group.

CLIMATE CHANGE AND HEAT STRESS PREVENTION POLICIES IN ZIMBABWE - TAKING INFERENCES FROM OTHER COUNTRIES

Experience gained from the developed world indicates that the impact of climate change can be reduced by the creation and enforcement of targeted heat-related public health policies that are compatible with available financial, human and technological resources (Frimpong et al., 2015). Countries, particularly those located in the tropics and other hot and humid areas, need to develop all-inclusive climate change adaptation policies to protect their populations. Zimbabwe's Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC 1998 -

2014) and the Zimbabwe Agenda for Sustainable Social Economic Transformation (Zim-Asset) 2013-2018 were used to evaluate the country's preparedness to mitigate the effects of heat waves and to protect street hawkers who are deemed to be a particularly vulnerable sector of society.

The United Nations Framework Convention on Climate Change (UNFCCC) lobbies individual countries to develop and implement climate change policies and programs as a way to reduce and prevent climate change impacts on the population. Zimbabwe views climate change as an important issue that needs to be tackled. There is evidence of perennial droughts, floods, hail storms, more hot days and heat waves that impact the agro-based economy, natural resources, livestock production and the wellbeing of the population. According to the Zimbabwe's Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) (1998), there is a lack of financial and human expertise within Zimbabwe to embark on climate change research programs. Zimbabwe developed the National Climate Change Strategy to deliver and strengthen climate change and disaster risk management policies. However, this has now been superseded by the Zimbabwe Agenda for Sustainable Social Economic Transformation (Zim-Asset) 2013-2018. The Zim-Asset acknowledges the effects of climate change and this has led to the creation of the Ministry of Environment, Water and Climate which falls under the Food Security and Nutrition Cluster of the Zim-Asset Strategy.

Although Zimbabwe ratified the UNFCCC approach, it has no separate Climate Change policy legislation. According to the Zimbabwe National Climate Change Response Strategy (ZNCCRS) 2014, climate change is covered in various uncoordinated sector policies, which include the following: National Policy and Program on Drought Mitigation, Draft Disaster Risk Management Policy, Second Science, Technology and Innovation Policy 2012, Agricultural Marketing and Pricing Policy and Small, Micro and Medium Enterprise Policy. Though climate change is recognized, such divisions in policies through sectoral areas are deficient in dealing with the predictable impacts of climate change and the scope of vulnerability. The uncoordinated sectoral approach leaves some areas of the population, like the street hawkers who operate under unregulated conditions, vulnerable as no

government organ is responsible for their social protection. The holistic framing of health to cover climate change effects is not clearly articulated in all these different sector policies. This creates a gap in the understanding and implementing action on health impacts. In African countries like Botswana, Ghana, Nigeria, Tanzania, South Africa and Zimbabwe there is a lack of clear regulatory and policy frameworks that have a defined authority to manage the implementation and adaptation issues of climate change, particularly for the informal sector of street hawkers (Chagutah, 2010; Madzwamuse, 2011). In this case, climate change receives inadequate policy direction with inadequate allocation of resources. Kenya has established a national climate change secretariat that is part of the Ministry of Environment and Mineral Resources. This group is responsible for coordinating climate change elements located in different ministries.

The Second Zimbabwe Communication (2013) shows that extensive systematic research related to climate change has been conducted on water resources, agriculture and forestry by government institutions and non-governmental organizations. The reason for this focus bias may be that Zimbabwe relies substantially on rain-fed agriculture and climate reliance resources (Chagutah, 2010). Various initiatives are being carried out by government in conjunction with other partners and communities to deal with the effects of climate change on vulnerable communities and ecosystems. The studies, however, are biased towards rural populations and therefore exclude the vulnerable urban population of street hawkers (Brown et al., 2012). Development in Africa also focuses on the advancement of the rural population (Parnell & Walawege, 2011). Research on human health issues related to climate change is focused on malaria and other water borne diseases, however, no studies have been conducted to assess the association between climate change and the health of outdoor workers, particularly street hawkers, who spend most of the day exposed to direct sun. Climate change effects are projected to aggravate the heat-related health issues in developing countries that lack heat prevention strategies and policies. In considering the World Health Assembly's four climate change priorities of 2008: (1) the scale and nature health vulnerability; (2) health protection and promotion strategies; (3) decision-making support, surveillance and monitoring; and (4) assessments

of financial and other resources aimed at health protection (WHA, 2008), Zimbabwe has not conducted any occupational health studies that include heat disorders.

Zimbabwe promulgated an environmental management law in 2002 that regulated environmental monitoring functions. Some had previously been carried out by environmental health departments in central and local government authorities. These included monitoring for environmental issues, including air pollution and water pollution which now fall under the Environmental Management Authority. This approach impacted negatively on urban environmental monitoring activities as no monitoring is currently conducted. Consequently, there is a lack of data needed to evaluate services, identify risks and protect the health of the population. Monitoring the risk of heat-related health impacts is emerging as a concern in public health and there is a need for it to be included in the country's climate change strategy (Kjellstrom, 2009). The Environmental Management Act (Chapter 20:27) which embraces climate change effects has not been reviewed since the adoption of the new constitution in 2013.

There appears to be no clear delineation between environmental and climate change related issues administered by different governments departments and no focal sector to coordinate activities. According to the goal of the climate change response strategy, of mainstreaming climate change adaptation and mitigation strategies, Zimbabwe needs a multi-stakeholder engagement approach to develop a national climate change framework that will provide measures to protect the population who include those who are vulnerable, such as street hawkers. Susceptible groups must be identified in both rural and urban settings and be involved in decision making. This will enable social and economic development that will address climate change impacts. The current Zimbabwe Climate Change Strategy does not include adequate heat wave mitigation strategies to protect vulnerable people.

Zimbabwe Change Strategy Showing Overlap and Gaps Compared to France

Western Europe was hit by severe heat waves in August 2003 (Kovats & Hajat, 2008; Rey et al., 2009). The 2003 heatwave in France caused 14,800 deaths in the first three weeks of August leading

to a major review of policy. France now regards climate change as a priority target whilst Zimbabwe views it as an issue that needs to be dealt with. Both countries have National Communications to the United Nations Framework Convention for Climate Change. French policies developed to deal with climate change effects, including heat prevention plans, were used as a benchmark to measure Zimbabwe progress in this regard. The Zimbabwe Climate Change Strategy has no heat prevention strategy. Table 1 provides a summary of the gaps that still exist in the Zimbabwe's strategy compared to that of France.

Table 1: Comparison of France and Zimbabwe's Climate Change Strategies with inclusion of heat prevention

	France 6 th National Communication on climate change October 2013	Zimbabwe 2 nd National Communication on climate change October 2013
National Communication to United Nations Framework Convention for Climate Change	<p>Tackling climate change is a priority target for France.</p> <p>The French Environmental Charter on environmental education for sustainable development is a national priority and is inscribed in the constitution. It emphasises environmental education and training as the core principles of the French Republic towards tackling climate change.</p> <p>The French National Adaptation Plan (PNACC) was developed through a vast consultation exercise that resulted in over 200 recommendations which were used as a foundation basis for its development.</p>	<p>Zimbabwe views climate change as an important issue that needs to be tackled.</p> <p>The Zim Asset's emphasis is on recurrent drought and floods that impact the country due to climatic changes. Global warming affects the country's agro-based economy that depends on rain-fed agriculture, livestock production and natural resources.</p> <p>The Zimbabwe National Climate Change Response Strategy is a response to the effects of the climate.</p> <p>Zimbabwe has a Medium Term Plan (MTP) 2012-2015 to deal with climate change which was superseded by the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (Zim Asset) 2013-2018.</p>
Heat Prevention Policy Inclusion	<p>Heatwave Plans were developed and put in place to manage the immediate effects of this type of crisis.</p> <p>Developed regional and local (cities and inter-municipality) adaptation schemes. All report to the NAP for consistency.</p>	<p>No heat wave plans are in place.</p> <p>Will institutionalise climate change response governance framework at the national, provincial, district and ward levels – still being developed.</p>

While France views climate change and environmental education as a national priority enshrined in the constitution, Zimbabwe recognizes it is an issue that needs to be addressed and their focus is on the impact of drought and floods. France has a sophisticated heat wave management plan that was developed after extensive consultation and Zimbabwe has yet to address the issue at this level. There is therefore a significant difference between the developed country approach, compared to that of Zimbabwe. The French strategy can clearly not be directly adopted in a developing country where people are poor and have no access to resources such as electricity and air conditioned public spaces. A more regionally appropriate strategy needs to be employed, such as the planting of trees to provide shade and taking steps to educate people and reduce the urban heat island effect.

CONCEPTUAL FRAMEWORK: HEAT HAZARD DUE TO CLIMATE CHANGE, A LINK BETWEEN EXPOSURE, SUSCEPTIBILITY AND ADAPTATION STRATEGIES FOR A VULNERABLE POPULATION

In developing countries, such as Zimbabwe, there is a lack of knowledge amongst the general population about the health impacts of heat stress and heat exposure management is sub optimal (Phuong, Few, & Winkels, 2013). There is a need to conduct further research on the impacts of heat wave events to inform decision makers and the population about their roles and responsibilities in planning adaptation strategies, raising public awareness and developing policies. Figure 2 outlines a conceptual framework for this approach and incorporates concepts drawn from the Intergovernmental Panel on Climate Change (IPCC), Special Report on Managing the Risks of Extreme Events and Disaster to Advance Climate Change Adaptation (SREX) and Ahmedabad reports (Field, 2012; Tran et al., 2013). This framework outlines heat as an environmental hazard associated with climate change, establishing a link between exposure, susceptibility of individuals and their adaptation strategies. The conceptual framework can apply to different hazards or disasters with a known cause. In this case, it can be used to develop heat stress prevention policies and guidelines.

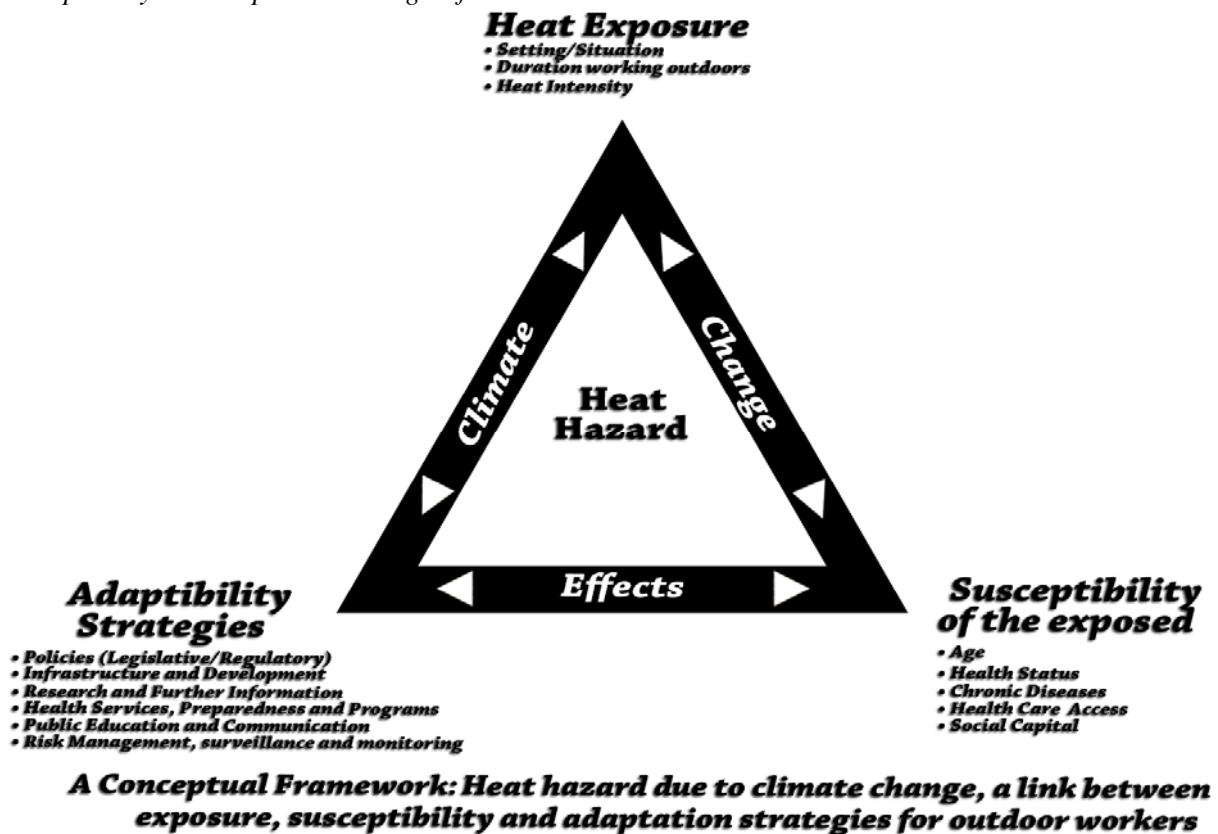
The theory of susceptibility in relation to climate change has different interpretations. In this paper the concept is assumed to recount the extent to which heat as a hazard affects the human social and environmental system (Reed et al., 2013). In terms of this model, street hawkers are physically exposed to heat as a hazard. Exposure is the state of subjection to and the duration and/or degree to which an individual is in contact with heat. Street hawkers conduct activities in the open, on hot paving in direct sunlight, and they work long hours. Some might shelter under improvised plastic cover, but they remain vulnerable. During summer, these workers experience extreme heat events that can result in heat stress and other chronic health effects.

In this framework, susceptibility is how an individual succumbs to, or is affected by, the effects of heat. The susceptibility of those exposed is dependent on their individual characteristics which include age, health status of individuals and social capital (Tran et al., 2013). In Bulawayo, outdoor workers encompass various members of the population and vending is their primary source of income. These low socio-economic groups include the elderly and children, as well as people with chronic diseases.

The exposed group needs to have the capacity to cope with and recover from heat-related stress. Adaptability in this model refers to the capacity of those affected to respond and recover from the disturbance (Reed et al., 2013). In Zimbabwe, the National Climate Change Strategy should include heat stress prevention policies to reduce health burdens, particularly for outdoor workers. Without government support the adaptive capacity for the street hawkers is limited by poverty, poor public and environmental health and uncoordinated sectoral institutional interventions. There is a lack of infrastructure and development services for outdoor workers, including access to potable water and sanitation facilities. Adaptation strategies for heat stress prevention should be guided by policies formulated through the involvement of outdoor workers as stakeholders. These policies and regulations will influence the design of infrastructure that suits the needs of the outdoor workers in combating the effects of climate change. Some interventions might include public education, health promotion programs, disaster preparedness, environment monitoring and information drawn from

research (Tran et al., 2013). Heat stress prevention policies and climate change adaptation strategies are important in minimizing heat stress and other heat-related illnesses and for protecting the vulnerable street hawkers of Zimbabwe.

Figure 2: Conceptual Framework: Heat hazard due to climate change, a link between exposure, susceptibility and adaptation strategies for outdoor workers



SREX and Ahmedabad reports (Field, 2012; Tran et al., 2013)

Sustainability of Outdoor Work in the Context of Climate Change and Rising Temperatures

Thermal conditions in urban environments are influenced by urban microclimates (Lin, Li, Zhu, & Qin, 2008). Urban vegetation is a crucial component of the environment that can help to combat high temperatures and enhance thermal comfort in the urban setting (Ketterer & Matzarakis, 2014).

Growing trees in urban areas is an effective strategy that can be implemented to reduce direct heat exposure on urban pedestrians and street hawkers (R. D. Brown, 2010). In the context of Zimbabwe, and Bulawayo in particular, there are not many trees in the urban setting where street hawkers can

set up their stalls areas in the shade of trees. Considering the benefits of trees, such as evapotranspiration, shading, wind speed reduction and radiation, urban vegetation can aid in heat stress management in the context of rising temperature due to climate change. The fact that outdoor work will increase in developing countries, then urban social forestry to cool down the urban environment of cities is imperative, healthy and sustainable. In Bulawayo, tree planting could be a workable measure that could ultimately increase thermal comfort for street hawkers in the future.

Implications for Practice and Future Research

Our research has important practical implications for policy formulation for heat prevention strategies to manage the new public health dilemma of heat-related illnesses using a conceptual framework. Countries that have no policies or policies developed without a conceptual framework run into difficulties of managing heat exposure effects and leave the population prone to heat-related illnesses. The theoretical factor is that of a coordinated approach of managing the exposure effects through identifying and assessing the situation. Controls applied through the provision of resources and from a consultative approach are vital in managing heat-related illnesses. The research finding also gives challenges for further research on heat-related information that concerns the hazardous nature of heat exposure due to climate change in developing countries without policies and strategies. This lack of substantive action on heat prevention has led to a need for research to quantify the extent of the problem and to identify knowledge levels of people in developing countries about climate change, heat-related illness and adaptation strategies.

Limitations

There is a lack of literature on heat stress policies in developing countries, particularly as this relates to vulnerable groups such as street hawkers. Zimbabwean strategies on heat management are biased to sustainable agriculture and not to illnesses associated with heat exposure.

Conclusion

Temperatures in Zimbabwe are increasing due to climate change and this presents a challenge as there are no heat stress prevention strategies. Lessons learnt from heat wave fatalities in France, should be used as an indicator to measure Zimbabwe's heat wave preparedness. Heat wave management policies need to be developed to enable a coordinated response to protect vulnerable groups, including street hawkers. There is evidence of vulnerable groups being susceptible to heat stress due to high temperatures caused by climate change. Social forestation in urban areas is highly recommended to provide cooling systems for sustainability in the context of climate change effects. The conceptual framework above can be used as a guide to developing much needed heat prevention policies. Research to provide empirical evidence on the levels of exposure and vulnerability of street hawkers has to be conducted in line with current climate change trends. There are gaps in the Zimbabwe National Climate Change Strategy on heat prevention policy inclusion when compared with the French National Adaptation Plan. Further research is required on occupational heat exposure and heat-related illness. Currently, there is no evidence that there has been any targeted policy direction directed at the development of strategies to mitigate the effects of heat waves on vulnerable people in Zimbabwe. Lessons learnt by France could be used as a basis to guide the development of regionally appropriate strategies in a Zimbabwean context. .

References

- Brown, D., Chanakira, R. R., Chatiza, K., Dhliwayo, M., Dodman, D., Masiwa, M., . . . Zvigadza, S. (2012). Climate change impacts, vulnerability and adaptation in Zimbabwe. *International Institute for Environment and Development (IIED) Climate Change Working Paper, 3*.
- Brown, R. D. (2010). *Design with microclimate: the secret to comfortable outdoor space*. Island Press.
- Chagutah, T. (2010). *Climate change vulnerability and preparedness in Southern Africa: Zimbabwe country report*. Heinrich Boell Stiftung, Cape Town.
- Coco, A., Jacklitsch, B., Williams, J., Kim, J.-H., Musolin, K., & Turner, N. (2016). *Criteria for a Recommended Standard: Occupational Exposure to Heat and Hot Environments*.
- Centers for Disease Control & Prevention. (2008). Heat-related deaths among crop workers--United States, 1992--2006. *MMWR: Morbidity and mortality weekly report, 57(24)*, 649-653.
- Corburn, J. (2009). Cities, climate change and urban heat island mitigation: Localising global environmental science. *Urban studies, 46(2)*, 413-427.
- Field, C. B. (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation: special report of the intergovernmental panel on climate change*. Cambridge University Press.
- Frimpong, K., Van Etten, E., Oosthuizen, J., & Fannam, V. N. (2015). Review of climate change adaptation and social protection policies of Ghana: The extent of reducing impacts of climate change and heat stress vulnerability of smallholder farmers. *International Journal of Social Ecology and Sustainable Development (IJSESD), 6(4)*, 1-14.
- Grumm, R. H. (2011). The Central European and Russian heat event of July-August 2010. *Bulletin of the American Meteorological Society, 92(10)*, 1285-1296.
- Gubernot, D. M., Anderson, G. B., & Hunting, K. L. (2014). The epidemiology of occupational heat exposure in the United States: A review of the literature and assessment of research needs in a changing climate. *International Journal of Biometeorology, 58(8)*, 1779-1788.
- Hanna, E. G., Kjellstrom, T., Bennett, C., & Dear, K. (2011). Climate change and rising heat: Population health implications for working people in Australia. *Asia-Pacific Journal of Public Health, 23(2 suppl)*, 14S-26S.
- Hayhoe, K., Sheridan, S., Kalkstein, L., & Greene, S. (2010). Climate change, heat waves, and mortality projections for Chicago. *Journal of Great Lakes Research, 36*, 65-73.
- Intergovernmental Panel on Climate Change. (2007). *Climate Change: Impacts, Adaptation and Vulnerability*. Cambridge University Press: Cambridge.
- Ketterer, C., & Matzarakis, A. (2014). Human-biometeorological assessment of heat stress reduction by replanning measures in Stuttgart, Germany. *Landscape and Urban Planning, 122*, 78-88.
- Kjellstrom, T. (2009). Climate Change, direct heat exposure, health and well-being in low and middle-income countries. *Global Health Action, 2*.

- Kjellstrom, T., Butler, A. J., Lucas, R. M., & Bonita, R. (2010). Public health impact of global heating due to climate change: potential effects on chronic non-communicable diseases. *International Journal of Public Health*, 55(2), 97-103.
- Koppe, C., Kovats, S., Jendritzky, G., & Menne, B. (2004). Heat-waves: risks and responses. Health and Global Environmental Change Series, no. 2. *World Health Organization*.
- Kovats, R. S., & Hajat, S. (2008). Heat stress and public health: a critical review. *Annual Review of Public Health*, 29, 41-55.
- Lin, B., Li, X., Zhu, Y., & Qin, Y. (2008). Numerical simulation studies of the different vegetation patterns' effects on outdoor pedestrian thermal comfort. *Journal of Wind Engineering and Industrial Aerodynamics*, 96(10), 1707-1718.
- Madzwamuse, M. (2011). *Climate Governance in Africa-Adaptation Strategies and Institutions*. Heinrich Boell Foundation.
- Mpofu, B. (2010). *No place for 'undesirables': The urban poor's struggle for survival in Bulawayo, Zimbabwe, 1960-2005*.
- Parnell, S., & Walawege, R. (2011). Sub-Saharan African urbanisation and global environmental change. *Global Environmental Change*, 21, S12-S20.
- Parsons, K. (2003). *Human thermal environment: The effects of hot, moderate and cold temperatures on human health, comfort and performance*. New York: CRC Press.
- Patz, J. A., McGeehin, M. A., Bernard, S. M., Ebi, K. L., Epstein, P. R., Grambsch, A., . . . Rose, J. B. (2000). The potential health impacts of climate variability and change for the United States: Executive summary of the report of the health sector of the US National Assessment. *Environmental Health Perspectives*, 108(4), 367.
- Phuong, V., Few, R., & Winkels, A. (2013). *Heat stress and adaptive capacity of low-income outdoor workers and their families in the city of Da Nang, Vietnam*.
- Reed, M., Podesta, G., Fazey, I., Geeson, N., Hessel, R., Hubacek, K., . . . Rickenbach, M. (2013). Combining analytical frameworks to assess livelihood vulnerability to climate change and analyse adaptation options. *Ecological Economics*, 94, 66-77.
- Rey, G., Fouillet, A., Bessemoulin, P., Frayssinet, P., Dufour, A., Jouglu, E., & Hémon, D. (2009). Heat exposure and socio-economic vulnerability as synergistic factors in heat-wave-related mortality. *European Journal of Epidemiology*, 24(9), 495-502.
- Rusvingo, S. L. (2015). The Zimbabwe soaring unemployment rate of 85%: A ticking time bomb not only for Zimbabwe but the entire SADC Region (2014). *Global Journal of Management And Business Research*, 14(9).
- Tran, K. V., Azhar, G. S., Nair, R., Knowlton, K., Jaiswal, A., Sheffield, P., . . . Hess, J. (2013). A cross-sectional, randomized cluster sample survey of household vulnerability to extreme heat among

- slum dwellers in Ahmedabad, India. *International Journal of Environmental Research and Public Health*, 10(6), 2515-2543.
- United Nations Framework Convention Framework on Climate Change. (2014). *Sixth Nations Communication on Climate Change*. Retrieved from https://unfccc.int/national_reports/annex_i_natcom/submitted_natcom/items/7742.php
- United Nations Framework Convention Framework on Climate Change. (2013). *Zimbabwe Second National Communication on Climate Change*. Retrieved from <http://unfccc.int/resource/docs/natc/zimnc2.pdf>
- World Health Assembly. (2008). *Sixty-First World Assembly, WHA61.19, Climate change and health*. Geneva, Swizerland.
- World Health Organisation. (2014). *Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s*.
- Young, T., Tucker, T., Galloway, M., Manyike, P., Chapman, A., & Myers, J. (2010). *Climate change and health in the SADC Region*.