

BEITBRIDGE RESIDENTS' PERCEPTIONS OF EXTREME HEAT



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1. Executive summary

The study sought to explore residents' perceptions of extreme heat as well as the impacts of extreme heat on urban and rural communities in the border area of Beitbridge, including how residents are coping with extreme heat. The study employed a mixed research method approach (by incorporating both quantitative and qualitative methods) as the main methodological underpinnings of the study so as to understand the nature and the extent of the impact of extreme heat in Beitbridge. Quantitative method involved a survey collected through questionnaires while key informant interviews and focus group discussions allowed for the collection of qualitative data and this approach allowed for data triangulation. The study discovered that extreme heat has profound impacts on the community of Beitbridge. Extreme heat had an impact on health, livelihoods, water, energy sources, and social life. However, different groups developed eclectic coping mechanisms to circumvent the impacts of extreme heat. These coping mechanisms include: drinking a lot of water and beverages, using sheds, sleeping outdoors, use of fans and air conditioners, bathing multiple times, swimming, constantly checking on the old and young, and avoiding working during the afternoon. The study also revealed that despite the challenges posed by extreme heat, there is no significant attention paid to extreme heat at institutional level. Lastly, the study identified the need for information dissemination and awareness on extreme heat, through collective efforts by the government departments and other stakeholders together with the concerned communities. Participants also suggested the use of social media, text messages, the internet, television and radio, road shows and official communication through community leaders as some of the ways of effectively ensuring the largest uptake of self-protective measures for vulnerable groups.

2. Purpose of the study

Broadly, this empirical study aimed at capturing the perceptions of Beitbridge residents on extreme heat. Specifically, it sought to understand, in detail; i) how different groups perceive and experience risks related to extreme heat, ii) how different social groups are coping with extreme heat, iii) institutional interventions to help community to cope with extreme heat, and iv) effective communication and outreach strategies that can be adopted to ensure the largest uptake of self-protective measures for vulnerable groups. It is hoped that study findings will bring to light the need to seriously consider the realities of extreme heat to the attention of academics, private sector, the government and Non-Governmental Organisations. It adds literature on the knowledge of extreme heat through the lenses of concerned communities by way of focusing on their perspectives and lived experiences with extreme heat.

Key terms

3. Introduction and background

Africa is considered one of the most vulnerable regions to weather and climate variability. Climatic events such as extreme heat pose an ever-increasing risk to African communities. Exposure to heat extremes can have serious adverse effects on individuals and development. Extreme heat, however, is commonly seen as “normal” by governments in Africa and the general perception is that people have adapted to cope with it. Extreme heat is considered a “silent killer” in Africa because it rarely receives adequate attention. This is partly due to the claim that Africa is already a hot continent and actual heatwaves might be mixed up with normal temperature conditions. This points to a crucial need to engage with and learn from affected communities as an entry point to understanding complex extreme heat impacts in Africa. Literature and research around extreme heat in Africa are still relatively limited but are expected to improve as people seek adaptation to and mitigation of the effects of the phenomena. For as long as there are expectations of an increase in global warming, one should expect extreme heat to increase in frequency and intensity.

Extreme heat is still considered an emerging natural hazard although documentation and recording of the phenomena can be traced back to as early as the beginning of the twentieth century. The World Meteorological Organisation has drafted guidelines on the definition and monitoring of extreme weather and climate events (WMO 2018). The Recommended definition of a heatwave is: “A period of marked unusual hot weather over a region persisting for at least three consecutive days during the warm period of the year based on local climatological conditions, with thermal conditions recorded above given thresholds.” According to the UK government meteorological office, a heatwave is an extended period of hot weather relative to the expected conditions of the area at time of the year, which may be accompanied by high humidity. The office further says that to be considered a heatwave, the temperatures must meet or exceed the temperature threshold of the given area. The thresholds differ depending on location even in a given country. This means in Zimbabwe for example the temperature threshold for Beitbridge can be different from the threshold of the capital city, Harare. Consequently, there is no single and universally accepted definition (Queslati et al., 2017). In addition, the characterisation of events according to WMO, should consider the following aspects:

- Magnitude: The departure from normal temperature, reflecting the climatological extremity of the event.
- Duration: Measuring the duration of the elevated temperatures.
- Event: The geographical extent of the heatwave.
- Severity: Indicating potential damages and impacts of the event.

While definitions vary, a heatwave is usually measured relative to the usual weather in an area and relative to temperatures for the season. The extreme temperatures should persist for about two to three consecutive days for it to be considered a heatwave. To clearly identify a heatwave, there is a need for temperatures to be compared not only in magnitude and frequency but also in geographical space. What may be considered as a heatwave in one area may not be so in another. For instance, a temperature of 35 degrees Celsius even though persisting for three days may not be considered a heatwave in the United Arab Emirates (UAE), but will definitely be one in Zimbabwe.

Sub-Saharan Africa has witnessed an increase in heat in the past two decades (Ceccherini 2017). The heat influenced by climate change induces vulnerability within sub-Saharan Africa. Of late, the heat manifests through occasional or seasonal heat waves that sweep through different parts of Africa. As such, scholars, climate experts and policy makers have attempted to understand the impact of heat on societies in order to understand their full impact on their everyday lives (see Pasquini et al. 2020; Russo et al. 2016; Mishra, 2015). In this attempt, some of the work has directed its focus on the scientific aspect of heat whilst paying less attention to the social impact of heat. Therefore, this study seeks to understand public perceptions towards heat in Africa particularly Zimbabwe. The aim of this study is to contribute to the growing literature on heat paying particular attention to the how the public perceives heat and its immediate social impacts. The study is informed by the growing realisation that Zimbabwe is witnessing unprecedented temperature increases that raise heat levels in urban and rural communities. Some of the communities in Zimbabwe are averaging around 37° Celsius (98.6 Fahrenheit) to 40° Celsius (104 Fahrenheit) during the summer season. Against this background, these high temperatures warrant for an in-depth study to comprehend subjective narratives of individuals in relation to their perceptions towards heat.

4. Objectives of the Study

Broadly, the study sought to analyse public perceptions towards heat as well as strategies employed to circumvent extreme heat. Specific objectives are as follows;

1. To determine how different groups perceive and experience risks related to climate induced heat.
2. To explore how different groups are coping with climate induced heat
3. To establish institutional interventions to help communities to cope with heat
4. To explore effective communication and outreach strategies that can be adopted to ensure the largest uptake of self-protective measures for vulnerable groups in Beitbridge District.

5. Literature review

5.1 Extreme heat in a global context

Extreme heat has since become a global phenomenon with its effects being felt more since the turn of the millennium and causing a greater risk to humanity together with other extreme weather patterns (Martínez-Austria and Bandala 2018). While there are varying definitions of extreme heat among the scientific fraternity, the general consensus points to persistent high temperatures, usually over consecutive days, usually in the form of a heat wave. A heat wave “is characterized by at least 7 consecutive days with maximum daily temperatures greater than 32 °C (90 °F) and night-time minimum temperatures greater than 21 °C (70 °F), with daytime maximum temperatures over 38 °C (100 °F) and night-time temperatures that remained above 27 °C (80 °F) for at least two of those day” (Hayhoe, Sheridan, Kalkstein and Greene 2010, 69).

Global increase in temperatures (by 2.5 degrees Celsius since the pre-industrial level has affected an estimated 1 billion people worldwide with the climate change induced heat stress being felt more in tropical and sub-tropical low-income and middle -level income countries (Andrews, Le Quéré, Kjellstrom, Lemke and Haines 2018).

Extreme heat is currently most felt in Pakistan and central North Africa, with projections showing a likelihood of other parts of North Africa, central and Southern Africa, southern America, south Asia and the Middle East are more likely to be affected (Andrews et.al 2018). The global North has not been spared from extreme heat either. Studies in the United States concur to realities of extreme heat particularly in the southern states (from California to Florida) (Zhang and Shindell 2021).

The old-aged (over 65), the very young, women, people of colour, those from low-income areas, urbanites and ethnic minorities are more exposed to extreme heat effects (Hayhoe et.al. 2010, Hansen, Bi, Arthur Saniotis and Nitschk 2013, Andrews et. al 2018). The urban heat island effect (whereby urban temperatures increase due to human activity) has been identified as the major cause of heatwaves in urban areas worldwide. This becomes a cause for concern considering the rapid global urbanisation.

Effects of extreme heat are crosscutting and multifaceted, with global studies showing how extreme heat affects different populations located in different contexts including their livelihoods, health, productivity, land use and human security. A systematic review of 301 peer reviewed articles from 98 countries shows that extreme heat is treated as a health issue in the global North (Southern, Northern and Western Europe, Central Asia and Northern America, Oceania) while studies in the developing world (Africa, Eastern Asia, Southern Asia and South-eastern Asia) focus on the impact of extreme heat on agriculture and livelihoods and human security (Turek-Hankins et.al 2021). Studies in the global North have focused on issues such as workability and labour productivity in relation to extreme heat (Zhang and Shindell 2021, Andrews et.al 2018). For instance, the United States is estimated to have lost 1.7billion annually between 2006-2016 owing to rising temperatures (Zhang and Shindell 2021).

In extreme cases, extreme heat threatens the very survival of people. The survivability threshold is “a heat stress condition in which exposure causes core body temperature to increase to potentially fatal levels during low-intensity physical activity” (Andrews et.al 2018, e542). To Andrews et.al (2018, e542) survivability threshold is whereby the daily maximum WBGT exceeds 40°C for 3 consecutive days. Excessive heat stress resulting in human mortality and morbidity were recorded in Chicago in 1995, in Western Europe particularly Paris in 2003. The heat waves resulted in 500 and 70 000 deaths respectively (Hayhoe et.al 2010, 66). The 2010 Russian heatwave also killed more than 50 000 people (Turek-Hankins et.al 2021:2). In 2015, 2245 deaths were attributed to heat in India (van Oldenborgh et.al 2018:366).

Heat adaptation is often through cooling systems in residential and workplaces in high income countries, but the poor particularly those in the developing countries can hardly afford them (Hayhoe et.al 2010). Thus, middle- and low-income countries usually adopt behavioural and cultural adaptation methods (Turek-Hankins et.al 2021:2). Despite this inconvenient reality, governments are yet to pay full attention to heat including channeling resources towards them, and this has resulted in limited and lack of extreme heat knowledge among the public (Martínez-Austria and Bandala 2018).

5.2 Extreme heat in Africa

Despite its relatively small contribution to global warming emissions, Africa is among the developing regions that are facing disproportionately greater impacts from climate-related extremes and is in the climate zone where the temperature change signal is expected to emerge first from climate variability (Mahlstein et al., 2011). Africa's

higher exposure to the impacts of climate change arises from its increased vulnerability due to limited adaptation and economic capacity, and an ineffective institutional structure. Consequently, the expected impacts of extreme heat both during and after the events are expected to be higher in Africa (IPCC, 2014). In the last three decades Africa has suffered 27% of the global fatalities due to climate and weather-related fatalities (Munich Re, 2011).

Furthermore, the droughts of 1974-1975 (over the Sahel region) and 1984-1985 (over Sudan and Ethiopia) alone led to the death of hundreds of thousands of people (Guha-Sapir et al., 2004). Urbanisation and fast-growing population pressure on land use and land cover further increases the vulnerability of the region to heat island effects and extreme heat. Many regions of Africa have already experienced increases in surface temperature as reported for different sub-regions, analysing various data sets. Temperatures are estimated to be 1-2 degrees Celsius higher in recent years than they were in Medieval Climate Anomaly (Nicholson et al., 2013).

Minimum and maximum temperatures also show an increasing trend over Ethiopia, Kenya and Tanzania (Gebrechorkos et al., 2019). While Russo et al. (2016) showed the occurrence of more intense heat waves with longer duration and wider waves in recent years in Africa, Vizy and Cook (2012) estimated an increase of 40-60 heatwave days per year on average in the period 1989-2009 over north-western Sahara. Furthermore, the significant increase in temperature specifically during warm seasons over northern Africa is unlikely to be due to natural forces alone but human interference as well. In addition to the ongoing socio-economic challenges throughout the continent, changes in temperature are expected to increase energy costs in future. Parkes et al. (2019) estimated Africa's cost of energy -intensive cooling systems to be USD \$51 billion and USD \$487 billion by 2035 and 2076 respectively. As indicated by the World Bank Group (2020) only 44.5% of the Sub-Saharan population has access to electricity indicating a huge vulnerability of the population to heatwave effects

Several studies have assessed changes in heatwaves over Africa; in the Sahel region (Queslati et al., (2017), over Ethiopia, Kenya and Tanzania (Gebrechorkos et al., 2019), over northern tropical Africa (Moron et al., 2016), and at continental scale (Russo et al., 2016; Ceccherini et al, 2017). These studies show that there is an increase in temperature and heat waves over different regions of Africa and most likely at continental scale as well. Examples of heatwaves across Africa are as follows:

i. South Africa heatwave in 2015/2016

This heatwave was recorded from the 30th December 2016 to the 6th of January 2017. It is one of the widely reported heatwaves in Africa. In the 8 days leading to the period of the heatwave positive temperature anomalies were recorded compared to the 1981 to 2010 period. During the 8 days of the heatwave temperatures were significantly above the threshold figures. This indicated warmer than average temperatures resulting in higher heat stress conditions. The period, a week after the heatwave, temperatures dropped and negative anomalies were recorded. The effects of this heatwave were felt in neighbouring countries as the heatwave spread in the region.

ii. Morocco heatwave in 2000

In 2000 a heatwave was recorded in Morocco which lasted for 5 days from 30th of July to 3rd of August. This heatwave has been specifically cited because it had some considerable economic impact to the country. In the 5 days leading to the period of the heatwave there were some slight warm anomalies compared to the 1981 to 2010 temperature figures. At the time when this was happening the rest of the continent had slightly cooler temperatures.

During the 5 days of the heatwave temperatures were around 6 degrees Celsius above the threshold temperatures. Temperatures started to dissipate after the period of the heatwave returning to the usual figures. The economic loss from the effects of the heatwave reached USD 809 000. The Moroccan heatwave was shorter (5days) when compared to the South African heatwave which had 8 days. In addition, the rise in the heatwave in Morocco is steeper, increasing at 6 degrees Celsius than for South Africa which rose by about 4 degrees Celsius in 8 days. The heatwave was confined to Morocco whereas in South Africa it spread into neighbouring countries.

iii. Kenya extreme heat 1987-2016

In Kenya, extreme heat and their associated impacts are ignored and neglected due to several reasons, including unreliable and inconsistent weather datasets and heat detection metrics. Based on Climate Hazards centre Infrared Temperature with Stations (CHIRTS) satellite infrared estimates and station blended temperature, a study investigated the spatiotemporal distribution of the heatwave events over Kenya during 1987-2016 using Heatwave Magnitude Index daily (HWMId). The results showed that contrary to the absence of heat records in official national and international disaster databases about Kenya, the country experienced extreme heat ranging from less severe (normal) to deadly (super extreme) between 1987 and 2016.

The most affected areas are those located in the eastern parts of the country, especially in Garissa and Tana River and in the northern east side around the upper side of Turkana county. It was observed that the recent years' hot temperatures are more severe in magnitude, duration and spatial extent. The highest magnitude of the heatwaves was recorded in 2015 (HWMId = 22.64) while the average for the reference period is around 6 HWMId. Kenya was mentioned as one of the hotspot countries in Africa that has experienced an increasing extreme heat during the last two decades.

The HWMId of heatwave events increased significantly across the years at 5% level in several regions of Kenya particularly in Turkana, West Pokot, Mandera, Wajir, Garissa and Tana River counties. Extreme heatwave events were recorded in Garissa, Tana River, Turkana and West Pokot counties while most of the remaining areas experienced moderate to severe temperatures on average over the 1987-2016 period. The top 5 most severe events (super extreme) occurred in the last 15 years, especially in 1999,2005,2006,2015 and 2016. Heatwave duration ranged from 3 to about 9 days with the longest recorded around Garissa, Tana River and Turkana counties.

The table below shows historic extreme heat and heatwaves compiled from news reports, academic literature and climate reports for the African continent between 1980 and 2020.

Year	Region	Impact	Characteristics	References
1982/3	Sahel, Sahel-Sudan and Guinea		Concurrent with the Sahel drought and ENSO event	(Russo et al.2016)
1987	South Africa		Concurrent with the Sahel drought and ENSO event	(Russo et al. 2016)
1988	Sahara			(Russo et al. 2016)

1989	Sahel, Sahel-Sudan and Guinea		Locals reportedly remember high temperatures	(Codjoe et al 2020)
1990	Mediterranean			(Russo et al. 2016)
1992	Mediterranean, Sahara, Congo and South Africa		Concurrent with a drought	(Barbier et al. 2018, Harrington and Otto 2020)
1995	Mediterranean and Sahara	27 reported deaths in Egypt		(CRED 2020)
1996	Mediterranean and Sahara	22 reported deaths in Egypt		(CRED 2020)
1997/8	Sahel-Sudan and Congo		Concurrent with an ENSO event	(Oueslati et al. 2017, Ceccherini et al. 2017, Russo et al. 2016)
2000	Mediterranean and Sahara	News reports of 4 million chickens dying. Up to 809 000 USD of damage recorded in Morocco		(CRED 2020.)
2002	Sahara and Congo	60 reported deaths in Nigeria	In the Sahara temperatures as high as 50.6 degrees Celsius during June and July.	(World Meteorological Organisation 2013, CRED 2020)
2003	Mediterranean and Sahara	40 reported deaths in Algeria	Heatwave in Europe in the same season	(American Meteorological Society 2004, World Meteorological Organisation 2013, CRED 2020)
2004	Mediterranean, Sahara, Sahel, Sahel-Sudan and Congo		ENSO event. Maximum temperature recorded on 29 June in Sidi-Simane, Morocco of 47 degrees Celsius.	(American Meteorological Society 2005, Russo et al. 2016, Oueslati et al. 2017.)

2005	Mediterranean and Sahara		ENSO event	(World Meteorological Organisation 2013)
2008	Sahara and Congo			(Russo et al. 2016)
2009/10	Sahara, Sahel, Sahel-Sudan and Guinea		ENSO event	(Russo et al. 2016)
2010	Mediterranean, Sahara and Morocco		Heatwave in Europe in the same season and ENSO event	(Fontaine et al. 2013, Russo et al. 2016, World Meteorological Organisation 2013, Oueslati et al. 2017)
2011	Congo, Mid-Africa and Madagascar			(Russo et al 2016)
2012	South Africa, Mediterranean, Sahara, Sahel and Guinea		Ouarglon, southern Algeria reports 50 degrees Celsius on 2 August. In October in Morocco recorded up to 36 degrees Celsius	(Russo et al. 2016, Achberger2020, Ceccherini et al. 2017)
2013	Sahara, Sahel, Sahel-Sudan, Guinea and South Africa.		Warmest temperature up until 2013 on 6 March in Ghana, South Africa records its highest to date of 47.3 degrees Celsius on 4 March. Temperatures above 40 degrees Celsius recorded in Nigeria.	(World Meteorological Organisation 2015, Oueslati et al. 2017)
2015	Mediterranean and Sahara, Sahel, Sahel-Sudan, Congo, Horn of Africa, South Africa	110 deaths and 66 injuries in Egypt, 16 deaths reported in Sudan	Heatwave reported to have lasted 40 days. Concurrent with an ENSO event	(Benzerga 2015), CRED 2020, World Meteorological Organisation 2016, Russo et al. 2016)
2016	Mediterranean, Sahara, Sahel, Sahel-Sudan,	11 deaths and 20 injuries reported in South Africa. Was	Concurrent with a drought and ENSO event. Temperatures reached 42.7	(Russo et al. 2016, CRED 2020, World Meteorological

	Guinea, South Africa.	the warmest in April to date in the Sahel.	degrees in Pretoria and 38.9 degrees Celsius in Johannesburg on 6 January.	Organisation 2016, Codjoe et al. 2020, Batte et al. 2018)
2017	Mediterranean and Sahara		On 17 May reported record of 42.9 degrees Celsius at Larch station northern Morocco	(World Meteorological Organisation 2017)
2018	Mediterranean and Sahara		Algeria recorded a peak of 51.3 degrees Celsius in July.	(World Meteorological Organisation 2018)
2019	Mediterranean, Sahara, Southern Africa, Sahel-Sudan	Reduction of avocado crops in some regions. Court houses in Malawi allow the exemption of wearing of wigs. Increase in deaths of elephants in Botswana and Zimbabwe.	In Nigeria 42.2 degrees Celsius recorded in Minna 120 km northwest of Abuja. Kano 345km north of Abuja recorded in excess of 40 degrees everyday since the beginning of April. Temperatures of up to 47 degrees Celsius in Morocco. Temperatures up to 45 degrees Celsius in Malawi.	(Jansen 2019, Aljazeera news 2019, Morocco World News 2019, Tebele 2019)
2020	Mediterranean and Sahara		Temperatures reached between 42 and 47 degrees Celsius in Morocco.	(Kasraoui 2020)

5.3 Extreme heat in Zimbabwe

Zimbabwe has not been spared by the debilitating impact of climate change (see Brown et al 2011; Unganai and Murwira, 2010; Musarandega et al 2018; Bhatasara, 2017; Chanza and Gundu-Jakarasi, 2020) has this has resulted in unprecedented temperature rises over the past two and half decades. Consequently, it has resulted in incidence of high temperatures and heat. As a result, Zimbabwe is experiencing hot summer days and extremely dry winter days (Ngwenya et al 2018). Zimbabwe and other Southern African countries have been witnessing annual temperatures ranging from 0.2°C to 0.5°C (Young et al 2010). In recent times, heat waves have incessantly hit most of the parts of Zimbabwe in the past decade (2011-2021). Recently, in 2021 the heatwave hit most of the parts of Zimbabwe with temperature ranging from 37°C in most parts of the country. On Tuesday 9 November 2021, Zimbabwe reported following temperatures: Harare 37°C, Bulawayo 40°C, Masvingo 42°C, Victoria Falls 43°C, Gweru 42°C, Mutare 41°C, Kadoma 44°C, Kwekwe 43°C, Beitbridge 42, Kariba 43°C, Bindure 41°C,

Chipinge 41°C, and Karoi 38°C (NewsdzeZimbabwe 9 November 2021). As such, the incidence of heat has reconfigured social realities within the context of Zimbabwe.

5.4. Societal Impacts of extreme heat

Extreme heat can have significant direct and indirect impacts on society. It is only the vulnerable individuals or sectors of society that may experience the direct impacts of heatwaves. Although the main factors of vulnerability may vary geographically, depending on the social, economic and political circumstances, there are some commonalities across countries in terms of heat risk factors including being elderly, having pre-existing cardiovascular or respiratory disease, living alone, working outdoors or being involved in heavy labour indoors close to industrial heat sources. In some places gender, the nature of a person's dwelling, where they are temporarily or permanently resident, being urban and poor and having certain medical conditions such as diabetes may also play a role. The elderly and children may also be affected during heat stress with the latter usually suffering from classic heat disorders while the former usually succumb to heat due to cardio-respiratory causes.

Further to the direct effects, extreme heat can burden health and emergency services and also increase strain on physical infrastructure such as energy, water and transport. Hospital admissions increase during heatwave events although the level of increase may vary by heat intensity and by socio-economic factors such as age. Increased demand for water and electricity may result in shortages and even blackouts. Crops and animals can be badly affected during extreme heat which may cause issues related to food and livestock security to rise.

5.4.1 Extreme heat and the question of livelihoods in Zimbabwe

Climate change through incessant heat has reconfigured livelihoods in Zimbabwean societies. Extreme heat has resulted in droughts particularly in semi-arid areas of Zimbabwe. Dube et al. (2013) observe that climate change has affected local ecologies in Matobo District and resulted in negative impacts on agricultural activities. These agricultural activities constitute the livelihoods of the locals. Consequently, the societies are relegated to a state of food insecurity and abject poverty. Gukurume (2013) highlights how heat stress in Bikita District ushered in food insecurity and poverty as livelihoods were disrupted through failure and death of livestock. However, societies have attempted to circumvent the effects of climate change particularly extreme heat and heatwaves through a number of measures. In circumventing the impacts of climate change particularly extreme heat, Bhatasara (2018) through the case study of Mutoko District observes how locals have found eclectic way to deal with the egregious impacts of climate change through various measures. These measures include 'reorganising crop production practices, intensifying and expanding micro-irrigation, water conservation, increasing role of indigenous knowledge, emphasis on the role of trees, and doing nothing' (Bhatasara, 2018: 159). Therefore, climate change in the form of extreme heat has reconfigured the lived experiences of individuals within the societies in Zimbabwe.

5.4.2 Extreme heat and public health in Zimbabwe

The incidence of extreme heat in Zimbabwe has had a negative bearing on public health. Ngwenya et al (2018) contend that heat stress has resulted in public health challenges for individuals particularly those who are

economically disadvantaged. They use the case study of Bulawayo to highlight the impact of heat on workers who are engaged in outdoor activities. Ngwenya et al (2018: 4) note that:

‘The combined exposure to high temperatures, humidity and radiant heat from direct sunlight, as well the lack of ready access to portable water, means that this sector of the population are at a much risk of suffering the effects of the heat stress and its related illnesses which can cause death and other chronic conditions such as renal diseases.’

As such, heat waves are a challenge to the individuals exposed to them as they may compromise their health or even cause death. However, there is a paucity of policy frameworks that respond to the public health challenges induced by heat. Extreme heat must be understood as a serious threat to human life in the context of Zimbabwe despite less documentation of the problem. Therefore, exposure to heat must also be viewed as a public health challenge that requires urgent attention from the individuals and the major social institutions such as the government and other stakeholders.

6. Methodology

This section discusses the methodological issues informing the study including the research site, sampling, research process, data collection methods, data analysis and ethical considerations.

6.1 Study site

This study was conducted in the border district of Beitbridge, Zimbabwe. Beitbridge is located in South Western Zimbabwe, at the border with South Africa and it is one of Zimbabwe’s hottest borderlands. The district has a total population of 94,000 comprising 44,358 men and 49,642 women. Beitbridge district was purposively sampled because of its high temperature records and its multi-ethnic composition unlike other districts in the country. This allowed us to capture ethnic and culture specific dimensions of risk perceptions and coping with climate induced extreme heat. Formal clearance for the research was obtained from the Midlands State University, ethics clearance number SS/002/22. The district has been negatively impacted by climate change with the summer season becoming hotter and longer while winter is now warmer. Extreme heat has thus become frequent in Beitbridge’s Limpopo basin borderland (Matsa 2020). The temperature range for Beitbridge increased from 1.4°C in the 1950s to 3.3°C in 2012 (Matsa and Dzawanda 2019:7). Mean annual temperature for Beitbridge district is now between 25 and 27.5°C (Matsa and Dzawanda 2019) with the average daily maximum temperatures varying from 30–34°C during summer to 22–26°C in winter (Mupangwa, Walker and Twomlow 2011:1098). Climate change has also resulted in seasonal changes with the month of February becoming colder compared to the traditional June and July cold spells that used to characterise weather patterns in Beitbridge including the rest of Zimbabwe. The months of July and June are now warmer (Matsa and Dzawanda 2019).

6.2 Research Approach

To fully understand the dynamics underpinning perceptions on risks included by heat, peoples’ coping and institutional interventions, the study adopted a Q-squared approach, i.e both qualitative and quantitative

methodology. Data was drawn from 2 wards (one urban, one rural for comparative purposes) in Beitbridge district, using simultaneous and multiple methods. Qualitative methodology helped to capture the voices, perceptions, lived experiences and meanings attached to extreme heat including in their gendered, class and age dimensions. The quantitative approach allowed quantifying data in addition to (dis)confirming qualitative findings. The mixed method research design maximised on the strengths of the multiple research instruments.

6.3 Data collection

Data collection involved simultaneous use of questionnaires, focus group discussions and observation. This involved a small survey where 150 questionnaires were administered to 69 men and 80 women and one respondent who fell into the other category. Participants' figures are representative of the general gendered population in Zimbabwe where there are more women than men. According to the 2022 population census, women comprise 52.8% of Beitbridge district's population. In addition to the survey, four (4) focus group discussions (2 in Beitbridge town and another 2 in Beitbridge rural) were held with 41 people (18 men and 23 women). We also conducted 3 key informant interviews with the village head, meteorological department official and a health department official. Observation of dynamics related to the impacts of extreme heat also allowed for the capturing of issues as they transpired in their (natural) settings, including photography. Multiple methods enabled the collection of the amount and quality of data to respond to the study's objectives.

6.4 Survey Demographic Profiles

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	69	46.0	46.0	46.0
	Female	80	53.3	53.3	99.3
	Other	1	.7	.7	100.0
	Total	150	100.0	100.0	

Within the survey, 67 participants belonged to the 18-35 age cohort, 66 belonged to the 36-55 age cohort with 9 aged between 56-64, while 8 participants belonged to the 65 and above cohort. It was difficult to get participants aged 55 and above owing to the country's life expectancy which currently stands at 61. 4. This is illustrated on the table below.

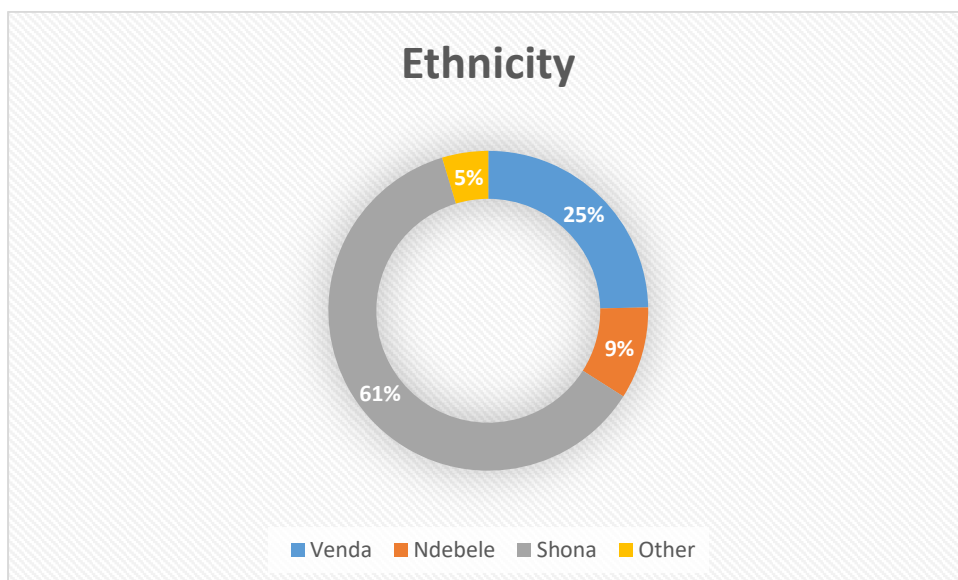
Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-35	67	44.7	44.7	44.7
	36-55	66	44.0	44.0	88.7

56-64	9	6.0	6.0	94.7
65+	8	5.3	5.3	100.0
Total	150	100.0	100.0	

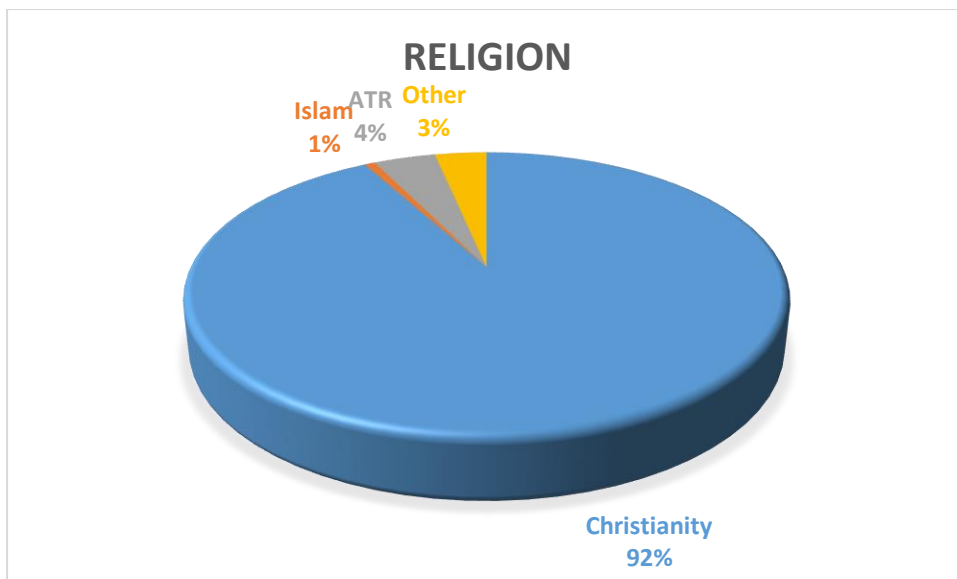
The majority of the respondents (84) were married, 37 were single, 14 widowed, 11 divorced while 4 did not state their marital status. In terms of ethnicity, we found that the majority of the participants were Shona. This is despite the fact that the Venda are the autochthonous ethnic group in Beitbridge district. This can be explained by the fact that the border town is attractive to labour migrants from other districts, where the dominant Shona ethnic groups in Zimbabwe, come from. As our interviews revealed, the Shona are attracted by cross border related livelihoods in the border town. As well, the Shona dominated Beitbridge town and not the rural areas. The rural areas were dominated by the Venda autochthones. The ethnic composition is illustrated below:

Ethnicity



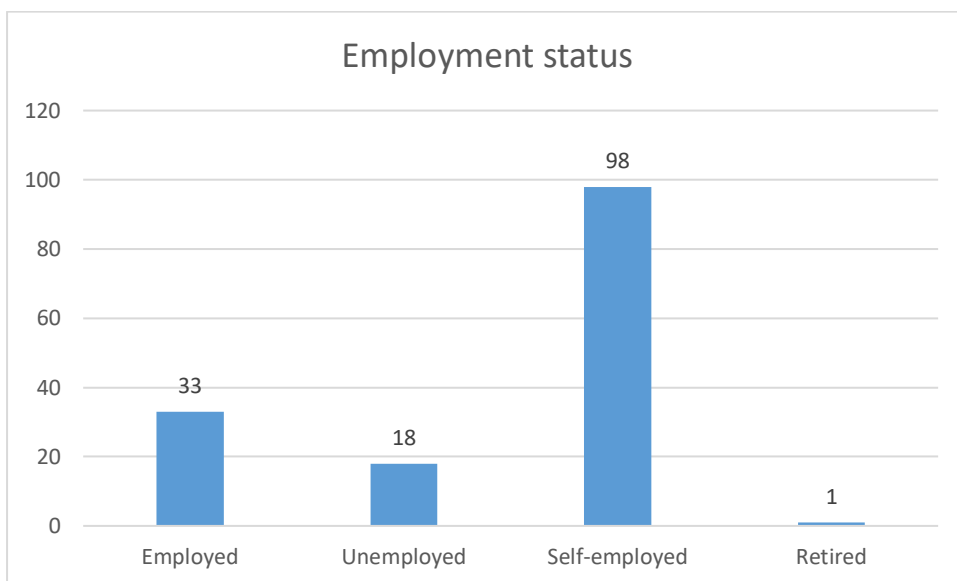
Concerning religion, the majority of the respondents were Christians (92%) and this is reflective of the dynamics ensuing in Zimbabwe. This is illustrated on the chart below.

Religion

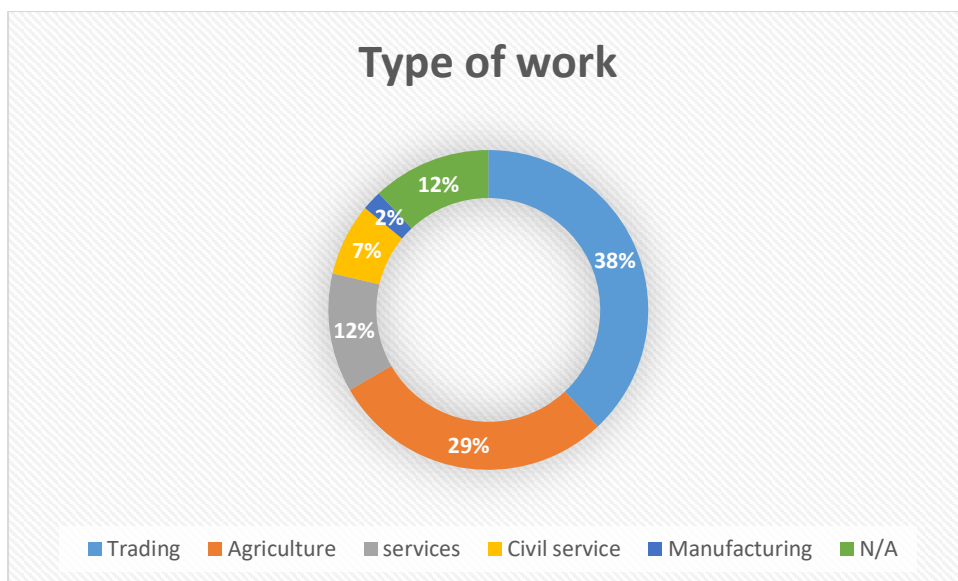


Employment status

Out of the 150 respondents, 33 were employed, 18 unemployed, 98 self-employed and 1 respondent was retired. This is illustrated in the graph below. The statistics are indicative of the general high informalization of the economy. This is illustrated in the bar graph below.



Those who were employed were mainly in trading (mainly vendors and cross border traders), with the majority of the rural population engaging in agricultural activities while an insignificant number was in the manufacturing sector as shown below:



6.5 Sampling procedures

The survey method involved simple random sampling and questionnaires were distributed to willing participants depending on their interest to participate in the study. Focus group discussions however involved purposive sampling as we sought to ensure that different age groups from the three ethnic groups in both the rural and urban wards. Our aim was to capture how the various groups perceive risks related to heat and the coping strategies. Then quota sampling was applied to select young adults (18-35), the middle aged (36-55) and the elderly (above 55). We therefore ensured that each focus group discussion included all the age cohorts. To some extent, the age cohorts allowed us to capture age specific generational and historical perceptions and experiences encountered by the various age groups due to climate change induced heat. The age cohorts and ethnic observed did not however entail that other factors which may influence perceptions and coping strategies on heat such as class are overlooked. In fact, the research revealed that class had a bearing on perceptions and experiences of extreme heat more than age and the questionnaires did not reveal statistical significance of age and ethnicity in relation to residents' perceptions of climate change. Key informants were also purposively sampled because of their valuable knowledge on heat related issues.

6.6. Data collection methods

The study was largely a fieldwork-based assignment, involving collection of primary data using both qualitative (observation, in-depth-interviews, Focus Group Discussions, Key Informant Interview) and quantitative (survey) data collection methods. Secondary data sources were also utilized to identify gaps in literature gaps and show our study's contribution. The fieldwork for this study took place between August and October 2022.

Three Key Informant Interviews were conducted with officials from the Beitbridge Meteorological Department, the District Health Department and a traditional leader in the district. These helped to engage expert knowledge on extreme heat in Beitbridge including in its indigenous dimension. Four Focus Group Discussions (2 in the rural areas and 2 in Beitbridge town) were conducted with ordinary Beitbridge residents in a bid to capture public

perceptions. Focus group discussions lasted for one-two hours and each group consisted of 8-10 participants across with a total of 41 participants comprising 26 women and 15 men. They helped in getting an in-depth understanding of experiences of extreme heat. Further, the researchers also observed how Beitbridge residents coped with extreme heat. The observations engendered understanding the lived experiences of the communities under the influence of extreme heat. The observations reinforced some of the contributions forwarded by the participants in the survey, focus group discussions, and key informant interviews. Additionally, a survey was conducted in both sites using questionnaires to capture and quantify the extent of the impact and influence of extreme heat in Beitbridge. A total of 150 questionnaires were distributed to participants.

6.7 Data Analysis

A thematic analysis was used to analyze qualitative data while Statistical Packages for Social Sciences (SPSS) was used to analyze quantitative data. Qualitative data thematic analysis involved interpreting words, events, activities and emotions as they are communicated by participants. It also involved carefully observing participants' action including in their natural contexts as they practice their everyday routines, including in relation to livelihoods patterns, fetching water and siting in sheds. Such processes entail inductive reasoning, thinking, and theorizing on the part of the researchers. Further, the intuitive and inductive nature of qualitative data thematic analysis involved scrutinizing generated data in order to develop themes, concepts and possible propositions. Secondly, data was coded with an understanding of the context in which it was collected. Quantitative data analysis through SPSS involved analyzing (mainly descriptive) statistics. In addition, it further allowed for the generation of tables, including frequency tables, graphs and pie charts to give a pictorial presentation of data and also allowed for comparison.

6.8 Ethical considerations

Overall, the whole research process ensured that the rights of all individuals participating in the study were respected. In the context of COVID-19 it meant that the actions of the assessors did not put themselves and others at risk of infection. Hence, empirical data collection was gathered under strict observation of all COVID-19 regulations including social distancing and the wearing of masks, where these were mandatory. The research adhered to general ethical considerations including confidentiality, informed consent, privacy and protection from harm. As well, verbal informed consent was obtained before each interview, Focus Group Discussion and observation. This entailed clearly outlining the objectives of the study to the participants. Researchers also outlined participants' rights such as the right to refuse to answer certain questions if not comfortable, right to withdraw at any time during and after the research and their chance to comment on the final report before it's publication. Pseudonyms were used to ensure privacy and confidentiality.

7. Findings and Conclusions

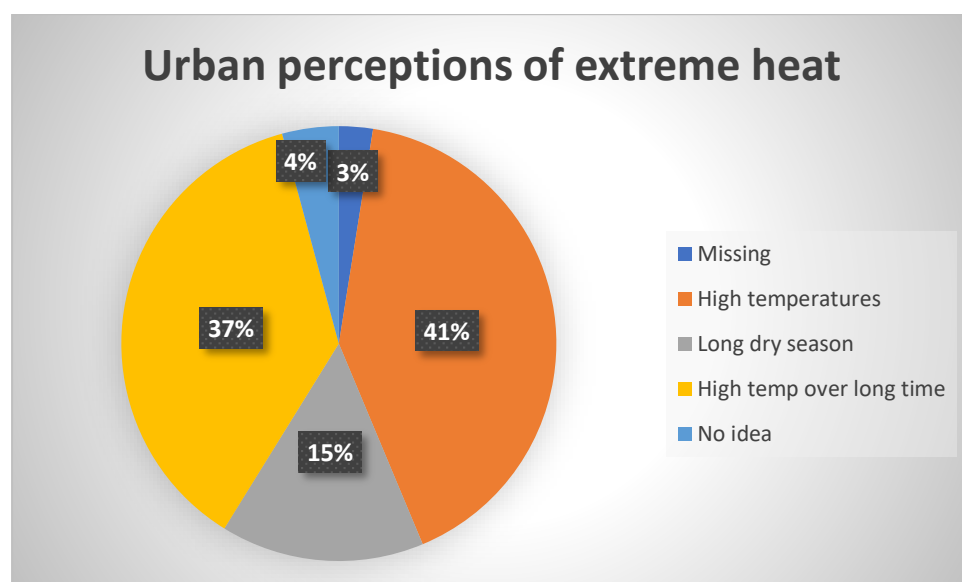
7.1 Beitbridge urban area

7.1.1 How different groups perceive and experience risks related to climate induced heat

This section discusses how different groups perceive extreme heat in both the rural and urban areas in Beitbridge district.

7.1.1.1 Conceptualisation of extreme heat in Beitbridge

Most participants (41%) highlighted that extreme heat is measured by high temperatures, with 37% reasoning that extreme heat is measured by high temperatures over a long period of time, while others (15%) indicated that extreme heat is measured by long dry seasons as illustrated below.



There was a general perception that temperatures have been steadily increasing in the district over the last 50 years though those in Beitbridge town noted that the 2021-2022 season had been characterized by a colder winter. However, those in the rural areas noted that they continue to experience soaring temperatures and a general change in climatic conditions. As one of the old participants (76 years old) explained in a focus group discussion;

The rains have generally been lower in this district, but this has worsened over the years. Long back, the rain season used to start around October but these days rains start in December. But there are long dry spell in-between the rain season. The low rainfall has also meant that the weather is very hot because rains have a cooling effect on (atmospheric) temperature. That is why Beitbridge has become so unbearably hot.

The meteorological department stated that they did not have a definitive temperature for extreme heat, however they stated that for Beitbridge district any temperature above 41 °C is considered extreme. Both focus group discussions and the questionnaires revealed that Beitbridge residents normally experience extreme heat from the month of August up to April with temperatures soaring between October and mid-December. The residents'

perceptions were also confirmed by a key informant from the meteorological department who highlighted that temperatures in Beitbridge usually reach the peak in the month of November.

Participants and key informants also reported that they always experienced persistent high temperatures in the border town and they always dread the hot season. This is made worse by the fact that winters are usually warm and hot in Beitbridge, compared to other parts of Zimbabwe, except for Kariba and Hwange. The upsurge in temperatures was also confirmed by a key informant from the meteorological department who indicated that temperatures have been increasing in Beitbridge over the years and that Beitbridge recorded its highest temperature (44.8°C surpassing the previous record of 44.4 °C) on 3 November 2021.

7.1.1.2 Perceived causes/drivers of extreme heat in Beitbridge

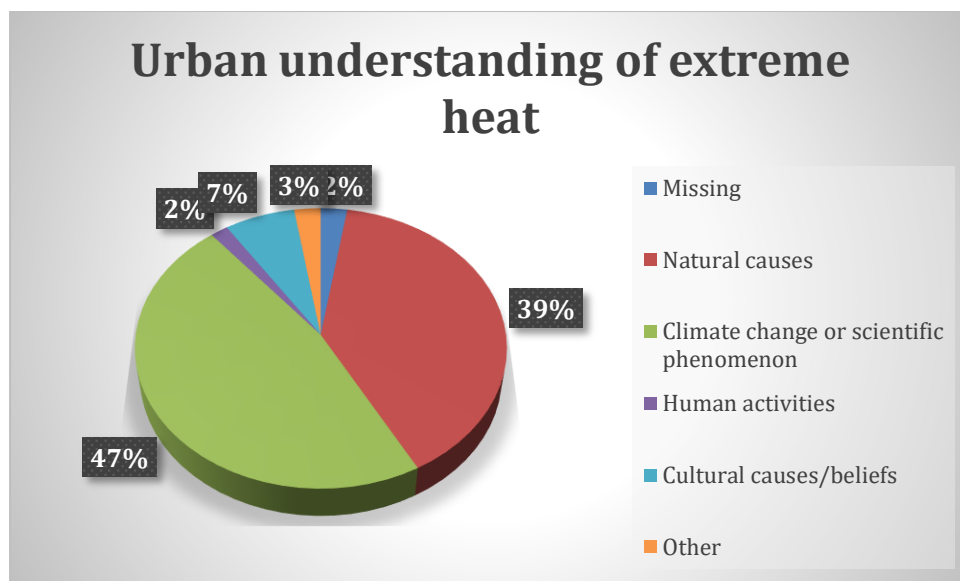
Natural causes and human activity

The soaring temperatures affect both Beitbridge rural and urban communities. The meteorological department attributed these to the district's geographical location as a valley in a low-lying area. In addition, deforestation fueled by firewood harvesting was also identified as a major driver of extreme heat in the district. Shortages of electricity and the high price of cooking gas were also fueling the demand of firewood in Beitbridge town, in addition to the rural households that always rely on firewood. Firewood vending was identified as one of the thriving livelihoods in the town and the rural areas as well.

The key informant from the meteorological department further added that urbanization (through the urban island effect), was also fueling high temperatures in the district. He added that the town has been drastically expanding in the last 10 years as more migrants are coming into the town for cross border related livelihoods. Thus, the demand for accommodation by the newcomers in addition to natural population growth, is promoting rapid urbanization, which in turn results in extreme heat.

The soaring temperatures also frequently induce floods in November and December and the key informant from the meteorological department further highlighted that floods have since become a perennial problem in the district. The loamy soil in Beitbridge also makes the district susceptible to flooding such that each time the district records 50mm rainfall, there are bound to be flash floods.

Most residents (47%) believed that extreme heat was a result of climate change with another (%) attributing extreme heat to natural causes while the rest thought that human activities, cultural causes and other causes accounted for extreme heat. Below is the table highlighting individual perceptions on the causes of extreme heat.



Others reasoned that the construction of the new Tokwe-Mukosi dam in the nearby Masvingo province was in the long run, going to cool Beitbridge temperatures. However, this claim was dismissed by the meteorological department.

7.1.1.3 Factors that expose residents to extreme heat in the district

A panoply of socio-economic, environmental and infrastructure related factors expose Beitbridge residents to extreme heat.

Overcrowding and housing

Social inequalities expose different residents to the dangers of extreme heat. Our research revealed that different individuals in both rural and urban parts of the district are invariantly exposed to extreme heat. Like all cities in Zimbabwe, Beitbridge is composed of high, middle and low density areas. To the eastern part of the town are the affluent low density suburbs where high income earners reside. These areas have bigger residential stands and houses and they also have spaces for gardens and trees. A few houses also have swimming pools. This implies that in the event of extreme heat, such households are in a better position to adapt since they are not overcrowded. Residents in those areas can also seek refuge under the shade of trees and those who own swimming pools can swim. Our research further revealed that water availability is less erratic in that part of town. Conversely, the high density residential areas in the western side of the town are characterized by small residential stands, with some covering only 150m².

Overcrowding is therefore a pervasive characteristic in low income areas. The houses in those suburbs are small, yet the area also has a higher population density, with other households having six members sharing a single room. Participants pointed out that rentals are generally high in Beitbridge compared to other towns and cities in Zimbabwe, with the cheapest rooms going for more than USD60/month. Our research revealed that the town from time to time receives migrants from other parts of the country who throng the town for livelihood purposes. As one participant noted;

Most people are here for green pastures, not luxury, they want to save money, so they normally rent single rooms in order to save money, so you will find that people here are overcrowded and the rentals are too expensive. So, when it is hot people suffer in those overcrowded rooms.

In addition, those who rent single rooms also cook and iron in the same room thus further amplifying the heat in those rooms. Thus, overcrowding exposes residents to heat stress such that occupants often resort to desperate adaptation measures discussed later in the report. The limited spaces in low income areas further imply that residents are not able to plant trees around their homes, leaving them without the much-needed tree shades in the event of extreme heat. They are also short of space to construct swimming pools and the majority cannot afford them. The town council's elective distribution of water, characterized by persistent water cuts in the low-income areas during the hot season, also leaves the western residents in short supply of water for drinking, cooling and bathing, thus further exposing them to extreme heat.

Livelihoods and exposure to extreme heat

We also found out that different livelihoods strategies practiced in both the rural and urban areas exposed participants to extreme heat. Like any town in Zimbabwe, most of the residents in Beitbridge town work in the informal sector. The informal sector thrives even more in Beitbridge by virtue of it being the country's busiest border town. Thus, a lot of people participate in the informal sector as vendors, taxi drivers, clearing agents, cross border traders, money changers, hawkers and human traffickers (facilitating sporadic crossing into South Africa), among others. Most if not all of the informal workers work outdoors, thus exposing themselves to direct sunlight and extreme heat.

We observed that there is a shortage of sheds for the outdoor workers. In some cases, the sheds themselves actually hinder business as the customers are usually those in transit, and/or people who will be moving around the town. Most of the vendors, for instance, sold fruits in open spaces such as car parks, at the border, along major roads, at shopping centres, near schools and in the residential areas. Those areas are short of trees for shade and the local council has also failed to construct stalls for the informal traders. In most cases, participants pointed out that they chose to endure the heat rather than seeking shed as that would result in them losing customers. As one vendor highlighted:

“You need to brave the heat in order to gain more customers”

Some participants were also involved in cross border trading and they bought their wares in the nearby South African border town of Mussina. They pointed out that crossing the border is always a difficult task for them because of the exposure to high temperatures at the long border queues. Border queues however do not apply to the majority of cross borders who lack required documents, particularly, the traveler's passport. Such people are therefore forced to cross into South Africa (illegally) via the Limpopo river. They are often assisted by the human traffickers (known as Maguma-guma in the vernacular) plying the river for fees. The trips also involve walking through the forest for more than 20km in the scorching heat, and participants reported being constantly dehydrated and exhausted due to the combination of the long distances and exposure to heat.

7. 1. 2 The impacts of extreme heat in the urban spaces

Participants reported that extreme heat was having a toll on their lives including on their health, livelihoods and social life. Key informants also highlighted that measures are supposed to be taken to alleviate residents from the effects of extreme heat.

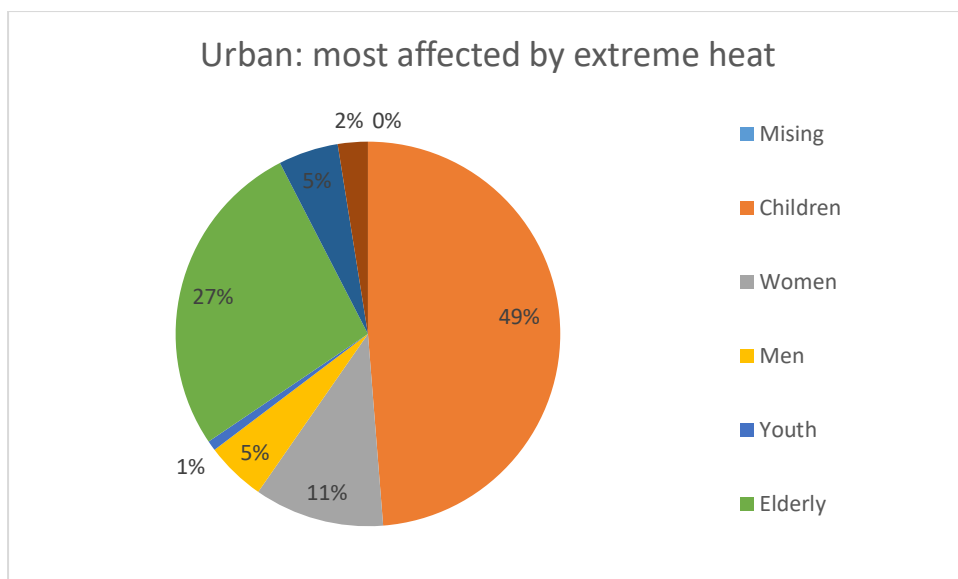
7.1.2.1 On health

Most participants highlighted that extreme health affected their health and that abnormal health patterns were significant during the hot season. 109 out of 119 respondents stated that they had at least one person whose health has been affected by extreme heat in Beitbridge and this is illustrated in the table below.

Anyone whose health has been affected by Extreme Health in your family

Anyone_affected_by_EH in your family		D4.Anyone_affected_by_EH			Total
Count		missing	yes	no	
A0.Location	Urban	1	102	16	119
	Rural	0	23	8	31
Total		1	125	24	150

Participants also stated that children and the elderly are most affected by extreme heat as illustrated below.



In the urban areas, most participants indicated that they regularly suffered from headaches from the month of August up to April. Women also indicated that they often experienced rash and swelling under their breasts. As one respondent stated;

At one time I developed a rash that I could not understand, only to be told at the clinic that it was all caused by heat.

Infants also develop rash persistently during the hot season. Those who are asthmatic also reported intense difficulty with breathing and the old were said to be constantly weak during the hot season. As one asthmatic participant pointed out;

I always get asthmatic attacks when it is very hot. Breathing becomes very difficult for me and I constantly need help. It is a very difficult time for me.

Those with albinism were also more affected and this was exacerbated by the exorbitant sun cream prices. Participants also pointed out that young children often struggle with swollen eyes during the hot season. Participants in the rural areas also stated that they often experienced pain when urinating during the hot season and this mostly affected children. As one participant explained;

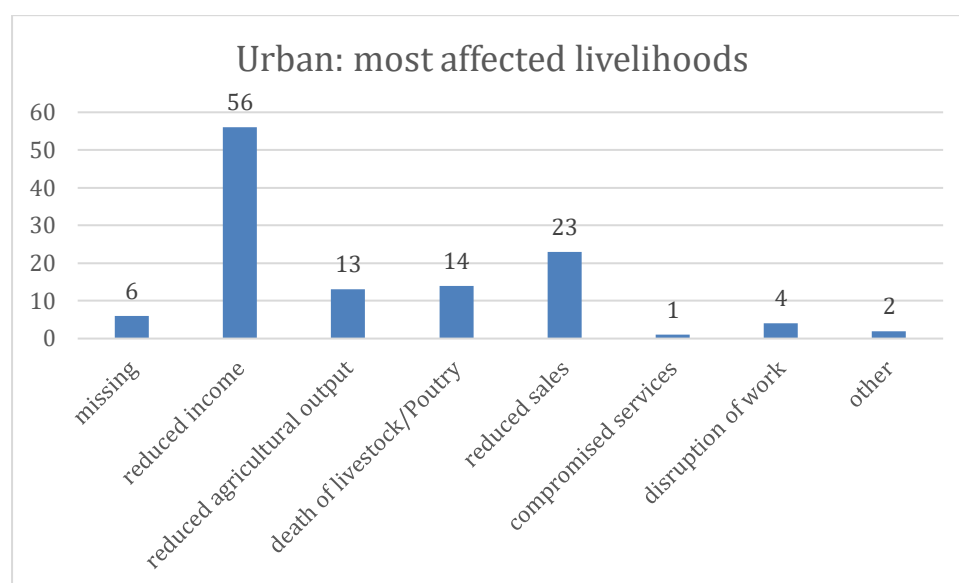
During the hot season we struggle a lot with urinating, we experience pain and a hot sensation when urinating. Children cry when urinating and our pants are left with a salty discharge, when we visit the clinic, we are told that we should drink lots of water.

An informant from the Ministry of Health highlighted that extreme heat is a serious health issue among the residents and it mostly affects the old, infants, those with chronic illnesses and pregnant women. The health official also explained that the pain experienced when urinating was caused by severe dehydration. Pregnant women also reported that they often faced challenges during the hot season as they would constantly sweat during the hot season. General fatigue is also pervasive in Beitbridge district during the hot season and the heat stress

also affects animals, with another key informant stressing that people, animals and birds collapse whenever there are heat waves in the district.

7.1.2.2 On urban livelihoods

All participants indicated that they were negatively affected by extreme weather as it reduced their income, agricultural outputs, sales and water availability. Extreme heat also compromised services, disrupted work and would result in perishables going bad. Below is the table showing the impact of extreme heat on livelihoods.



Extreme heat reduces participants' income as they are sometimes forced to abandon their work due to heat. This was stated by the vendors and cross border traders. Some reported that extreme heat forces them to abandon work altogether, as shown in the following excerpt;

When it's hot the body gets weak and I frequently get sick during this time. So, I rarely sell much and my business gets affected. Sometimes I am forced to spend my little capital and I go broke, yet recovering is just difficult since no one gives you capital.

Another one, a carpenter added;

For us there is no benefit [from extreme heat] at all because we make furniture and operate from open space.

Those who worked outdoors and on open spaces would also seek shed in the pavements and under trees, away from their customers, resulting in decreased incomes and sales. Cross border traders who evade the formal border, using the illegal route via the Limpopo river into South Africa also reported facing a difficult time on their journeys by foot. They said that they walked for more than 7 km in the scorching heat. As one participant explained;

We use the [illegal] route on foot, so the journey is long to the next taxi rank both in Zimbabwe and South Africa. Those with bigger bodies particularly struggle more. Others faint, and in some cases other cross borders die due to dehydration.

Fruit vendors indicated that their fruits, particularly bananas and some citrus, would easily go bad in times of extreme heat and they would be forced to sell other things. Bananas are thus in short supply during the hot season. Those who sold vegetables also reported losses during the hot season as for instance, green leafy vegetables would easily turn yellow, and thus unattractive to customers. Others however pointed out that the heat came as a blessing in disguise as they capitalized on the adaptation strategies. Others also took advantage of fellow vendors who could not stand the heat by 'taking' their customers. As one vendor explained;

Our fellow vendors who are lazy and weak abandon their work when there are heatwaves. Some of us then grab that opportunity. We simply tell them that their usual supplier is not around, knowing pretty well that they will be somewhere nearby hiding from heat. So those customers end up buying from us and we make money while others will be seeking comfort in shades.

Vendors pointed out that they made money during the hot season by selling water, including frozen drinking water, ice blocks and cold drinks to fellow residents and those in transit at the border post and the local bus ranks. The demand for cold drinking water, ice and drinks often meant that some vendors would temporarily stop selling their usual produces and products for water. As one vendor explained;

We all sell water and drinks during the hot season and this gives us more profit. Water and beverages are more profitable during this period. We can get as much as 300 (South African) Rands (15usd) per day compared to 170-180 Rands we normally get for fruits when it's cold.

Another participant said;

In Beitbridge, if you sell water, drinks, freezits and ice-cream in the hot season, you will make money. For us vendors, and even other people, money circulates better in this town during the summer season especially during very hot days because of water compared to the winter season.

Some vendors also reported that they target routes used by illegal border crossers into South Africa to sell their water, drinks and ice. They sell cold water and drinks at various points in the forests at very exorbitant prices.

7.1.2.3 On water

Participants noted that extreme heat had a huge impact on water sources. Beitbridge belongs to Zimbabwe's hottest region and water and rainfall are already a problem. This implies that the district's water tables are always low and this is exacerbated by high temperatures owing to extreme heat. However, as already mentioned, the availability of water becomes worse during the hot season and this affects the lives of residents in so many ways. The town Council struggles with providing water and as already mentioned, there is unequal distribution of water in Beitbridge such that those in the affluent low density areas have better access to council tapped water compared to those living in poor, high density areas.

Residents in the town, particularly those in the high density area rely on buying water as the following excerpt shows;

...without money for water, you cannot survive in this part of town, you need to buy water for drinking, for laundry, for flushing the toilet, for bathing...for everything, and that makes our lives so difficult.

Participants in Beitbridge town also noted that tap water is usually hot and that makes it very difficult to drink and cool the hot bodies. While some can circumvent this problem through cooling the water using fridges and water dispensers, the situation is difficult for those without cooling equipment or power.

7.1.2.4 On energy sources

Extreme heat causes water levels to decrease, including in the country's major hydroelectric power source, the Kariba dam. As such, residents noted that electricity availability is severely compromised, yet they would need the electricity for cooling purposes. Those in the rural areas also noted that extreme heat sometimes results in the wilting of trees, particularly seedlings, such that future sources of firewood are severely compromised.

Those that use solar power however noted that extreme heat is a blessing in disguise as they are able to generate more power for lights, entertainment and in some cases, fridges and small fans. This was the case especially in new urban suburbs where the energy authority has taken more than 15 years to connect electricity. As one participant explained;

Extreme heat affects our energy sources positively because there is no electricity connection in our neighborhood. So, when it's very hot we have enough solar energy to power our entertainment system and fridges unlike during winter.

Some households with electricity connection also use solar power to supplement their electricity. As well, most households in the rural areas also used solar power for charging phones, lights and in a few cases, better-off households owned better solar systems which could power television sets.

7.1.2.5 On social life

Extreme heat disrupts social life as people find it difficult to visit and physically check on each other when it is extremely hot. Extreme heat leaves people's bodies weak and this makes them reluctant or too distressed to walk. Social gathering and social activities such as social clubs are sometimes abandoned as gathering is reduced. As one respondent noted;

We are not able to visit others, or go to churches or clubs. Our husbands do not go for soccer

Residents therefore stay away from each other (at least physically) when it is hot. For some, this implies missing a lot on information, including petty gossip with friends and relatives, and in some instances, a strain in interpersonal relationships as the following excerpt shows;

I can't go out with my friends due to heat...it costs since we then need a car and refreshments for the outing and conversation to be fun... [so] I no longer have a pleasing social life due to heat, I barely meet up with my friends and people think it is just an excuse to avoid them.

Focus group discussions also revealed that extreme heat affected intimacy as people had less sex in the face of extreme heat compared, for instances, to the winter season. To some participants, reduced sexual activity caused strains in marriages and intimate relations. As one participant noted;

It becomes boring because you really want to get intimate and close to your partner yet it will be too hot to do so. We are less happy during the hot season, but come winter we are very happy and close because the sex binds us.

7.1. 3 How different groups are coping with climate induced heat

Our research revealed that different people/households coped with heat differently, and this was mainly depended on one's socio-economic position. Thus, generally, those who were financially better off had better coping strategies in both the rural areas and Beitbridge town. The following statistics summarises some of the cooling aids and gadgets owned by participants.

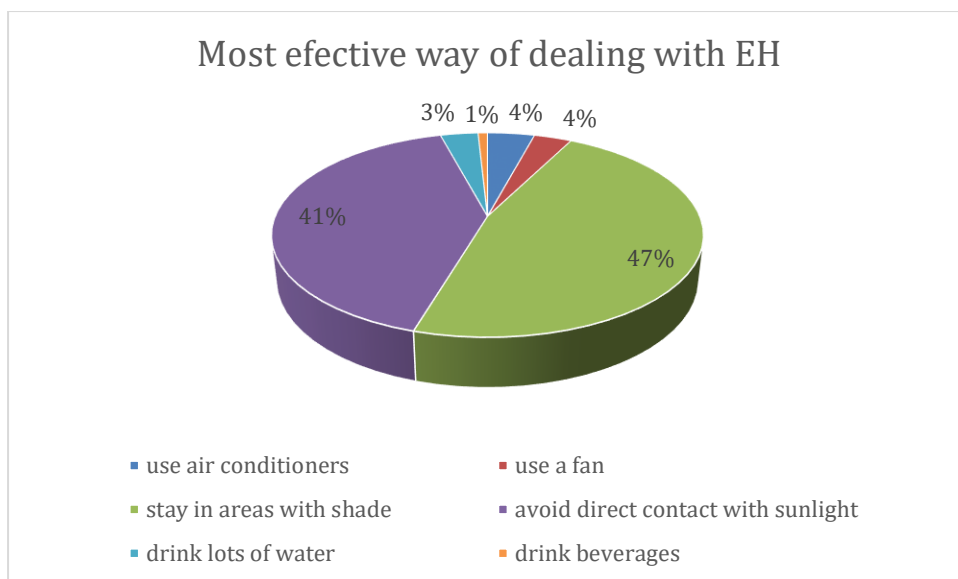
Cooling aids owned

A0.Location * F2.Do_you_own

Count

		F2.Do_you_own				
		air conditioners	a shade	a fan	a fridge	Total
A0.Location	Urban	3	79	14	23	119
	Rural	0	31	0	0	31
Total		3	110	14	23	150

As well, coping strategies were different for those in the rural areas and the urbanites. Drinking lots of water, using sheds, bathing regularly, sleeping outdoors, checking on children and the old regularly, using fans and swimming were some of the most effective coping strategies adopted by residents. Our survey however revealed that respondents felt that shades and avoiding direct sunlight were the most effective ways of dealing with extreme heat as presented below:



7.1.3.1 Drinking lots of water

All participants noted that drinking lots of water helps them to deal with extreme heat as it cools their body and it also gives them energy as the following excerpt shows;

When it's very hot we survive through drinking lots of water and we also make sure that children and babies drink water constantly.

Water is mostly drawn from the tape and boreholes. Residents however pointed out that they prefer council taped water to the borehole water because the latter is salty. Thus, tape water is usually stored in bulk in cases of water cuts by the council. Residents then use the borehole water for other needs including laundry, cooking and cleaning. As already mentioned, distribution of council water between low density and high density areas is not even. Thus, from time to time, residents from the low density areas sell water to high density residents particularly during the hot summer season when water availability is erratic.

Residents prefer to have cold drinking water and those with electricity connection and fridges often enjoy this privilege. Erratic electricity availability however makes the availability of cold water difficult. Other urban residents, particularly those from new neighbourhoods where electricity is yet to be connected pointed out that they relied on solar energy and in most cases, the power generated is not sufficient to power the fridges for more than 12 hours a day at best and not at all, at worst. Low income earners reported that they preferred renting houses in areas that either experienced severe power cuts or had no electricity connection at all, as these were comparatively cheap. However, this compromised their access to cold water. Those who rented solar powered houses also noted that their landlords did not allow them to use fridges and some refused to refrigerate their water. Such dynamics thus make the provision of cold water difficult for many, especially the low-income earners. Others pointed out that they bought ice to circumvent this problem or they would simply buy cold and frozen water from local vendors and some shops. Those who are into poultry also noted that they need cold water for their birds and that without cool water, the birds die. They therefore put ice in the water in order to ensure that their birds adapt to extreme heat.

Other participants noted that the need for cold, but unavailable water force them to resort to desperate measures including soliciting for cold water under pretense. As one participant noted;

Sometimes we get into pharmacies and we pretend like we want to take pills, when in fact we would be after free cold water from their water dispensers. We make it a point that we drink every free cold water available even if it's not meant to be accessed for *free* per se.

7.1.3.2 Beverages/drinks for cooling purpose

A few participants (1%), particularly in Beitbridge town highlighted that they also drink beverages in an attempt to relieve themselves from heat. The majority of those who said they afford beverages indicated that they only afford one beverage per day. They mostly take opaque drinks, made from sorghum and finger millet, locally known as *maheu*. A 500ml of *maheu* costs USD.50 and this drink is popular with most residents since it can also be taken as/and/or with food. Most residents in Beitbridge town indicated that they would have *maheu* at least twice a week. *Maheu* is also home brewed and most people in the rural areas rely on o home brewed *maheu* since they could hardly afford the commercial ones.

Others noted that they would from time to time take other fluids including fizzy drinks such as Coca-cola, Pepsi and diluted syrups. Extreme rural poverty however limited this option for the majority as the following excerpt from a Focus Group Discussion in rural Malala village shows;

We only buy drinks on December the 25th (Christmas day), at times we even fail to afford drinks on Christmas day.

7.1.3.3 Sheds

Both urban and rural residents pointed out that they used sheds to shelter themselves from the scorching sunlight during the day. Sources of sheds included buildings, trees and tents. The study further revealed that the choice and type of sheds used by different households also reflected social differences. Urbanites living in the affluent low density suburbs generally had bigger stands ranging from 3000 to 500m². This implies that they could afford to build bigger houses and still be left with enough space for gardening and planting trees. The trees are therefore critical sources of shed for people, dogs and cats in the afternoon.

Participants, including a key informant from the meteorological department pointed out that plants including vegetables, trees and shrubs are difficult in Beitbridge. Most plants including trees wilt before they mature, and as such, unlike most parts of Zimbabwe, Beitbridge district generally has few trees, including exotic fruit trees that are characteristic of most Zimbabwean households elsewhere. Beitbridge rural areas have also been affected by severe deforestation thereby further exposing non-human species particularly animals to extreme heat as well. Such dynamics therefore limit residents' adaptation strategies when faced with extreme heat.

Apart from trees, participants also used sheds from buildings including pavements and verandahs. This helped to shelter them from sunlight in the absence of alternatives such as trees and air conditioners. Participants however noted that sheds from buildings are unsustainable as they are not always available throughout the day. Further, building walls emit heat and this makes them uncomfortable to use when people are facing heat stress.

7.1.3.4 Sleeping outdoors

Participants noted that the hot season is characterized by hot nights which make it difficult for them to sleep indoors and as mentioned earlier, this is exacerbated by overcrowding. Poor ventilation in some cases, also make the rooms hotter. Also as already mentioned, some families sleep in the same room that they use for cooking and this emits more heat especially during the night as people would need to be indoors. Further, walls would be hot owing to heat absorbed during the day. Resultantly, residents opt to sleep on the pavements inside their houses or outdoors.

Even though sleeping outdoors would ensure more space and fresh air, it was a problematic strategy owing to various reasons. Firstly, it exposes people to mosquitoes which also happen to breed during the hot season. Interviews also revealed that mosquitoes are a serious problem in Beitbridge, particularly during the hot season. Thus, irritating mosquito buzz and bites made sleeping or staying outdoors very difficult. Scorpions and snakes also made sleeping and staying outdoors dangerous. Scorpions and snakes usually move on the surface during hot season as the underground would be too hot for them as well.

7.1.3.5 Fans and air conditioners

19 participants in Beitbridge town noted that they owned electric fans for cooling. The border town's proximity to South Africa implied that the residents can buy fans and other commodities in that country at a cheaper price compared to other parts of Zimbabwe. Commodities are relatively cheaper in South Africa. However, residents complained that the erratic availability of electricity made it difficult to use their fans since they did not have alternative sources of energy to power the fans. Others also noted that the fans are not very reliable since they fail to cool the air in times of extreme heat. Instead, they can amplify the heat. They noted that fans end up producing hot air. Fans are also unsuitable for those with respiratory diseases such as asthma and for babies too. All rural participants did not own fans due to unavailability of electricity and poverty.

Only three participants in the town indicated that they had access to air conditioners at their workplace and none reported having an air conditioner at home. This shows how air conditioners are out of reach from the majority of the community of Beitbridge. In town some pointed out that they only come across air conditioners in upmarket shops and a few relatives and friends who reside in the affluent suburbs. As one participant noted;

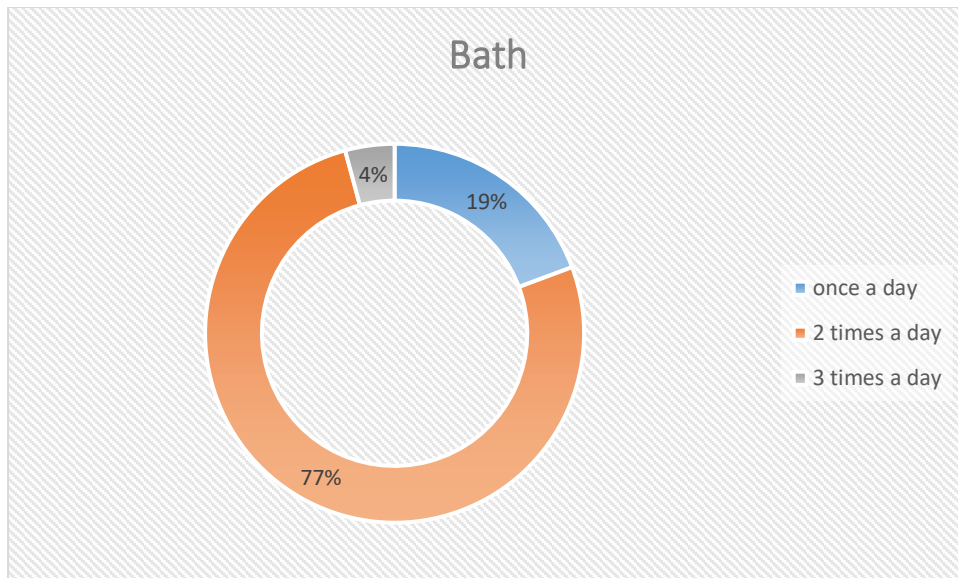
A car air conditioner is the only type I know, not that found in homes and offices. I have never visited any friend or relative with one at home or at work.

Most of those in the rural areas also confessed ignorance to what an air conditioner is including what it is used for. Inability of poor people to afford cooling systems has been identified as a challenge to coping with extreme heat elsewhere (Hayhoe et.al 2010).

7.1.3.6 Bathing

Participants noted that they resorted to bathing to cope with extreme heat. 73% of the participants indicated that they bathe twice per day. Bathing was a cheaper alternative given the unavailability of swimming pools and related facilities in the rural areas and the exorbitant fees in town. Participants also noted that they would also put water

in small dishes for their young ones to play in and cool their bodies. The following pie chart summarizes bathing frequencies on hot days.



Persistent water in the hot season, however, made frequent bathing, at least with clean water difficult for most people.

7.1.3.7 Swimming

There were no swimming pools in the rural areas where we conducted our study and this is typical of the Zimbabwean countryside, save for resort areas. The rivers which would provide an (unsafe) alternative for a swimming pool also run dry during the hot season. There were no dams in and near the villages that we conducted our study either, meaning that water related leisure including for the purposes of relief from heat induced stress is hard to come by, thus severely limiting residents' coping mechanisms. As well, there were no swimming pools in the high density areas in Beitbridge town. Only a few households were reported to own a swimming pool in the low density areas.

There was however, a privately owned swimming pool where residents could access for USD3 per day. The money was certainly out of reach for most residents, particularly the low income earners, who are the majority in Beitbridge. As one participant explained;

Swimming pools are there but they are for rich people. You can't waste money on swimming when you struggle to put food on the table. If you give your child a whole USD3 just to *play* in water, they will still come home demanding food that you already do not have. So it's wiser to save that money and buy them basic food.

7.1.3.8 Checking on the old, young and the disabled

As discussed, participants strongly felt that the old, young children and those with chronic illness and disabilities were more susceptible to extreme heat. They thus felt the need to regularly check on them during times of hot weather. They also noted that they need to constantly ensure that those populations are not exposed to sunlight during the day and that they are not exposed to heat during the night. Young babies are often left naked or clothed in light clothes and diapers. Parents and guardians often check for heat stress induced discomfort including baby cries. In the rural areas, participants also noted that they often dress children in light wet clothes.

7.1.3.9 Avoiding working during the afternoon

Most people, especially those in the rural areas, pointed out that they avoided working in the afternoon in order to protect themselves from direct sunlight. They therefore wake up early around 4 am and they make sure that they are done with their chores especially in the gardens and the fields by 8 am when the heat worsens. Likewise, in town, other vendors, particularly those that operate in the residential areas, also start working in the evening after 5 pm when temperatures are relatively cooler.

7.1. 4. Towards institutional interventions to help communities to cope with heat

Our Key Informant Interviews revealed that Zimbabwe does not have a (clear) Response Plan to deal with extreme heat. Instead, the government prioritises floods and cyclones, and this is despite the fact those very disasters are related to extreme heat. The interview with the meteorological department for instance revealed that Beitbridge often experiences flash floods in the month of November when the district records its highest temperatures.

Focus group discussions also revealed that residents deal with heat stress on their own, without any assistance from the government, the private sector and humanitarian organisations. This was despite the fact that residents were failing to deal with challenges caused by extreme heat. In fact, all participants noted that we were the first to engage them on the extreme heat topic, as the following excerpt shows;

The government seems to be ok with us burning [being exposed to heat] each year. I think they have come to the conclusion that it's normal and ok for us to experience heat so much that they seem unmoved. Yet we struggle each time from August. In fact, no one has come here to talk about it. You [the research team] are the first to talk to us about this topic.

A key informant from the meteorological department however noted that a local funeral parlour was donating tree seedlings, as a long-term plan to combat climate change. He added that this was a positive move towards the much-needed reforestation in the district, with a possibility of such trees providing shed for people and animals among other benefits. He however noted that the project would not be easily achieved given the fact that trees generally perform poorly in the district as they often wilt before they mature.

Key informants noted that the challenges of extreme heat are being trivialized and yet they have futile effects on people, animals and the broader environment. Lack of attention to extreme heat by authorities had also been captured elsewhere (Martínez-Austria and Bandala 2018). They thus suggested that there is an urgent need to address this challenge given that Beitbridge's temperatures keep rising and that globally the world is struggling with extreme heat. Environmental justice therefore needs to be addressed. Strategies suggested included

prioritizing children, the old, the sick, pregnant women, outdoor workers including vendors, hawkers and waste collectors. Key informants also stressed the need for provision of sufficient clean and safe water particularly during the hot season, given the water challenges that residents face during that time. It was also stressed that water needs to be available equally between the low and high density suburbs as this could help alleviate the poor who are often forced to buy water from low density residents. Provision of sheds was also stressed as well as the need to drill more boreholes and dams to enable villagers to irrigate their gardens and provision of water for the animals. It was also noted that there is a need to conscientise residents on extreme heat, given its challenges and threats.

Participants proposed various means which they thought would help them deal with extreme heat including the provision of sheds, alternative livelihoods, provision of fences around their homes, drilling more community boreholes, and possible water connections near or at their house, alternative sources of energy among others.

Those who worked outdoors such as vendors and carpenters highlighted that the provision of permanent sheds in place of umbrellas would go a long way towards shielding them from direct sunlight. Fieldwork observations revealed that most vendors did not have permanent stalls, but would use makeshift stalls, or even sell on the open, in direct sunlight. They therefore implored the city fathers to avail permanent vending sites with sheds throughout various points in the town. Participants in both sites also noted that it is critical to provide residents with sheds at their homesteads, in an effort to shield them from extreme heat, in the absence and ineffectiveness of sheds from trees. Others also identified the provision of mosquito nets as a panacea to the hot nights that are further disrupted by the problem mosquitoes during the hot season.

Others opined that alternative sources of livelihoods from vending to indoor activities would help protect them from extreme heat. This was a recurrent theme from vendors who felt that they resorted to vending as a result of unemployment. Such a solution however, sounds challenging since it is a structural issue. Others suggested that they start other income generating activities such as poultry, sewing among others, as this could limit their exposure to sunlight.

Other participants pointed out that alternative and sustainable sources of energy such as biogas and solar could go a long way in circumventing the challenges caused by power outages as a result of low water levels from hydro-electric sources during the hot season. This could help limit energy pressure posed by cooling gadgets such as air conditions and fans during the hot season. The environmentally sustainable sources can also help combat climate change caused by deforestation caused by villagers and urban dwellers' demands for firewood. The same sentiments were also echoed by one key informant who said that;

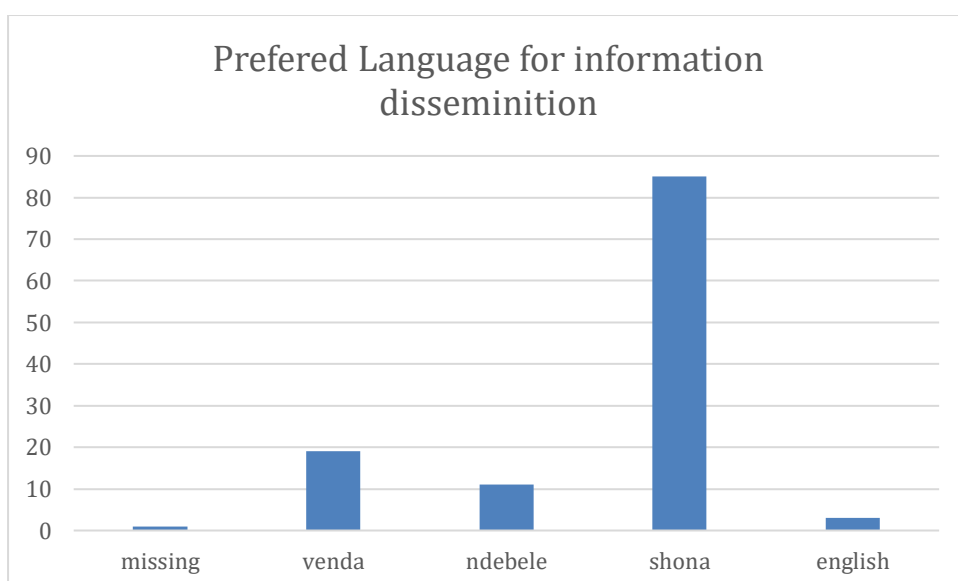
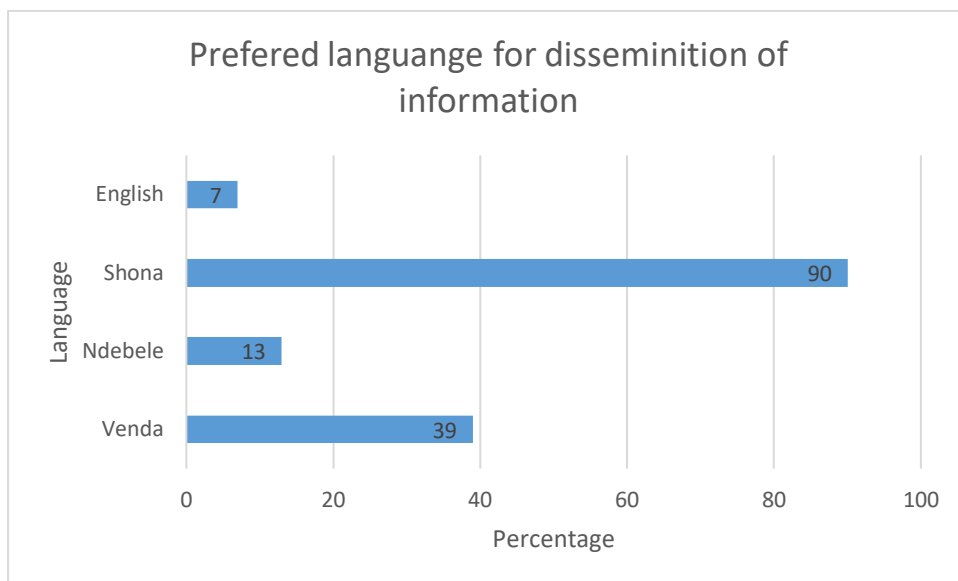
more alternative and sustainable energy sources are critical and this has to be known. The complaints of low water levels at Lake Kariba and their effects on the national grid obviously call for a paradigm shift towards biogas and solar power.

Both key informants and ordinary participants also stressed the need to decisively address the perennial challenge of water access in the district. Those in the urban areas reasoned that this can go a long way towards addressing the energy crisis, particularly through dam construction. Addressing the energy crisis this way would result in the provision of electricity which is critical for cooling purposes. Others further opined that dam construction can be a panacea towards cooling atmospheric temperatures in the long run. Those in the urban areas also called for the

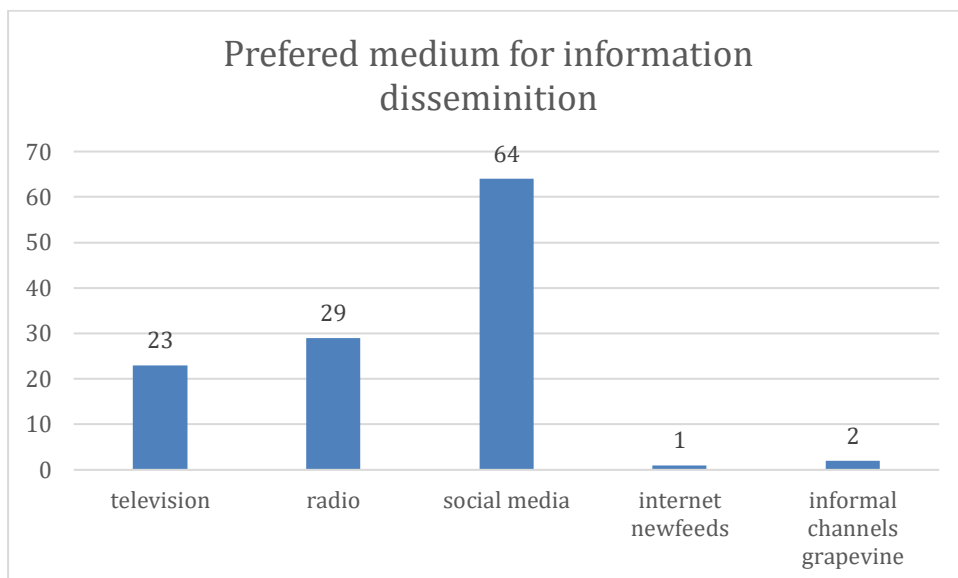
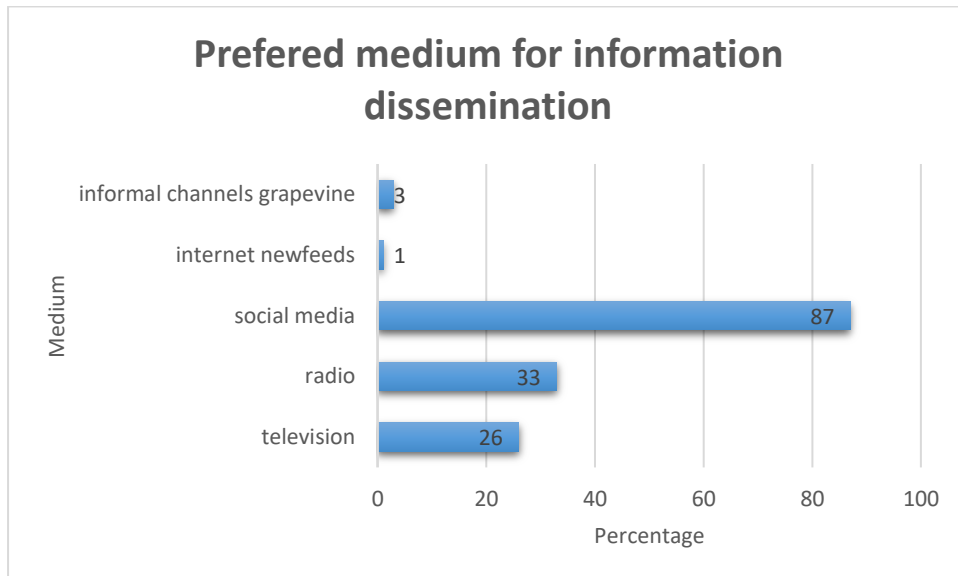
construction of public and affordable swimming pools as those that are currently available are privately owned and hence beyond the reach of many.

7.5 Communication and outreach strategies in urban Beitbridge

As already discussed, no organization has specifically conducted any program, including conscientisation and outreach programs in relation to extreme heat in Beitbridge. This study however revealed that there is an urgent need to do so. Participants including key informants pointed out that there is a need for extreme heat knowledge dissemination. The majority pointed out that this message needs to be relayed from the month of August when the hot season starts. This was thought to be more effective than, for instance, to relay the information in winter. They also stated that the language should mainly be in the vernacular (including Shona, Venda, Ndebele) and English. This is also captured in the bar graph below:



Disseminating knowledge on extreme heat was considered crucial as it helped in preparing adaptation measures against extreme temperatures and anticipated heat stress. Most participants in the town pointed out that they would prefer the use of social media, radio, television and road shows for disseminating information on extreme heat, including the weather report. Preferences for information dissemination from questionnaires are summarized below:

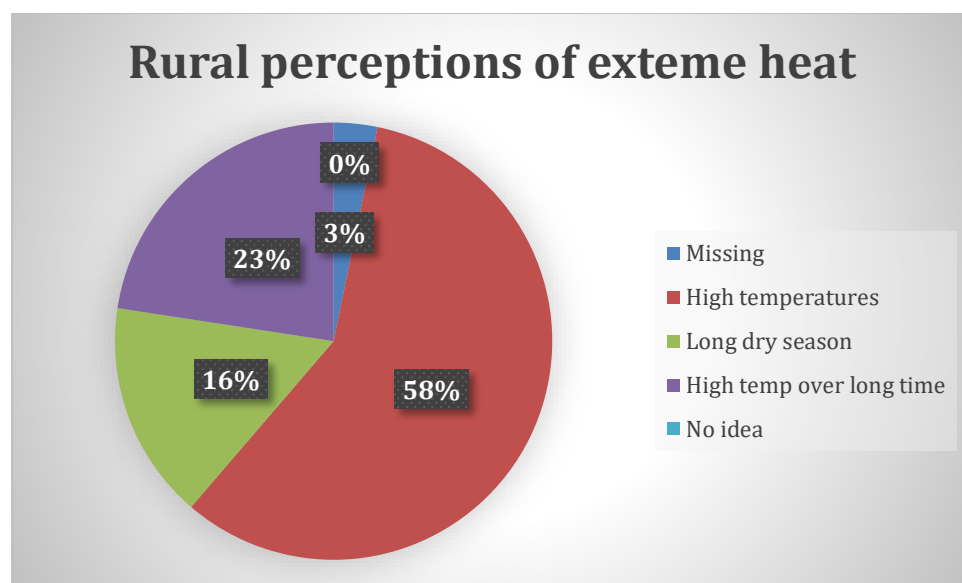


From the above table, there is a high preference for information dissemination through social media as most of the participants noted that social media can relay information fast to them and their entire communities. They noted that other stakeholders can send them direct messages to their phones so that they have reliable information. Radio and television were pointed out to be more reliable, however low to no frequency coverage in some parts of Beitbridge was identified as a possible barrier to TV and radio communication. This often forced Beitbridge residents to resort to South African radio and television through the use of satellite decoders.

7.2 Findings for rural Beitbridge

7.2.1.1 Rural perceptions of extreme heat

In the rural areas of Beitbridge the participants had various views on what constitutes extreme heat. The majority (58%) of the participants perceived extreme heat as high temperature while 23% of the participants perceived extreme heat as high temperatures over a long time. However, 16% of the participants perceived extreme heat as long dry seasons while 3% of the participants had no idea on how to perceive extreme heat. The below pie chart provides graphical representation of the perception of extreme heat by the rural population.



The various perceptions of extreme heat underscore how extreme is understood within the context of rural Beitbridge. The participants highlight a lack of agreed understanding of what is extreme heat in Beitbridge rural area.

Perceived causes of extreme heat in rural areas

Extreme heat and the supernatural

Unlike the urbanites, focus group discussions in the rural areas revealed a belief that climate change and extreme temperatures are also attributed to the supernatural causes. The general belief was that people were using *juju* to get rich and that angered the ancestors, who in turn punitively withheld the rains and unleash heatwaves and high temperatures. Others opined that by nature, *juju* and magic thrives in hot temperatures and dry weather. As one participant reasoned;

Those with *juju* do not want the rain and they want the earth to be dry and hot. Their *juju* cannot function under wet and cold conditions. People in Beitbridge town are getting rich so quick by using *juju* and that is affecting us here. That does not resonate well with a favourable climate. That is why we are in this mess.

Participants explained that others in the rural areas were also using *juju* and that also added to the burden of high temperatures. As one participant added;

Whenever you walk around you are bound to come across red cloth, brooms and winnowing baskets, some hanging on trees and others just dropped on the intersections of paths. You can only have a hot country because of that and do not expect the rains to come.

As such, extreme heat is also linked to supernatural beliefs as most of the participants believe that witchcraft and sorcery related actions by individuals are responsible for causing extreme heat. Thus, extreme heat is perceived as a punishment for wrongdoing through involvement in witchcraft and sorcery by other members of the community.

Factors that expose people to extreme heat

Poor housing

Our fieldwork in the rural areas participants attested to the realities of housing-related social inequalities and how they expose different villagers to extreme heat. We also observed that ensuing rural class differences determined the type of houses that villagers owned. The most vulnerable owned and stayed in a one roomed hut, while some were zinc roofed. This often implied that those villagers also cooked and slept in the same hut. As one participant in a focus group discussion explained;

We are overcrowded, six people in a hut. We sleep together with our children and that is the same hut we cook in so it is really hot.

Such conditions also resulted in overcrowding which also exposed villagers to heat. These conditions make life very difficult to the rural population as they have to find ways to adapt to the situation at hand.

Geographic factors

The geography of the place exposes the rural community to extreme heat. As witnessed in the urban area, the rural community also finds it difficult to grow trees particularly exotic ones. The region largely relies on the indigenous trees that include the baobab, amarula, and thorn trees. This makes it difficult to maintain trees and forestry in a bid to counteract extreme heat. The situation is compounded by the fact that some animals feed on these trees whilst humans largely rely on them for energy (firewood). One of the participants noted that:

The main challenge we face with tree is that it is difficult to grow new ones [...] at the same time animals eat the branches and leaves and us we will be expecting firewood from those trees.

The above narration depicts how it is difficult to have trees in Beitbridge as trees are vital in reducing extreme heat. As such, the geography of the place exposes the rural community to extreme heat due to the failure to ameliorate the impact by the natural environment.

Rural livelihoods and exposure to extreme heat

In the rural areas participants also highlighted that they were exposed to extreme heat as they worked outdoors in the fields and their gardens. Our research revealed that most villagers are involved in horticulture. They grow leafy vegetables that they sell in Beitbridge town, and in a few cases, among themselves. They also grow a bit of maize and some indigenous grains and these are rain fed. Villagers however noted that they rarely get any harvest from the fields owing to erratic rainfall patterns in the district. Thus, horticulture is the main source of income for the villagers. Gardening however involves extensive watering particularly during the dry season. Villagers use buckets to ferry water from the wells. The wells however usually run dry in September and when that happens, villagers either give up gardening or they fetch water from government sunk boreholes that are often situated far away from their gardens. Watering thus exposes the villagers to heat. Besides watering and weeding the gardens, villagers also need to guard their gardens from marauding domestic animals including donkeys, goats and cattle. All the villagers noted that they owned donkeys while others also owned cattle and goats. Except for a few who afford wire fences, most of the gardens are fenced using tree branches-a practice that exacerbates deforestation in a community that is already rocky and heavily deforested as illustrated in the picture below.



The tree fences are however susceptible to animal break-ins and thus villagers are forced to spend the whole day guarding their fields from the animals. Lack of shades in the gardens thus results in further exposure to extreme heat. Children are also exposed to extreme heat since they love to play outdoors. Some, especially those in the rural areas are exposed to extreme heat as they have to walk to school, often, for long distances. Young children, especially boys are also responsible for herding domestic animals including donkeys, cattle and goats and this greatly exposes them to heat stress. The picture below shows children playing in the open on a very hot day in Malala village.



The above picture highlights how Beitbridge is exposed to extreme heat due to lack of vegetation shade. This exposes the community particularly the most vulnerable groups which are the minors and the elderly.

7.2. 2 The impacts of extreme heat in the rural spaces

Participants in rural Beitbridge reported that extreme heat was having a toll on their lives including on their health, livelihoods and social life. Key informants also highlighted that measures are supposed to be taken to alleviate residents from the effects of extreme heat.

7.2.2.1 Health impacts

Extreme heat poses challenges to people living in rural Beitbridge. The study revealed that children and the elderly are the most groups affected by extreme heat. Children encountered difficulties during urination and developed headaches and rash during days with extreme heat. One of the concerned parents noted that:

Children are the most affected by extreme heat as they travel long distances to school on barefoot as some do not have footwear, again children hard to control as they will play at any place even without shade or cover during hot days. As a result, they end up having headaches, rash, and pain when they urinate.

Therefore, children are the most affected group during extreme heat. Unlike children, the elderly are the second most affected by their morbidities. The elderly noted that they are living with diseases such as hypertension, diabetes, and stroke. Elderly participants noted that extreme heat worsens their conditions. An elderly participant highlighted that:

When it's too hot I struggle even to walk as my condition (hypertension) worsens and my feet swell and the whole body eventually becomes weak.

Another elderly participant added that:

We suffer a lot during summer as the heat will be unbearable and we end up getting sick.

The above points made by the parents and the elderly depict how children and the elderly are affected by extreme heat in the context of rural Beitbridge. Within the study, it is revealed that next group to be affected by extreme heat is women followed by people living with disabilities, men, youth, and others felt that it affected everyone equally. Women revealed that they are affected as they will be involved with most of the domestic chores. People living disabilities were said to be having challenges relating to health during days with extreme heat.

7.2.2.2 On rural livelihoods

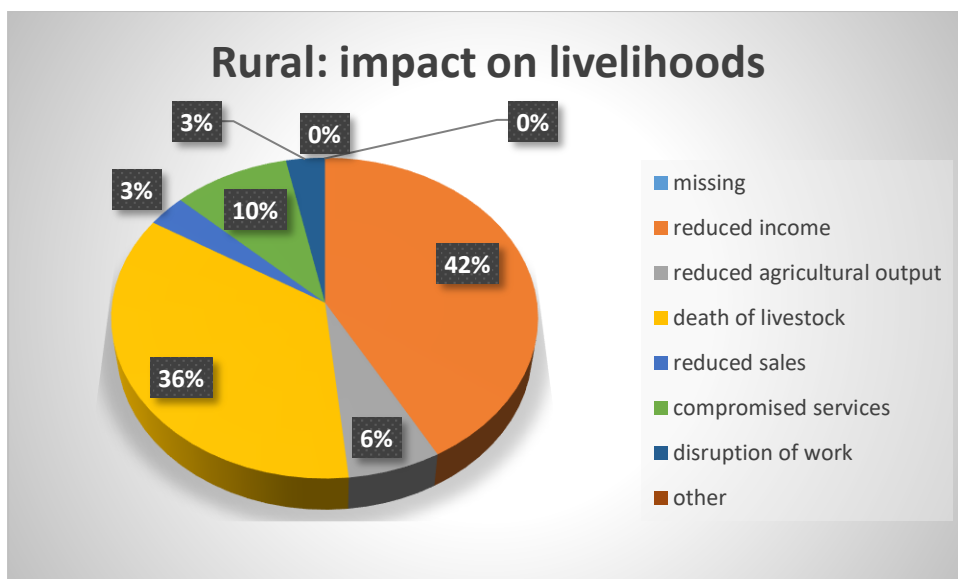
Extreme heat also reduces water availability as the water table decreases, thereby affecting livelihoods of those that depend on water, particularly the communal farmers. Rural participants reported that their gardens often wilt from August onwards. In fact, on our first field visit (20-26 August 2022), we found that some gardens were already abandoned due to water scarcity. Communal farmers further also noted that their vegetables are severely affected by extreme heat as diseases such as leaf mites and red spiders thrive under very hot conditions. Loss of green vegetables also poses a threat to household food security and nutrition as these are the main source of diet, often eaten together with the staple thick porridge, sadza. And, to most people this is a stressful time as they lose their food and source of income. As one participant explained;

We get psychologically sick whenever the hot season and these heat waves come, because we know trouble is upon our gardens.

The loss of vegetables is also summarized by one of the participants who said;

Hot temperatures really cost us and we do not benefit anything from these heatwaves. The rivers and our wells will dry. [Therefore, they will be] no vegetables in the market and most families here will suffer from hunger. For some households, that means sadza and salted water.

In some cases, water and pasture scarcity result in the death of domestic animals. Often, villagers are forced to sell their animals during this time, fearing drought related losses. The below chart highlights the impact on livelihoods.



7.2.3 On rural water

In the rural areas, water challenges imply walking for long distances, sometimes carrying the water bucket on the head, while better off families use wheelbarrows and ox-drawn carts. Wheelbarrows and ox-drawn carts enable households to fetch more water at a time, at least 60 litres, per trip. For female-headed households and those without access to wheelbarrows and ox-drawn carts, the burden of carrying water over long distances is often left to women and children. This is very difficult given that one usually carries only a 20 litre bucket over a long distance. As one participant explained;

Our neighbour's borehole [where we usually get water] gets dry when it gets very hot. We are then forced to use government boreholes, but these are far away. We are therefore forced to carry water over our heads for more than 3km.

7.2.4 On energy sources

Shortage of firewood in the rural areas piled on the pressure on women who had to walk long distances in search of firewood in private farms. Firewood poaching also resulted in clashes with farm owners. In some cases, men had to take over firewood fetching using ox-drawn carts, since women could not manage the long distances, often more than 5km away. Participants therefore noted that they are forced to use firewood sparingly while those in the urban areas use alternative sources like gas for cooking, in the absence of electricity.

7.2.5 On rural social life

Focus group discussions also revealed that in some cases, social relations would be damaged and conflicts would arise over water as some neighbours blamed those with boreholes with water for being stingy and some were bitter because of this. Unlike in the urban areas, villagers do not believe in buying and selling water as this is considered a common good provided by the supernatural. Selling water is therefore considered a taboo. Yet when the water table becomes low, sharing becomes problematic and those who are denied the precious liquid become bitter. As one participant noted;

when our neighbour's borehole water reduces, they will not be willing to share and they become distant because they do not want us to ask for water. It pains us a lot because you can see that your neighbor is avoiding you because of water. That's when you realize that that poverty is witchcraft because if I was richer, I would drill my own borehole and remain dignified.

Those with water would advise those seeking water to sink their own boreholes and this caused social rifts as the following excerpt shows;

My neighbours always clash with me in the hot season. They want me to provide water for free and I cannot do that because I paid lots of money to sink this well. So, a lot of gossiping goes around. Some even threaten to throw dead pets in my well, but I can only give them when I have enough to share. I can't be providing for everyone. I am not the government.

Others however felt that asking for help like water during the dry season actually helped to cement social relationships. As one participant noted;

Sometimes the situation brings us together because we borrow from neighbours or ask relatives for help.

Most participants however emphasized on the negative impacts.

7.2.3 How different rural groups are coping with climate induced heat

7.2.3.1 Drinking lots of water

Communal residents also noted that drinking lots of water helped them cope with extreme heat. Community boreholes and private boreholes provided villagers with the precious liquid. Private boreholes however proved unreliable in the dry season as they would dry up. This left community boreholes as the sole source of safe drinking water, and villagers travel for longer distances to access water. The gendered nature of fetching water implies that women and at times, children, are left with the burden of carrying water for long distances. Participants highlighted that cooling drinking water is often difficult in the rural areas due to energy constraints so widespread in the communities. Serve for a few cases, the majority of rural residents did not have access to electricity owing to poverty and this is despite the government's Rural Electrification Program. Failure to connect rural households to electricity, despite some households being in a position to afford its payment, has left a majority of rural households unconnected to electricity. This severely affects villagers' access to cold water so pertinent to the people in the face of extreme heat.

Like the urban dwellers, the rural participants however tried, though with very limited success, to access cold water. They would buy cold and frozen water from the local shops which had electricity connection. Poverty however always ensures that only an insignificant fragment of the rural population has access to cold water since the majority cannot afford it. One participant noted that:

“Here in rural areas we cannot afford buying cold water as it is expensive at the shops and this is due to the fact that we do not have access to electricity here”

A 500ml of cold/frozen water costs USD0.50 and this is beyond the reach of most rural households who live on less than a dollar a day. Rural ingenuity, however, is persistent in an effort to have cold water, albeit with limited success. As such, some villagers used indigenous knowledge to cool their water including through storing water in locally made clay pots. Others, albeit a few again, also cooled their drinking water by using wet sackcloth-covered water bottles which are usually hung on trees for continuous cooling. This method was however unfamiliar with most villagers, thus showing the need for knowledge transfer between generations and the villagers themselves. In most cases though, they end up relying on warm water.

7.2.3.2 Beverages/drinks for cooling purpose

Within the focus group discussion, participants noted that beverages are the best option for cooling down but they are beyond the reach of the majority of the rural population. The beverages include soft drinks and opaque drinks (*maheu*). The participants cannot afford to buy soft drinks as they cost an average of US\$0.50. Most participants highlighted that they had no stable source of income. Again, the issue of lack of electricity in rural areas was highlighted as one of the major challenges in accessing beverages for cooling purposes. This resulted in difficulties accessing beverages at shops that are usually located far away from their villages.

7.2.3.3 Sheds

Sheds from trees were used as a way to avert extreme heat. However, in the focus group discussions it was revealed that the trees for shed are scarce as the area is not suitable for exotic trees. The few indigenous trees are pruned for firewood and the animals feed on them. A traditional leader noted that:

We try hard to conserve the few trees we have [...] we prune the trees for firewood. The trees are a source of food for animals particularly goats as they target the leaves. At times we prune the leaves for the goats to survive in most times during extreme heat.

The above quotation from the traditional leader highlights the scarcity of shed within the context of rural Beitbridge. This affects the communities in dealing with extreme heat as trees are a scarce resource within the area.

7.2.3.4 Sleeping outdoors

In the rural areas, sleeping outside was also made difficult by donkeys which moved around during the nights. Beitbridge has a high population of donkeys and their owners usually neglect them. Poor households are most affected since they cannot afford to fence off their yards, thus allowing the donkeys access to their yards. In some cases, thieves break in as people will be sleeping outside. One participant noted that:

There are many dangers of sleeping outside as you cannot even trust fellow human beings and animals as well.

Participants also pointed out that sleeping outdoors is not suitable for babies as this can expose them to windy conditions that can compromise their health. As such, the general lack of sleep to some causes insomnia, sleeping disorders and general discomfort.

7.2.3.5 Fans and air conditioners

Unlike the urbanites, the rural population noted that they do not have access to fans and air conditioners for use during extreme heat. The participants lamented the failure to access electricity as the major contributor to the lack of fans and air conditioners for the use during extreme heat. A traditional leader noted that:

Fans and air conditioners are things that are foreign here [...] some of our children have never seen a fan or an air conditioner here.

Again, other participants noted that they cannot afford to buy solar systems as the technology was beyond their reach due to lack of financial power. As such, fans and air conditioners are gadgets associated with the urban not the rural Beitbridge.

7.2.3.6 Bathing and swimming

Bathing was mentioned as one of the ways used for cooling during extreme heat. However, some of the participants noted that shortage of water was also preventing them to bath as many times per day as they would have wished due to the influence of extreme heat. Some mentioned that in some villages the dry wells and boreholes meant long walks to the community boreholes and that made water for bathing a luxury. Therefore, in most cases, individuals would repeatedly bath using the same water. Children would also bath together, sharing a single bucket of water. On swimming, the rural community highlighted that it did not have swimming pools and that the rivers had long dried up due to extreme heat. Hence, there were no resources for swimming during extreme heat.

7.2.3.7 Checking on the old, young and the disabled

Within rural Beitbridge, other social groups maintain constant observation of the old, young, and disabled. These are the most vulnerable social groups to extreme heat. The old are more vulnerable due to living with chronic diseases and old age. The young particularly toddlers are more vulnerable as they tend to play outdoors where there is direct contact with the sun and extreme heat. Participants noted that children are more vulnerable to headaches and rash on their body. Persons with disabilities were said to be vulnerable as they may be having underlying health conditions. One of the most affected groups is the people living with albinism as their skin is easily affected by the sun and extreme heat.

7.2.3.9 Avoiding working during the afternoon

A significant number of participants noted that they avoid working during the day when temperatures would be high. Most of the participants noted that they prefer to work in the early hours of the day thus 4am to 9am when heat extreme becomes unbearable. This trend was associated more with hard manual labour like agricultural activities and maintaining fences. However, some household tasks that were deemed not heavy were said to be done even during the day as people could perform those tasks under the shed. One of the participants noted that:

If you notice some of the tasks done by us women can be done even when it is too hot but unlike most of the tasks performed by men.

The above quotation points out to the gendered nature of performing duties despite the incidence of extreme heat. Performing of duties is attached to gender and women are expected to perform even when there is extreme heat due to the social understanding that their chores or duties are “light” and they can be performed under shed or even not under the shed.

7.2.5 Towards institutional interventions to help communities to cope with heat in rural spaces

The rural community like the urban community reported that there is no institutional response towards dealing with extreme heat. The meteorological officer noted that they only manage to disseminate readings but there are no measures that have been set in place to evade the effects of extreme heat. Most of the villagers noted that they have received no help particularly from the government and other independent organizations. A local leader noted that:

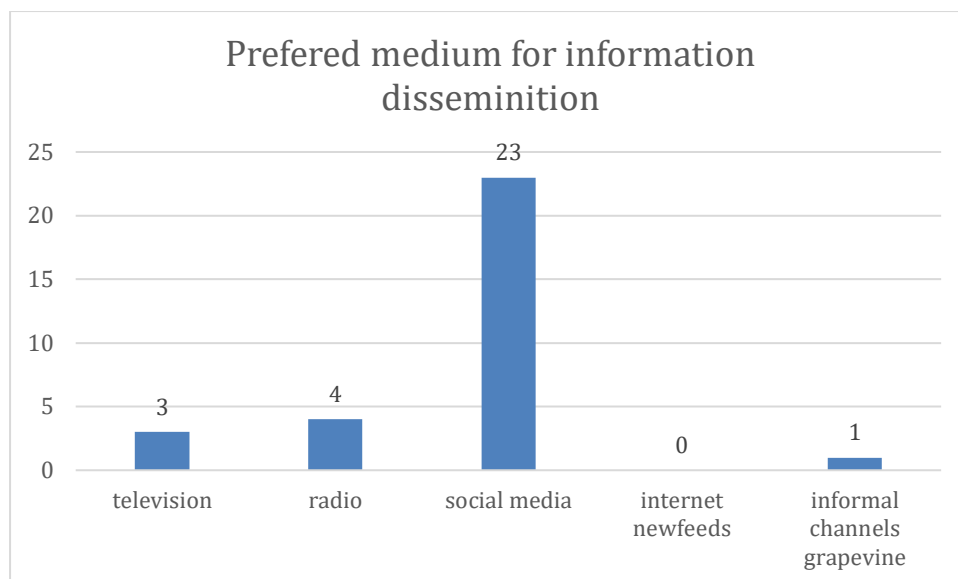
Here we are on our own when it comes to extreme heat ...
we are given support in other things but not in heat.

This view by the traditional echoed the views of other villagers who noted that here "heat is a normal thing to us and no one cares about us". The above statement highlights how extreme heat has been normalized within the content of Beitbridge rural. This normalization results in neglect by institutions. There is a lack of a Response Plan on the part of the government and other organisations that can help with dealing with extreme heat.

As well, participants in both the rural and urban areas stressed the need for the government and its partners to drill more boreholes, and especially those that are solar powered, in order to arrest the challenge of water for domestic use. Suggestions were also made that if possible, the water could be piped near residential areas in order to relieve residents from walking long distances to fetch water.

7.2.6 Communication and outreach strategies in rural Beitbridge

Communication was highlighted to be one of the things that needed to be improved in order to deal with extreme heat. Participants noted that they needed to receive prior communication regarding impending extreme heat. The majority of the participants noted that they need this communication so that they prepare how they will go ahead with their day-to-day business. Below is a table of preferred means of communication.



The above table shows the preferences of the means for communication by the rural population. The participants also noted that communication was supposed to be dispersed periodically.

8. Limitations

There was a need alter original timeframes outlined in the proposal and Inception Report owing to administrative and natural factors. The ethics clearance took longer than anticipated due to internal University issues and it was granted on 18 August. However, the timing also allowed us to conduct fieldwork when Beitbridge temperatures were starting to get hotter (winter ends in late July to mid-August in Zimbabwe). As well, high temperatures are usually recorded in November in Beitbridge and conducting fieldwork then would have allowed us to capture, at least by way of observation, some extreme heat related dynamics in their natural settings. We however tried to avert this limitation by conducting more fieldwork in October. The informal nature of livelihoods in Beitbridge also entailed that some would be participants were not willing to spare their time by participating in the study. We thus had to adjust some interview schedules, while in some very few cases, potential participants would decline to participate citing busy schedules. However, we still managed to reach our target.

Conclusions

Extreme heat has been the most under-rated weather hazard in Africa. Unlike the remarkable impacts of other weather-related disasters such as droughts and floods, extreme heat can nonetheless be deadly, costly, and damaging to health, infrastructure, agriculture, and an ecological system. Heat stress can contribute to morbidity among children and the elderly reduce labour productivity during the hottest periods and accelerate degeneration of infrastructure. It is therefore imperative to consider future projection of extreme heat to be able to deal with associated vulnerabilities. HWMId could be used for emergency warning alerts for short periods as well as

providing long term insights for adaptation strategies and actions. It is against this background that this study attempted to highlight the impacts of extreme heat on the community of Beitbridge (town and rural).

The main focus of the study was to gain an in-depth understanding of: i) how different groups perceive and experience risks related to extreme heat, ii) how different social groups are coping with extreme heat, iii) institutional interventions to help community to cope with extreme heat, and iv) effective communication and outreach strategies that can be adopted to ensure the largest uptake of self-protective measures for vulnerable groups. The study employed a mixed research method approach as the main methodological underpinnings of the study so as to understand the nature and the extent of the impact of extreme heat in Beitbridge. The study discovered that extreme heat has profound impacts on the community of Beitbridge. The study discovered that extreme heat has profound impacts on the community of Beitbridge. Extreme heat impacts on health, livelihoods, water, energy sources, and social life. However, different groups developed eclectic coping mechanisms to circumvent the impacts of extreme heat. These coping mechanisms include: drinking a lot of water and beverages, using sheds, sleeping outdoors, use of fans and air conditioners, bathing multiple times, swimming, constantly checking on the old and young, and avoiding working during the afternoon. The study also revealed the lack of institutional help and commitment towards addressing the challenges faced by residents due to extreme heat including through alternative livelihood strategies, provision of electricity, sheds, and swimming pools among others. Participants therefore highlighted their desire for institutions to help them cope with extreme heat in a bid to help communities, institutions offer help such as material support, dissemination of information and knowledge. Lastly, there is a need to disseminate information on extreme heat including through road shows, social media, TV and radio, text messages, internet feeds and the grapevine. Such information can help raise awareness and alert residents timeously such that they prepare on time.

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