An Analysis of Knowledge on and Responses to Climate Change Induced Health Hazards: The Case of Mt Darwin District in Zimbabwe

By

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Declaration of Originality

I, Margaret Tawodzera, hereby present for consideration by the Disaster Risk Management Training and Education Centre for Africa (DIMTEC) within the Faculty of Natural and Agricultural Sciences at the University of the Free State (UFS) my dissertation in partial fulfilment of the requirements for the degree of Master's in Disaster Management.

I sincerely declare that this dissertation is the product of my own efforts and that no other person has published a similar study from which I might have copied and at no stage will this work be published without my consent and that of the Disaster Risk Management Training Education Centre for Africa (DIMTEC).

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Abstract

The study examined household knowledge and responses to climate change induced health hazards in Mt Darwin District, Mashonaland Central Province, Zimbabwe. Establishing the extent to which local communities understand climate change and related health hazards, and their responses, is profoundly important for effective disaster management strategies. The study was situated within the social capital theory contextualised in disaster management and emphasised on the importance of knowledge and skills that are constructed through social relationships, networks and interactions. Emphasis was built on valuable information gained and shared among social networks and groups principled on trust, norms, values, sociability and reciprocity. A mixed method approach of research was used to assess the extent of knowledge and perceptions relating to climate change health hazards and the actions being undertaken by the households to avert these hazards. Quantitative and qualitative analysis was employed on data collected using a structured questionnaire and drawn from a total of 210 households in 10 wards in Mt Darwin. A total of 204 questionnaires were completed for analysis. The sample was drawn using the random sample approach from Mt Darwin District. Climate change is a diverse topic where households view climate change as increasing intensity in rainfall, unusual rainfall patterns, prolonged dry spells, erratic rains, and increasing wind speed. While only 38% of the respondents were not aware of climate change, only 7% of the households correctly identified climate change as caused by both natural and manmade forces. About 89% of the respondents indicated that hazards are occurring mainly because of meteorological and hydrological causes. The study further found that climate change knowledge is not influenced by the conventional forces that are age groups, gender, education and past experience of climate related hazards. Further, the majority of households were not taking action against climate change hazards. The findings largely cement those that were established in other studies. The study therefore recommends education and awareness programmes to deepen community understanding of climate change. The programs should consider all age groups, gender and be inclusive of all people regardless of whether they have previously experienced some hazards or not. However, programs to strengthen people's sharing of local level information as identified in the study should be put in place, promoting sharing of the information through social networks and community information channels. Despite the communities having some knowledge gaps and lacking deep understanding of pathways of how climate change alters health outcomes and some critical responses; there

were pockets of vital information within the Mt Darwin community that can be useful in local oriented disaster risk management initiatives.

Dedication

To my two sons (Ryan and Chrislee), my daughter (Princess), and my entire family, for the endurance and understanding whilst I worked away from home and undertook this study.

To my late husband Maxwell, I know you would have been very proud seeing me successfully complete this project.

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Definition of Key Terms

Knowledge - the recent rising strand of research on knowledge of climate change and responses to climate change induced health effects, risks or hazards broadly defines knowledge as understanding, comprehension, awareness and perceptions of climate change.

Response - a response is any action taken by an individual, community or country to tackle or manage environmental change either in anticipation of the changes or after they have been experienced (Tompkins and Adger, 2003).

Disaster Risk Management- refers to the systematic process that integrates risk identification, mitigation and transfer, disaster preparedness, emergency response and rehabilitation or reconstruction in order to reduce the impacts of hazards.

Adaptation - the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2007).

Climate change- is defined as "a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use" (IPCC, 2007).

Climate variability: are the variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forces (external variability) (IPCC, 2007).

Global warming- change in the global average surface temperatures.

Green House Gases (GHGs) - greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface,

the atmosphere itself, and by clouds. These gases result in the greenhouse effect and they include water vapour, carbon dioxide, nitrous and methane.

Health hazards–these are direct and indirect threats to human health. Health hazards are situations, physical events, phenomena or activities with potential damaging effects on human health or that leads to injury or loss of life (Magunda, 2010). The IPCC Third Assessment Report (2001) stated that climate change has direct health impacts due to weather extremes. Various processes of climate and environmental change pose ecological disruption that occur in response with diverse health consequences and climate change induced events causing economic, social and political dislocation with traumatic, infectious, nutritional and psychological consequences (WHO, 2003). Thus health hazards that are related to climate change hazards will be broadly considered in this study as illness, injury and death emanating or related to poor air quality, water and food borne contamination, changing patterns of disease spread by animals, ticks and insects and extreme weather events (Berry et al., 2009).

Acronyms

CIMC	CARRIBBEAN INSTITUTE OF MEDIA AND COMMUNICATION
CO_2	CARBON DIOXIDE
FAO	FOOD AND AGRICULTURE ORGANIZATION
GHGS	GREENHOUSE GASES
GOZ	GOVERNMENT OF ZIMBABWE
H_20	WATER VAPOUR
IFRC	INTERNATIONAL FEDERATION OF RED CROSS AND RED CRESCENT SOCIETIES
IPCC	INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
MoHCC	MINISTRY OF HEALTH AND CHILD CARE
NGOS	NON-GOVERNMENTAL ORGANIZATIONS
OECS	ORGANISATION OF EASTERN CARIBBEAN STATES
SCT	SOCIAL CAPITAL THEORY
TDRM	TOTAL DISASTER RISK MANAGEMENT
UNFCC	UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE
WHO	WORLD HEALTH ORGANIZATION
ZIMSTAT	ZIMBABWE STATISTICS OFFICE

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 Background

This study examined household knowledge and responses to climate change induced health hazards in Mt Darwin District, Mashonaland Central Province, Zimbabwe. The Intergovernmental Panel on Climate Change (IPCC) (2007; 2014) defined climate change as the change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. This change in climate, either naturally or due to human factors, has certain effects and impacts on agriculture, food security and health. Health hazards have been defined as potential consequences of reduced state of physical, mental and social well-being of the population (IPCC, 2014). While literature on climate change has been growing in Zimbabwe (Simba et al., 2012; Tshuma and Mathuthu, 2014; Rankomise, 2015), specific locality evidence on climate change, community understanding of the climate phenomenon and evidence on health impacts, is scarce. Establishing the extent to which local communities understand climate change and related health hazards, and their responses, is however profoundly important for effective disaster management.

Evidence unequivocally suggests health as the most human dimension to suffer the consequences of climate change. World Health Organisation (WHO, 2009) identified health hazards emanating from climate change as death from thermal extremes and weather disasters, vector borne diseases, higher incidence of food related and waterborne infections, photochemical air pollutants and conflicts driven from depleted natural resources. Earlier, the IPCC (2007) had summed that food, water, industry and settlements will be affected by climate change worsening health status of millions of people by increasing deaths, disease and injury due to heat waves, floods, storms, fires and droughts. Due to climatic forces malnutrition is likely to exacerbate together with diarrhoeal diseases and malaria.

Despite this evidence at the global level, regional and national efforts articulating and informing the relationships between climate change and health remains scant. IFRC (2014) called for more evidence on localised partial perceptions and responses to climate change induced hazards. It further commented that disaster prevention encounters difficulties where local knowledge, culture and beliefs are un-explored. Similarly, Lotz-Sisitka and Urguhart (2014) reiterated the need for specific and localised knowledge and capacity needs on climate

change. This study was therefore an attempt to importantly build a knowledge base on the existing knowledge about climate change induced health hazards in specific communities and how habitats are responding to such hazards; importantly informing disaster risk management efforts in the country.

1.2 Climate Change

1.2.1 Global Overview

There is consensus among scientists that climate is changing with varying global consequences (IPCC, 2007; Bhusal, 2009; Chaudhary and Aryl, 2009). Chaudhary and Aryl (2009) stated that scientists have presented and tested evidence to substantiate alarming facts of climate change. Observed and anticipated changes in climate change include changes in precipitation, heat waves, intense hurricanes and storms. These changes in the surrounding environment will affect human health through complex interactions with human behaviour. The changes in climate are often rapid and have widespread threats to human life. Such changes are exhibited by changes in climate normalcy; changes in average temperature and precipitation for a given place and time across decades. The 20^{th} and 21^{st} Centuries have shown significant changes to mark the warmest and driest centuries in global history.

Climate change is a result of both natural and human forces. The interactions among the atmosphere, the land, oceans and solar radiation reaching the earth cause changes in climate on the earth's surface. This is a result of naturally occurring gases, for example carbon dioxide (CO_2) and water vapour (H_2O), which trap heat in the atmosphere resulting in the greenhouse effect. The larger proportion of climate change is due to anthropogenic greenhouse gas concentrations, mostly carbon dioxide (UNFCC, 2007). Anthropogenic greenhouse gas concentrations result from the burning of fossil fuels like oil, coal, and natural gas that add carbon dioxide to the atmosphere causing changes and variability in climate.

The main characteristics of climate change processes include ice cap melting, changes in precipitation and changes in average temperatures. Climate change causes hazards that include droughts, floods, heat waves and cyclones. It has resulted in changes in type, frequency and intensity of extreme events that includes these cyclones, floods, droughts, and heavy precipitation events. The major threats arising from climate change include disease spread, casualties, famines, economic losses, biodiversity losses and loss of traditional lifestyles (UNFCC, 2007; Meehl et al., 2007).

Climate change has a number of impacts and effects on the environment, social, economic, health and related sectors. Water resources, agriculture, food security, human health, terrestrial ecosystems and biodiversity could be altered by changes in various climatic components. Severe water shortages and flooding will be the result of changes in rain water patterns. Increase in temperatures will change the crop growing season, affecting food security and altering the distribution of disease vectors putting more people at risk of contracting malaria and other vector borne diseases.

1.2.2 Climate change in Zimbabwe

Zimbabwe has not been spared by sustained changes and variability in climate. The country has experienced a warming trend towards the end of the twentieth century. Scholars agree that the climate of the country is changing though research remains scant (Manyeruke et al., 2013; Mudzengi et al., 2013; Mugandani et al., 2012; Zivanomoyo and Mukarati, undated). Shifts in rainfall patterns, increases in mean temperature, and increased frequency and extremity in drought, floods and heat waves have all been cited as evidence of climate change.

Consistent with global trends, Zimbabwe experienced a warming trend towards the last quarter of the 20th Century. The annual mean temperature has been found to be increasing at 0.4^{o}C since 1900. The 1990s are ranked the warmest as well as the driest seasons. During the wet season, day temperatures have been found to have warmed compared to night temperatures. As shown in Figure 1.1 the number of days with minimum temperatures below 12^{o}C has been declining while those with a maximum of 30^{o}C or above have been increasing. Warming is expected to worsen in future; at global warming rates of 0.1^{o}C and 0.4^{o}C, Zimbabwe is projected to record average temperature rises of 1.3^{o}C and 4.6^{o}C respectively.

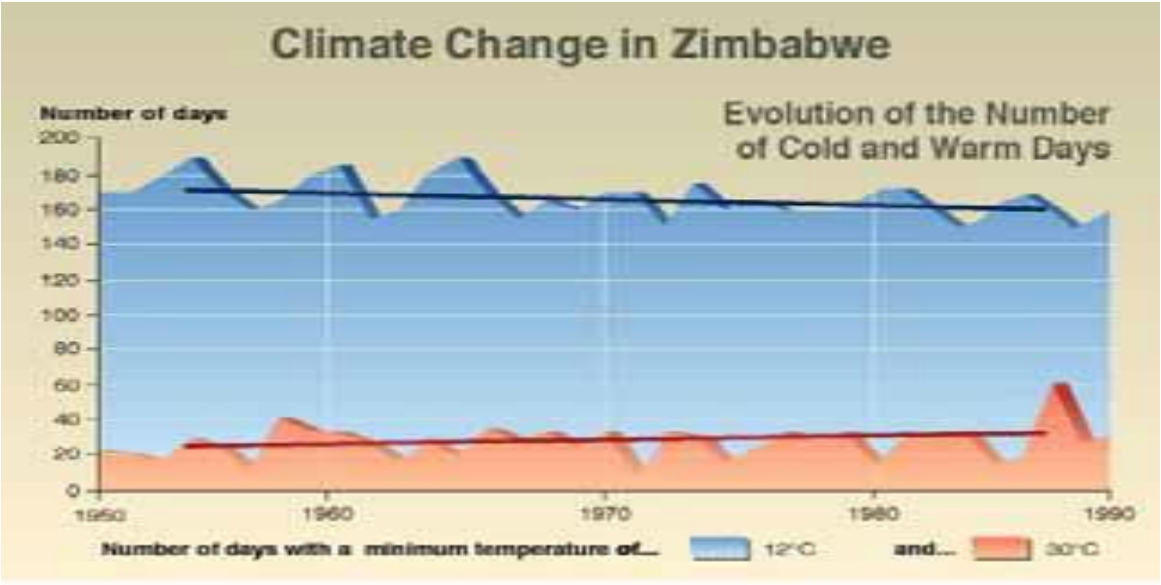

Figure 1.1: Number of Days with minimum temperature of 12°C and Maximum of 30°C
Source: Manyeruke et al., 2013

Rainfall patterns have been affected by climate change. The rainy season, that normally begins from mid-November and ending in April has shifted to begin in December and increasingly becoming uncertain. Overall rainfall declined by 5% across the country since 1901 and the 1990s have witnessed the driest seasons (Manjengwa et al., 2014). Manjengwa et al. (2014) indicated that the timing and amount of rainfall in Zimbabwe is increasingly becoming uncertain. The frequency and length of dry spells have increased while rainy days have declined. Figure 1.2 below shows that rainfall is generally declining while in Figure 1.3 it is shown that negative rainfall variation has been increasing in both time periods and rainfall amounts. This therefore means that it is more likely to experience below normal rainfall covering a number of seasons now as compared to previous decades.

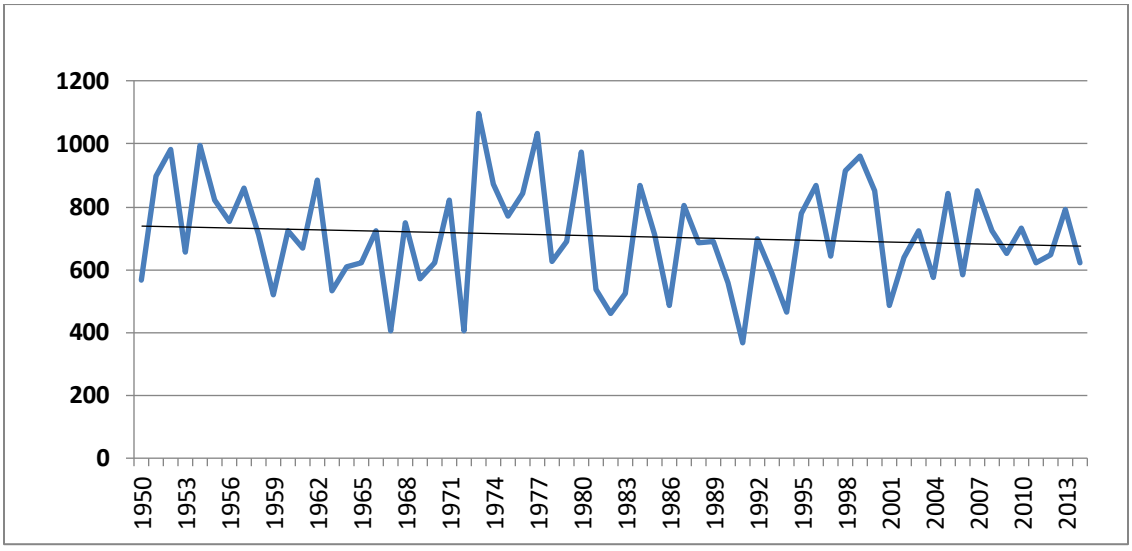

Figure 1.2: Zimbabwe Annual Rainfall and Trend line 1950 – 2014
Data source: Zimbabwe Meteorological Services, 2014

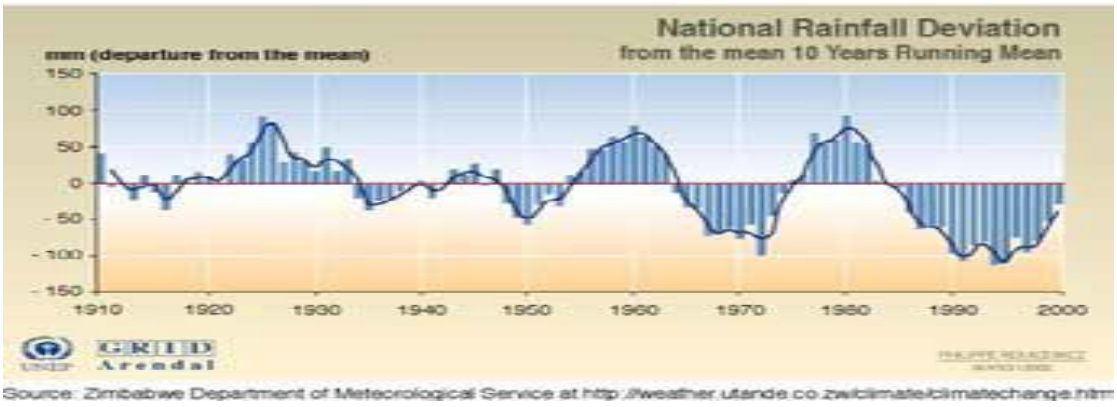

Figure 1.3: Rainfall deviation, 1910-2000
Source: Manyeruke et al., 2013

Contradicting evidence suggests that the rainfall amount has not changed but the distribution and rain days have declined. Figure 1.4 shows that the beginning of the rain season has slightly shifted from October to November. The number of rain days has declined though monthly rainfall amount exceeds that of the old climate. This feature is explained by increased rainfall intensity, for example, two rain days can amount to monthly rainfall. Thus, rainfall seasons with frequent and prolonged dry spells of up to 60 days can still record normal rainfall amounts. Maximum rainfall which used to be received in January is now being received in December as shown in the figure below. Evidence therefore clearly indicates that Zimbabwe's climate has changed.

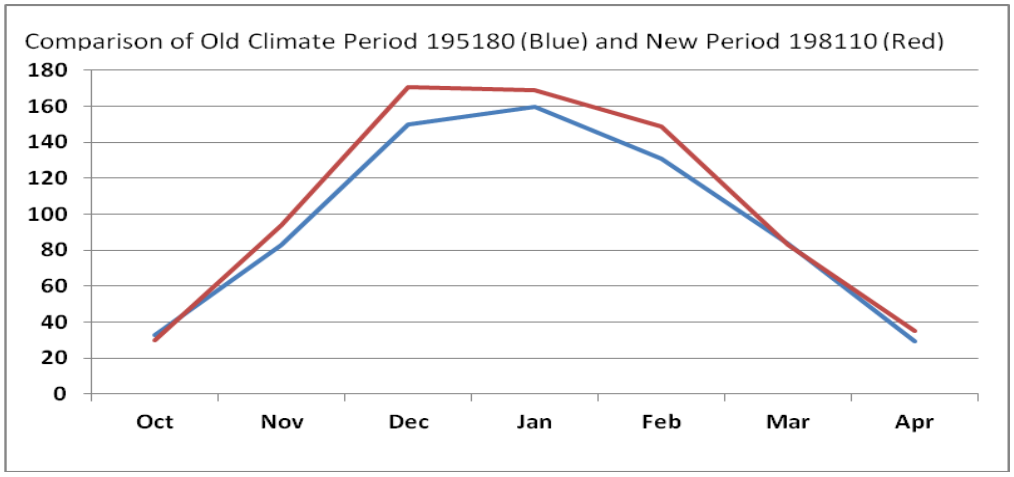

Figure 1.4: Old (1951-1980) and New (1981-2010) Climate
Source: Zimbabwe Meteorological Department, 2015

Frequency, spread and intensity of droughts have heightened. During the 1960s and 1970s, droughts used to occur after a period of 10 years yet the eighties has registered droughts in every 3-4 years. Successive droughts have also been registered between 2001-2003, 2004-05, and 2006-07. The areas being affected by these droughts are widening, enlarging Zimbabwe's epidemic prone zones and changing the agro-ecological zones with serious threat to food security and nutrition.

Zimbabwe has since registered increased frequency and intensity of extreme climate events. Droughts and floods have become alternating, more frequent and more intense posing direct and indirect threats to the population of Zimbabwe. There was Cyclone Eline in 2002 which was followed by Cyclone Japhet in 2003 that affected the greater part of Zimbabwe, damaging property and taking lives of hundreds of Zimbabweans. Rain seasons have turned to be unusual. In 2007/08, there were heavy down pours between November and December that broke the highest records followed by drought during the last part of the same rain season (Jan-April). Thus rainfall seasons have become more unusual, uncertain and unpredictable as characterised by droughts, floods and dry spells.

Since 2009, heat waves have become a common feature between October and November, breaking record temperatures. In October 2015, extremely high temperatures were recorded, breaking records of the past 6 years. Average temperature increased from between 35^{o}C - 41^{o}C to 33^{o}C - 43^{o}C. Record high temperatures have been recorded in most parts of Zimbabwe that included Mt Darwin, Masvingo, Marondera, Chivhu, Zvishavane, Harare and Kwekwe. These record high temperatures recorded in 2015, followed some high temperatures

of a similar nature, an increase of 2^{o}C from the 1954 records, which was recorded in 2010[1]. Initially, these temperatures have been attributed to a low pressure system caused by winds blowing across the country from warmer tropics. These extreme hot and dry conditions are patterns of a weather shift from normal that calls for precautionary and adoptive measures, particularly for children and the elderly who succumb to these extreme conditions.

1.3 Health and Climate Change

Health hazards due to climate change are diverse and complex. These include heat stress; vector-borne diseases (such as malaria, dengue fever and yellow fever); extreme weather events; air pollution; communicable diseases (such as HIV/AIDS, TB and cholera), and non-communicable diseases (such as cardio-vascular and respiratory diseases) (Munzhedzi, and Cele, 2014**)**. The deleterious impacts of climate change are further expected on mental and occupational health, food insecurity, hunger and malnutrition. Wardekker (2011) argued that hazards due to climate change will have health effects that include an increased burden of malnutrition, diarrhoeal, cardio-respiratory and infectious diseases, increased morbidity and mortality from heat waves, floods and droughts, changes in distribution of some disease vectors, and hence substantial burden on the health delivery system.

LANCET (2009) lamented climate change as the biggest threat to global health during the 21st century. Natural and climate change hazards due to climate change include extreme storms, heatwaves, and air pollution, vector borne infections, water shortages and food shortages. The hazards are disproportionately distributed across the globe with developing economies likely to be most affected as they lack the financial means, effective health delivery systems as well as technology to adapt and mitigate against climate change. UNFCCC (2011) posited that the projected climate change-related exposures are likely to affect the health status of millions of people worldwide, particularly those least able to adapt, such as the poor, the very young and the elderly. The web in Figure 1-5 illustrates the various mechanisms through which people's health is affected by climate change.

[1]Presentation by the Zimbabwe Meteorological Department (MSD) at a Pre-Planting Workshop Held by ZIMCODD at New Ambassador Hotel, Harare-Zimbabwe, on the **17th of November 2015.**

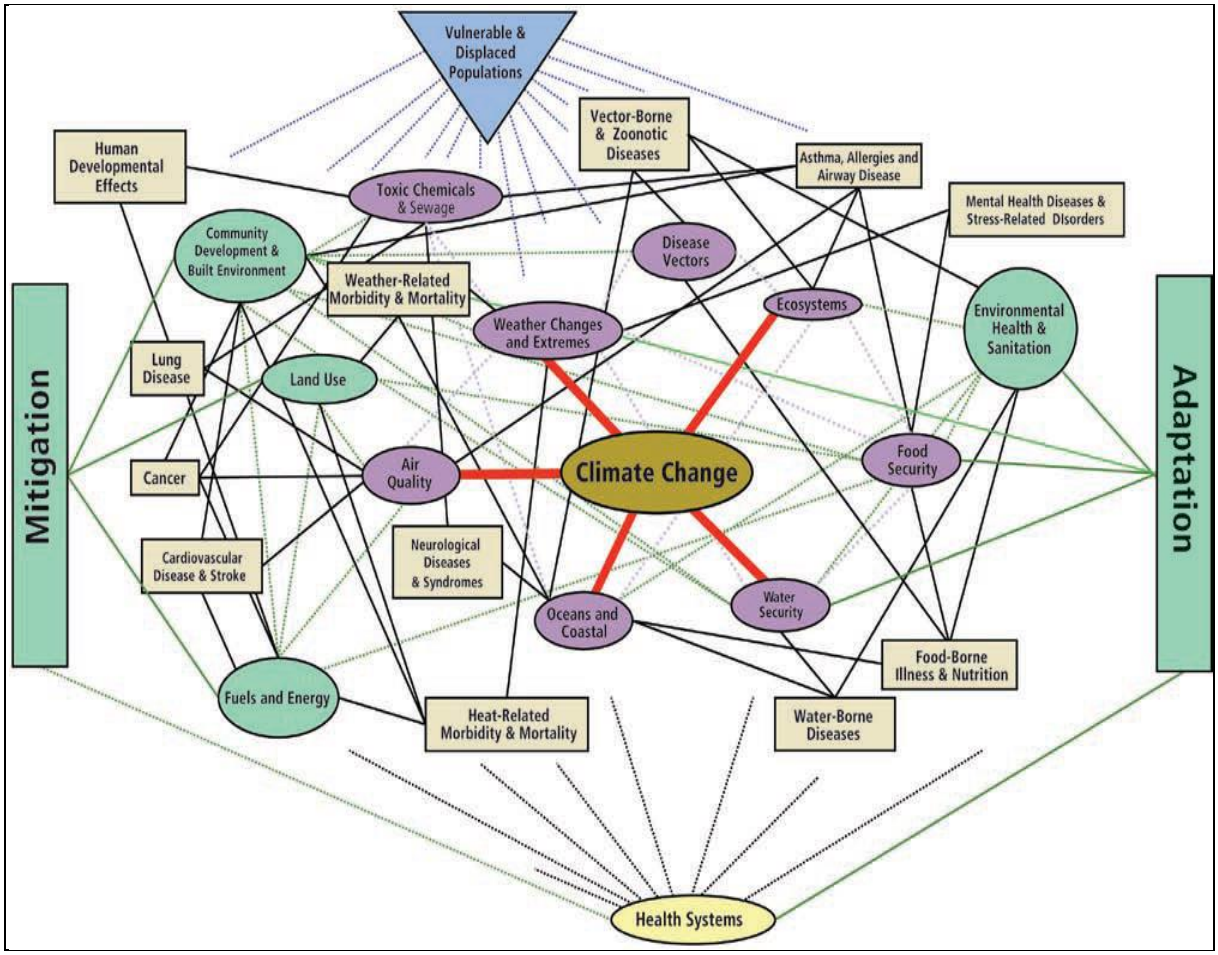

Figure 1.5: Health Hazards of Climate Change
Source: The Interagency Working Group on Climate Change and Health, 2010.

1.3.1 Effects of Extreme Storms, floods and droughts

The occurrence of extreme weather and climate events have increased in both severity and frequency as predicted by Boko et al. (2007) and Christensen et al. (2007). WHO (undated) indicated that the number of extreme weather/climatic events increased from 243 in the 1980s to 247 in the 1990s. Regions, nations and communities are facing disasters that include storms, droughts, extreme heat and floods. In some instances, these disasters alternate during the same season posing extreme health threats (G.0.Z, 2013). Extreme weather and climate events have direct impacts on human health such as death, injury, loss of property, disruption in or loss of livelihoods, and infrastructure destruction (Clayton et al., 2014). About 10 thousand people have been killed and 104.3 million affected by these extreme climatic/weather events in the 1990s.

Other effects include air pollution, flooding, water borne diseases, an increase in vector borne diseases and heat related deaths. Beyond the physical impacts, extreme events pose indirect health effects such as psychological stress. The impacts of extreme events are hard to predict and compute as other impacts of climate change result in several secondary effects and delayed outcomes arise while social and remedial support mechanisms greatly influence the effect of extreme weather events on communities.

Zimbabwe has since registered increased frequency and intensity of extreme climate events. Droughts and floods have become alternating, more frequent and more intense posing direct and indirect threats to the population. Cyclone Eline in 2002 which was followed by Cyclone Japhet in 2003 affected the greater part of Zimbabwe, damaging property and claiming lives of hundreds of Zimbabweans. Rainy seasons have become an unusual occurrence, in 2007/08, there were heavy down pours and storms between November and December that broke the highest records followed by drought for the last part of the rain season (Jan-April). Manjengwa et al. (2014) indicated that, although the quantity of rainfall in a seasonal year in Zimbabwe maybe normal, the rain may fall during violent storms.

1.3.2 Heat waves Increase Death and Illness

Climate change increases heat-related illnesses and deaths. Extreme heat and stagnant air masses will increase heat related illnesses and deaths (Kovats et al, undated). Jakuboski (2013) indicated that heat waves cause discomfort, dehydration, heat exhaustion and heat strokes. These conditions deteriorate into death or permanent disability if early treatment is not given. Excessive heat that causes dehydration has the potential to damage the brain, heart and kidneys among other body parts. Health effects of heat waves can be seen through disorientation, seizures and abnormal rise in body temperature (hyperthermia) that can be fatal. The Centre for Disease Control argued that higher temperatures are linked to respiratory problems as higher temperatures contribute to the build- up of harmful air pollutants.

The frequency, intensity and duration of heat waves are already being altered in Zimbabwe. Rises in air temperature are likely to increase death and illness due to heat stress, heatstroke, cardiovascular diseases and kidney diseases (NRDC, 2011). Heat waves have devastating effects to persons with pre-existing conditions. Persons to be mostly harmed are the elderly, children and those in economically disadvantaged communities. As heat waves affected Zimbabwe with the year 2015 breaking record temperatures, people's health is at risk of this

climate change induced health hazard. Effects of heat waves in Zimbabwe cannot be ruled out on exacerbating mortality from HIV/AIDS, influenza and pneumonia, tuberculosis, stroke and coronary heart disease; the top causes of death in Zimbabwe.

1.3.3 Air pollution

Climate change is predicted to diminish air quality leading to health problems when the national standards are exceeded. An increase in temperatures increases ozone smog formation which is associated with death and an increase in hospital admissions for people with pre-existing respiratory diseases such as asthma while the health conditions for people with cardiac or pulmonary diseases will increase (Knowlton, undated)[2]. Air pollution is hazardous; its negative effects further include lung inflammation, emphysema, chronic bronchitis, lung cancer, heart attacks and stroke, deformation in babies, nose, eye and throat irritation, and damages to the nervous system.

1.3.4 Vector borne infections

Climate change will affect the pattern of occurrence for vector borne diseases such as malaria, bilharzia and dengue fever which are among the most infectious diseases that are difficult to prevent and control. It is already difficult to predict the behaviour of mosquitos, ticks and fleas that cause diseases in both humans and animals. As the ecology and epidemiology of vector borne diseases depends on the host (humans and animal vectors), the environment and the pathogen, vector borne infections are influenced by changes in temperatures and surface water, habitat changes, climate change among other things. The insects include the mosquito species that spread malaria, viral diseases such as dengue and yellow fever. Stagnant water enables the breeding of mosquitos while humid conditions enhance viability for the adult mosquitoes.

Malaria and bilharzia are among the major vector borne diseases of public health concern in Zimbabwe (MOHCC, 2014). Between 2008 and 2011, malaria accounted an annual average of 8 901 inpatient admissions (6.35% of in-patient admissions for the top ten diseases) (ZIMSTAT, 2013) and 644 179 out-patient's attendances (7% of the leading ten causes of out-patients visits). In 2009, the incidence of malaria was at 9.4% with 5 million people estimated to be at risk, while an average of 1.5 million cases and over 1000 deaths are recorded annually (G.O.Z, 2009). Moss et al (2012) indicated that while tremendous gains in reducing malaria incidence have been recognised for the past years in Southern Africa,

[2]Kim Knowlton, Climate and Your Health: Addressing the Most Serious Health Effects of Climate Change. NRDC

Zimbabwe witnessed the resurgence of malaria after fifty years of successful control. The best and worst case scenarios show high incidences of malaria hazard in the low lying parts of the country. Emergence and re-emergence of malaria has been noticed with previously malaria free zones experiencing new cases of malaria. Today, about 45 of the country's 62 districts are malaria risk prone with 33 districts being in the high risk category. Almost half of the population is at risk from malaria and changing rainfall patterns, temperatures and extreme events will have an effect on the ecology and epidemiology of malaria.

1.3.5 Water security

Climate change has been predicted to affect water security in Africa and Zimbabwe in particular. Few et al (2004) and Christensen et al (2007) predicted that water scarcity and stress will heighten in Africa with potential for conflicts over the 50 trans-boundary river basins. GOZ (2013) indicated that droughts, floods and extreme temperatures have reduced the amount and quality of fresh water despite the increasing competing needs in domestic use, industrial use, cropping, river flow and ground water recharge. In 1998, the Government of Zimbabwe raised the alarm of the possible shift from annual flow regimes for major rivers to seasonal flows.

Between 1990 and 2012, the proportion of Zimbabwean population with access to improved and safe drinking water has been constant at 80%[3]. Lack of access to quality water has negative health effects as quality water is a precondition to good health. Lack of and unpredictable access to quality water has effects on mortality related to water borne diseases such as cholera and typhoid. Due to water problems countrywide, Zimbabwe experienced the worst cholera outbreak recorded in Southern Africa that killed 4000 and affected 98 741 people in 2008/9 (Chikumba, 2010). In recent years, diarrhoea has become a common killer of children in Zimbabwe. Lack of access to safe water for domestic use may also increase food borne diseases.

1.3.6 Food security, hunger and malnutrition

Agriculture has been predicted to suffer the most consequences of climate change. Increased frequency, duration and intensity of droughts, excessive temperatures, and uncertain, sparse and erratic rainfall will reduce agricultural productivity. The change in climate has negative effects on agricultural productivity in Africa as temperatures are already high. Food systems

[3]WHO and UNICEF. (2014). Progress on Drinking Water and 2014 Sanitation.http://www.unicef.org/gambia/Progress_on_drinking_water_and_sanitation_2014_update.pdf

will be affected with profound negative effects to the availability, access and utilisation of food.

Most areas in Zimbabwe are receiving less and less rainfall, reduced rain seasons and uncertainty on the beginning and end of rain seasons (Magutah, 2010). Climate change has been found to severely affect agriculture, reduce land quality and yields and resulting in failure to plant at all. Chokodzi (2013), and Mano and Nhemachena, (2005) indicated that productivity of smallholder farmers that constitute the majority of farmers (more than 90% of farmers in Zimbabwe) has severely declined due to the perils of climate change. Persistent food security problems in Zimbabwe have been blamed on climate change: frequent droughts, uncertain rainfall seasons, floods and heavy down pours. In 2014, about 2.2 million of the 13 million people in Zimbabwe were food insecure during the peak hunger period (January to March). The prevalence of food inadequacy for the period 2011 to 2013 of 39.7% remains high and close to 52.5% of the country's population was projected as food insecure during the 1991/92 severe drought. Due to disruption of agricultural production system, prevalence of undernourishment is high in Zimbabwe at 34.5% in 2011 while 4.5 million people were undernourished in 2014 (FAO, 2014).

1.3.7 Mental health

The direct and indirect impacts of climate change exacerbate mental health. Displacing of communities, destruction of physical infrastructure such as homes, schools, clinics and road networks, loss of life, climate induced diseases and injuries cause the destruction of social and biophysical support systems with severe effects on mental health and human well-being. Muzhedzi and Cele indicated that climate extreme events have been associated with deterioration of mental capacity and increased hospitalisation due to issues such as mental disorders, mood disorders, somatoform disorders senility and psychological development disorders. As climatic events render some areas uninhabitable and possibly unproductive, environmental distress, disturbed sense of place will worsen mental health as anxiety, apathy, helplessness, depression and chronic psychological distress will result.

1.4 Study Area

The study was undertaken in the Mt Darwin district in Mashonaland in the Central Province of Zimbabwe. In 2011, the district had an estimated population of 218 724 out of a total provincial population of 1.088 million (ZIMSTAT, 2013). It is the most populous district among the seven districts in Mashonaland Central Province, accounting for 20% of the provincial population. The district is about 156 km from Harare and about 69 km from the

provincial town, Bindura. The District lies 16^0South and 31^0East of Bindura, bordering with Mozambique along the Mukumbura River in the North, Rushinga in the East, Shamva in the South and Muzarabani in the West. The average temperature for the district is 24^0C in summer and 14^0C in winter. Average rains of 650-800mm are received in the summer season per annum. About 80% of the district falls within agro-ecological regions 4 and 5 receiving rainfall between 650 and 800 millimetres per annum while the other 20% falls within ecological regions 2b and 3 where rainfall is fairly high. The summer is dry and hot with a short raining season that historically covered the period November to February. Prolonged dry spells also characterise the summer while winters are generally cool and dry. People in the district are fairly educated despite that males are better educated compared to women.

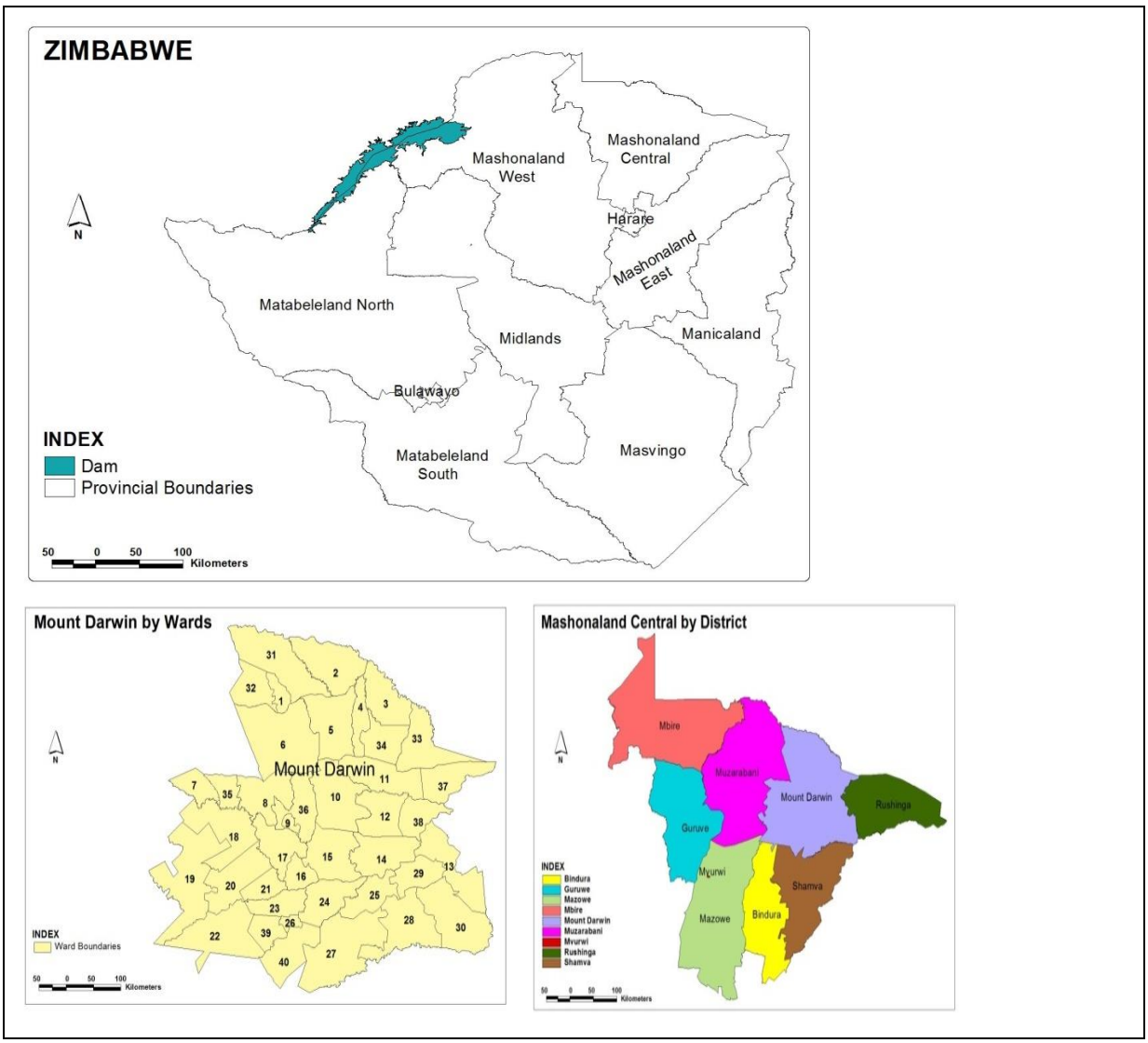

Figure 1.6: Maps for Zimbabwe, Mashonaland Central Province and Mt Darwin District
Source: ZimStat, 2015

Most parts of the area are not suitable for agriculture as they are characterised by poor sandy soils and unsuitable topology. Persistent droughts are also exacerbating food insecurity in the region. Communal farming is common in the district with cotton, tobacco, sweet potatoes, maize, ground nuts and round nuts being the most produced crops.

Mt Darwin district is among disaster prone areas in Zimbabwe; experiencing floods in nine of the past fourteen years, recurring heat waves since 2009 and a number of strong winds that have destroyed houses, schools and clinics, and displaced a number of people. The area has been experiencing a growing number of diseases and extreme events related to climate change and variability. Table 1-1 indicates that reported cases of tuberculosis, Acute Respiratory Infection (ARI), diarrhoea, dysentery and cancer have grown by 233% between 2004 and 2014 (MoHCC, 2014). Although cases of malaria and bilharzia have declined between these periods, they remain high as indicated again in Table 1-1. Between 1999-2000 and 2008, the area experienced cholera epidemics that were caused by floods and claimed more than 800 lives.

Malaria incidences are high and the district is ranked seventh with an incidence rate of 73.75 per 1000 in 2011 behind Nyanga (202.07), Mudzi (174); Mutasa (164), Mutoko (164), Chimanimani (111) and Chiredzi (85) (ZIMSTAT, 2011). In addition, diarrhoea and dysentery cases are high in the district. In 2011, the incidence of diarrhoea was at 46.8 per 1000 while that of dysentery was at 7.4 per 1000. The district houses one government hospital and one mission hospital.

Table 1.1: Comparing Reported Cases in 2004 and 2014

	2004	2014	Change (%)
TB	3,447	4,252	23
ARI	65,936	121,294	84
Asthma	1,913	67	-96
Malaria	42,524	21,518	-49
Bilharzia	3,872	3,309	-15
Diarrhoea	5,451	14,368	164
Dysentery	1,236	1,834	48
Cancer (Breast, Cervix, Prostate)	119	1,130	850

Source: Ministry of Health and Child Care, 2014

In 2011, chaos was reported in the district as 160 houses were destroyed by floods and strong winds. The area experienced violent storms on 28 November 2012 that destroyed a school and several houses. On January 5 2015, it was reported that 100 families were left homeless

after 52 houses and a secondary school were destroyed by violent floods[4]. On 9 January 2015, a school and a clinic were destroyed while 276 homes were damaged in Mt Darwin following violent storms and floods. Heat waves have also affected the district with the record high temperature of 38.6^{o}C recorded in November 2015[5]. The health characteristics of this district connect well with climate issues making it an interesting district to examine. The district's proximity to the border with Mozambique means a mix of culture, behaviour and interactions that directs heterogeneity in responding to climatic events. Overall the fact that it is the most populous district in the province offers strategic interests for examining it.

1.5 Justification of Study

Climate change has deleterious effects on natural and human systems, infrastructure and economies that all feed into the health status of people. Within these changing global climatic systems, calls have been made for broad spectrum policy responses and strategies implemented at local, national, regional and global level. The impacts, responses, vulnerabilities, mitigation and adaptation issues have been well researched and documented, however, the link between health and climate change has not been mainstreamed. There have been strong calls for appreciating community level knowledge on climate change, impacts and responses; in particular, understanding locals' knowledge which is important in shaping effective policies and strategies for reducing exposure, vulnerability and building resilience to the potential adverse impacts of climate change (Parkinston and Butler, 2005; IPCC, 2012; WHO, 2009).

This study helped to build a knowledge base in attempts to manage health hazards emanating from climate change. Specifically, the study helped to identify information gaps on climate change, helping in defining the educational needs of communities and focus health interventions. Maibach (2011) indicated that decisions to address climate change health hazards are too important to be left to experts and policy makers alone; there is need to understand vulnerable communities better, consulting, informing and empowering them in issues shaping their climate-health understanding. The study, in a way, provided the base that shapes participation and involvement of locals in national health and climate issues, policies and strategies as enshrined in the climate change strategy. The study contributed to literature by documenting the extent to which local communities relate climate change to health, an issue which has been neglected in research.

[4] Herald Zimbabwe, http://www.herald.co.zw/floods-leave-100s-homeless/
[5] Herald Zimbabwe, http://www.herald.co.zw/violent-storm-wreaks-havoc-in-mt-darwin/

1.6 Research Problem

Evidence suggests that climate change induced health hazards have increased in Zimbabwe (GOZ, 2013:53). These health hazards include infectious diseases, high incidences of vector and water borne diseases (malaria, diarrhoea and dysentery); violent storms and floods leaving people homeless and perennial mild and severe droughts resulting in malnutrition. In order to address these climate change induced health hazards, public health awareness, resilience and disaster risk reduction programmes centred on the community and among the people are vital (Hague et al., 2012; Kaim, 2013; IFRC, 2013). Developing these programmes require a comprehensive understanding of the community, its knowledge, behaviour and perceptions (GOZ, 2013). Hori and Shaw (2014) posited that community knowledge and perception of climate change is a factor in increasing local awareness of climate disaster risk reduction and it encourages more disaster risk reduction actions by communities themselves, hence sustainability of such actions. Hague et al (2012) indicated that as communities are vulnerable to climate change, their knowledge and perceptions on climate change are useful in drafting climate change related disaster reduction strategies and adaptation programmes.

Despite the importance of local knowledge and perceptions to climate change disaster risks and hazards emphasised above, there is little evidence on the existing knowledge on climate change in Zimbabwe, particularly, knowledge on the relationship between climate change and health hazards. Most studies at local levels have concentrated on establishing the impact of climate change, adaptation and mitigation efforts as well as response to climate change impacts thereby limiting evidence on community understanding of climate change induced health hazards and their coping strategies (see Munaku and Chigora, 2010; Parry, 1988; Mere, 2013). This is so despite the signalised importance of community knowledge on climate change (Maibach, 2011). GOZ (2013) argued that lack of reliable and appropriate information on present and future climate risks and hazards, and sufficiently high resolution and continuous evidence of local level understanding of climate change are among the major obstacles to reduce health hazards induced by climate change. This knowledge gap has often led to ineffective and resisted disaster risk reduction initiatives (education and training) and public awareness programmes.

The research study attempted to build a base on local level knowledge on climate change induced health hazards and responses to such hazards. The research focused on health hazards as climate change has had considerable health impacts in Zimbabwe (GOZ, 2013). It is important to appreciate climate change health hazards in the context of disaster risk

management and for purposes of improving health outcomes and achieving sustainable development goals. This study was therefore a valuable contribution to the literature on community specific understanding of climate change induced health hazards. Specifically, this research fed into the four strategies of disaster risk management identified in the Zimbabwe National Climate Change Response Strategy that are to;

i. Identify and address factors that should be considered in building adaptive capacity in local communities,
ii. Gather evidence for developing effective adaptive, disaster preparedness and response capacities,
iii. Carry out research to fill the existing knowledge on risks and hazards associated with climate induced disasters,
iv. Encourage behavioural change for disaster risk management through education, information and regulation.

1.7 Research Questions and Objectives

1.7.1 Research Questions

a) What do people in Mt Darwin District of Zimbabwe understand about climate change induced health hazards?
b) How are people responding to climate change induced health hazards in Mt Darwin District?
c) Are their responses to climate change induced health hazards related to the knowledge they have of these hazards?
d) What policy advice on disaster risk management, climate change and health hazards can be deduced from the results of this study?

1.8 Objectives of the study

1.8.1 General Objective

The general objective of the study was to analyse the existing knowledge on climate change induced health hazards in Mt Darwin and responses to such hazards.

1.8.2 Specific Objectives

a) To establish what the people in Mt Darwin District of Zimbabwe understand and comprehend about climate change induced health hazards,
b) To establish household responses or coping strategies to climate change induced health hazards in Mt Darwin District of Zimbabwe,

c) To establish how responses to climate change relate/correspond to understanding and perceptions on climate change induced health hazards,
d) To assess and evaluate the results of this study in an attempt to propose policy to policy makers on climate change induced health hazards.

1.9 Research Design and Methodology

1.9.1 Research Design

The cross sectional approach was used to collect data from Mt Darwin District. The study was designed to efficiently and effectively establish the knowledge that the people in Mt Darwin had regarding climate change and related health hazards. Focus was on identifying what the people knew and identifying the information gaps regarding climate change and health hazards. Comprehensive literature was undertaken to guide the study. Literature guided the study in relation to the conceptual framework underpinning the study, methods mostly applied and their strength and weaknesses, some valuable empirical findings.

1.9.2 Research Method

The mixed research approach was applied in this study. Qualitative and quantitative methods were employed in this study within the context of total disaster risk management (TDRM). The purposive random sampling technique was applied to select relatively older respondents for the interviews as they were likely to have been exposed to different climatic events for a longer time period. Questionnaires were used as the means of data collection during interviews. The study focussed on direct climate-health hazards that included thermal stress, death, and injury, and indirect hazards such as changes of disease vectors (mosquitoes) that cause vector, air, food and water borne diseases such as malaria, diarrhoea, bilharzia and typhoid.

1.9.3 Data Collection Instruments

1.9.3.1 Interviews

This is a face to face process between the interviewer and the interviewee that involve the questioning and recording of the responses. Questioning may be bi-directional, thus the interviewee may also ask questions though the interviewer initiates the process. Kothari (2004) stated that, "interviews are a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews." This method is usually executed following a well a structured way and the output is a function of the ability of the interviewer to solicit

views. Interviews offer the researcher the potential to probe responses while respondents can seek clarity on questions.

Interviews were chosen for this study because they offered useful insights on the context, allowing respondents to describe situations in depth while at the same time offering opportunities for probing and clarification. Utilising interviews enabled the researcher to gather knowledge and subjective opinions on climate change induced health hazards that shape local behaviour to climate change and impacts of programmes. Through the interviews the interviewers were able to solicit more information in greater depth, offering them a chance to overcome resistance of the respondents, yielding an almost perfect sample of the general population. The interviews also offered flexibility to restructure questions and integrated with the observation method personal information was able to be extracted.

1.9.3.2 Questionnaire

The study used a structured questionnaire that acted as the medium of data collection during the interview process. The questionnaire is the heart of the interview process and consists of a number of carefully constructed questions pertaining to the phenomenon being investigated and these questions are responded to during the interview by the interviewee (Kothari, 2004; Finn and Jacobson, 2008). The questionnaire was used because it enabled the researcher to define concepts in relation to the research questions and objectives. These concepts were applied uniformly across respondents thereby reducing the influence of the researcher through interpretation of concepts. The use of questionnaire during interviews enabled the researcher to clarify the questionnaire hence avoiding challenges posed by illiterate interviewees.

1.9.4 Population and Sampling

The people in Mt Darwin district were the study population from which a sample was drawn. The study sought to interview respondents covering the whole district's distinct wards and areas to ensure that the diversity of the district was covered. In order to select a representative sample from diverse and distinct areas within the district, stratified random sampling procedure was employed. The study used the ZIMSTAT district maps for surveys to identify key status from which respondents were drawn on a random basis. Specifically, the ZIMSTAT 2012 sampling frame was used to extract a representative (probability) sample from at least 10 of the 40 wards in Mt Darwin using the stratified random sampling technique. The sample was drawn from wards 1- 6, 11, 16, 19 and 23 which represented the most rural and populous wards in Mt Darwin. The selected wards had a total population of 61

497, thus about 29% of population in Mt Darwin. A sample of 250 households was sampled from the population based using the convenience sampling approach.

1.9.5 Data Collection

Primary data was collected in Mt Darwin district through self- administered structured questionnaires, in-depth interviews, key informants' interviews and observations. Three research assistants were engaged to assist in data collection. These assistants were trained before the actual survey to ensure standardisation of questions as well as reduction of researcher bias in the interviewing process. The collection of data took place in August 2016. Data collection began by mapping of respondents that was then accompanied by the actual face to face interviews which helped in clarification of questionnaires and further interrogation.

1.9.6 Ethical Considerations

The study upheld highest research ethics. Respondents' rights were respected and that included protection of private information. Participation in the interviews was at the discretion of the respondents and this was explained to the respondents before the interviews. The researcher had to seek the consent of the interviewees for them to proceed with the interviews and the data collected did not identify the respondents. Respondents were made aware that they could withdraw from the interview if they felt so at any stage of the process. The researcher also abided with the ethical considerations and an ethical clearance was given by the University of Free State, Faculty of Natural and Agricultural Sciences Ethics Committee (Clearance number UFS-HSD2016/0586).

1.9.7 Data Analysis

Data was analysed using the Statistical Package for Social Sciences (SPSS) and Microsoft excel spreadsheets. The analysis was centred on specific variables that were of interest to the objectives of this study. Open questions were analysed by compressing the responses through systematic evaluation of common terms. Open group discussions evaluations were centred on specific areas that were interrogated by the researcher and her panel. Graphs, tables and charts were used as the medium of analysis and data description focusing on identifying trends and divergence in views.

CHAPTER 2. THEORETICAL AND EMPIRICAL REVIEW

2.1 Introduction

This chapter reviewed theoretical and empirical literature that guided the study by clarifying the nature and meaning of the problem that was being investigated. The chapter primarily serves three purposes; firstly, to discuss social capital theory within the context of managing climate change health hazards, secondly, importance of knowledge on climate change induced health hazards, and thirdly empirical evidence on the perceptions and knowledge on climate change health hazards.

2.2 Social Capital Theory

The social capital theory guided this study. While most studies have used the conceptual framework to explain the theoretical relationships among variables of interest, in this study, the social capital theory was used to explain why at all one should consider analysing the knowledge of households on climate change induced health hazards. The social capital framework has been utilised in related research to explain the importance of various social components in mitigating climate change and managing natural disasters, hazards and risks (Nam, 2013; Toan et al., 2014; Bhandari, 2014; Ueda, 2011).

Social capital is a multidimensional concept that has been widely defined and discussed in the literature. The construct of social capital as discussed in the past few decades by authors such as Bourdieu (1977); Coleman (1988); Foley, et al. (2001); Gittell and Thompson (2001); James, Schulz and van Olphen (2001); Putnam et al. (2000); Sampson (2001); and Warren, Thompson, and Saegert (2001) refers to social networks, connections/relationships and sociability. Nam (2013) defined social capital as social networks and skills owned by individuals and used to facilitate specific actions. Similarly, a number of studies regarded social capital as the social characteristics of a person (Glaeser et al., 2002; Carpenter et al., 2004; Karlan, 2005).

Putnam (2000) and Krishna (2004) regarded social capital as common property of a group that facilitates collective action for mutual benefits of the members. Thus social capital can be viewed from an individual perspective (micro) and group perspective (macro) with overall implication of generating added value if inputted. Social capital is embedded at the micro-institutional level (communities and households) as well as in the rules and regulations

governing formalized institutions in the marketplace, political system and civil society (Moser, et al., 2010).

Coleman (1988) and Burt (1992) argued that social capital refers to the process where resources are created by and accessed through relationships. Supporting the preceding idea, Cohen and Levinthan (1990) envisages social capital as the linkages of knowledge bearers through boundary spanners, advice networks and relationships. Ideally, social capital refers to the means of creating and sharing knowledge that turns to be an asset or resource of vast potential if exploited. In the view of Portes (1998, 2000), the social capital construct is bestowed on the basic tenet that in times of crisis one can exploit the asset in a person's family, friends and associates. It therefore implies that those who have better networks, associates, friends and civic associations are better positioned to counter economic, social, political and natural misfortunes or poverty or other vulnerabilities.

On the opposite spectra, social capital is regarded as values of collective action and social integration. Brouwer and Nhassengo (2006) and Minamoto (2010) used the concept to better understand how people affected by disasters use the available resources to cope or meet their urgent needs. Neal and Phillips (1995) argued that social capital can be exploited in communities by decentralized decision making using trust and reciprocal normative behaviour leading to more effective response to the disasters. Buckland and Rahman (1999) argued that communities endowed with social capital can better prepare for natural hazards such as floods.

Mendis et al (2003) contextualised social capital as the informal networks and associations within the community with the potential power to influence the ability and willingness of the residents in working together for their mutual benefits. It includes norms, values and networks that facilitate collective action in a given society. That means on one hand social capital alters individual thinking and behaviour towards societal gains. Social capital can be disintegrated into bonding, bridging and linking components. These forms are defined as:

- Bonding social capital is construed as relations among family members, friends and relatives,
- Bridging social capital occurs within loosely related but demographically similar individuals,

- Linking social capital according to Woolcock (2001) refers to relations with sympathetic individuals in positions of power and that are beyond one's community.

Putman (2001) argued that social capital can both be a stock or a mobilising force that is collectively related to cultural capital. This capital combines with human, economic and natural capital to develop associative power. Various constituencies of social capital such as the voluntary sector, churches, networks/trust, diversity, sports groups, and kinship networks create associative, market, bureaucratic and communal power. These forms of power create the capacity to maintain economic vitality, access to resources, vital civic culture and the capacity to subsist or persist.

Knowledge, perceptions and various capacities of the communities are influenced by social capital. Culture as a component of social capital influences rights, world views, world perceptions, identity, and access to knowledge, governmental relations and resource availability. Similarly, community participation which is another component of social capital has an effect on planning, knowledge exchange, knowledge relevant to decision making, networking density, community ties, ability to build ties and social contract. In addition, social capital builds institutions and institutional linkages. These influences information and communication, and cooperation and development. Climate change and related hazard information can therefore be exchanged through social networks. As with building resilience of communities against socio-economic vulnerability, social capital is important in building the resilience of communities against climate change posed hazards.

Public awareness is one of the forces that directly benefits from the social capital framework. Communities that have effective networks based on mutuality and reciprocity are better able to share information and transfer knowledge. This influences the extent of common information among the public regarding climate change and related hazards. Through informal networks, households share information on hazards and disasters, factors leading to these forces and the actions at individual or collective levels to address and reduce exposure and vulnerability to disasters related to climate change.

In the social capital discourse, households are not passive, they possess social assets acquired, developed, improved and transferred across generations and societies. Importantly, the social capital framework recognises that social networks are built upon values, norms, knowledge, social learning and information sharing that is vital in the climate change adaptation and perceptions discourse. After realising the importance of social capital, studies have

concentrated on examining the relationships between social capital and other variables such as adaptation to climate change and coping with climate change risks, whilst little has been done to take the stock of social capital (thus the values, knowledge, culture, experiences, skills, and networks) amongst individuals. Related studies have utilised the social capital construct to analyse perceptions on climate change and coping strategies (Toan et al., 2014); adaptive capacity to climate change (Nam, 2011; Berberyan, undated); and adoption of conservation agriculture (Sicili, undated).

The important component of social capital relevant to this study relates to knowledge, skills, information sharing and social learning within and between networks of individuals/households. Social networks are built upon vital skills and knowledge that are shared as individuals benefit from information sharing in a reciprocal manner. Individuals can accumulate knowledge and skills and learn through formal and informal institutions. In business, Jones et al. (undated) indicated that through social networks, social knowledge is created and social capital enables the flow of information. Schuller regarded this as the human capital component of social capital[6]: thus the overlap between the human and social capital frameworks. While Woolcock attempted to dissociate the knowledge and skills embedded in social networks by defining social capital as, "who you know than what you know", authors such as Coleman (1988) and Lester et al. (2008) support that social capital and human capital are conceptually and practically difficult to separate and isolate.

Knowledge embedded in social networks, groups or communities is diverse. Islam (2013) argued for indigenous knowledge as a form of social capital. This knowledge evolves from the different sources within the social process, built through associations of groups, accumulated through close contact with nature and evolves in the local environment in a creative and experimental manner. Indigenous knowledge systems are dynamic, constantly incorporating outside influences and inside innovations and has been tested and found valid in the local context (Johnson, 1992). In social networks, indigenous knowledge covers areas of agriculture, human health, ecological systems, sustainable use of natural resources, and the environment.

[6] Human capital refers to variables that include expertise, experiences, knowledge, reputation and skills of individual (Becker, 1964; Coleman, 1988). Human capital is more inclined to the utilization of these components to enhance productivity and earn more incomes. Social capital is more concerned with the construction of these variables and their sharing within the social networks to influence or benefit individual members.

Social capital is important in the climate change and climate change induced health hazards discourse. Through social capital climate knowledge is created and shared, coping strategies are determined and the propensity and priority to adapt to climate change health hazards are influenced (Smit et. al., 2000). Ellen and Harris (1996) underscored the importance of social capital such as the skills, experiences and insights of people that are applied to maintain or improve livelihoods and can be taped in the development process in areas of agriculture, use and management of natural resources, health care, community development and poverty alleviation among other things.

Resilience in the face of rising hazards of climate change is largely dependent on social capital (Petzold and Ratter, 2015; Masud-All-Kamal, 2014; Smit et al., 2000). The underlined significance of social capital is in mitigating, adapting and coping with the hazards of climate change with less focus on climate knowledge accumulation as enhanced by the society. Coping with climate change hazards is regarded a social process that requires collective action and is shaped by social characteristics (Adger, 2001). These characteristics promote, inhibit, stimulate, dampen or exaggerate coping and response strategies as socially or endogenously constructed.

Social knowledge exists on the detrimental or harmful impacts of climate change that include health hazards in water contamination, property damage, displacement and loss of life (Smit, 2000). Managing the health hazards of climate change requires exploitation of social knowledge such as hazards experienced and those perceived by communities and social coping strategies. Gathering community perspectives and experiences enables policy makers to understand the gaps in social coping, weaknesses and strengths of the system; importantly feeding sustainable national response strategies on the hazards posed by climate change.

Different dimensions of social capital affect exposure to hazards of climate change, coping and responses and adaptation strategies. Adger (2003) and Pelling and High (2005) suggested that social capital is critical in creating and passing information concerning hazards, disasters, and mitigating exposure to these shocks. Vitally, social elements influence information exchange among groups and networks of individuals, anchored on trust and cooperation thereby changing individual members' behaviour towards the hazards of climate change. Kane and Shogren (2000) and Frankhauser et al. (1999) posited that social capital affect individual member behaviour, recognition of potential hazards, the responses to hazards,

potential management of the hazards and reduction of the impacts of hazards which are manipulated in the social networks and skills.

Social capital is anchored on social skills, trustworthy and reciprocity that affect knowledge sharing and acquiring. Nam (undated) reiterates that through trust of information in social networks, individuals can recognise and understand climate change and the associated hazards. A trustworthy person is likely to receive information from peers and share that knowledge to peers thereby promoting knowledge acquisition and learning. This information is either positive or negative. On the negative realm, social networks may act as conduits of misconceptions of climate change effects-false information can be easily spread within the networks.

2.3 Climate Change, Hazards and Perceptions

Empirical examinations on the knowledge/perceptions on climate change, associated hazards and response strategies are not new though they are very few. According to Rushinga et al., 2014:.311), studies on knowledge or perceptions on climate change and related hazards underlined the facts that,

i. Communities have developed systems that adapt to local, natural and environmental conditions and manipulate micro-climate,
ii. Sustainability of interventions to reduce the hazards of climate change depends on people's knowledge and ability to adapt,
iii. Community decisions are related to information acquired whether through records or interacting with natural environment,
iv. People have always been experimenting through interaction with weather and climate,
v. Responses to climate change would be sustainable when people's knowledge, values and priorities are recognised,
vi. It necessary to understand the way people see and understand their vulnerability and needs,
vii. Indigenous knowledge is intuitive and experimental.

Abdel-Monem (2014) argued that studies on knowledge, perceptions and understanding of climate change and responses have been undertaken as ways to measure and track climate change effects and develop effective and sustainable interventions. Social scientists are enabled to assess the changing environment of people's knowledge towards climate and climate related hazards and disasters. In the 1990s, these studies were anchored on

establishing public awareness on climate change while early efforts were meant to gauge public understanding of climate change causes and effects (Boston et al., 1994; Read et al., 1994) together with the associated value judgements (Kompton, 1991; Kimpton et al., 1996). In other contexts, studies were to establish respondent characteristics, and associated perceptions and attitudes towards climate change. The relationship had been found to be complex and unclear.

Local people's perceptions, impacts and adaptation studies have been prompted by the limitedness of scientific evidence to alert policy makers to the possible hazards of climate change at local level (Bhusal, 2009). Scientific evidence is locally narrow and globally wide leaving little information known about community learned experiences on natural hazards. At the core, is the recognition that vulnerability exists today, it will not disappear on its own but is growing and there is need to make active interventions that reduces the extent to which communities are vulnerable. While scientific evidence has grown, credible evidence on the knowledge of practical community experiences with climate change hazards, the impacts and responses need to be exploited. This body of research and evidence is more important as the natural hazards on climate change have worsened impacting negatively on agriculture, health, food security, hunger and life experiences (Klein, 2004; Bhusal, 2004).

Addressing hazards and impacts of climate change has evolved from the top-down to the bottom up approach. Under the new approach, people's vulnerability to hazards is considered a process involving socio-economic and policy environments, people's perceptions and the various elements of decision making (Bryant et al., 2009; Wall and Smit, 2005; Belliveau et al., 2006; Gbetibouo, 2009). In particular, Gbetibouo (2009) noted that scientific evidence represents the assumed and technical adjustments to natural hazards posed by climate change. The evidence shows mechanisms to avert hazards rather than the measures that have been actually adopted. There is no guarantee that the potential adaptation and response options are feasible, realistic or likely to occur. Therefore, research has shifted to explore actual responses to disasters and hazards and behaviour as grounded on individual knowledge/perceptions of the hazards.

Bryant et al., (2009), Madison (2000) and Gbetibouo (2009) pointed to the influence of social capital in understanding climate change, hazards and people's responses. Social characteristics influence updating of climate change information (speed and type of information), translation of knowledge into responses and gradual learning of climate change

and responses. Learning is done through experience, copying or through instruction of the society, network or group. According to Gbetibouo (2009) responding to the hazards of climate change depends on personal and family characteristics as influenced by their peers' perceptions and values present in their communities and associations. As a result, it is important to examine and update the knowledge base on community perceptions and responses to local climate change and hazards.

Ogalleh (2012) posited that local knowledge is important for targeting people and understanding solutions for climate change and variability hazards and for adaptation. It was argued that local knowledge takes various forms that include traditional ecological knowledge (Berkes et al., 2000; Folke, 2004), to local ecological knowledge (Olsson, 2004). This knowledge is cumulatively built (including practice and belief), location specific, acquired through observation of and interaction with the environment and transferred through oral traditions from generation to generation. The cumulative body of knowledge on weather and climate change hazards has been developed and applied by households, used to shape and interact with household practices and health outcomes.

This social knowledge is time, place and culture specific hence cannot be easily generalised. It needs to be updated continuously through research as it is both dynamic and innovative. The local knowledge is used to respond to hazards such as droughts, floods, storms, famines and extreme events. It has been found to match quantitative climate data in some settings while diverging from the same in other settings (Ogalleh, 2012).

Perceptions on climate change and hazards need to be investigated as the views of stakeholders are different as well as their actions to respond. Leiserowitz (2005) noted that the different views of scientists and lay public are important for policy making. Experts definitions on hazards are scientific (identify, describe and measure threshold in physical vulnerability to natural systems or the critical components of the current climate system). Scientific evidence define the hazards and social vulnerability to climate change-issues that cover increased rates of infectious diseases, destabilisation of order and the disturbance or severe economic impacts.

The scientifically identified, described and measured climate change impacts and vulnerability may differ from the household perspectives. Leiserowitz (2005) and Dessai et al (2005) stated that lay public perceptions' and interpretation of climate change and its hazards are based on psychological, social, moral, institutional and cultural processes. The expert

definitions based on probabilities and severity of consequences are narrower than the lay public's multidimensional and complex set of assessments. Public perceptions on climate change, hazards of climate change and responses are not only shaped by scientific and technical descriptions of hazards but by a variety of psychological and social factors that encompass personal experience, effect and emotional, imagery, trust, values and world views (Slovic, 2000).

Public perceptions can constrain or spur policy actions meant to address the hazards and people's experience, particularly emerging natural hazards of climate change. The socio-political contexts within which policy makers operate constitute the component of public hazard perceptions. Leiserowitz (2005) stated that public opinion can fundamentally compel or constrain political, economic and social actions to address the hazards of climate change. Public perceptions on the hazards and risks of climate change influence their support or opposition to climate policies and actions to reduce hazards of climate change. Due to these preceding factors, both lay public and expert (scientific) interpretations of climate change, the hazards of climate change and responses are of paramount importance in the policy continuum.

2.4 Evidence of Climate Change Knowledge

Scientific evidence on climate change and associated hazards became a public concern since 1988 (Leiserowitz, 2004). The heat wave that killed at-least 10 000 people in the United States in 1998 and severe drought with record temperatures cautioned the public and grew concern over hazards of climate change. Leiserowitz indicated that by 1989 most people in the United States became more concerned about climate change hazards. By 2004, in the United States, opinion polls and academic research reviewed that the public had valuable information about climate change and how government should have tackled it.

In Zimbabwe, academic and policy based research have been conducted, though very few studies exist. The only research related to this study was on the perceptions of climate change and adaptation to microclimate change and variability among smallholder farmers (Rusinga et al., 2014). The study underlined the growing hazards of climate change in Zimbabwe and the need to understand how perceptions affect people responses to the hazards as well as the need to establish local adaptation capacity. Rusinga reported that farmers were knowledgeable about climate hazards with information mainly drawn from the government through the extension services department, non-governmental organisations (NGOs), local

sharing and local microclimate environmental indicators. Knowledge was found to be context specific and non-generalizable.

Elsewhere, studies have concentrated on the knowledge and perception of climate change and the associated hazards, particularly focusing on agricultural hazards. Studies (Ogalleh et al., 2012; Gbetibouo, 2009; Bhusal, 2009) questioned farmers' local perceptions and responses to climate change and variability and underscored the importance of farmers' knowledge for responding to the hazards of climate change. Results from mixed methods employed in these studies were mixed and complicated. In some instances, local knowledge on the hazards of climate change was found consistent with climate data records (Ogalleh et al., 2012; Gbetibouo, 2009) while others found poor and marginalised groups to be unaware of climate change and its impacts, and was not undertaking any measures to cope with the effects. As a result, the need to broaden and intensify research on the understandings and local knowledge across all sectors and considering gender, ethnicity and economic conditions was encouraged.

Research that explored local knowledge and perceptions on climate change, hazards and responses has been undertaken in both developed (Preet et al., 2010; Leiserowitz, 2005; Debono et al., 1997) and developing countries (Chaudhary and Bawa, 2011; Haque et al., 2012). Some of these studies were prompted by the World Health Organisation's (WHO) indication that there are significant and emerging threats to public health, particularly in low income and tropical/subtropical regions. Toan et al. (2014) noted that it is most likely that these regions will not perceive climate change threats while Haque (2012) stated that in developing countries little is known about the community knowledge/perceptions of climate change yet it is a vital tool in developing adaptation to the hazards of climate change.

Among the above literature, the links between health and the climate hazards such as increased frequency of heat waves, floods, storms, changing temperature and precipitation that alter the life support system (air, food, water) were identified. The hazards pose direct and indirect effects that include death, increased transmission of infectious diseases, disability and suffering (Haque et al., 2012). Resultantly, research has been carried out by students, educators, farmers and scientists to show and emphasise the importance of local or community knowledge and responses to these hazards of climate change. Haque noted that this research at community level is still lacking, compromising the efficacy of national adaptation and climate response strategies.

Increased climate change hazards such as temperature decline in frost days and increased frequency of heavy downpours underlined investigations on local perceptions in Japan. Toan et al., (2014) indicated that the majority of people had heard about climate change and its associated hazards while those living in poor areas had less information on the same. About two thirds of the people interviewed in the study correctly interpreted climate change as storms, floods, deep cold, and long heat waves while small proportion either incorrectly interpreted climate change hazards as earthquakes and air pollution or had no knowledge at all about climate change and the associated hazards.

A number of health hazards of climate change were identified in the literature. Toan et al. (2014) lamented the health hazards of climate change as increased children illness both in summer and winter. The hot and humid environment has been labelled favourable for development of bacteria, insects, flies and rats or rodents that carry diseases. Hot weather was associated with increased headache, fatigue and dizziness. Hypertension and other cardiovascular diseases were thought to be more common. Cold weather has heightened cough and fever while other diseases such as pneumonia, influenza and dengue fever (among other infectious diseases) are now common.

Haque et al. (2012) posited that changes in climate have occurred and hazards have heightened in the past ten years, with no significant difference in the perceptions between males and females. The hazards of climate change include heat waves, hotter summers, cold winters, erratic and severe cold for short periods, cold weather destroying agriculture, everyday life and health particularly for the aged. The frequency of climate variability induced diseases and health problems have also notably increased due to climate hazards. People bemoaned the increase in diseases despite improvements in health facilities. Communities' highlighted increased emergence of unknown diseases and outbreaks. Extreme heat, cold and rainfall have been linked to the recurring fever/cough/cold, dysentery, headaches, diarrhoea, skin diseases, burning sensations, conjunctivitis, jaundice, blisters, asthma, chicken pox, weight loss and pneumonia. Future environmental hazards were perceived to include droughts, storms and cyclones. People use environmental observations to predict changes in climate.

In evaluating the Americans' perceptions on whether or not climate change is dangerous, Leiserowitz (2005) argued the two reasons for such a research. Firstly, people contribute to greenhouse gas emissions that cause climate change, and secondly, people support political

leaders and government policies, programs and interventions to mitigate or adapt to climate change.

Leiserowitz (2005) found that Americans perceived climate change as a moderate hazard, with impacts on the standards of living, water and rates of diseases. A large group of the population were concerned with the global hazards of climate change than the local hazards. It was found that Americans did not associate temperature related mortality and morbidity (heatstroke), health effects of extreme events (tornadoes, hurricanes, extreme precipitation), air pollution health effects (asthma and allergies), water and food borne diseases (cholera) or vector and rodent borne diseases (such as malaria) with climate change hazards. This is so despite that human health is likely to suffer from the climate change induced health hazards. Thus, locally, climate change may not be associated with extreme weather events such as heat waves, hurricanes, and droughts (Leiserowitz, 2005).

Leiserowitz (2005) indicated that risk perceptions are socially constructed, with different interpretive communities predisposed to attend to fear and socially amplify some hazards while ignoring, discounting or attenuating others. In 2003, Leiserowitz found interpretive society to perceive climate change as a very low or non-existent danger. In the United States, this community was found to be predominantly white, Republicans, politically conservative, holding pro-individualism, pro-hierarchism and anti-egalitarian world views, and anti-environmental attitude, distrustful of most institutions, highly religious and rely on radio as main source of news. They are "naysayers" who believe that climate change is natural, it is not as bad as the media portrays, doubt the science regarding climate change as a false theory or conspiracy theory. These naysayers are socially and politically active and high participatory affecting policy and climate change interventions.

Lay public interpretations of health hazards of climate change remain sensitive to technical, social and psychological qualities of the hazards that are not well modelled in hazards assessments (Slovic, 2000). Slovic (2000) pointed to the need for consultative, multiple voice and multiple perspectives in developing solutions to the hazards of climate change.

In Bangladesh, the Asia Foundation (2012) found that most people had heard about climate change. Varied definitions are given to climate change that includes hazards such as floods, storms/cyclones and droughts. People define climate change according to climatic hazards they face. It was found that climate change had increased in the past 10-30 years and the

intensity of impacts had increased. About 80% of the respondents reported impacts of climate hazards that include flood, flash-floods, and cyclones and droughts.

The impacts of the climate hazards include less agricultural output, loss of biodiversity and livestock. Agriculture was the sector reportedly being affected by climate change, followed by loss of income in drought affected areas while health hazards were the second in flood or flash flood areas. Generally, health hazards were the third mostly ranked impacts of climate change hazards. Small proportion (40%) of the population was taking measures to reduce the hazards caused by climate change. It is however unfortunate that the specific health hazards of climate change have not been unpacked in the study.

2.5 Conclusion

This section reviewed literature in an attempt to situate this study. The study was carried out within the social capital framework of disaster risk management. The primary crux of our theoretical framework is that valuable information is gained and shared among social networks and groups principled on trust, norms, values, sociability and reciprocity. As noted, (Ueda, 2011), people who experience hazards have better understanding and the correct information of the phenomena, and this information should be shared between concerned parties that include authorities and other community members. Effective disaster reduction measures are based on the knowledge of the people that is continuously developed through interaction and education systems (public awareness campaigns).

The review indicated that literature related to this study is growing though a few studies still exist, particularly on health hazards and responses to the climate change induced health hazards. Various studies have pointed to the importance of local knowledge in building interventions for addressing hazards posed by climate change including consenting authorities' programs. Overall, social capital plays a pivotal role in disaster risk management by establishing power against hazards through fostering a feeling of trust/bond/networks, developing knowledge and sharing risk information including education on hazard prevention and safety. Social capital determines preparedness, hazard sensitivity, training and hazard information shared among community members that helps to respond to hazards and reduce casualties in the occurrence of disasters.

The foregoing discussion underlined social capital as an important tool of disaster risk sharing, reduction and management. Correct information needs to be shared between those experiencing hazards (victims) and those concerned (stakeholder). People who experience

hazards have better understanding of the phenomenon and policy makers have to learn from them. Policy makers who prioritise social/local/communal information are likely to easily gain consent and develop sustainable and effective countermeasures. This is so because, as the preceding discussion alluded to, hazards are not only natural (global warming-heavy rain-floods) but socially constructed as people amplify the damages through inadequate information, poor response and unreasonable development. Thus this research recognised the importance of local/communal/social knowledge in building the culture against hazards and disasters and the sharing of information.

CHAPTER 3. RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter is a detailed narration of the research design and methodology drawing insights from the literature survey provided in Chapter Two. Research methods, data collection instruments, personal interviews, data type, nature and collection are discussed in detail. The chapter provides a narration to these concepts as well as indicating how they were utilized in the study summarizing the merits and demerits of some of the procedures in justifying why they were adopted in the study. Further, population and sampling as well as sampling procedure are discussed.

3.2 Research Design

According to Kothari (2004), research design refers to the conceptual structure within which the research is carried out. It is the research design that facilitates research efficiency and maximum information - collection of maximum data at minimal costs of effort time, money and other resources. In other words, research design is the complete strategy that presents the overall procedures followed by the research, the data to be collected, methods of data collection, and how the data will be analysed in attacking the central research problem. The design of the research depends on the purpose of the research which can be categorized as exploratory, experimental, diagnosis and description or combination of one/more of the latter. Thus there are a number of research designs that range from experimental to explorative and are determined by the research purpose. Cognisant of the availability and skills of the researcher and assistants, means of obtaining information, the time available for the research; and associated costs, a flexible survey research design which considered many facets of the research problem was opted for this study.

The study utilized the survey design that facilitated better understanding of the present through descriptive of and cross sectional interaction with the study objects. This design enables an accurate description of the situation or association between variables, minimizes bias and maximizes the reliability of the data collected and analysed (Kothari, 2004; Leedy and Armrod, 2013). The design is compatible with both qualitative and quantitative research methods. The cross sectional approach was used to collect data for establishing the extent to which residents in Mt Darwin district comprehend climate induced health hazards. The study

was designed to efficiently and effectively establish the knowledge that the people in Mt Darwin had regarding climate change and related health risks through analysis of data collected using face to face questionnaires. Focus was on identifying and describing what the people knew and identifying the information gaps regarding climate change and health hazards.

3.3 Research Methodology

The research methodology is the systematic way of solving a research problem and it encompasses research methods. Appropriate research methodology enables a researcher to extract meaning from the data in order to solve the research problem. Generally, research takes the form of qualitative or quantitative approach or a combination of the two. The research methods, logic behind the methods, data collected and data collection techniques all fall under research methodology.

The mixed research approach was utilized for this study. Mixed research methodology entails combining the qualitative and quantitative approaches to the research process maximizing on the benefits of each method and minimizing the weaknesses (Cresswell, 2011). Quantitative research is employed to answer questions pertaining to the associations between measured variables with the purpose of explaining, predicting and controlling phenomena while qualitative research helps to provide answers to the critical questions on the complex nature of phenomenon, helping to describe and understand the phenomena from participant's point of view. Combining the two approaches is meant to benefit complementary components of the research approaches.

Glesne and Peshkin (1992) and Leeds and Armrod (2000) conceded that qualitative and quantitative approaches are appropriate for answering different kind of questions, hence we learn more when we have the two approaches to our disposal than when we are limited to one approach or the other. In this study, quantitative research methods helped to summarize the number of people that conceded that climate change poses specific health hazards, while qualitative method helped to better understand why participants linked climate change to certain health hazards. Overall combining the two approaches in this study enabled explaining, describing, exploring and interpreting the knowledge on climate change induced health hazards in Mt Darwin district and people's responses to such hazards.

3.3.1 Research Methods

Research methods refer to all the methods/techniques that are used in undertaking research operations. As the type of the research fell within the library and field research categories, research methods at our disposal included analysis of historical records and documents, observations, questionnaire interviews, focus group discussions and case studies. Research techniques within the compass of these research methods include recording of notes, content analysis, identification of socio-economic background of respondents, and detailed schedule of open and close ended questions. This study therefore utilized the field research methods and utilized a questionnaire in conducting personal interviews for data collection.

3.3.2 Questionnaire

This study utilized a semi-questionnaire as the medium for primary data collection during the personal interviews. A questionnaire is a list of questions, which seeks to source data from the people to answer certain laid down research objectives. The questionnaire was regarded as the heart of the survey process that required careful designing and construction of questions pertaining to the phenomenon under investigation and the questions were asked to respondents during the interview process (Finn and Jacobson, 2008).

The questionnaire enabled the researcher to define questions in line with the research concepts and objectives thereby enabling the collection of relevant and sufficient data. Employing a structured questionnaire ensured that these concepts were applied uniformly across respondents thereby reducing the influence of the researcher through varied interpretation of concepts. Open and closed questions were used to ensure that in the research they complemented each other, thus maximising the research output. The designing of the questionnaire considered the need to ensure that questions are clear from any form of misunderstanding and that these questionnaires were impartial and logical. In other words, the researcher ensured that questions were easy to understand, were concrete and conformed to the respondent's way of thinking. Control questions were included to check on the reliability of the respondent.

Before the final survey the questionnaire was pretested in a pilot study. The questionnaire was pretested in Ward 3 for the convenience of the researcher and only 10 respondents were interviewed checking on precision, consistency, easy of understanding, and the nature of responses as well as time to completion. During this pilot study, the questionnaire was tested and weaknesses identified and adjusted, the pre-test also helped in improving the survey

procedure. Structured questionnaires were opted because they are simple to administer and relatively inexpensive to analyse. Flexibility was allowed for alternative responses from the respondents but was kept at minimal for the purposes of consistency and analysis. Given the primary objective of the research, probing for attitudes and reasons for certain actions was not critical, hence a structured questionnaire sufficed.

3.3.3 Personal Interviews

Personal interviews were undertaken during this study where the investigator followed a rigid procedure and sought answers to a set of pre-conceived questions through face to face interviews. During the face to face interviews, the interviewer asked questions generally in a face-to-face contact with the respondents. These were structured interviews and the findings largely depended on the ability of the interviewer to ask the questions in a clear, understandable and unambiguous manner. Personal interviews enabled the researcher to clarify the questions hence circumventing challenges posed by illiteracy.

The personal interviews were chosen given their strengths in that more information can be obtained in greater depth, interviewer by his own skill can overcome the resistance, if any, of the respondents, the interview method can be made to yield an almost perfect sample of the general population, there is greater flexibility under this method as the opportunity to restructure questions is always there, observation method can as well be applied to recording verbal answers to various questions, personal information can as well be obtained easily under this method, samples can be controlled more effectively as there arises no difficulty of the missing returns; non-response generally remains very low, the interviewer can usually control which person(s) will answer the questions-this is not possible in mailed questionnaire approach (Kothari, 2004). If so desired, group discussions may also be held. Additionally, in personal interviews, the researcher meets the people from which data is sought, enable intensive investigation, is more economical for qualitative and descriptive studies, and provide a relatively safe basis for generalizations and require relatively less skills from the interviewer.

3.3.4 Data

The study used primary data - data not yet available but collected through survey. This data was collected afresh, for the first time and hence original in nature. Leedy and Armrod (2013)

indicated that the researcher's perceptions of the truth are various layers of truth-revealing fact and closest to truth are primary data as they are most valid, illuminating and truth manifesting. Primary data were opted for this study because, firstly secondary data that meets the research objectives was unavailable, secondly primary data was thought to be directly relevant to the problem at hand, and thirdly, primary data offered greater control over data accuracy. The data was cross sectional in the sense that it was collected from a cross section of respondents at a point in time. The survey collected both qualitative data (data which yield non-numeric responses, arbitrary categories that could be coded but could not be manipulated arithmetically) and quantitative data (data which yielded numeric responses that could be meaningfully manipulated using conventional arithmetic).

3.4 Population and Sampling

Households in Mt Darwin district were the study's target population from which a sample was drawn. The study focused on households in Mt Darwin. In order to select a representative sample from diverse and distinct areas within the district, purpose and random sampling procedures were employed. The researcher purposively selected 10 of the 40 wards in Mt Darwin: wards 1- 6, 11, 16, 19 and 23 which represented the most rural and populous wards in the district. The selected wards had a total population of 61 497, thus about 33% of population in Mt Darwin.

Sample size determination was one of the most important procedures in undertaking this research. A sufficient sample size is critical for valid results (Leedy and Amrord, 2013). Generally, the larger the sample size, the better. This generalization has been found not too helpful to researchers faced with a practical research problem to solve (Leedy and Amrord, 2013; Hardon et al., 2004 ;). Gay (1996) suggested survey guidelines where for small samples of less than 100 populations sampling is of little relevance whilst for larger populations exceeding a population of 5 000, the population size is almost irrelevant rendering a sample of 400 adequate.

The adequacy of sample size is affected with the degree of heterogeneity of the study population. In markedly heterogeneous populations, a larger sample size is preferred than in homogeneous samples. Statisticians have also drawn formulas that consider the degree of precision the researcher intends to draw conclusions or predictions. Brannen et al (2004) however argued that the most important factor to determine sample is the type of research

question to be answered. In some studies, it is neither the sample size nor the distribution of the sample that matters most but the inclusion or capture of important case or ideas. Thus the research question itself offers enough concerns about the number of interviews to be conducted than focusing on the sample size and distribution.

Some researchers have argued that concentration on sample size deters attention to data collection accuracy as validity, meaningfulness and insights of a research have more to do with information richness than sample size. Sample size between 20 and twenty-five were identified as adequate for descriptive and quantitative studies (Bryman 2012). However, Gerson and Horowitz (2002) were of the view that interviews fewer than 60 cannot support convincing conclusions, and those above 150 produce too much material to effectively and expeditiously analyse. In research designs mixed between qualitative and descriptive, Hardon et al. (2004) suggested that large enough sample size is vital to reflect important variations in the population though the sample size should be small enough for intensive study methods. In fact, Herdon et al. (2004) concludes that a feasible sample size is determined by resources such as time, human, money and transport, and these resources are important not only in data collection but analysis as well given that the more data you collect the more problems in analysis.

Sample size remains important in research as indicated by the above varied consideration to it. This study considered varied factors in determining the sample size. The study was both descriptive and qualitative hence the need for a fairly large sample that reflected variations in population as well as a reasonable small sample size for reasonable analysis. Resources were factored too as they formed the ultimate determinant of a feasible survey. The researcher was guided further by the available related literature as summarised below. A sample of 200 households proportionately distributed across the wards was opted which is 1.5% of the total households in the selected wards. This sample size was arrived at on qualitative basis not through statistical sample size formulae. However, it fitted well within related literature as academic researchers have sampled below 269 households while nationwide surveys were fairly large as pointed in the table below. In order to cover for gaps, 210 households were interviewed.

Table 3.1: Sample size distribution in literature

Author	Sample Size	Research Topic
Rusinga et al., 2014	43	Perceptions of climate change and adaptation to micro-climate change and variability among smallholder farmers in Mhakwe Communal Area, Zimbabwe
Bhusal, Y., 2009	113	Local Peoples' Perceptions on Climate Change, Its Impacts and Adaptation Measures in mid-Mountain Region of Nepal
Tarik et al., 2014	135	Climate Change Survey Measures
Ogalleh et al., 2012	206	Local perceptions and Responses to climate change and variability: The case of Laikipia District, Kenya
The Asia Foundation, 2012	269 per each of the 10 Districts	Climate Change Perceptions Survey
Haque,et al., 2012	450	Households' perceptions of climate change and human health risks: A community perspective
Leiserowitz, A. A., 2005	673	American Risk Perceptions: Is Climate Change Dangerous
Gbetibouo, G.A, 2009	794	Understanding Farmers' Perceptions and Adaptation to Climate change and Variability
Toan et al., 2014	1444	Perceptions on Climate Change and its Impact on Health: an integrated quantitative and qualitative approach

Source: Author Compilation, 2016

The population and sample distributions are as summarised below:

Table 3.2: Population and Sample distribution across wards

Ward	Population	Households	Sample
1	3,489	809	10
2	12,180	2960	36
3	4,526	1140	13
4	4,574	1030	14
5	4,434	1057	13
6	4,823	1147	14
11	8,861	1394	26
16	9,423	865	28
19	9,125	1929	27
23	9,187	1393	27
Total	**70,622**	**13724**	**210**

Source: Zimbabwe Statistical Agency, 2015

3.5 The Sampling Procedure

Since 10 of the 40 wards in Mt Darwin sampled were determined by the researcher purposively, the next procedure was to determine the households to be interviewed from each ward. The simple random sampling approach was employed for this purpose. Simple random sampling is a sampling procedure such that sampling units are randomly selected and each unit has an equal chance of being selected from the sampling unit. Cochran (1977) stated simple random sampling as the sampling of a sample of size n from a population of size N in such a way that every one of the ${}^{N}Cn$ distinct samples has an equal chance of selection. In other words every member of the sampling unit has equal chance of being in the sample of size n. The following steps were undertaken in implementing this sampling procedure.

- familiarization with area of study - through maps and touring the district,
- Collection of household records from Village Head Secretaries and the District Administration Office, and comparing these household records,
- Capturing the households in Microsoft Excel,
- Assigning random numbers to the households using Microsoft Excel 2007 and polling the required sample from the respective wards,
- Interviewing the households,

3.6 Conclusion

This chapter has explored the research design and methodology utilized in this research. The methodology, design, population and sampling, and sampling procedures for the research were designed. The study was based on the integrated approach of both qualitative and quantitative design that utilized descriptive study methodology. A sample of 210 households was selected from the households in 10 wards of Mt Darwin district using the simple random sampling procedure. The succeeding chapter, Chapter four, presents the analysis of results.

CHAPTER 4. DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents the results of the study and an analysis of the results. The chapter begins with descriptive statistics giving sample size and demographic statistics of respondents. Results are presented to reflect on knowledge on climate change, perceptions on climate status, perceptions on hazard occurrences, health effects of climate change, perceptions on the occurrence of diseases attributable to climate change, actions to reduce climate change induced health hazards and actions being undertaken by respondents to reduce the health hazards posed by climate change. Quantitative data is presented in the form of tables, pie-charts and bar graphs. Pearson's Chi-square test is used to detect some associations between the categorical variables. Unstructured or qualitative responses synthesized by examining the recurring responses or a list of responses from the respondents are summarized in boxes.

The sampling and data collection processes went well despite some political hackles encountered. As visitors in the Mt Darwin District, the research team was subjected to a number of political offices for vetting and approval. In some wards the research team were sent back and forth as lower office bearers needed the permission of their superiors despite us having the permission letters granted by the Ministry of Health and Child Care (MoHCC). However, after complying with all the requirements and having assured the authorities that our research was entirely for educational purposes and was cleared by the MoHCC as well as the Ethics Committee at the University of Free State; we got maximum cooperation from the local leadership, mainly councillors and ward secretaries, and village heads and their secretaries.

The sampling and data collection processes took more time and resources than planned due to some unexpected challenges. The research team was not able to obtain household names as initially planned as it was ruled sensitive by the local leadership. As a result, the option of village mapping and assigning of numbers to every household was co-opted. These numbers were letter used for sampling. During the data collection process, the proposed dates for data collection in each ward were given prior and the information was conveyed through the ward councillors and secretaries. This reduced the chances of failing to find respondents. However, 13 sampled households could not be found at their homesteads and follow up interviews were

done through the assistance of village secretaries. It was avoided to replace the households with others present as it amounts to bias.

4.2 Descriptive Statistics

4.2.1 Sample and Demographic Statistics

A total sample of 204 respondents was complete for analysis after the rigorous process of data cleaning, checking completeness and consistence of responses. Among the respondents were 75% male headed households and 25% female headed households. The majority of the household's heads were married (76%) while those widowed constituted 13%, divorced 8% and single 3%. The majority of the household heads interviewed attained secondary education (43%), standard four (4) (22%) and standard six (15%). Primary and higher education constituted about 12% and 8% respectively. The exact distribution of respondents by sex, marital status and education is summarized in Table 4.1.

Table 4.1: Sex, Marital Status and Education of the Respondents, n=204

		Number of respondents	Percent	Cumulative Percent
Sex	**Male**	152	74.5	74.5
	Female	52	25.5	100.0
Marital status	**Single**	7	3.4	3.4
	Married	154	75.5	78.9
	Divorced	17	8.3	87.3
	Widowed	26	12.7	100.0
Level of education	**Standard 4**	45	22.1	22.1
	Standard 6	31	15.2	37.3
	Primary	25	12.3	49.5
	Secondary	87	42.6	92.2
	Higher	16	7.8	100.0

Household heads were of age spread between 21 and 93 years with an average of 55 years. The household size was spread between 2 and 13 with an average size of 6. About 85% of the households under study settled in Mt Darwin before the year 1990 whilst about 47% settled in the area between 1970 and 1989. The latest year of settlement is 1938 and the earliest is 2004. Detailed presentation of households' settlement in the area is presented in Figure 4.1.

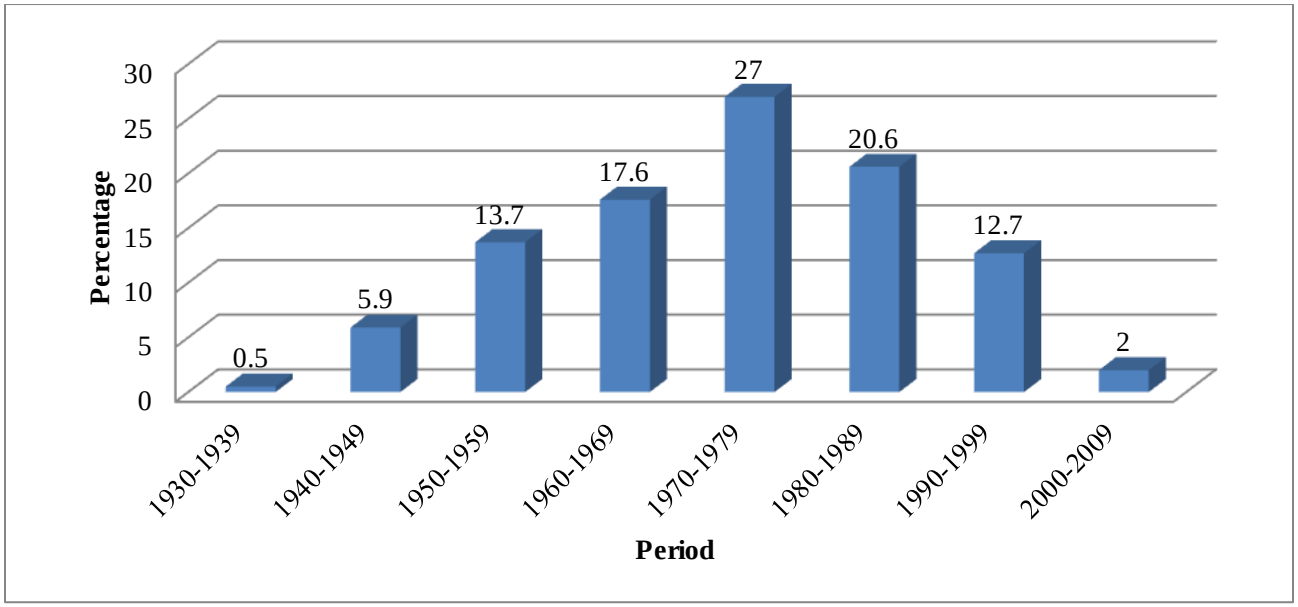

Figure 4.1: Respondents' year of settlement in Mt Darwin

4.2.2. Sources of Livelihood

The sources of livelihood of the household were analysed as narrated by the household head. About 90% of the respondents agreed that they engaged in livestock production whilst 88% practiced food crop production. Cash crop production was practiced by 79% of the respondents whilst 52% engaged in vegetable production. Among the interviewed respondents, only 52% received remittances from family members or relatives working away from home, either within or outside the country. Other sources of livelihood that include skilled trade/artisan, petty trade and hunting/gathering, and earning salary/wage and casual labour income were practiced by less than 20% of the respondents. The detailed distribution of the sources of livelihood among the respondents is as outlined in Figure 4.2 below.

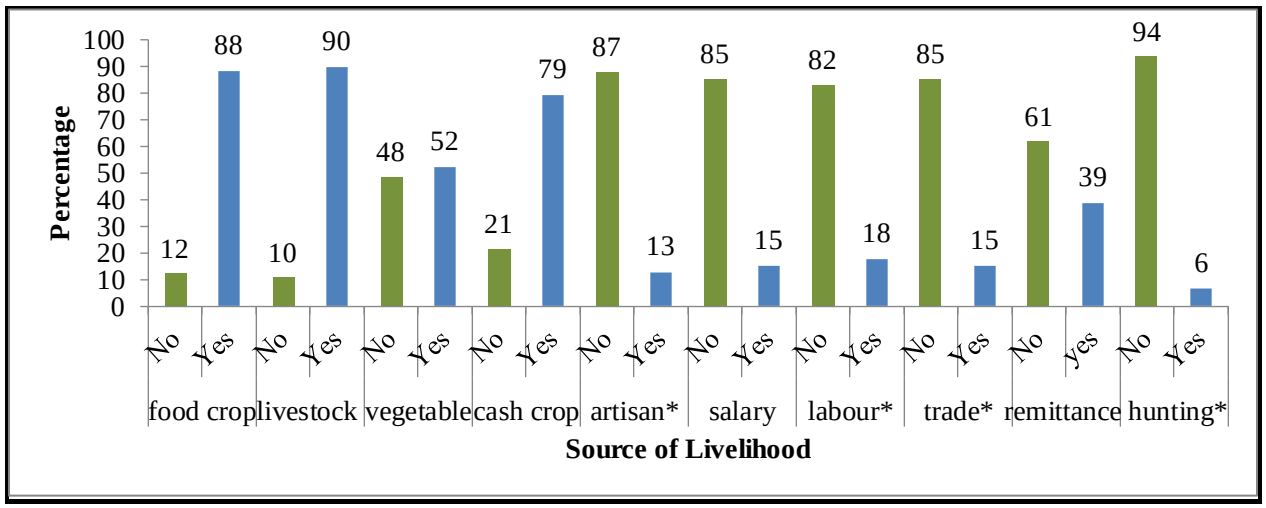

Figure 4.2: Sources of Livelihood for the Respondents, n=204

* The categories considered skilled trade/artisan, causal labour, petty trade, and hunting/gathering

4.2.3. Working Experience

Households were questioned whether or not they had some work experience outside their current income earning activities. The responses are presented in Figure 4.3 and Table 4.2. Among the 204 households interviewed, only 66 (32%) had professional work experience (experience outside their income earning activities) while 138 (68%) had none. Among those who had experience, 50% previously worked in urban areas, 27% in rural areas inclusive of Mt Darwin while the remaining 23% worked in rural areas exclusive of Mt Darwin District.

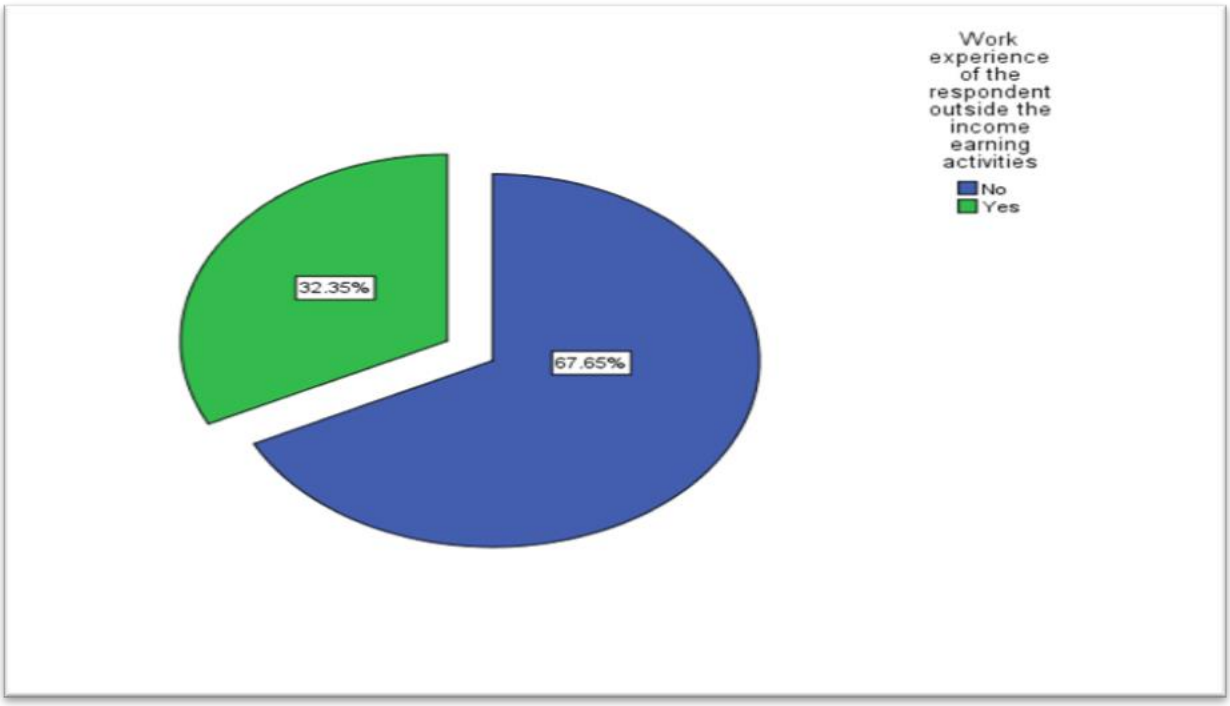

Figure 4.3: Work Experience of the Respondent, n=204,

Table 4.2: Specific work experience of the respondents, n=66

	Number of respondents	Percent	Cumulative Percent
Urban Area	33	50	50
Rural-Inclusive	18	27	77
Rural-exclusive	15	23	100
Total	**66**	**100**	

4.3 Knowledge on Climate Change

Respondents were asked if they had ever heard of climate change and the causes of climate change. The results are tabulated in table 4.3. Out of the 204 interviewed respondents, 126 (62%) had heard about climate change while 78 (38%) had not. Among the 126, who had heard about climate change, 42% indicated that climate change is caused by man-made phenomenon while 37% considered it a natural phenomenon, 14% referred to climate change as caused by spiritual forces whilst 7% indicated that both man-made and natural forces caused climate change.

Table 4.3: Knowledge on Climate Change, n=204 and n=126

		Frequency	Percent	Valid Percent	Cumulative Percent
Have you ever heard of Climate change?	**No**	78	38.2	38.2	38.2
	Yes	126	61.8	61.8	100.0
	Total	204	100.0	100.0	
What are the causes of Climate change?	**Man Made**	53	42	42	42.0
	Natural	47	37	37	79.0
	Spiritual	18	14	14	93.0
	Both man-made and natural	8	7	7	100.0
Total		**126**	**100%**	**100.0**	

An open ended question was asked for respondents to state the meaning of climate change based on their understanding. The qualitative responses to the question are summarized in Box 1. Among those who had heard about climate change (n=126) it is interpreted as change in weather, changes in weather components of rainfall and temperatures, sudden change in the expected and usual weather, changes in rainfall, temperature, wind, heat among other things. From the definitions, the interpretation of climate change as simple changes in weather components of rainfall and temperature was more recurring. The results augurs well with studies which found households to interpret climate change as changes in rainfall, temperature, storms, floods, deep cold, and long heat waves (Toan et al., 2014; Ogalleh et al., 2012). Few households also highlighted on the intensity and predictability of rains and wind as indications of the changing climate.

Box 1: Household definitions of climate change based on their own understanding

- Change of weather such as rainfall and fluctuations in temperatures,
- Change in weather of a place,
- Change in weather arrangement, focus and erratic rains,
- Change of rainfall dates, weather and low rainfall nowadays compared to the 1980s when we received rainfall between 400mm to 900mm every year,
- Changes in rainfall, temperature, humidity, and many other factors,
- It means changes in temperature, wind, rainfall, amount of heat, etc.,
- Natural change of seasons, maybe due to elements of weather like high or low and unreliable rainfall during summer season,
- Sudden change of the expected and usual weather conditions,
- The unusual presentation of seasons in a year,
- Change of weather and conditions,
- Is the unusual presentation of seasons in a year, year after year some of which are not favourable to human life,
- It is a change in weather patterns from the usual climatic conditions,
- Change of weather-rainfall patterns over time,
- The change in the weather and all that happen that affects rainfall and agriculture,
- It means the change in weather in our area such as raining season,
- Changes of weather patterns,
- Climate change means seasonal weather such as rainfall dates, hot season temperature change,
- It refers to changes in rainfall patterns, temperature, heat, wind among others,
- Change of seasons (*kuchinja kwemwaka*)
- Is a shift in weather conditions from those we used to experience to heavy rains, droughts, excessive heat, cyclones,
- Change of the seasons such as the months when certain weather phenomenon used to take place. Maybe change in intensity of weather elements e.g. rainfall, rainfall intensity,
- Change in the direction rains come from,

Various and wide interpretations and meanings were given to climate change. Climate change was associated with changes in weather patterns of rainfall and temperatures. The wide and various interpretations solicited signal poor understanding of climate change. The result is similar to findings by Monem et al. (2014). That means there are variations in how climate change is understood and the definitions suggested in Box 1 show some misconceptions about climate change in the district.

4.4 Factors affecting knowledge on climate change

The study further explored data to establish the forces depicting knowledge on climate change. This was done through tabulation of explanatory variable categories with the variable on knowledge of climate change. The idea was to establish if climate change knowledge varied with gender, work experience, age, education and hazard experience categories. The results are discussed and tabulated in the sub-sections below.

4.4.1 Gender and knowledge on climate change

The impact of gender on the acquisition and the existing knowledge on climate change was quite interesting. Policy makers would want to know if gender imposes some deviations on climate change knowledge posed by gender so as to ensure remedies are put in place. In order to establish the effect of gender on climate change knowledge, we cross tabulated the two variables (sex and knowledge of climate change) and the results are presented in the Table 4.4 below.

Table 4.4: Respondent's sex * Have you ever head of climate change? Cross-tabulation

			Have you ever heard of climate change?		Total	Pearson's Chi-square test	
			No	Yes		Critical Value	P-value
Respondent's sex	Male	Count	60	92	152		
		% within Respondent's sex	39.5%	60.5%	100.0%		
	Female	Count	18	34	52		
		% within Respondent's sex	34.6%	65.4%	100.0%		
Total		Count	78	126	204	0.387	0.534
		% within Respondent's sex	38.2%	61.8%	100.0%		

The results in the table above show that 39.5% of males had not heard about climate change while 60.5% had heard about climate change. Similarly, 34.6% of females had not heard about climate change while the remainder 65.7% had heard about the phenomenon. Generally, more females than males had heard about climate change. We therefore tested the relationship statistically to establish, whether or not, sex and knowledge on climate change are independent of each other using the Pearson's Chi-square test. The Chi-square statistic of 0.387 and a p-value of 0.534 means that the null hypothesis of an independent relationship

between sex and climate change knowledge cannot be rejected. This study therefore concluded that sex does not influence knowledge on climate change.

4.4.2 Age and climate change knowledge

The study also sought to evaluate the effect of age on climate change knowledge. Age is likely to have an effect on climate change as the people of differing ages are likely to be exposed to different information, knowledge and experiences. To establish the effect of age on climate change the researcher categorised households into three age groups presented in the table below.

Table 4.5 Respondent's age group * Have you ever head of climate change? Cross-tabulation

			Have you ever heard of climate change?		Total	Pearson's Chi-Square test	
			No	Yes		Critical value	P-value
Respondent's age group	< or = 40 years	Count	22	37	59		
		% within Respondent's age group	37.3%	62.7%	100.0%		
	> 40; <or= 60 years	Count	22	42	64		
		% within Respondent's age group	34.4%	65.6%	100.0%		
	>60years	Count	34	47	81		
		% within Respondent's age group	42.0%	58.0%	100.0%		
Total		Count	78	126	204	0.906	0.636
		% within Respondent's age group	38.2%	61.8%	100.0%		

The results of the cross tabulations showed that of the households aged less than or equal to 40 years 37.3% and 62.7% had not heard and had heard about climate change respectively. This was similar for those households of age above 40 or equal to 60 where 34.4% and 65.6% of the households had not heard and had heard about climate change respectively. In the group of households aged above 60 years, 42% had heard about climate change while 58% had not. The indication from the result is that climate change information or knowledge is concentrated on households' middle aged (between 40 to 60 years). The results were then further tested statistically using the Pearson's Chi-square test to establish whether a statistical relationship exists between the variables or if it is by chance.

The Chi-square test statistic of 0.906 and a p-value of 0.636 imply that the null hypothesis of an independent relationship between age and climate change knowledge could not be rejected. Thus there was no statistical relationship between the two variables, age and climate change knowledge.

4.4.3 Education and knowledge on climate change

Education is a vital component for spreading climate change knowledge and information. The exact impact is however uncertain. The study examined how households who attended different levels of education have fared in accessing information on climate change. The results are presented in Table 4.6 below.

Table 4.6: Respondent's level of education * Have you ever head of climate change? Cross-tabulation

			Have you ever heard of climate change?		Total	Pearson Chi-square test	
			No	Yes		Critical value	P-value
Respondent's level of education	Standard 4	Count	18	27	45		
		% within Respondent's level of education	40.0%	60.0%	100.0%		
	Standard 6	Count	14	17	31		
		% within Respondent's level of education	45.2%	54.8%	100.0%		
	Primary	Count	14	11	25		
		% within Respondent's level of education	56.0%	44.0%	100.0%		
	Secondary	Count	27	60	87		
		% within Respondent's level of education	31.0%	69.0%	100.0%		
	Higher	Count	5	11	16		
		% within Respondent's level of education	31.2%	68.8%	100.0%		
Total		Count	78	126	204		
		% within Respondent's level of education	38.2%	61.8%	100.0%	6.271	0.180

The results in Table 4.6 indicate that of households who attained standard 4, standard 6 and primary education, 60%, 54.8% and 44% had heard about climate change respectively. Contrastingly, 69% and 68.8% of the households with secondary and higher education had heard about climate change. That meant, the results showed a general trend where more education was associated with access to climate change information. This result was tested using the Pearson's Chi-square tests under the null hypothesis that knowledge on climate change is independent of education. The Chi-square statistic of 6.271 and a p-value of 0.18 means that the null hypothesis could only be rejected beginning at 18%. Therefore, at the conventional significance levels below 10%, it can be concluded that education and knowledge on climate change are independent, thus the study concluded that there is no relationship between education and climate change knowledge.

4.4.4 Exposure to hazards and climate change knowledge

If natural hazards are linked to climate change, it is of greater possibility that where climate change related hazards occur, people get informed about the causes which are climate change related. The study therefore examined if exposure to hazards related to knowledge on climate change. The cross-tabulation of responses on the experience of hazard and knowledge on climate change are presented in Table 4.7 below.

Table 4.7: Have you experienced any hazard in your area? * Have you ever heard of climate change? Cross-tabulation

			Have you ever heard of climate change?		Total	Pearson's Chi-square Test	
			No	Yes		Critical value	P-value
Have you experienced any hazard in your area?	No	Count	11	11	22		
		% within Have you experienced any hazard in your area?	50.0%	50.0%	100.0%		
	Yes	Count	67	115	182		
		% within Have you experienced any hazard in your area?	36.8%	63.2%	100.0%		
Total		Count	78	126	204		
		% within Have you experienced any hazard in your area?	38.2%	61.8%	100.0%	1.445	0.229

Table 4.7 above indicates that an equal proportion of households who had not experienced hazards had either heard of climate change or not. The majority; 61.8% of house-holds who had experienced hazards in their area, had heard about climate change. The relationship between the two variables was further tested using Pearson's Chi-square tests and a Chi-square statistic of 1.445 and a p-value of 0.229 were reported as in the table above. This meant that the null hypothesis of an independent relationship between exposure to hazards and knowledge of climate change could not be rejected. It was therefore concluded that there was no statistical relationship between exposure to hazards and households knowledge on climate change.

4.5 Perception on Hazard Occurrences

Respondents were asked on whether they had ever experienced hazards or not since their settlement in Mt Darwin. Among the respondents, 182 (89%) agreed that they had experienced some hazards since their settlement in Mt Darwin. Only 22 (11%) respondents objected to having experienced any form of hazard since their settlement in the area.

Table 4.8: Have you experienced any hazard in your area?

	Number of respondents	Percent	Cumulative Percent
No	22	10.8	10.8
Yes	182	89.2	100.0
Total	**204**	**100.0**	

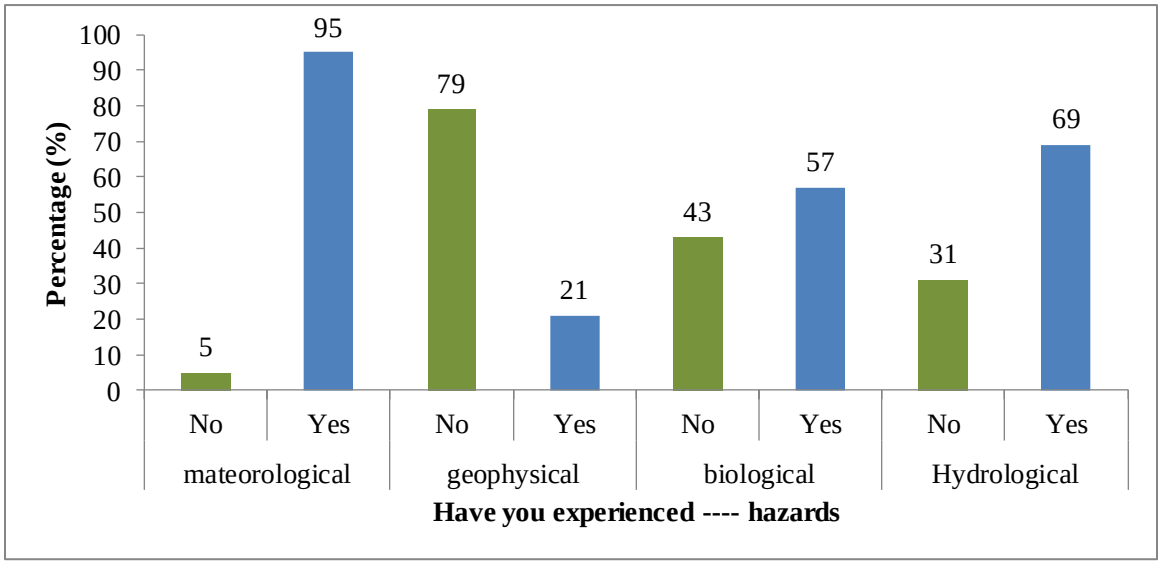

Figure 4.4: Types of hazards experienced in Mt Darwin, N=182

Respondents were further asked to specifically indicate the type of hazards they had ever experienced. As shown in Figure 4 above, the majority of respondents, 95%, agreed that they had experienced meteorological hazards while 69% agreed to have had experienced hydrological hazards. 57% of the respondents reported having experienced biological hazards such as cholera outbreaks. Geophysical hazards were the least being experienced as only 21% of the respondents had experienced these since their settlement.

The 182 respondents who agreed that they had experienced some hazards since their settlement in Mt Darwin were further asked if the patterns of hazard occurrences were changing. About 156 (86%) respondents agreed that the occurrence patterns of hazards were changing and 26 (14%) indicated that there were no changes in the occurrence patterns of the hazards. The responses are summarized below.

Table 4.9: Has the occurrences of hazards changed since year of settlement?

	Frequency	Percent	Cumulative Percent
No	26	14	14
Yes	156	86	100
Total	**182**	**100**	

Households indicated their perceived causes of the changing occurrence of hazards in the Mt Darwin district. The factors identified were classified as those that propel the occurrence of hazards and those that reduce hazard occurrences. Forces reducing hazard occurrences included improving education on good sanitary practices, use of new technologies to disseminate information, technical assistance received from non-governmental organizations, improving medical facilities and health education among other things. On the negative side, factors precipitating hazard increases included climate change, decreasing availability of safe water, overpopulation and poverty, destruction of forests and uncontrolled agricultural practices.

The full list of factors perceived to be causing changes in hazard occurrences are listed in Box 2 below. Unfortunately, the larger proportion of the sample was not knowledgeable on the forces accounting for changes in hazard occurrences. The forces listed in Box 2 did not exclusively indicate on climate change, particularly, increasing extreme events as accounting

for a larger proportion of the hazards in Mt Darwin. This implied that either the community did not appreciate the role played by climate change in causing hazards.

Box 2: Causes of changes in hazard occurrences in Mt Darwin District

Forces Reducing Hazards

- Knowledge of good hygiene such as washing hands,
- Behaviour change being taught,
- Availability of medical facilities
- Health education, new technologies, improving knowledge
- Proper sanitation,
- Improved health practices, awareness campaigns on cholera,
- Technical expertise given by NGOs

Forces Precipitating Hazards

- Cyclones and climate change,
- Cholera outbreaks due to insufficient water
- Changes in rainfall patterns, decreasing safe and portable water,
- Deforestations, veld fires, migration,
- Overpopulation, drinking water from unprotected sources,
- Insanitary resettlement of people,
- Overcrowding, natural, poverty,
- Uncontrolled agricultural practices,
- Drought, erosion
- Poor health facilities in some areas,
- The shifting rainfall patterns, sanitary awareness
- Destruction of forests, industrial gases dangerous gases from industries, chemicals washed into rivers such as fertilizers,
- Poor farming methods, heavy and unpredictable weather events, poor land planning, stream bank cultivation,

4.6 Perception on Climate Status

Respondents were asked about their perceptions on the current climate status as well as the perception of climate status at the time of settlement in Mt Darwin. The perceptions were measured on a scale ranging from extremely bad to very good. On the perception of the current climate status, 73 (36%) and 80 (39%) regarded the climate as extremely bad and very bad respectively. The remainder of 51 (25%) regarded the climate status as bad as shown in the table below. The perceptions of the respondents regarding current climate status and climate status at settlement time are presented in Table 4.10 below.

Table 4.10: Perceptions on Climate Status at settlement and current, n=204

		Number of respondents	Percent	Cumulative Percent
Perception on the current status of climate	Extremely Bad	73	35.8	35.8
	Very Bad	80	39.2	75.0
	Bad	51	25.0	100.0
	Total	204	100.0	
Perception on climate status at the time of settlement	Extremely Bad	3	1.5	1.5
	Very Bad	15	7.4	8.8
	Bad	38	18.6	27.5
	Good	117	57.4	84.8
	Very good	31	15.2	100.0
	Total	204	100.0	

Respondents were further asked to indicate their perceptions on trends of key climatic variables. Table 4.11 illustrates the views of the respondents regarding climatic variables that are rainfall, temperature, sun's heat and drought frequency among others. About 169 (83%) of respondents indicated that rainfall had decreased, 17 (8%) felt it has remained constant while 18 (9%) were not sure. At-least 165 (81%) of the 204 respondents felt that temperature, drought frequency, dry spells and heat-waves had increased. Between 101 (50%) and 161 (79%) of the respondents felt that wind, sun's heat and floods had increased while merely between 1 and 3 respondents were of the decrease opinion. The rest were of the constant opinion or not sure as shown in Table 4.11.

Table 4.11: Perceptions on Rainfall, Temperature, Wind, Sun's Heat, Drought Frequency, floods, Dry Spells and Heat-waves Trends

	Decreased	Constant	Not Sure	Increased
Rainfall	169 (82.8%)	17 (8.3%)	18 (8.8%)	-
Temperatures	1 (0.5%)	12 (5.9%)	17(8.3%)	174 (85.3%)
Wind	-	38 (18.6%)	46 (22.5%)	120 (58.8%)
Sun heat	1(0.5%)	16 (7.8%)	26 (12.7%)	161 (78.9%)
Drought frequency	8 (3.9%)	8 (3.9%)	-	188 (92.2%)
Floods	3 (1.5%)	44 (21.6%)	56 (27.5%)	101 (49.5%)
Dry spells	-	13 (6.4%)	18 (8.8%)	173 (84.8%)
Heat waves	-	9 (4.4%)	30 (14.7%)	165 (80.9%)

In order to validate and evaluate consistency in responses, the respondents were asked to indicate on the major observed shifts in rainfall and temperature. The findings are summarized in Box 3. The summary consists of the major recurring observed shifts for the two variables. Inferring from Box 3, the respondents observed decreasing rainfall amount, shortening rain seasons, increasing temperatures, recurring heat waves, increasing hot days, increasing extreme cold and hot weather, abnormal and unusual temperatures and increasing extreme rain events.

Box 3: Observed major abnormal shifts in rainfall and temperature

- The amount of rainfall has decreased over time, temperature is increasing especially in October,
- Rainfall has decreased, temperature has gone high
- Used to receive rainfall between 400 to 900mm, that of region 4. Now it has decreased to between 150mm and 300mm, in the 1980s-90s temperatures were constant but now we have recurring heat waves.
- Rainfall season has shortened, at times only two months or less. Excessive heat, heat that leads to deaths of birds and wild animals.
- It's difficult to plan as rainfall can come for only three months, Mt Darwin is having high temperatures that does not support agriculture
- Rainfall is erratic and has resulted in water shortages in the area, temperatures are slightly hot nowadays but not very hot
- Rainfall is now erratic, high temperatures are now being experienced with heat waves currently recurring.
- Later days we used to receive rainfall in mid-November up to May but now we are receiving rains late December. We are having high temperatures throughout the year yet later year's temperatures were high mid-September to November.
- Rainfall has decreased by far,
- We used to have rains from mid-November to mid-May but now we receive it in late December to early February. The temperatures were high in mid-September to mid-November but now it is hot all year round.
- Decrease in the amount of rainfall and type of rainfall. Temperature is no-longer constant-sometimes very cold and other times too hot experiencing heat waves.
- Rainfall decreased in amount as compared to years such as 1997. High temperatures being experienced throughout the year.
- Rainfall is low and temperature has increased,
- Rainfall no-longer coming normally since the 1990s
- Rainfall has decreased, temperature has been increasing due to low rainfall
- Our rainfall during the period 1999-2001 was very good but since 2002 we have very short rainfall season.
- No rains in 2015, temperatures moderated in 2015
- The season has changed drastically; we used to receive rains for three months but now only for a month or month and a half. Temperature have risen to unsatisfactory

4.7 Health Effects of Climate Change

The respondents were asked on whether they thought climate change affected their health and health hazards being experienced in Mt Darwin due to changes in rainfall, cold, flood and heat. The study found that 134 (66%) were of the opinion that climate change affected their health while 70 (34%) said climate change did not affect their health. As in Table 4.12 below, 201 (99%), 90 (44%), 107 (53%), 137 (67%), 119 (58%) and 104 (51%) were of the view that malaria, bilharzia, diarrhoea, respiratory infections, skin infections and malnutrition are health hazards emanating from changes in rainfall, cold, floods and heat respectively.

Table 4.12: Health hazards being experienced due to changes in climate variables, n=204

		Number of Respondents	Percent	Cum. Percent
Malaria	**No**	3	1.5	1.5
	Yes	201	98.5	100.0
Bilharzia	**No**	114	55.9	55.9
	Yes	90	44.1	100.0
Diarrhoea	**No**	97	47.5	47.5
	Yes	107	52.5	100.0
Respiratory	**No**	67	32.8	32.8
	Yes	137	67.2	100.0
Skin infections	**No**	85	41.7	41.7
	Yes	119	58.3	100.0
Malnutrition	**No**	100	49.0	49.0
	Yes	104	51.0	100.0

Households were asked to briefly explain how climate change affected their health. Only about 73 people of those who felt that climate change affected their health (n=134) responded by briefly explaining how health is affected by climate change. The responses are summarized in Box 4. Most of the respondents identified the effect of climate change on health as increasing scarcity of food resulting in malnutrition and related diseases. Droughts and excessive rains resulted in hunger and malnutrition. Water shortages resulted in outbreaks of diseases such as cholera and diarrhoea. In addition, climate change resulted in deaths and unplanned sell of livestock fetching low prices that affected people's income hence access to health services and nutrition (such as protein). Excessive rains and temperatures caused new and emerging diseases that were not common in the area. High temperatures also caused headache, dysentery, diarrhoea, skin damages and too much body

sweating leading to dehydration and weaknesses as well as mosquitoes that spread malaria. The respondents therefore viewed the health effects of climate change in varied ways but the greater portion of the population were not able to articulate these health effects.

Box 4: How does Climate Change affect health?

- Too much rainfall brings about floods hence outbreaks of diseases, hunger and malnutrition,
- Rainfall has become erratic and food shortages occurs, with diseases rising
- Lack of food for the family, loss of weight,
- Unable to feed my family since I depend on farming as an activity thus putting my family at risk of poverty
- Unable to feed family since I depend on agriculture to survive
- It affects agriculture since crops wouldn't grow well and animals die due to starvation and hunger as results of shortages of water due to low rainfall. As a result of high temperatures crops wilt and animals die. Death of livestock due to lack of water and pasture result in inadequate access to protein in diet
- Climate change can cause scarcity in water resources thereby influencing diarrhoea diseases. It can lead to vector breeding. Climate change is the major cause of most health problems we are experiencing in the community
- Outbreaks of diseases which affect people and livestock
- During hot weather we do not sleep in mosquito nets,
- Livestock sold unplanned and at unprofitable prices. Disease outbreaks and increase. People who are poor due to climate change are dying without seeking proper medication to better health centres because they do not have enough cash from either their livestock's or cash crops,
- The temperatures go beyond levels that our bodies are used to and new infections are emerging
- We will not have enough food hence malnutrition
- Due to the changes in climate many people are dying
- Sun 's heat cause headache to both adults and children
- When temperatures increase, mosquitoes breed fast resulting enhanced spread of malaria, headache, and dysentery.
- New diseases emerge while people frequently fell sick (*hosha dzisakamboonekwa dzinotanga uye vanhu vanongorwararwara*). Lack of rainfall is causing most of the diseases; people are drinking water from the same sources as animals causing a lot of diseases.
- Result in shortage of proper diet, unavailability of water for activities such as gardening and feeding domestic animals.
- High temperatures are causing skin damages, too much sweating during the day and at night leading to dehydration and body weakness
- Too little and too much rainfall cause food scarcity, too much temperatures such as heat waves exhaust the body, mosquitoes become active hence malaria becomes a problem.

The study also sought to examine whether or not people understood the channels through which diseases were altered by changes in climate. The majority of the respondents did not respond to this question or they gave irrelevant responses (for example asked how malaria is altered by climate change some simply answered it increased). However, a handful of some respondents managed to indicate their thoughts on how climate change altered a number of health hazards. The responses are listed in box 5 below.

Box 5: Alteration of Diseases by Climate Change

Malaria	Bilharzia	Diarrhoea
• Activated because mosquitoes which spread malaria favours hot areas. • Has increased due to favourable breeding sites. • high temperatures • less rains result in less mosquito hence less cases of malaria • change in temperatures and rainfall patterns affect the breeding of mosquitoes which affect the transmission of malaria	• unclean water • increase in heat • people drink unsafe and unclean water from dams sharing with cattle	• occurrence has increased due to poor water availability • low rainfall, water and sanitation, • Drinking of unsafe water due to water shortages • little or no water • drought, • Little and dirty water, • dirty water • poor diet, • sharing water sources with animals,
skin infections	**Malnutrition**	**Respiratory Infections**
• due to excessive heat • heat wave • excessive sun's heat • cross infections • change of weather	• due to droughts, poor rain seasons, poor distribution of rain days, shorter rain periods, changing suitable crops, • lack of food • imbalanced diets	• experienced due to excessive winds and dust, too much cold, extreme cold days, • heat increasing • blowing wind • cold • unpredictable and constantly changing temperatures

The results in Box 5 are mixed. In some cases, households were able to articulate the channels through which diseases were altered by climate change. In the case of malaria, respondents indicated that changes in both rainfall and temperatures affected the breeding of mosquitoes which spread malaria. Some respondents thought that bilharzia was altered by shortages in water which caused people to share water sources with animals. The alteration of diarrhoea by climate change was well articulated as respondents noted that water shortages forced people to drink dirty and unsafe water. While households correctly stated that increase in temperatures and heat waves caused skin infections, they were not able to state the mechanisms through which the skins were affected. This pattern was also observed in the responses given under respiratory infections in Box 5.

In order to infer on the health impacts of climate change, respondents were asked about the years that they regarded as bad and good based on their experiences. The findings are reflected in Box 4 below. Some of the good years mentioned by respondents included 1990, 1993, 1999, 2000 and 2005 among others. The bad years experienced by the respondents included 1983, 1992, 2002 and 2015. As shown in Box 4, the bad and good years were defined by temperatures, drought, food availability, occurrence of disease outbreaks, level of harvest, earnings from agriculture and cash generated from agriculture for meeting expenditures.

Box 6: Respondents' bad and good years, and the major effects

Good Year	Effects	Bad Year	Effects
1990	Good yield, people earned enough money from fields for seeking medical attention, good cotton production.	1983	Food shortages
1993	Good yield, people earned enough money from fields for seeking medical attention, good cotton production.	1992	Food shortages, malnutrition
2001	good harvests and no disease outbreaks	2008	Food shortages, cholera outbreak
2005	good harvest, managed to purchase cattle, constructed houses,	2010	cholera, malaria, drought, malnutrition,
2012	few disease outbreaks	2015	Drought, food shortages, extreme temperat

Knowledge on households' understanding of health hazards linked to particular climatic events was also assessed. Changes in rainfall have been linked to health hazards such as diarrhoea, malaria, bilharzia, malnutrition and cholera among other things. Changes in temperatures are linked with malaria, new unknown diseases, skin infections; respiratory knowledge on households' understanding of health hazards linked to particular climatic events was also assessed. Changes in rainfall have been linked to health hazards such as diarrhoea, malaria, bilharzia, malnutrition and cholera among other things. Changes in temperatures have been linked with malaria, new unknown diseases, skin infections, respiratory infections, diarrhoea, excessive sweating and deaths. Hazards associated with wind included respiratory infections and destruction of settlements while sun's heat was reported to result in headaches, skin infections, unknown diseases, diarrhoea, malaria, malnutrition and diarrhoea among children. The full views of the respondents on health hazards associated with drought frequency, floods, dry spells and heat waves are disclosed in Box 7 below.

Box 7: Health Hazards Associated with particular climatic variables

Rainfall	temperature	wind	Sun's heat
• diarrhoea • malaria • affect harvests • malaria, • lack of food for the family • bilharzia, malnutrition • cholera, • no food to feed family,	• malaria, • new diseases in the area, • skin infections, • respiratory infections, diarrhoea diseases • respiratory infections, skin infections • excessive sweating, • death	• respiratory infections • destroys houses and huts • blowing/destruction of settlements	• Headache • skin infections • affects skins • cause diseases unknown to the area • diarrhoea • skin infections • malaria • malnutrition • diarrhoea to kids
Drought frequency	**floods**	**Dry spells**	**Heat waves**
• malnutrition • cause hunger • poverty and • diarrhoea • hunger	• diarrhoea, • bilharzia • malaria • new diseases and	• poor harvest • malaria, • diarrhoea • respiratory infections	• headache • skin infections • diarrhoea, • respiratory infectio • heat stress,

4.8 Perception on disease occurrence attributable to climate change

Respondents were asked on their overall perception regarding the occurrence of diseases attributable to climate change. The majority of respondents, 155 (76%) were of the view that the occurrence of diseases attributable to climate change had increased, 11 (5%) opined that disease occurrence had decreased while the remainder 38 (19%) felt disease occurrence was constant. The results are illustrated in Figure 4.5 below.

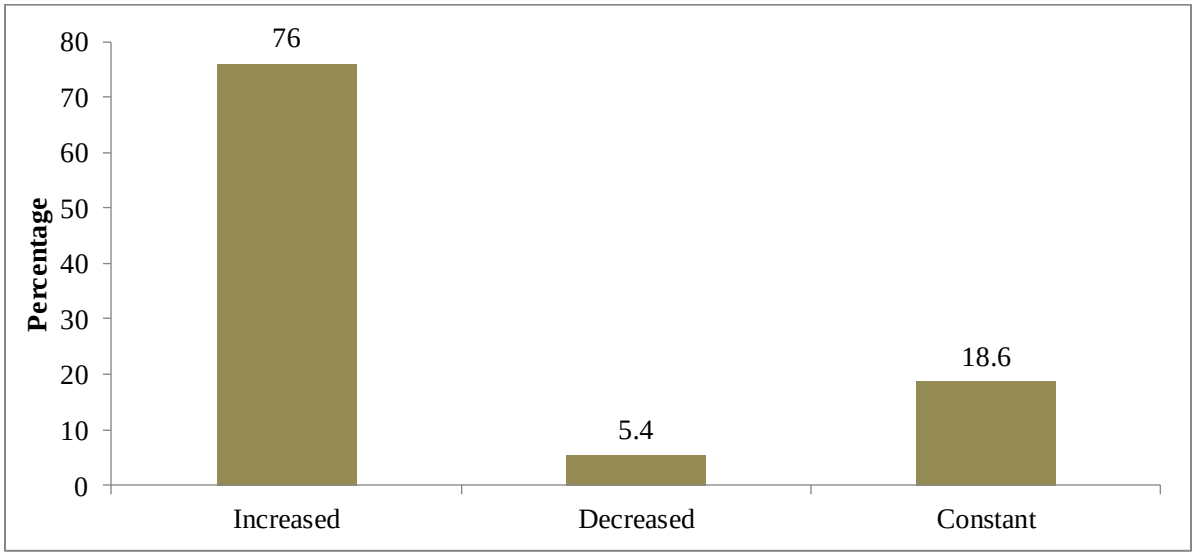

Figure 4.5: Overall perception on disease occurrence attributable to climate change

In addition to overall perception on the occurrence of diseases attributable to climate change, respondents were asked on the present frequency of diseases in summer and winter compared to the last 5 to 10 years. The responses are illustrated in Figure 4.6 below. About 41% and 42% felt that the present disease frequency in summer was high and very high compared to the last 5.10 years respectively. Only 5.4% of the respondents were of the opinion that disease frequency in summer had become low and very low compared to 5-10 years ago while 12% stated that they did not know. About, 41% and 48% of the respondents highlighted that the present occurrence of disease in winter is high and very high compared to 5-10 years ago respectively. Only 1% and 4% of the respondents felt that the present disease occurrence in winter was very low and low compared to the last 5-10 years while 6% indicated that they did not know.

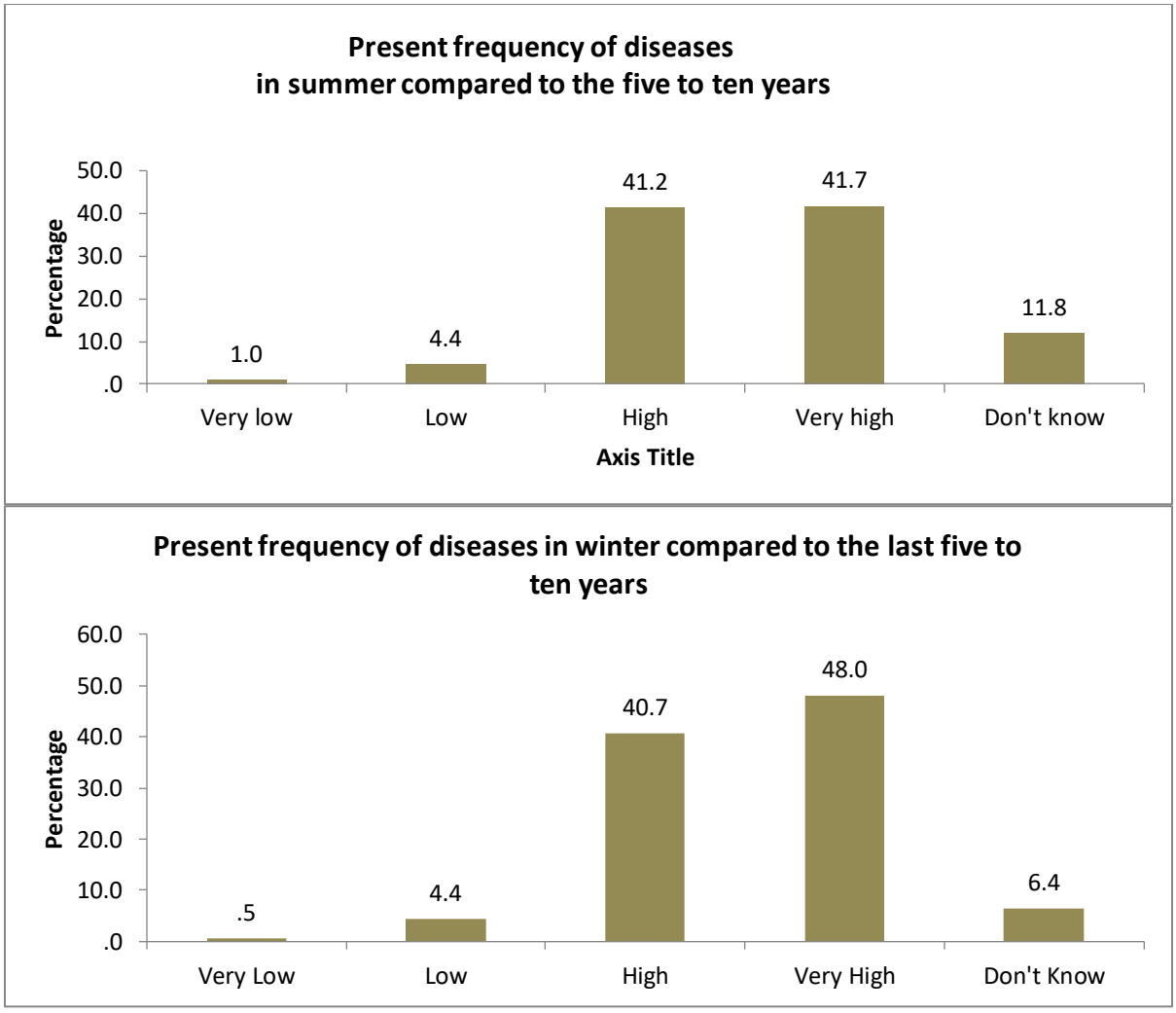

Figure 4.6: Present frequency of diseases in summer and winter compared to the last five to ten years

4.9 Action to reduce climate change induced health hazards

Respondents were asked if they were taking action to reduce the impact of health hazards induced due to changes in climate. About 109 (53%) indicated that they were not taking any action while 95 (47%) indicated they were taking some action.

Table 4.13: Are you taking any action to reduce the impact of health hazards posed by climate change?

	Number of respondents	Percent	Cumulative Percent
No	109	53.4	53.4
Yes	95	46.6	100.0
Total	**204**	**100.0**	

Respondents taking action were further asked to identify specific actions that they were taking for specific health hazards. The results are summarized in Box 8 below. In order to reduce the health hazards posed by malaria, the use of mosquito nets was the most common response in the district. Use of pills and residual spraying was also cited by the respondents. Common response for avoiding health hazards of bilharzia was to avoid playing in water while home hygiene and drinking boiled water were the commonly cited actions against diarrhoea. Households mostly received donor aid as action against malnutrition while wearing suitable clothing was the common action against respiratory infections. There were no satisfactory actions identified by the respondents on skin infections besides planting more trees and immediate visits to clinic. Comprehensive list of households' actions against hazards posed by climate change are identified in Box 8.

Box 8: Actions to reduce the impacts of health Hazards Associated with Climate Change

Malaria	Bilharzia	Diarrhoea
• use treated nets • undergo malaria treatment • malaria control-nets and pills • residual spraying • seek immediate treatment, • visit clinics, prevention pills, • using repellants,	• avoid playing in water • checks and treatment • de-worming • treat stagnant water, • checks and treatment • seek urgent treatment	home hygiene practice, drinking boiled water drinking safe water from safe sources Hand washing, drink treated water
skin infections	**Malnutrition**	**Respiratory Infections**
• planting more trees around us, • immediate visits to clinic	• gardening • early planting of crops, • going back to traditional foods • receive donor aid • planting early maturity crops, • eat locally available foods • purchase food to supplement	• health education • wearing clothes that allows fresh air to enter the body • seek shade when the sun is too hot • wearing suitable clothing

4.10 Factors affecting taking action against climate change health hazards

This study had the objective to examine if actions to reduce the impacts of health hazards emanating from climate change vary with knowledge about climate change or not. In order to achieve this, the variable on knowledge about climate change was cross tabulated with the variable on actions against climate change health hazards. The results are presented in Table 4-14. The results showed that 52 (66%) of those who had not ever heard about climate change were also not taking action against health hazards imposed by climate change. Of those who had heard about climate change, 69 (55%) were taking action against the health hazards imposed by climate change. This result showed that people with knowledge on climate change are more likely to take action against the hazards imposed by climate change.

Table 4.14: Knowledge and actions against climate change cross-tabulation

		Are you taking any action to reduce the impact of health hazards posed by climate change		Total	Pearson Chi-Square Tests	
		No	Yes		Value	Asymp. Sig (2 sided)
Have you ever heard of climate change?	No	52	26	78		
	Yes	57	69	126		
Total		**109**	**95**	**204**	**8.891**	**0.003**

The relationship between knowledge of climate change and taking action against the health hazards imposed by climate change was formally tested using the Pearson's Chi-square test. The test statistic of 8.89 and p-value of 0.003 implied that the null hypothesis of independence of the two variables could not be accepted at the conventional levels of significance. We therefore conclude that knowledge of climate change is related to taking action against climate change induced health hazards.

The study also examined the relationship between household head's education and action to reduce the impact of health hazards due to climate change. The results are shown in Table 4.15. Results in Table 4.15 show that 27 (60%) and 20 (64%) who had standard four and standard 6 were not taking action to reduce the impacts of climate change induced health hazards respectively. About 13 (52%) and 40 (46%) of household heads with primary education and secondary education indicated that they were taking some action against the

climate change induced health hazards respectively. In addition, the majority (81%) of household heads with higher education indicated that they are taking some action against climate change.

Table 4.15: Respondent's level of education and action to reduce the impact of health hazards posed by climate change cross tabulation

		Are you taking any action to reduce the impact of health hazards posed by climate change		Total	Pearson Chi-Square Tests	
		No	Yes		Value	Asymp. Sig. (2-sided)
Respondent's level of education	Standard 4	27	18	45		
	Standard 6	20	11	31		
	Primary	12	13	25		
	Secondary	47	40	87		
	Higher	3	13	16		
Total		**109**	**95**	**204**	**10.354**	**0.035**

The results above signal a relationship between education level and taking action against climate change. The relationship between the two categorical variables was tested using the Pearson Chi-square test. A Chi-square statistic value of 10.35 and significance value of 0.035 implies that the null hypothesis of the independence between the two variables cannot be accepted at the 5% level of significance. This meant that there is a significant relationship between the household's level of education and taking action to reduce the health hazards associated with climate change.

Table 4.16: Experience of hazard * taking action to reduce the impact of health hazards cross-tabulation?

		Are you taking any action to reduce the impact of health hazards posed by climate change		Total	Pearson Chi-Square Tests	
		No	Yes		Value	Asymp. Sig. (2-sided)
Have you experienced any hazard in your area?	No	14	8	22		
	Yes	95	87	182		
Total		**109**	**95**	**204**	**1.032**	**0.310**

Table 4.16 presents cross tabulation of households' responses on the experience of hazards and taking action to reduce the impact of health hazards posed by climate change. The study found that 14 (64%) and 95 (52%) of the households who had not experienced any hazard in their area were not taking action to reduce the impact of health hazards posed by climate change. The Chi-square value of 1.032 and p-value of 0.31 implied the null hypothesis that the two variables are independent could not be rejected at the conventional levels of significance. That meant there was no relationship between experiencing hazards and taking corrective action against the hazards posed by climate change.

The study additionally examined the relationship between knowledge on hazard occurrence in Mt Darwin and taking action to reduce the impacts of health hazards posed by climate change. These results are tabulated in Table 4.17. The majority, 14 (64%) and 95 (52%) of the household heads who reported that they had not and had experienced hazard were not taking action to reduce the impact of health hazards posed by climate change. The Pearson's chi-square test value of 1.032 and p-value of 0.310 implied that the null hypothesis that responses on experience of hazard in Mt Darwin were independent of taking action to reduce the impacts of health hazards posed by climate change could not be rejected at the 5% level of significance. This therefore implied that there was no significant relationship between knowledge about hazard occurrence and taking action to reduce the impact of climate change induced health hazards.

Table 4.17: Experience of hazard in your area? * taking any action to reduce the impact of health hazards posed by climate change cross-tabulation

		Are you taking any action to reduce the impact of health hazards posed by climate change		Total	Pearson Chi-Square Tests	
		No	Yes		Value	Asymp. Sig. (2-sided)
Have you experienced any hazard in your area?	No	14	8	22		
	Yes	95	87	182		
Total		**109**	**95**	**204**	**1.032**	**0.310**

4.11 Analysis and Interpretation of Results

Analysis and interpretation of results is the process of giving meaning to the study findings in order to better understand the results and interrelationships among variables. The findings presented in the preceding sections are summarized and discussed in a concise manner and in relation to the study objectives.

The data presented was drawn from households of both gender and age diversity as reflected by the proportion of males and females interviewed, and both range and average age. The distribution of years of settlement shows that views of the earliest settlers are captured as well as those who were born and grew up in the area, and those who settled in Mt Darwin later. The responses summarized therefore reflect lived and shared information relating to climate change by people of varied groups through interaction overtime. The majority of respondents relied on agriculture for livelihood. As agriculture is directly affected by changes in climatic patterns, respondents' reliance on agriculture could have influenced their knowledge on climate change and related hazards.

There was high awareness on climate change among the respondents signalled by 62% of them who had heard about climate change. Respondents' interpretation of climate change as changes in weather components of rainfall and temperature, and rainfall intensity and predictability augured well with literature which found households to weakly interpret climate change as changes in rainfall, temperature, storms, floods, deep cold, and long heat waves (Toan et al., 2014; Ogalleh et al., 2012). It shows lack of in-depth knowledge on climate change.

However, the 38% of the respondents who had heard about climate change is a significant number that require education about climate change in order to raise awareness on climate change related health hazards. Only 7% of the respondents had correct information on the causes of climate change (natural and man-made forces). The majority of respondents attributed climate change to man-made, natural and spiritual causes implying that there were knowledge gaps in as far as the causes of climate change are comprehended.

Respondents were aware of hazard occurrences in the district. Meteorological, hydrological and bio-physical hazards were more common in the district. About 86% of the respondents were of the view that hazard occurrences were changing in Mt Darwin District. Improving education, knowledge, sanitation, health facilities and technical expertise were some of the factors noted by the respondents to be affecting hazard occurrence in the District. Climate

related factors including shifting rainfall patterns, cyclones and drought were cited as causes of changes in the occurrence of hazards in Mt Darwin. Climate forces such as increasing frequency of extreme events such as wind, rainfall and temperatures were not mentioned among forces attributing to causes of hazard occurrences.

The respondents regarded the climate change as bad and extremely bad if compared to the time of settlement. This was represented by decreasing rainfall, and increasing temperature, drought frequency, dry spells, heat-waves, strong winds, sun's heat and floods. According to the respondents increasing temperature, recurring heat waves, increasing hot days, increasing extreme cold and hot weather, abnormal and unusual temperatures and increasing extreme events were more frequent.

Majority (66%) of the respondents considered climate change to have an effect on their health. Households explained that changing patterns of rainfall were mainly leading to food scarcity and malnutrition. In addition, water scarcity was considered to worsen diseases such as cholera and diarrhoea as well as causing death and unplanned sell of livestock. The responses given indicated that malaria, diarrhoea, respiratory infections, skin infections and malnutrition were the health hazards mostly affected by climate change in the district. The results however showed that even if people were aware that climate change poses health hazards that included malaria, diarrhoea, respiratory infections, skin infections and malnutrition, they were not aware of the mechanisms/channels through which some of these hazards were altered by climate change. This was shown by the fact that 46% of the respondents who were aware that climate change affects health were not able to explain how health is affected by climate change. Furthermore, the majority of respondents failed to respond to the question on how specific health hazards are altered by climate change. Within the society, a handful of the respondents were aware of the mechanisms through which health hazards such as malaria, bilharzia, diarrhoea, skin infections, malnutrition and respiratory infections were altered and their knowledge may be useful in hazard prevention if it's tapped into. Households poorly understood how respiratory and skin infections were affected by climate change even though they acknowledged that the occurrence of these hazards had changed due to climate change. The study also noted that, households identified good and bad years based on food availability/harvest compared to the health hazards that occurred during t particular seasons. As a result, hazards such as direct and indirect death and damages posed by climatic events were of less weight.

It was commendable that there were some households knowledgeable on the multiple health hazards posed by specific climatic variables such as rainfall. In the study, some households identified that rainfall changes led to variations in the occurrence of diseases such as diarrhoea, malaria, malnutrition and cholera. Similarly, wind was linked with respiratory infections and destruction of houses and other infrastructure. Heat waves were identified as leading to headaches, skin infections, diarrhoea, respiratory infections and heat stress among other things. Thus, some sections of the community appreciated that climatic forces caused multiple health hazards.

In Mt Darwin, the occurrence of diseases attributable to climate change had increased. Households indicated that the occurrence of diseases in both summer and winter were high/very high if compared to the last 5 to 10 years. There was convergence on the views of the respondents pertaining to the occurrence of health hazards-health hazards emanating from climate change had increased in recent years compared to some years ago.

The majority of the respondents were not taking any action against climate change induced health hazards. In addition, actions were being taken by households on common health hazards such as malaria, bilharzia, diarrhoea and malnutrition while the same was not being done on hazards such as skin and respiratory infections. In addition, there were no indications that households were taking action against hazards posed by climatic events such as extreme cold, excessive heat, strong winds and flooding. Uses of early warning system, meteorological advice and pre-season health advice were not identified as some actions useful to guard against climate change induced hazards.

The study found out that knowledge on climate change was related to taking action against health hazards induced by climate change. That meant households with knowledge on climate change were more likely to take action meant to reduce the effects climate change induced health hazards. The study also established inter-dependence between education level and taking action against climate change. This meant that education can be an important channel through which people are taught to take action against climate change. This implied that it is important to ensure that households and communities understand climate change so as to take the correct action against the hazards of climate change. The study also deduced that knowledge on hazard occurrences is independent of taking action to reduce health hazards posed by climate change. This study therefore placed importance on ensuring that climate change knowledge is fostered in communities through education and ensuring that knowledge

on hazard occurrence positively influences adoption of actions to reduce the impacts of hazards.

4.12 Conclusion

This chapter has presented and analysed the study results. The chapter gave details on descriptive statistics, knowledge on climate changes, perception on hazard occurrence, perception on climate status, health effects of climate change, perception on disease occurrence attributable to climate change, action to reduce climate change health hazards and factors affecting action against climate change induced health hazards by the respondents. The next section gives the study conclusion, recommendations and identifies areas of further research.

CHAPTER 5. DISCUSSION OF THE RESULTS

5.1 Introduction

This section gives meaning of the statistical analysis and the results summarised in tables, graphs and boxes in chapter four above. Hess (2004) posited that effective discussion of results entails stating the major findings of the study, explaining the meaning of the findings and why such findings are important, relating the findings to those of related studies, considering alternative explanations to the findings and stating the relative clinical relevance of the findings. Discussion of results therefore should be construed as the processing of results to give a meaning to the reader. The meaning is driven from the writer's opinions informed by related studies. Chiefly, the chapter serves to answer to the questions asked when this research was conceived and indicate how well the results fits in the existing and related body of knowledge.

5.2 Results Discussion

This study focused on identifying what people in Mt Darwin district comprehended about climate change induced health hazards and the likely responses. The study found that only 62% of the respondents had heard about climate change. This result compares lower than the 87% of respondents who had heard of climate change by OECS (2013). Knowledge awareness has been found to vary by country as the OECS (2013) survey indicated that in countries such as Dominica 80% of the respondents had heard about climate change while as high as 92% in Antigua.

In Jamaica, the Caribbean Institute of Media and Communication (CIMC) (2012) found a larger percentage of about 83% of the respondents to have heard of climate change and knowing the meaning of it. Similarly, Leiserowitz et al. (2010) found out that a larger proportion of the Americans had heard about the greenhouse effect. In Bangladesh, the Asian Foundation found that most of the respondents had heard about climate change. In Mt Darwin the findings of this study shows that the proportion of people who have heard of climate change falls short by a larger proportion to those of related studies. The result therefore implies that there is less comprehension of climate change in Mt Darwin District.

This study found out that people were largely unaware and there are misconceptions about the causes of climate change. Only 7% of the respondents were aware that climate change is caused by both natural and man-made forces. Of greater concern was the fact that 14% of the

respondents viewed climate change as caused by spiritual forces. The greater proportion also thought that climate change was caused by man-made forces while the remaining 37% were of the view that natural forces accounted for climate change. This unawareness on the causes of climate change was reported by the Asian Foundation (2012) in Bangladesh where 46% of the respondents opined that climate change is a phenomenon caused by nature or God. Furthermore, the finding was consistent with findings in Nigeria where the majority of respondents identified man-made forces as responsible for climate change compared to natural forces (Ojoro et al., 2015). The Asian Foundation noted that there is great inconsistency between the extent people have heard about climate change and the level of unawareness on the causes of climate change.

The households understood climate change in varied ways: mainly the characteristics of climatic events they were experiencing. Climate change was understood as change in weather such as rainfall and temperature fluctuations. This is similar to findings by the Asian Foundation in Bangladesh. However, this study found that respondents related climate change to weather phenomenon becoming unusual. In Bangladesh, the Asian Foundation found that climate change was linked to strong climatic events normally experienced such as floods, droughts, heavy rain, storm/cyclone and high temperatures. Though not frequent, some respondents in this study mentioned heavy rains, droughts, excessive heat and cyclones as outcomes of shifting weather conditions due to climate change. The major departure from related findings is that in those settings in the current study, climate change was largely viewed in the lenses of strong climatic events which were likely to result in disasters.

Evidence from this study indicated that sex does not have a statistical relationship with knowledge on climate change and this was consistent with findings from the OECS study (2013). This result deviated from the arguments that perceptions and reactions to climate change differ with respect to women and men (Rohr, 2007). OECS (2013) and the CIMC (2012) also found that age groupings and education have a significant impact on the knowledge on climate change which is in deviance with our findings as education and age were found to be independent of climate change knowledge. Possibly, this could be explained by an education system that is devoid of teaching and informing issues relating to climate change. This has the fundamental effect of dampening climate change awareness. If any community awareness programs have been done in the area, it implies that they have not been effective.

Hazards were pervasive though those who experience these hazards were not aware of the linkage between these hazards and climate change. Most of the respondents, 89%, indicated that they had at-least encountered some form of meteorological and hydrological hazards. However, contrary to expectations and findings from other studies (Lujala et al., 2015; Menny et al., 2011), climate knowledge repository had been found to be unrelated to personal experience with these hazards. Lujala et al (2015) stated that climate change knowledge, attitudes and perceptions are explained by variables that include gender, education and political preferences, but most importantly by direct personal experience of damage posed by climatic related events such as floods and landslides. Related to the argument that personal experiences of hazards pose a greater impact on climate knowledge, Munny et al. (2011) argued that experience of extreme weather events affect knowledge on climate change. The finding therefore implies a huge climate change knowledge deficit even among those who have experienced climate change related hazards.

However, the finding that hazard occurrence patterns were changing is consistent with literature (Wardekker, 2011; UNFCC, 2011; G.O.Z, 2013; Clayton et al., 2014) which points out that due to climate change, hazards are increasing. Qualitative views of the respondents indicated that there were some rich pockets of information among the Mt Darwin community knowledgeable on forces altering the occurrence of hazards. The few respondents who managed to answer the qualitative question identified factors largely agreed to be altering hazard patterns and exposing communities to vulnerability. Chief among these factors was climate change which was linked to cyclones, severe water shortages, extreme weather events and drought among other things. Other factors such as poverty, migration, overcrowding, poor facilities and infrastructure, poor planning mentioned by the respondents exacerbated vulnerabilities to hazards as discussed in various literature (IPCC, 2007; Carter et al., 2012; Handmer et al., 2012; Chimanikire, 2013; Hori and Shaw, 2014; Rankomise, 2015).

Respondents' views regarding the current climate status augured well with the existing body of literature on climate change in Zimbabwe. The current climate was not favourable to the respondents as shown by the overwhelming rating ranging mostly between very bad to extremely bad as compared to the time at settlements. Respondents viewed rainfall as decreasing while temperatures were increasing together with wind speed, sun's heat, drought frequency, floods and dry spells. This was consistent with expressions in the literature (Simba et al., 2012; G.O.Z, 2013, Majengwa et al., 2014). Simba et al argued that respondents in Masvingo province of Zimbabwe regarded climate as changing manifested in increasing

frequency of droughts, dry spells, shifts in rain seasons, rising temperatures, declining rainfall amounts, and more frequent mid-season droughts. Households' views might have been shaped by their interaction with the environment over the years. The correct interpretation of their environment raised hope in raising the awareness of the community on the health hazards posed by climate change.

Majority of the respondents (66%) regarded climate change as an intervening variable for their health. A significant proportion of the respondents opined that climate change altered diseases such as malaria, respiratory infections and skin infections change while lesser percentage of the respondents agreed on the same for bilharzia, diarrhoea and malnutrition. Similar results were posited by the CIMC (2012) when about 62.8% of the respondents stated that climate change was related to health epidemics. The Asia Foundation found 80% of the respondents confirming that health hazards were among the household level impacts of climate change. Thus the findings of this study are within the confines of related studies. The health impacts of climate change mentioned in Box 4 tallies well with some literature (IPCC, 2010; Menny et al 2011, The Asia Foundation, 2012).

Heat related mortality among the elderly, chronically sick, very young and those socially isolated were identified among the health hazards posed by climate change by the IPCC (2010). Menny et al (2011) added changes in infectious diseases, scarcity of drinking water, increased malnutrition, increased death, diseases and injury emanating from extreme climatic events. Other health hazards as espoused by Menny et al include increased burden of diarrhoeal diseases, increased frequency of respiratory diseases and increased spatial distribution of some infectious diseases. Menny et al (2011) found that 24.9%, 36.9%, 37.9% and 29.9% of the respondents regarded health hazards as emanating from drought, flood, flash floods and cyclones respectively. While the general effects of climate change on health has been identified in this study, deep understanding was in deficit regarding the differential impacts of these changing climatic events on different societal groups such as the young and the elderly, and the rich and the poor- an aspect which has been identified in literature above.

Nemachena et al (2014) and Moyo et al., (2012) found that the effects of climate change were agriculture biased though about 34% of the households regard climate change as having an impact on health. Households mentioned that in 2011, some people died in Hwange due to heat stress. In addition, Nhemachena et al (2014) stressed that the general perceptions on the impacts of climate change are that it adds to other multiple factors such as poverty, HIV and

AIDS, food insecurity to worsen health outcomes. McMichael et al. (2006) identified similar hazards from climate change-altering of microbial proliferation causes of food poisoning such as unsafe drinking water and changes in vector-pathogen-host relations and infectious disease, geography changes the occurrence of malaria, dengue and viral diseases. Changes in mean climatic conditions and variability alter the ecosystem manipulating crops, livestock, and other yields with a nutritional effect on households while also causing environmental degradation. In addition, Lancet noted that environmental degradation will result in displacements that will worsen poverty and exacerbate health effects such as mental health, infectious diseases, and malnutrition, and physical injuries. Thus the study results on the health hazards posed by climate change were within the parameters of existing board of literature.

However, the majority of households generally lacked knowledge on the exact mechanisms through which health is affected by climate change. These findings are similar to other study findings as the majority of the respondents were not well knowledgeable about the exact channels through which health outcomes were altered by climate change. Birungi et al. (2015) stated that even though the people's perceptions on health hazards of climate change tallies with well documented evidence, they lack knowledge on exact ways through which various impacts of climate change are transmitted.

The study findings showed that the majority of the respondents were not taking actions to reduce the health impacts of climate change. OECS (2013) observed similar findings as merely 34.1% of the respondents were found to have taken personal measures to guard against the impacts of climate change. Taking actions to reduce the health impacts of climate change was found to be influenced by climate change knowledge and education, while surprisingly, previous exposure to hazards was found to insignificantly affect households' decisions to take actions against climate change. Even though the households undertook some important hazard mitigation strategies, the strategies were limited, for example actions such as building appropriate houses were not mentioned.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter summarizes the study on knowledge and responses to climate change induced health hazards in Mt Darwin District, Mashonaland Central Province of Zimbabwe. The chapter gives a summary of the study and some recommendations that are guided by the findings. The chapter concludes by outlining some areas of further studies.

6.2 Summary of the study

This study examined the knowledge on and responses to climate change induced health hazards in Mt Darwin District, Mashonaland Central Province, in Zimbabwe. The study came upon the backdrop of unequivocally evidence suggesting health as the most human dimension suffering the consequences of climate change with the World Health Organization (2009) identifying health hazards emanating from climate change as death from thermal extremes and weather disasters, vector borne diseases, higher incidence of food related and waterborne infections, photochemical air pollutants and conflicts driven from depleted natural resources. The study recognized the scant regional and national efforts articulating and informing the relationships between climate change and health and headed the call by organizations such as the IFRC (2014) on producing more evidence on localized partial perceptions and responses to climate change induced hazards in order to inform disaster prevention and circumvent the likely difficulties where local knowledge, culture and beliefs are un-explored.

The study emphasized on valuing community level knowledge on climate change, hazards and responses; in particular, understanding locals' knowledge which is important in shaping effective policies and strategies for reducing exposure, vulnerability and building resilience to the health hazards of climate change. The attempt was to build a local knowledge base by identifying information gaps on climate change, helping in defining the educational needs of communities and focusing health interventions meant to reduce the health hazards of climate change.

Vitality behaviour of the research to the Zimbabwean community was shown by its ability to contribute to the four strategies of disaster risk management identified in the Zimbabwe National Climate Change Response Strategy that are to identify and address factors that should be considered in building adaptive capacity in local communities; gather evidence for

developing effective adaptive, disaster preparedness and response capacities; carry out research to fill the existing knowledge on risks and hazards associated with climate induced disasters; and encourage change for disaster risk management through education, information and regulation.

The study carried four objectives centred on establishing what the people in Mt Darwin District of Zimbabwe understood and comprehended about climate change induced health hazards; establishing household responses or coping strategies to climate change induced health hazards in Mt Darwin District of Zimbabwe; ascertaining how responses to climate change related/corresponded to understanding and perceptions on climate change induced health hazards; and assessing the results in an attempt to guide policy on disaster risk management.

The Social capital framework which places importance on the social components in mitigating climate change and managing natural disasters, hazards and risks guided this study by indicating why at all one should be concerned about local settings, knowledge and behaviour. The research used the mixed method research approach and data was collected from 210 households in Mt Darwin District and 204 questionnaires were complete for analysis.

This study found that a fairly high proportion (38%) of the population was not aware of climate change. Households were not aware of the causes of climate change as only 7% of the respondents understood that climate change is a both man-made and natural phenomenon. Furthermore, about 14% of the households believed that changes in climate were spiritually related. Households knowledgeable about climate change interpreted it as changes in rainfall amount, pattern and intensity; changes in temperatures; frequency and intensity of drought; and other sudden changes in expected weather patterns and unexpected weather events. The definitions were more consistent to the scientific interpretations of climate change despite some variations from the exact scientific definitions of climate change. Unfortunately, these qualitative descriptions of climate change were managed by a few respondents.

Household responses generally overwhelmingly supported that hazards were occurring in Mt Darwin. Meteorological and hydrological hazards were more common followed by biological hazards with geophysical hazards being less likely. As households further overwhelmingly agreed that the occurrence patterns of hazards were changing, they suggested education, proper sanitation, improved technology and improving health facilities as some factors that

can contribute towards reduction of hazards. However, climate change, decreasing water availability, overpopulation, poverty and deforestation were factors listed as propelling hazards. However, most respondents were not able to qualitatively account for the factors causing changes in hazard occurrence, especially the role of climate change.

Households perceived current climate as bad or extremely bad characterized by decreasing rainfall amount, increasing temperatures, and frequent dry spells, drought and heat waves. Further, respondents agreed that occurrence diseases attributable to climate change had increased, and it was now high/very high in both summer and winter compared to the past 5-10 years. While the majority of respondents felt that changes in climate affected their health, the proportion of those who felt otherwise was high (44%). Malnutrition, disease outbreaks such as cholera, malaria headache, skin damages new and emerging diseases were some of the health hazards posed by changing climatic patterns. While a few respondents were able to give a number of hazards emerging from changing climate, there were some households (greater proportion) who were unable to articulate these hazards. The study also found out that respondents were not able to articulate the channels through which specific health hazards such as skin infections were altered by climate change. On the positive side, households were able to indicate that climatic variables such as temperature could have multi-level health hazards.

Evidence suggested that the majority of respondents were not taking action against climate change induced health hazards. Households were taking action against malaria, bilharzia, diarrhoea, and malnutrition while less action was being taken against skin infections and respiratory infections. Taking action against climate change induced health hazards was shaped by knowledge on climate change and education than knowledge/experience on hazard occurrences.

6.3 Recommendations

Drawing on the established existing knowledge, actions against hazards of climate change and analysis the following policy recommendations are suggested:

6.3.1 Education

From the findings of the study a significant proportion of the respondents (38%) lacked knowledge on the phenomenon. Education of these communities on climate change is necessary as informed communities are more effective when it comes to implementing disaster risk reduction and management programmes. Households need the correct

information pertaining to causes of climate change in order to demystify the association of climatic issues with spiritual forces.

It is therefore imperative for the responsible departments in the Government of Zimbabwe to effectively and fully implement the recently crafted Zimbabwe National Climate Change Response Strategy so as to ensure building adaptive capacity especially in affected communities such as the people of Mt Darwin. Climate change education is necessary to build knowledge and bring convergence among the households on understanding climate change. Educational campaigns in these areas affected by climate change need to advance the knowledge on climate change as a force precipitating changes in patterns and occurrence of hazards in the district. Households' knowledge on the increasing hazard occurrences, increasing patterns of climate change related diseases and perception about climate status is an instrumental base to anchor community education on climate change and health hazards prevention.

There is need to build knowledge amongst the Mt Darwin communities on the mechanisms through which a number of health hazards are altered by climate change. Some of the households interviewed had in-depth knowledge on the health hazards posed by climate change than understanding of mechanisms through which such hazards are altered. The influence of knowledge on climate change and education level on taking action against climate change induced health hazards implied that building climate change knowledge by incorporating climate change education through formal education systems could be a useful strategy to reduce effects of health hazards. It is therefore pertinent for the Education Ministry to streamline climate change education into the mainstream education curriculum so that those still in school are also educated on this phenomenon.

However, considering that most of the household heads were past the formal education system and the majority having attained secondary education (43%), it is necessary to design informal education programs that target adults who are out of school. Public awareness programs can further be modelled towards sensitizing on the relationships between extreme cold events and chronic illnesses such as asthma, chest pains, short and difficulty in breath and heart diseases in order to promote proper action. These awareness schemes need to be innovative in order to reach out and spread within communities.

6.3.2 Public Awareness on Action against Climate Change induced Health Hazards

There is need to raise awareness to communities in Mt Darwin on the strategies against the health hazards posed by climate change through appropriate incentives. It is worrying that the majority of the households in the study area were not taking action against the health hazards induced by climate change. Responsible authorities should broaden awareness from commonly experienced hazards such as malaria to include awareness on the interaction of extreme events and chronic diseases such as cancer. Special focus should be given on raising awareness on actions such as drinking more water, staying indoors and wearing protective clothing to guard against the health hazards induced by extreme climatic conditions. Awareness can also be raised on the hazards posed by flooding such as death, injury and infections in order to improve preparedness and responses to flooding and reduce disasters since hazards such as floods and hailstorms have previously been experienced in Mt Darwin District.

6.3.3 Make use of local knowledge

The study established that communities in Mt Darwin were not completely unaware about climate change and related health hazards. A significant proportion of households in the study area possessed vital information and knowledge about climate change and hazard occurrences that are useful in drafting disaster reduction strategies. There are some actions that are commonly practiced as mitigation against hazards induced by climate change. Public programs meant to reduce exposure to climate change induced hazards should streamline the existing knowledge and identify areas that need further education and those where new information is necessary. In addition, making use of the local and existing knowledge will help to improve public buy in to the related programs. Making use of local knowledge motivates households as they easily appreciate their practical experiences compared to scientific and complex theoretical explanations. Luganda (2004) pointed out that the role of indigenous and lay expertise in understanding and responding to climate change health hazards increases as the hazards become increasingly felt and observable.

6.3.4 Fostering Community Based Learning

The existing knowledge signified that there was a repository of climate change and related hazards information among the households which can be shared and exchanged within the Mt Darwin community. Strategies can be moulded around community based learning which can offer behaviour change on responses towards climate change induced health hazards and help to reduce the climate change related disasters. These community based learning programs

should target direct personal contact, appeals and social support as well as using social media as useful tools to spread the existing information on climate change and related health hazards in order to promoted effective response, adaptation and preparedness. Community learning should include encouraging group discussions and sharing of lay information on climate change as effective tools in building preparedness to hazards.

6.3.5 Targeting Specific Hazards

The study found out that households were more knowledgeable on hazards that include malaria, bilharzia and diarrhoea among others. There was however less knowledge and action amongst the respondents on the hazards of a chronic nature. In addition, households possess little knowledge on the complex relationships between climate change and respiratory and skin infections, chronic diseases, and how people with pre-exposure ailments are affected by climate change. In this view, this study proposes the Government of Zimbabwe should come up with policies that target educating and raising awareness on specific health hazards.

6.4 Areas of further study

This study focused on outlining the existing knowledge on climate change induced health hazards and responses to reduce the likely impacts of climate change induced health hazards. Based on the in- sight findings of this research the following research topics are suggested as areas of further study:

- A national survey and in-depth analysis of climate knowledge comprehension and responses to health hazards: community case studies,
- An in-depth examination of the causes of climate and related health hazards knowledge differentials across communities and households,
- Evaluating effective methods for transmitting knowledge on climate change induced health hazards and responses,
- Evaluation of the households' differential behaviour towards government programs to reduce health hazards emanating from climate change,
- Examination of the extent of concern regarding specific health hazards and exploration of household recommendations towards building resilience and preparedness to hazards induced by climate change,

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Annexure 1: Research Questionnaire

INTRODUCTION GUIDE

Dear valued respondent,

My name is Margaret Tawodzera. I'm a student at the **University of Free State, South Africa**, studying for Master's Degree in Disaster Management. I am carrying out a research on **"An Analysis of Knowledge on and Responses to Climate Change Induced Health Hazards focusing on Mt Darwin District in Zimbabwe."**

Your household has been randomly selected to represent your neighbourhood. Your participation is voluntary and it is our hope that you will participate since your views are important. You do not have to answer all the questions asked if you do not want but it would be greatly appreciated if you could respond to all questions openly and answer as many as you can so that our research is as comprehensive as possible. Your response will be treated in confidence and will be used for academic purposes only; therefore, you can be entirely open in your responses.

Completing the questionnaire should not take more than 30 minutes at most. The instructions are included in each part of the survey. You can answer in English. Should you require any clarification feel free to ask the researcher administering this questionnaire. Should you have any questions or concerns about completing the questionnaire or about being in this study, you may contact the Research Leader. This project has been approved by the Research Ethics Review Committee at the University of Free State and the Authorities in Zimbabwe.

Questionnaire No//											
Section A: Respondent Demography Details [Tick the appropriate box]											
1. Village Name		**2. Ward**		**3. Sex**	Male		Female				
4. Age											
5. Marital Status											
Single		Married		Divorced		Widowed		Other, specify			
6. Household/Family Size											
7. Highest level of education attained											
Standard 4		Standard 6		Primary		Secondary		Higher education			

8. What is your main source of livelihood (income earning activity)? [Tick Appropriate boxes]

Livelihood		**Livelihood**	
i. Food Crop Production/Sales		vi. Salary/ Wages	
ii. Livestock Production/ Sales		vii. Casual Labour	
iii.Vegetation Production/Sales		viii.Petty Trade	
iv.Cash Crop Production/Sales		ix.Remittances/Gift	
vSkilled Trade/ Artisan		x.Hunting and gathering of natural products including fishing	
xi. Other, specify			

9. Do you have any previous work experience outside communal income earning activities (previous jobs)?

Yes		No	

10. If yes, specify work experience?

i. Formerly worked in urban areas	ii. Formerly worked in rural areas covering area under study
iii. Formerly worked in rural areas outside the area under study	

11. **When did you first settle in this area?** Year

Section B: Climate Change Knowledge

12. Have you ever heard about climate change?

Yes		No	

13. Based on your understanding, what does climate change mean?

14. What are the causes of climate change? [Tick appropriate]

Man made		Natural		Other, specify

15. Have you experienced any hazards related to climate in your area? If no skip to Q17.

Yes		No	

16. What hazard occurrences have you experienced in your area among the following? ***[tick appropriate response]***

Disaster type	***Yes***	***No***
i. Hydrological e.g. floods,		
ii. Meteorological e.g. cyclones		
iii. Biological e.g. cholera outbreaks		
iv. Geophysical e.g. earthquakes		

17. Has the occurrence patterns of hazards given in Q 16 changed over the years since your settlement in Mt Darwin?

Yes		No		Not changed	

18. What do you think are the causes of the changes in the occurrence of hazards in Mt Darwin?

i._____

ii._____

iii._____

iv_____

v._____

19. What is your perception on the current climate status in Mt Darwin District

Extremely Bad		Very bad		Bad		Good		Very Good	

20. What was your perception on the climate status in Mt Darwin District at the time of your settlement?

Extremely Bad		Very bad		Bad		Good		Very Good	

21. Listed below are the some of the climate variables. How have the following variables progressed since you settled in this area?

Climate variable	**Decreased**	**Constant**	**Not Sure**	**Increased**
Rainfall				
Temperature				
Wind				
Sun's heat				
Drought frequency				
Floods				
Dry spells				
Heat waves				

22. Kindly explain current major abnormal shifts that you have observed occurring in climatic patterns that you can compare to your past experiences?

Rainfall_____

_____

_____

Temperature_____

_____

_____

23. Since you first settled in this area do you have memorable good and bad years? Briefly explain how these impacted on the health of the people in this area?

Good year	**Major effects on your health**	**Bad year**	**Major effects on your health**

Section C: HEALTH HAZARDS DUE TO CLIMATE CHANGE

24. Do you think climate change affects your health?

Yes ☐ No ☐

Briefly in _____

_____

_____

_____

_____

25. Amongst the health hazards listed below, which ones are you experiencing in this area due to changes in rainfall, cold, flood and heat?

Health hazard	Response	Please tick appropriate response	Response	Please tick appropriate response
Malaria	Yes		No	
Bilharzia	Yes		No	
Diarrhoeal diseases	Yes		No	
Respiratory Infections	Yes		No	
Skin Infections	Yes		No	
Malnutrition	Yes		No	
Others, specify	Yes		No	

26. How has climate change altered the health conditions above?

Health hazard	Mechanisms through which diseases are altered
Malaria	
Bilharzia	
Diarrhoeal diseases	
Respiratory Infections	

Skin Infections	
Malnutrition	
Others, specify	

27. Can you link the changing climatic patterns to specific health hazards in Mt Darwin? [fill table below and use codes below]This is a multiple response question.

Climatic Variable	**Health hazards**
Rainfall	
Temperature	
Wind	
Sun's heat	
Drought frequency	
Floods	
Dry spells	
Heat waves	

i. Malaria
ii. Bilharzia
iii. Diarrhoeal diseases
iv. Respiratory Infections
v. Skin Infections
vi. Malnutrition
vii. Other, specify

28. What is your overall perception on disease occurrences attributable to climate change?

Increased ☐ Decreased ☐ Constant ☐

29. What is the present frequency of diseases in summer compared to the last five to ten years?

Very low ☐ Low ☐ High ☐ Very High ☐ Don't Know ☐

30. What is the present frequency of diseases during winter compared to the last five to ten years?

Very low ☐ Low ☐ High ☐ Very High ☐ Don't Know ☐

Section D: RESPONSES TO CLIMATE INDUCED HEALTH HAZARDS

31. Are you taking any action to reduce the impact of the health hazards identified in Q26 above? (If no actions skip to Q34).

Yes ☐ No ☐

32. What actions are you adopting to reduce effects of the identified health hazards?

Health hazard	Action/Responses against health effects
Malaria	
Bilharzia	
Diarrhoeal diseases	
Respiratory Infections	
Skin Infections	
Malnutrition	
Others, specify	

33. Any other issues you may want to clarify on the relationship between climate change and health in your community?

_____
_____
_____
_____
_____
_____

Thank you.

Annexure 2: Ethical Approval Letter

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
NATURAL AND AGRICULTURAL SCIENCES
NATUUR- EN LANDBOUWETENSKAPPE

Faculty of Natural and Agricultural Sciences

21-Jul-2016

Dear **Mrs Margaret Tawodzera**

Ethics Clearance: **An Analysis of Perceptions and Responses to Climate Change Induced Health Risks: The Case of Mt Darwin District in Zimbabwe**

Principal Investigator: **Mrs Margaret Tawodzera**

Department: **DiMTEC (Bloemfontein Campus)**

APPLICATION APPROVED

This letter confirms that a research proposal with tracking number: **UFS-HSD2016/0586** and title: **'An Analysis of Perceptions and Responses to Climate Change Induced Health Risks: The Case of Mt Darwin District in Zimbabwe'** was given ethical clearance by the Ethics Committee.

Your ethical clearance number, to be used in all correspondence is: **UFS-HSD2016/0586**

Please ensure that the Ethics Committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the Ethics Committee on completion of the research.
The purpose of this report is to indicate whether or not the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the Ethics Committee should be aware of.

Note:

1. This clearance is valid from the date on this letter to the time of completion of data collection.
2. Progress reports should be submitted annually unless otherwise specified.

Yours Sincerely

Prof. PD (Danie) Vermeulen
Chairperson: Ethics Committee
Faculty of Natural and Agricultural Sciences

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