

AfricaInteract: Enabling research-to-policy dialogue for adaptation to climate change in Africa

Review of Research and Policies for Climate Change Adaptation in the Health Sector in Southern Africa

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AfricaInteract (<http://africainteract.coraf.org/en/>) is a platform enabling research-to-policy dialogue for adaptation to climate change among a broad range of African stakeholders in sub-Saharan Africa. These include civil society, researchers, policy-makers, donors, and the private sector working on adaptation to climate change in the agriculture and health sectors as well as urban areas with water and gender as cross cutting issues. The overall objective of *AfricaInteract* is to develop a platform for the effective and efficient transfer of information to policy makers, with the ultimate aim of enhancing the resilience of vulnerable populations.

AfricaInteract is funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) under the auspices of the Forum for Agricultural Research in Africa (FARA). The regional focus of *AfricaInteract* is based on the Regional Economic Communities in the four sub regions of sub-Saharan Africa. Focal organizations coordinating regional activities are as follows: The Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) – East Africa; Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) – Southern Africa; Commission des Forets d'Afrique Centrale (COMIFAC) – Central Africa; and Energie-Environnement et Developpement (Enda) – West Africa.



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Table of Contents

Executive Summary.....	7
1 Introduction.....	8
1.1 Background and motivation.....	8
1.2 Scope of the review, methods and structure.....	8
2 Overview of Health Situation in the Region.....	9
2.1 Review of key health indicators in the region.....	9
2.2 Policy processes and key players on health and climate change adaptation.....	10
2.3 The role of climate change challenges.....	10
2.3.1 Observed climate.....	10
2.3.2 Climate change projections.....	10
2.3.3 Adaptation to climate change.....	11
2.4 Other key drivers and crosscutting issues affecting health in the region.....	11
2.4.1 Population growth and urbanisation.....	11
2.4.2 Water resources supply and demand.....	11
2.4.3 Gender and health.....	12
2.4.4 Traditional health versus formal health systems.....	12
3 Research Related to Climate Change in the Health Sector	12
3.1 Food and water borne diseases.....	12
3.1.1 Status of scientific evidence for implications of climate change for food and water borne diseases.....	13
3.1.2 Causes of vulnerability to food and water borne diseases (structural,individual).....	13
3.1.3 Options for strengthening adaptive capacity to food and water borne diseases.....	14
3.1.4 Lessons learnt and the barriers and constraints to adaptation to water and food borne diseases.....	14
3.2 Vector borne diseases.....	14
3.2.1 Status of scientific evidence for implications of climate change for vector borne diseases.....	15

3.2.2	Vulnerability and options to increase adaptive capacity against vector borne diseases.....	16
3.3	HIV/AIDS and climate change.....	16
3.3.1	Status of scientific evidence for implications of climate change for HIV/AIDS and for people living with HIV/AIDS.....	16
3.3.2	Options for addressing challenges of HIV/AIDS and climate changex.....	17
4	Health Policies Related to Climate Change.....	18
4.1	Reviews of climate change considerations in national government health sector policies and strategies.....	18
4.2	Review of climate change considerations in regional health sector policies and strategies.....	19
4.3	Review of health considerations in climate change policies and strategies.....	19
4.4	Review of key arguments for policies on adaptation to climate change in the health sector.....	19
4.5	Review of key policy actors and networks involved with adaptation to climate change in the health sector.....	20
4.6	Review of identified or inferred 'missing voices' in research and policy debates.....	22
4.7	Lessons from efforts to promote research-policy dialogues on adaptation in the health sector.....	22
5	Gaps In Climate Change Adaptation Research And Policy In The Health Sector.....	23
5.1	Key research gaps.....	23
5.2	Key policy gaps.....	23
5.3	Options and possible policy 'spaces' or opportunities for improved uptake of research findings.....	24
6	Conclusions and Recommendations.....	24
6.1	Recommendations.....	25
	References.....	26
	Website consulted.....	29

Acronyms and Abbreviations

COMESA	Common Market for Eastern and Southern Africa
COP	Conference of Parties to the UNFCCC
GDP	Gross Domestic Product
HDI	Human Development Index
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
IPCC	Intergovernmental Panel on Climate Change
NAPA	National Adaptation Programme of Action
NGO	Non-governmental organisation
RISDP	Regional Indicative Strategic Development Plan
SADC	Southern African Development Community
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

The impact of climate change is being felt across the globe, including in Southern Africa, exemplified by increased incidence of extreme events such as flooding and prolonged drought. These changes, which are partly attributable to anthropogenic activities, will have major implications on human health, ecosystems and the economies of various countries and regions.

In Southern Africa, most of the models project drier conditions as a result of increased warming. Extreme events are also projected to occur with greater incidence in some parts of the region, such as flooding in the Mozambican floodplains. The impact of climate change in the health sector in the region is projected to increase the disease burden by changing the transmission patterns of some diseases as habitat suitability for vectors changes. The incidence of food and water borne infectious diseases is also projected to increase.

This synthesis report was conducted in order to advance our understanding of progress in responding to the threat of climate change in the Southern African region, through a review of policy development and implementation, and our understanding of the linkages between climate change and health. Within the region, particular focus was on South Africa, Zimbabwe and Malawi.

The scope of the review was on three key issues: firstly, it explored the current understanding of climate change in the region and its linkages with human health, specifically focusing on the spread of food, water and vector borne diseases, as well as HIV/AIDS. Secondly, the policy response to the climate change threat in the Southern African Development Community (SADC) region was assessed, looking at the degree to which climate change policies incorporate health issues and vice versa. The third and final section of the report is a gap analysis of both information and policy responses to the role of climate change in the health sector.

This review was a desktop study that relied on extensive literature search of both peer review literature and grey literature by key institutions in the region and globally such as government ministries, the World Bank, the United Nations, the SADC Secretariat and others. Information from online sources was retrieved using keyword search terms linked to climate change and health.

The current evidence shows that the SADC region is experiencing significant impacts on health from

incidences of droughts and flooding. However, there is no conclusive evidence that the recent incidences of flooding and drought are due to climate change, even though the projected impact of climate change is significant in the region.

In relation to health, there is some evidence base linking health with climate change and variability. For example, there is significant evidence that shows changes in the distribution patterns of malaria in the region. Projections show that the suitable habitat for the mosquitoes that transmit malaria will extend further south from their current geographic distribution. Incidences of water borne diseases are also on the rise, with evidence from Zambia showing an increase in incidences of diarrhoeal infection as a result of water contamination. The burden of disease due to HIV/AIDS will also increase, as exposure to some opportunistic diseases will be more prevalent in people with compromised immune systems.

The review showed that major knowledge gaps still exist in our understanding of how specific diseases will be impacted by climate change. In addition, most of the research work linking health to climate change has been conducted outside the Southern African region, so there is need for locally driven initiatives that integrate local context in understanding the impact of climate change on the health sector.

Significant progress in responding to climate change is being achieved, with various countries having developed policies and strategies. However in relation to health, the policy responses are still relatively inadequate compared to other sectors such as agriculture and water.

Most countries in the region have health policies but have not adequately incorporated climate change considerations in their implementation. In some cases climate change is recognised as a threat to the health sector, but no comprehensive strategies for managing the health impact of climate change have been developed.

The overall conclusion is that even though the issue of climate change in the health sector has become increasingly important in the region, more work still needs to be done to develop the knowledge base, mainstream health considerations into climate change policy and vice versa. Specific recommendations arising from this review include the need to improve the evidence base, the need to remove barriers to research uptake by policymakers and the need for a more coordinated approach to addressing the risks of climate change on the health sector in the region.

1 Introduction

1.1 Background and motivation

Changes in climate patterns may have considerable impacts on human health, the economy and the environment (Confalonieri et al. 2007; Haines and Patz 2004; Lipp et al. 2002). According to the Intergovernmental Panel on Climate Change (IPCC 2007), there is significant warming occurring in the Southern African Development Community (SADC) region. Whilst this warming is not uniform throughout the region, there is an observed increase in the number of warm spells and a decrease in extremely cold days. This has major implications for the health sector in Southern Africa, and understanding the evidence base will be critical for developing response strategies in the region.

The risks associated with climate change in the region have started to be recognised and several efforts are under way to develop both mitigation and adaptation strategies to cope with this threat. This project is part of one such effort, under which in 2011 the International Development and Research Centre (IDRC) selected the West and Central African Council for Agricultural Research and Development (CORAF/WE CARD) to manage the pan-African research-to-policy platform AfricalInteract. The goal of this platform is to facilitate the communication and transfer of information between researchers and policymakers in four areas critical to climate change adaptation, namely agriculture, human health, urban development and water as a crosscutting issue.

The aim of this report is to provide (1) a comprehensive review of climate change adaptation research and policy in relation to human health in the Southern Africa Region; (2) an analysis of knowledge gaps in adaptation research and policy in the health sector; and (3) a review of key stakeholders and opportunities for improving climate change adaptation in the health sector.

Some of the key questions this review sought to answer include the following:

- What is the role of climate change challenges in the context of the multiple challenges and opportunities facing the health sector in the region? (Section 3)
- What is the current state of knowledge on adaptation to climate change in the health sector in the region? (Section 4)
- What is the current state of knowledge on whether and how research findings are

integrated in health sector policies in the region? (Section 5)

- What are the major gaps in research on adaptation to climate change in the health sector? (Section 6)
- What is needed to ensure that research findings are better integrated into health sector policies? (Section 6)
- What is the current state of understanding on key stakeholders involved with research and policy on adaptation to climate change in the health sector in the region, and how can stakeholder involvement be improved? (Section 6)

1.2 Scope of the review, methods and structure

The objectives of the review were to assess the existing knowledge base on the impact of climate change on the health sector and to document current research and the state of knowledge of climate change impact on disease burden and related threats. The extent to which health concerns are mainstreamed into broader climate change policies and how health policies address climate change issues were also reviewed.

In terms of geographic scope, this study covered members of SADC in the region, with Zimbabwe, South Africa and Malawi as case studies.

The review was a desktop study that drew information from a wide range of sources, including peer-reviewed journal articles and interviews with key experts in the sector, including a consultative workshop with key stakeholders in the region. Grey literature was sourced from various organisations such as the World Health Organization (WHO), Organisation for Economic Cooperation and Development (OECD), government ministries, universities and regional bodies such as SADC and the Common Market for Eastern and Southern Africa (COMESA).

The review was based on a framework of analysis that recognised the threat of climate change to many people and communities in Southern Africa, with resultant negative impacts on productivity and ultimately economic development. Progress in mainstreaming climate change into health policies, strategies and action plans in the region is therefore critical for ensuring that the negative consequences of climate change on people and the economy are mitigated.

2 Overview of Health Situation in the Region

2.1 Review of key health indicators in the region

SADC has a population of 230m people in its 14 member States (World Bank 2011). The region has an average population growth rate of 2.1 percent, though it ranges widely from 0.4 percent in Mauritius to 4.2 percent in Zambia (Table 1). The countries in SADC with the highest Human Development Index (HDI) are Mauritius, South Africa, Botswana and Namibia. The HDI is an aggregation of different components of human development indicators such as life expectancy at birth, education level and standard of living (UNDP 2013).

The economy of the region has been growing steadily, with an average gross domestic product (GDP) growth of 4.9 percent compared to the global average of 3.8 percent (World Bank 2011). Some of the countries that experienced the highest growth in this period include Zimbabwe, Mozambique and Zambia. These growth rates are consistent with current trends that show countries in sub-Saharan Africa experiencing some of the highest economic growth rates globally.

Health conditions vary depending on the economic situation of the country, and health expenditure appears to mirror economic conditions. Countries with relatively high per-capita GDP like South Africa, Botswana and Mauritius also have relatively high per-capita health expenditure.

The burden of disease in SADC is largely attributed to communicable and infectious diseases, which are exacerbated by malnutrition, poor health services, inadequate infrastructure and rapid population growth. HIV/AIDS, malaria and tuberculosis are the main contributors to the burden of disease in the region. Approximately 30 percent of the population are infected with HIV, representing the highest proportion globally, and 40 percent of people infected with HIV are co-infected with tuberculosis (AfDB 2006). Meanwhile, Malaria accounts for 30 percent of outpatient visits and 40 percent of in-patients in Southern Africa. HIV/AIDS rates are however showing a declining trend, with the exception of Swaziland, where the rate has increased (SADC 2013). The latest statistics show that in several Southern Africa countries including South Africa, Botswana, Malawi and Namibia the incidence rate of new infections in children has been reduced by up to 50 percent (UNAIDS 2013).

In response, the governments in the region have developed strategic plans to control these three diseases (AfDB 2006). However, massive resource constraints limit the potential of SADC countries to respond decisively to health challenges, in a region that includes seven of the 33 countries classified as Least Developed Countries. Other diseases that are starting to impact the region as a result of changes in lifestyle include cancer, sugar diabetes and cardiovascular disease.

Life expectancy for most countries in the SADC region has improved significantly in the last ten years, though there are significant variations between states (SADC 2013). The average life expectancy at birth between 2000 and 2009 was 52.8.

Table 1: SADC Demographic, Economic and Human Development Trends based on World Bank Statistics (World Bank 2011).

Country	Population		Economic and Development Indicators			Health
	Total (000)	Growth rate (%)	HDI	GDP per capita	GDP growth (2011)	Health Expenditure per capita (US\$)
South Africa	50 587	1.2	0.629	3825.1	3.1	689.3
Angola	19 618	2.8	0.508	630	3.9	186.3
Democratic Republic of Congo	67 758	2.7	0.304	109.8	6.9	19.7
Tanzania	46 218	3.0	0.476	473.9	6.4	37.3
Mozambique	23 930	2.3	0.327	407.4	7.1	35.2
Botswana	2 031	1.2	0.634	4,377.6	5.7	431.9
Zimbabwe	12 754	1.4	0.397	347.7	9.4	-
Madagascar	21 315	2.9	0.483	238.2	1.0	19
Namibia	2 324	1.8	0.608	2,758.1	4.8	282.9
Mauritius	1 286	0.4	0.737	5,370.8	4.1	510
Zambia	13 475	4.2	0.448	443.9	6.5	87.2
Swaziland	1 068	1.2	0.536	1,812.2	1.3	264.8
Lesotho	2 184	1.0	0.461	532.3	4.2	141.1
Malawi	15 381	3.2	0.418	182.9	4.3	30.9

2.2 Policy processes and key players on health and climate change adaptation

The climate change policy processes in the Southern African region are very complex, which is a reflection of the state of affairs in the climate change debate in general with its various discourses from the global to local scales. There is no single coherent policy at the regional level, even though there are sectoral strategies. Instead there is a mix of interventions happening at various scales. For example SADC does not have an overarching climate change strategy, but it has a climate change strategy for the water sector. However, countries that fall under COMESA are covered by the climate change strategy for COMESA. At the national level, not all the countries have climate change strategies, but they are in various stages of developing such strategies.

Seven countries in the region also have National Adaptation Programmes of Action (NAPAs) as part of United Nations Framework Convention on Climate Change (UNFCCC) initiative for Least Developed Countries to identify priority activities that respond to their urgent and immediate needs to adapt to climate change.

It has generally been acknowledged that the health sector is lagging behind on climate change strategies. Most countries in the region have not yet developed a specific strategy for health and climate change. South Africa, which is regarded as a leader in the climate change sector, only finalised its National Climate Change and Health Adaptation Policy (NCCCHA) in 2012 (Myers and Rother 2012). Apart from South Africa no other country in the region has a specific climate change adaptation strategy for the health sector.

In a review of the current state of knowledge on the health sector in Southern Africa, Dube and Chimbari (2009) found that research on climate change and health is lagging behind in Africa in general, with fewer projects in SADC compared to East Africa. Within the region, South Africa appears to be playing a leading role in advancing understanding of the impact of climate change in the health sector, with several institutions and research projects focused on this subject.

Globally, the health risks associated with climate change are receiving increasing recognition. One of the most important undertakings in this regard was the hosting of the first Global Climate and Health Summit, organised by Health Care Without Harm at the 17th Conference of Parties to the UNFCCC (COP17) in Durban in 2011. The Summit called for the recognition of the health sector in the UNFCCC processes, as the sector is going to be adversely impacted by climate change, and also made an urgent call to action by the health sector in addressing the threat of climate change (Myers and Rother 2012).

There is no indication in the literature as to whether the outcomes of the Durban Declaration have been taken up in the subsequent climate change negotiations. However, the summit managed to achieve the goal of highlighting the importance of understanding the linkages between health and climate change, and it can be argued that health issues are likely to feature more prominently in the global, regional and national discourse on climate change in the coming years.

2.3 The role of climate change challenges

2.3.1 Observed climate

Significant changes to climate conditions in Southern Africa are already being felt, such as increased episodes of flooding and prolonged droughts. The IPCC report (2007) states that there is an observed increase in the episodes of warm spells and a decrease in the number of cold days, for most parts of the region using a baseline of 1961 and 2000. Minimum temperatures during this period will increase faster than maximum or mean temperatures. In relation to precipitation, higher rainfall anomalies and intense droughts have been attributed to increased inter-annual variability in the post-1970 period. The countries in the region that have experienced heavy rainfall and changes in seasonality include Angola, Namibia, Mozambique and Zambia.

2.3.2 Climate change projections

Numerous climate change projections have been carried out for the Southern African region, which rely both on downscaled global circulation models (GCMs) and regional climate models (RCMs). In particular the Council for Scientific and Industrial Research (CSIR) and the Climate Systems Analysis Group (CSAG) at the University of Cape Town have played significant roles in advancing our knowledge on climate science and developing new tools to better project future climates in the region.

Most of the models project drier conditions as a result of increased warming for most parts of the region (Boko et al. 2007). Increased episodes of extreme events are also projected for some parts of the region, such as flooding in the Mozambican floodplains.

Rainfall is projected to decrease across Southern Africa for the summer months of September, October and November, which also coincide with the start of the rainy season in the region, suggesting reduction in early season rainfall (Christensen et al. 2007). Rainfall in the region is strongly influenced by El Niño Southern Oscillation (ENSO) events, a variation in surface temperature in the Pacific Ocean which can cause extreme weather conditions. Climate change is projected to increase the

frequency of the warm phases of ENSO, which will result in frequent drought episodes in Southern Africa.

Most of the projected drying in the region occurs in winter, which corresponds to the dry season in most parts of Southern Africa except for the southwest region that receives winter rainfall. As a result, the projected winter drying does not contribute to the bulk of mean drying (Christensen et al. 2007).

The southwest region is projected to experience drying due to processes that result in increased moisture divergence and a systematic poleward shift of storm tracks, affecting winter rains. This drying trend may however be interrupted by strong orographic forcing that might alter conditions locally, resulting in rainfall (Christensen et al. 2007).

2.3.3 *Adaptation to climate change*

There is wide recognition that the impact of climate change is already being felt in the region, as a result of an increased incidence of disease outbreaks, flooding and prolonged periods of drought that have resulted in rising food prices (Richards 2008). Apart from mitigating the impact of climate change through reduction in greenhouse gas emissions, climate change adaptation is receiving attention, as the impact of climate change is increasingly being felt.

Adaptation is defined by the Smit et al (2001) as a process involving 'an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities'. Adaptation may include strategies, policies and measures that may be undertaken now or in the future to combat the impact of climate change, such as disease burden that is sensitive to climatic drivers (Ebi et al. 2005). In many instances adaptation measures are implemented reactively as a response to an actual situation that has occurred, such as observed changes in rainfall, or in other cases proactively with regard to anticipated changes.

Vulnerability refers to the susceptibility of a system to climate change, and is a function of exposure to the hazard, sensitivity and the adaptive capacity of the system (Smit 2001). In the health sector for example vulnerability of a community or individuals to increased disease burden is dependent on various factors such as the severity of the exposure to the risk, the current level of disease burden (sensitivity) and the capacity of the health care system.

An important consideration in understanding climate change adaptation is the concept of adaptive capacity, which is the ability of a system to respond to new conditions, such as increase in temperature, and its capacity to moderate potential damage (Gambusch and Menne 2003; Smit 2001). Simply stated, adaptive

capacity is the ability of a system, country or community to cope in the face of adverse perturbations such as the impact of climate change. Investments in measures that help society to cope, such as the provision of adequate water supply and sanitation, early warning systems, buildings and infrastructure help to increase adaptive capacity (Gambusch and Menne 2003).

2.4 **Other key drivers and crosscutting issues affecting health in the region**

2.4.1 *Population growth and urbanisation*

The average population growth rate for the Southern African region is more than two percent per annum, which is very high compared to global standards. This population growth rate will exert enormous pressure on existing resources, especially in the urban areas. It has also been projected that by 2050 more than 30 percent of the global population will be living in urban areas, adding pressure to existing urban challenges. The rural to urban migration is partly driven by climate change impacts on rural areas that have created unsuitable conditions for agriculture and increased prevalence of diseases, forcing rural populations to look elsewhere for more suitable living conditions. Unfortunately this large movement from rural to urban areas does not necessarily result in improved living conditions, as it has led to very high unemployment and poverty in urban areas.

Urbanisation is closely linked to climate change and human health, because cities concentrate large populations, which are adversely affected during extreme events. Due to high concentrations of poor people in urban areas, exposure to extreme events might hinder the supply of essentials to some of these poor areas (Barata et al. 2011).

2.4.2 *Water resources supply and demand*

Access to water will be affected by climate change across the region through changes in rainfall patterns and temperature, with major implications for health. Climate change is projected to result in prolonged incidence of drought in some regions in Southern Africa, and flooding in others such as the Mozambican floodplains (Engelbrecht et al. 2011). Water scarcity in the region will have major implications for food and nutritional security, and hence human health. In some instances, however, drought conditions create unsuitable conditions for vectors that transmit disease to spread. For example the *anopheline* mosquitoes which are responsible for malaria transmission breed in small, natural pools of clean water that might be affected by drought conditions (Dube and Chimbari 2009). On the other hand, extreme rainfall destroys infrastructure that will reduce the adaptive capacity of the population to cope with the potential risk of disease transmission.

2.4.3 Gender and health

The importance of understanding social differences and how they affect vulnerability to climate change and the ability to adapt cannot be underestimated. Many health and climate risks show clear gender differentials (WHO 2011). Natural disasters such as droughts and floods have been shown globally to kill more women than men, a clear indication that women in many cases are more vulnerable to the impacts of climate change than men. In the Southern African region, climate change will affect the availability of water supply for drinking, cooking and hygiene, and indirectly for food security. It has been shown that women suffer the most in relation to nutritional deficiencies and the burden of travelling long distances to access water resources (Ibid).

High mortality rates of women and children, numbering up to 2m deaths per year globally, also occur as a result of exposure to black carbon from the burning of biomass in poorly ventilated households. This is highly relevant in the Southern African region, where energy poverty is an issue of major concern (WCA 2012).

Incorporation of analysis of gender and other social differences in the development of climate change adaptation strategies has the potential to increase resilience of people to the impacts of climate change and variability in the region. This is vital because vulnerable people play critical roles as agents of change and are often key participants in disaster management (WHO 2012).

2.4.4 Traditional health versus formal health systems

Many communities in Southern Africa are still largely rural and are highly dependent on indigenous knowledge systems to adapt to climate change and related risks. Many communities in the region are dependent on traditional health services where formal health systems have not been extended. Traditional knowledge, especially in relation to medicine, also plays a critical role in primary health care (WHO 2003) where it has been estimated that 60 percent of the world's population use traditional medicines as their primary source. In some countries traditional health care knowledge systems have been incorporated into the public health system, signifying their importance in health management. Understanding the role of the traditional health care system in adaptation to climate change will be critical.

In the Southern African region, South Africa has been the most vocal in promoting the traditional health care system and pushing for its recognition in the formal health system. For example, South Africa is one of the very few countries in the region that is in an advanced stage of developing an indigenous knowledge protection policy that seeks to mainstream and protect indigenous knowledge systems and copyrights (Government of South Africa 2013).

Indigenous groups have also been quite prominent in the climate discourse, but mostly from the perspective of protecting communities they deem most vulnerable to the impact of climate change. These have among the lowest carbon footprints.

3 Research Related to Climate Change in the Health Sector

There is significant evidence from observational data that many natural systems are being affected by climate change. The effects of climate change and extreme events on disease emergence and resurgence are however still fraught with uncertainties, which also reflects the uncertainties in the climate change models. Over the last couple of years, significant progress has been achieved in our understanding of the linkages between climate variability and change and its impacts on health, even though less research work has been conducted in the health sector compared to other sectors (Christensen et al. 2007; Patz et al. 2005).

Increases in temperature and changes in precipitation patterns are expected to result in an increased occurrence of malaria, cholera and other diseases associated with extreme conditions such as strokes, dehydration and skin cancers. The impact of climate change on the health sector will vary according to the geographic location and current circumstances. In Southern Africa and the sub-Saharan African region in general, the impact of climate change on the health sector is likely to manifest itself through three major pathways, namely through food and water borne diseases, vector borne diseases and HIV/AIDS. However, in some cases warming could decrease incidences of tuberculosis infection, effectively reducing HIV/AIDS mortality.

3.1 Food and water borne diseases

Water and food borne diseases can be caused by pathogenic microorganisms and toxic contaminants found in water used for activities such as drinking and recreation. Such contamination can result in illnesses that include cholera and schistosomiasis. Food contamination can happen at various stages of the food supply chain right from production through transport to consumption (Portier 2008).

The incidence of food poisoning is projected to increase as a result of rising temperatures because higher temperatures create suitable conditions for microbes to multiply. Insects that are responsible for food contamination such as flies and other pests have a better survival chance during warmer weather, increasing the chances of food contamination (Menne et al. 2008). In addition to warmer temperatures, poor refrigeration facilities in many communities increase food poisoning incidence.

Water borne diseases are classified according to their mode of transmission into two main categories, namely water borne diseases (ingested) and water washed diseases (caused by lack of hygiene) (Confalonieri et al. 2007). Malnutrition and child mortality associated with contaminated water is still a major global challenge, affecting more than 2bn people living in dry regions of the world (WHO 2005). Findings from the IPCC (2007) show that water scarcity is associated with multiple adverse health outcomes, including diseases caused by water contaminated with faecal matter and other hazardous substances. The main factors contributing to an increase in water borne diseases as a result of climate change may include (Barata et al. 2011):

- Inadequate water supplies will lead to sanitation problems resulting in major challenges for personal hygiene and effluent dilution, which could increase the prevalence of infectious diseases.
- Extreme rainfall events will result in increased pathogen loading in areas of inadequate storm water and poor water infrastructure, a major characteristic of many countries in Southern Africa.
- Some microorganisms will also thrive as a result of increased temperature, exacerbating the prevalence of infectious diseases.

Water borne diseases are generally regarded as one of the main burdens of disease for poor countries and specifically for children under the age of five (Hunter 2003).

3.1.1 *Status of scientific evidence for implications of climate change for food and water borne diseases*

There is a clear association between increases in precipitation and outbreaks of water borne diseases, with climate change projected to produce more frequent and severe extreme precipitation (Portier and Thingpen 2010). Changes in ambient temperatures have a strong influence on the transmission patterns of arthropod borne diseases.

Several studies have been conducted to try and link climate change with water and food borne diseases. Most of these studies, however, have not been conducted in the Southern African region. The most reliable scientific evidence on understanding of the implications of climate change on food and water borne diseases comes from the latest IPCC report (Confalonieri et al. 2007), the findings of which are summarised below.

Food borne diseases are linked to climate change through various pathways, and according to the IPCC there is clear evidence which shows that climate change is having a significant influence in the spread of food borne diseases:

- High temperatures are projected to lead to an increase in the incidences of food poisoning, through organisms such as salmonellosis which were reported to have an almost linear relationship between reported increases in occurrence and increase in weekly or monthly temperatures (Confalonieri et al. 2007).
- Increase in temperature is also associated with an increase of pest species, such as flies, rodents and cockroaches that could potentially transmit diseases into humans. Consumption of mainly shellfish that is contaminated with algal blooms could potentially cause human disease as a result of the toxins that are produced.

There is a strong association between high temperatures and increased episodes of diarrhoeal diseases in adults and children. In Zambia, a study that investigated the incidence of diarrhoeal incidence in children during a specific rain season, found that 18 percent of the children infected resulted from contamination of drinking water (Nchito et al. 1998, as reported in Dube and Chimbari 2009). A similar study in the Limpopo river basin found that children were also adversely impacted by climate related ailments. The most prevalent diseases were diarrhoea, respiratory infections, asthma and malaria (Thompson et al. 2012).

3.1.2 *Causes of vulnerability to food and water borne diseases (structural, individual)*

Southern Africa is burdened by four main types of diseases: emerging infectious disease such as HIV/AIDS, old infectious diseases like tuberculosis, chronic diseases such as asthma and injury linked to climate events. The risk of outbreaks of water borne diseases increases where water, sanitation and personal hygiene standards are low (Menne et al. 2008).

Vulnerability to food and water borne diseases is affected by several factors, including pre-existing conditions such as weak public health care systems and limited access to primary health care. Such conditions result in a weak adaptive capacity of the system, resulting in a more severe impact of climate change.

Individual factors such as age, gender, education levels and pre-existing health problems (Barata et al. 2011) will also exacerbate vulnerability to climate change. Older people are more susceptible to infectious diseases, and well-educated individuals have the potential to make lifestyle choices that can buffer them against potential disease outbreaks. This is very relevant in the Southern African region, where poverty levels are very high. As a result the vulnerability to disease outbreaks is relatively high compared to high-income countries.

Institutional drivers of vulnerability are associated with factors such as knowledge, policy responses, governance practices and urban planning (Barata et al. 2011). For

example, in the past South Africa's AIDS policy has been criticised as being unprogressive and led to increased prevalence of the disease and deaths.

In a study of climate change vulnerability and adaptation preparedness in Zimbabwe, Chagutah (2010) found that 'disease often also deprives households of labour during critical periods, adding to vulnerability'. The most vulnerable groups include elderly populations (especially women), orphans and urban residents.

3.1.3 *Options for strengthening adaptive capacity to food and water borne diseases*

Options for strengthening the adaptive capacity to cope with the impact of climate change on water and food borne diseases recognise that the drivers of vulnerability are linked to other factors such as existing conditions. As a priority, therefore, the most important undertaking to reduce vulnerability to water and food borne diseases is to minimise water shortages through effective planning to ensure that there are adequate supplies for safe drinking and sanitation. This requires that planning for water infrastructure is timely and is able to respond to the increasing demand. In South Africa for example it has been estimated that 34 percent of water supplies in urban areas is lost due to leakages in pipes, because of poor maintenance of the system.

Considering that food poisoning is going to be more prevalent, one option for strengthening adaptive capacity involves setting minimum standards for food storage to ensure that consumers are not exposed to contaminated food. This option is, however, not easy to implement, since a large section of the population in the region is still largely rural with no access to energy and refrigeration facilities. Besides this, most rural communities grow their own food instead of purchasing from supermarkets.

Better watershed management, through the implementation of integrated water resource management (IWRM), will help to build landscape resilience and reduce soil erosion.

There is need for health systems to specifically plan for climate change, as it will become an additional burden to existing plans that are based on historical trends with no consideration of climate change. Accounting for the additional burden of climate change will therefore require the retrofitting of the current policy responses if they have not accounted for climate change, and in certain instances it might require a complete overhaul of how some diseases are managed.

There is need to improve disease surveillance to enhance identification of the key drivers of epidemic diseases (Portier and Thingpen 2010), and better information management between food handlers and producers to reduce the risk of disease outbreaks (Menne et al. 2008).

According to the IPCC, the need to protect urban populations from water and food borne diseases will

require a strong public health response, including the intensification of education and public awareness about the threats of food contamination and its management (Barata et al. 2011).

3.1.4 *Lessons learnt and the barriers and constraints to adaptation to water and food borne diseases*

Considering that there are very few studies that have been conducted in Southern Africa that link climate change with health (Dube and Chimbari 2009, Myers et al. 2011), it's been very difficult to document specific health adaptation lessons in the region. However, there are some obvious trends that have started to emerge and are worth discussing.

From the reviews it was clear that more research still needs to be carried out in the region to understand the magnitude and scale of climate change impacts on water and food borne diseases. Most of the existing understanding of these linkages is currently drawn from studies that have been carried out elsewhere; in some case such trends might not be locally applicable.

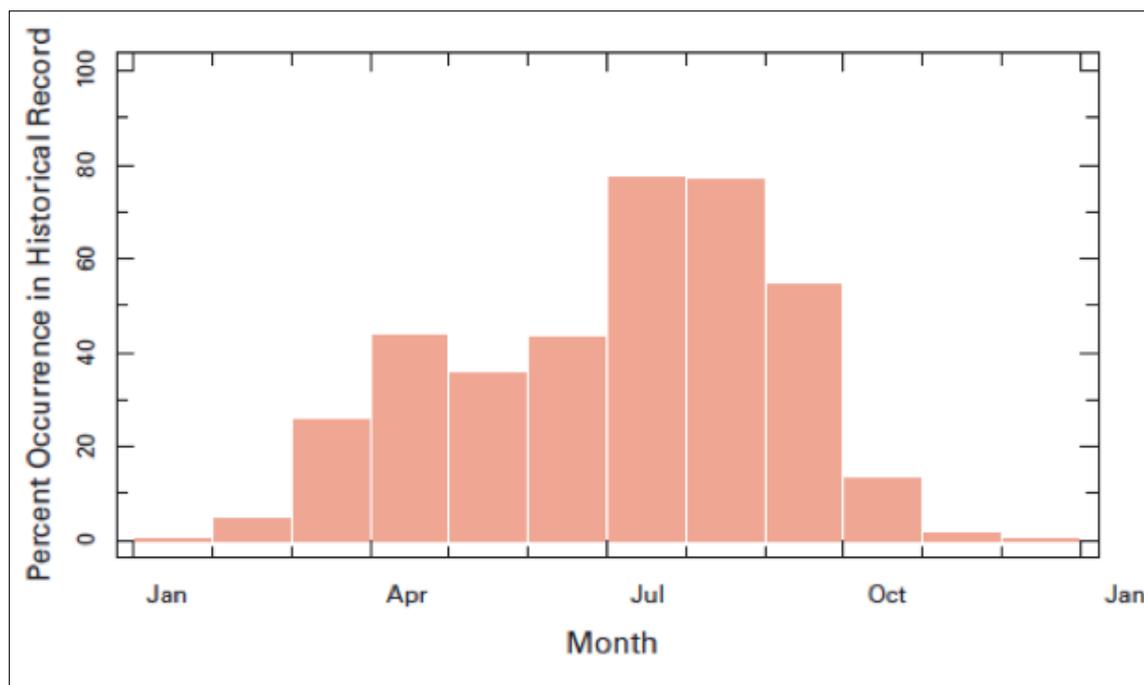
There are numerous barriers and constraints to adaptation related to food and water borne diseases, associated with information flows, institutional capacity and finance for adaptation. For example in Zimbabwe in the year 2010, it was reported that six provinces were food insecure and recurrent infectious disease outbreaks became more prevalent, calling into question the ability of the country to cope with minor emergencies (Brown et al. 2012).

The need to develop adaptive capacity to cope with the impact of climate change on health relies to a large extent on the generation of information that is reliable and relevant to the circumstances (Costello et al. 2009). Developing countries in particular will need to strengthen their informational, technological and scientific capacity to respond to the potential threat of climate change. This will ensure that vulnerability to climate change is minimised by building resilience in local, regional and national infrastructures (Ibid).

3.2 **Vector borne diseases**

Vector borne and zoonotic diseases (VBZD) are infectious diseases whose transmission cycles involve animal hosts or vectors (Portier and Thingoen, 2010). Vector borne diseases are those in which organisms, typically blood-feeding arthropods (insects, ticks, or mites), the vectors, carry the pathogen from one host to another, generally with amplification (increased virulence in the recipient host) (for example, malaria). Zoonoses are diseases that can be transmitted from animals to humans by either contact with animals or by vectors that can carry zoonotic pathogens from animals to humans (for example, avian flu). Both domestic animals and wildlife, including marine mammals, fish, sea turtles, and seabirds may play roles in VBZD transmission by serving

Figure 1. Occurrence of climate conditions suitable for malaria transmission. Source: WHO (2012)



as zoonotic reservoirs for human pathogens or by means of interspecies transmission of pathogens.

Statistics show that 40 percent of the world population is at risk of malaria, and this is projected to increase to 80 percent by 2080; meanwhile, more than half the world population lives in endemic dengue fever areas (DFID 2004). Due to their major impacts on human health, widespread occurrence and sensitivity to climate, vector borne diseases and their relationship to climate change are well studied (IPCC 2007).

In Southern Africa, transmission patterns of vector borne diseases are going to change, including changes in historical season of transmission (Fig. 1), as a result of climate change. For example, patterns of malaria distribution will change significantly without increasing their incidence rate.

3.2.1 Status of scientific evidence for implications of climate change for vector borne diseases

Changes in precipitation and temperature will alter environmental conditions due to changes in rainfall patterns with some areas receiving prolonged rainfall and drought periods. This will influence the geographical distribution and transmission of climate-sensitive vector borne diseases. Diseases such as malaria, schistosomiasis and cholera will be impacted. Climate change will specifically modify the dispersal, reproduction and maturation and survival rate of vector borne diseases (Gage et al. 2008).

Climate change will also affect the development of pathogens in vectors and the population dynamics of non-human vertebrate reservoirs (Ibid). Disease transmission is influenced by factors such as temperature humidity, rainfall, soil moisture and rising sea level.

Vector borne diseases that are considered sensitive to climate change include:

- Malaria – transmitted by mosquitoes
- Dengue fever – transmitted by mosquitoes
- Schistosomiasis – transmitted by snails
- Tick borne diseases

One of the main challenges in Southern Africa is the lack of adequate health and demographic data for quantifying the impact of climate change on human health. However significant progress has been achieved in understanding the impact of climate change on some major diseases such as malaria, one of the most studied vector borne diseases.

One of the most comprehensive studies on malaria involved the mapping of its risk in several African countries, with the results showing that climatically suitable areas for malaria will increase and contract with climate change depending on the region (Thomas et al. 2004).

In the Southern African region, studies have shown that changes in temperature and precipitation will alter the geographic distribution of malaria in Zimbabwe, with areas that were previously unsuitable for malaria becoming affected (Hartmann et al. 2002). The areas suitable for malaria in the region will extend further south, presenting new challenges for South Africa, which was previously not at the epicentre of malaria infections.

Currently 70 percent of malaria episodes occur in Africa, and that fraction is projected to rise substantially in the future (World Bank 2004). Rainfall is a limiting

factor for mosquito populations, with a reduction in precipitation associated with decreases in transmission (IPCC 2007). According to the IPCC, long term trends of malaria in Southern Africa show no significant association with climate, although seasonal changes in malaria were significantly associated with climate variables. Drug resistance and HIV infection were also found to be important drivers of malaria over the long term. Models project an expansion in the suitable areas for *Plasmodium falciparum* in some regions and contraction in other regions. Some regions will also experience a longer season of transmission (Ibid).

3.2.2 *Vulnerability and options to increase adaptive capacity against vector borne diseases*

The causes of vulnerability to vector borne disease are similar to those of other diseases in many respects, and they include the current status of the community or individuals that are affected. Communities that have poor health services are generally projected to have weak adaptive capacity and are more likely to suffer severe consequences of exposure to vector borne diseases. The presence of pre-existing conditions such as HIV/AIDS, tuberculosis and malnutrition, level of education and awareness all act as aggravating factors that increase vulnerability to vector borne diseases (Davis 2011).

The high rate of urbanisation in Southern Africa may also contribute to an increasing disease burden, as unplanned settlements in the urban fringes may lack essential sanitation services that will expose those who settle in such areas to many diseases. This is a significant issue in Southern Africa, where 36 percent of the total population lives in urban areas, and this is set to increase as climate change displaces people from rural areas.

In summary, the vulnerability of a population to health related impacts of climate change depends on multiple determinants, which include the extent to which health, natural and social systems are sensitive to changes in the weather and climate (Davis 2011). The spread of vector borne diseases is also affected by the demographic structure and population density. For example, countries with a high population of older people will be more vulnerable to health related impacts of climate change. In addition the size of the total population that is already at risk will determine the rate at which vector borne diseases will be spread. In relation to demographic structure, however, this is not a major cause of concern in Southern Africa, because the region still has a relatively young population compared to other regions of the globe.

The primary adaptation measure in dealing with vector borne diseases is the need for a well-prepared health system and public health system. Health systems that are better prepared now in dealing with current levels of disease and climate variability, are better prepared in the face of climate change (Nerlander 2009). However, with most countries in the region having very low per capita health expenditure, the health systems are not well prepared for the potential impact of climate change.

An early warning system has been implemented in the SADC region as part of the Abuja Targets for Roll Back of Malaria in Africa, which set a target that 60 percent of epidemics must be detected within two weeks of onset and 60 percent of epidemics will be responded to within two weeks of detection (DaSilva et al. 2004). Surveillance systems should be improved through the provision of better primary health care, improved laboratory facilities and standardised diagnosis (Nerlander 2009).

Resource constraints in the SADC region are a major impediment to the management of vector borne disease, including early detection and response. This is pertinent because seven of the 15 countries in the region are classified as Least Developed Countries.

The world's highest prevalence of HIV is found in the region, which has major implications for productivity. This is compounded by political instability in some countries that has led to an exodus of professionals out of the region, which has compromised the adaptive capacity of these countries.

Lastly, many adaptation measures in the region are not well coordinated, leading to potential challenges in targeting beneficiaries and duplication of roles (Chagutah 2010).

3.3 *HIV/AIDS and climate change*

3.3.1 *Status of scientific evidence for implications of climate change for hiv/aids and for people living with HIV/AIDS;*

The countries that have been most affected by the HIV/AIDS pandemic in Southern Africa include Botswana, Zambia, Malawi, Lesotho and Swaziland. HIV/AIDS poses multifaceted challenges with direct implications on productivity, disease burden and food security. This has major implications for the economy and quality of life. It has been reported for example that life expectancy in Botswana and Malawi dropped significantly from 62 years in 1990–1995 to 39–48 years in 2000–2005 (CHGA 2008; UNDP 2005 as reported in Dube and Chimbari 2009).

HIV/AIDS affects productivity because its impact is felt most among the most productive age group of 15–49 years. This has a direct link to economic productivity in the region, where HIV rates are among the highest globally. Food production will be particularly hard hit because of loss of labour associated with HIV/AIDS. Some countries such as South Africa, Botswana, Zimbabwe and Namibia are projected to have labour losses of up to 20 percent linked to HIV/AIDS.

According to Brown et al. (2012), the Zimbabwe National Network of People Living with HIV and AIDS is concerned about the impact of climate crisis on the vulnerability of people living with HIV/AIDS. It was estimated that approximately 14.3 percent of those aged 15 years and above were infected with HIV/AIDS in 2010.

Vulnerabilities faced by groups living with HIV/AIDS will intensify with climate change, especially in low lying areas and those areas with food insecurity (Ibid). In Zimbabwe for example poor water supply systems have contributed to an increase in water borne diseases, including a cholera epidemic in 2008. Diarrhoea can weaken immune systems, and adequate water supply and sanitary facilities are critical for managing diarrhoea; these, however, are severely lacking, especially in poor rural and urban areas (Ibid).

Some studies in the region have also established a direct link between HIV/AIDS, climate change and institutional capacity in the management of disasters. For example, Suarez et al. (2008) reviewed six disaster management institutions in Malawi to assess the combined impact of HIV/AIDS and climate change on their institutional capacity to manage disasters. The study found that HIV/AIDS has a major impact on staff performance, with high level of absenteeism and increased workload (Suarez et al. 2008).

A clear linkage therefore exists between HIV/AIDS and climate change as pertains to productivity and the vulnerability of HIV/AIDS sufferers to the impact of climate change due to the increased prevalence of disease.

3.3.2. *Options for addressing challenges of HIV/AIDS and climate change*

The prevalence of HIV/AIDS is related to a large extent to population density, nutrition, health status and movement of people. These factors are also impacted by climate change, and on the other hand HIV/AIDS has a negative impact on climate change adaptation because it affects productivity. The options for addressing the challenges of HIV/AIDS and climate change should therefore take these dynamics into account.

Multiple stressors, including HIV/AIDS, climate change and weak governance, will affect the vulnerability of the population in the region (Shackleton and Shackleton 2012; Drimie and Casale 2009). In relation to HIV/AIDS specifically, Southern Africa has been very successful, with many patients having access to Antiretroviral drugs and a drastic reduction in new infections of HIV in both adults and children. The response to HIV/AIDS has, however, largely taken place in isolation from the climate change response, with potential negative consequences on the effort to combat HIV/AIDS. An integrated approach to HIV/AIDS and climate change therefore represents the most pragmatic approach to the HIV/AIDS-climate change nexus.

As stated earlier, HIV/AIDS has a direct impact on productivity through reduction in the workforce as a result of sickness and death. One way to respond would be for organisations in countries that are hard hit by HIV/AIDS to develop a better understanding of the pandemic and its impact on organisational capacity. In this way contingency plans can be implemented in time to offset

any potential loss in productivity (Suarez et al. 2008). For organisations to prepare for this challenge requires better collection of data, information management, effective human resource planning and the implementation of workplace HIV/AIDS programmes. These are, however, not enough if the country does not have a progressive HIV/AIDS policy or strategy. Lacking such, these efforts would be unlikely to bear fruit.

The disease burden and the combined social response capacity of countries in the region need to be understood in order to plan comprehensively for the best use of resources whose application would simultaneously constitute improved adaptation and reduced vulnerability. In this case it's an integrated approach that is required. However, in countries like South Africa, where HIV is responsible for a quarter of the disease burden, other more amenable contributors to the burden need to be prioritised in order to free up capacity. Productivity and efficiency in services also need attention – and not just productivity reduction directly due to AIDS.

Managing HIV/AIDS is very expensive, and so is the cost of climate change adaptation. The need for substantial financial resources to be invested in managing the HIV/AIDS-climate change nexus is critical. Most of the countries in Southern Africa have very low health expenditure per capita, which has constrained their efforts to effectively manage climate change and HIV/AIDS prevalence in the region. These financial challenges could potentially be overcome, if the linkages between HIV/AIDS and climate change are well articulated affording this countries the opportunity of accessing global adaptation funds that could be used to manage both HIV/AIDS and climate change.

There is a lot of work that still needs to be done around changing attitudes of people in the region towards the stigmatisation of HIV/AIDS victims. This has led to alienation of HIV/AIDS victims and in turn has prevented some people from knowing their HIV status. This has major implications for the effectiveness of HIV/AIDS management in the region. Awareness raising and public education is therefore critical. Although it must be said that the situation has improved significantly over the years in Southern Africa, where living openly with HIV/AIDS is no longer viewed negatively, especially in urban areas. But in rural areas, stigmatisation is still a major issue, in addition to poor access to health care.

Many communities in the region rely on local knowledge to develop climate change adaptation measures; however, many of these communities have been devastated by the impact of HIV/AIDS. This has resulted in dysfunctional social structures in many communities, with many child headed households. Rebuilding social structures in vulnerable communities through services such as the provision of better access to health care and the implementation of psychosocial programmes will help to build community resilience against the impacts of HIV/AIDS and climate change.

4 Health Policies Related to Climate Change

There is wide variation in the region regarding progress in the development of policies and strategies for addressing climate change in the health sector. Specific review of the state of knowledge on policies and strategies for climate change adaptation are addressed under the following sections on health and climate change adaptation policies.

4.1 *Reviews of climate change considerations in national government health sector policies and strategies*

The understanding of how much progress has been achieved in climate adaptation is still in its infancy, despite the wide recognition of the health effects of climate change (Lesnikowski et al. 2011). In an analysis of Annex I parties to the UNFCCC, Lesnikowski et al. assessed 1,912 initiatives and found that 80 percent of health adaptation work is preparatory action, with only 20 percent consisting of tangible action. Only 15 percent of adaptation initiatives were explicitly human health related. The study also found that mainstreaming of adaptation action into existing institutions or programs is happening. Some of these trends mirror the situation in Southern Africa, where progress in implementing health sector adaptation has been quite slow compared with other regions (Young et al. 2010; Dube and Chimbari 2009).

South Africa is among the very few countries in the SADC region that has started to make serious progress in incorporating climate change adaptation measures into its policies and strategies. Most of the progress has however been made in the last three years, which culminated with the COP17 summit in Durban, where a climate and health declaration was issued.

Even though the National Climate Change Response Strategy for South Africa clearly states that climate change adaptation measures will be mainstreamed into the health sector, specifically through the Department of Health Strategic Plan, there is no mention of climate change in the National Department of Health Strategic Plan 2010-2013. The strategy has, however, clearly outlined how South Africa plans to combat diseases such as malaria, whose transmission patterns are projected to change as a result of climate change.

According to Myers and Rother 2012, following the COP17 meeting in Durban in 2011 there was an increase in climate change policy development in South Africa at all tiers of government. This included the development of the national climate change and health adaptation policy, as well as at the provincial level in the Western Cape Province and KwaZulu-Natal. At the local government

level, the city of Cape Town and eThekweni municipality have specific climate and health adaptation policies.

In terms of legislation, South Africa is governed by the National Health Act 2003, which provides a framework for a structured uniform health system within South Africa, taking into account the obligations imposed by the constitution and other laws on levels of government concerned with health services. Among other things, the Act makes provision for the control of vector borne diseases such as malaria, whose management is a national mandate. South Africa's National Infection Prevention and Control Policy Strategy (2007) also recognises that climate change will increase the transmission of infectious diseases. Even though the intervention measures proposed in the management of infectious diseases are not specific to climate change issues, some of the key principles used are similar to climate change adaptation such as risk management, promoting prevention, information sharing and capacity building.

Until recently Malawi's national health policy was still in a draft format, and there is no clear indication whether the policy has been finalised. The Ministry of Health is generally responsible for the provision of health care in Malawi, and uses a three-tiered health care delivery system comprising primary, secondary and tertiary health care systems. The top five health care priorities for Malawi in the draft policy include vaccines for preventable diseases; malaria; acute respiratory infections; diarrhoeal diseases including cholera; and sexual and reproductive health (Government of Malawi 2011). Even though the national health policy does not mention climate change, the health priorities correspond to the diseases that are going to be impacted by climate change. In addition the Malawi Growth and Development Strategy (MGDS), which is the overarching medium term strategy for Malawi, mentions the threat of climate change but not in the context of health care (Government of Malawi 2006).

What is clear from the health policy review is that most countries are putting measures in place to strengthen their health care systems. For example, Zimbabwe has a very well defined national health strategy, which acknowledges among other issues the likelihood of climate change increasing the country's disease burden (Government of Zimbabwe 2009). However, the primary focus for Zimbabwe is on improving the quality of health care for its people, as a result of acute funding shortages and lack of capacity and basic infrastructure. The other priorities that are highlighted in Zimbabwe's National Health Strategy, which is due for review in 2013, include: i) addressing the factors outside the health sector that impact on health; ii) addressing the burden of specific diseases and conditions affecting Zimbabweans; iii) supporting the overall health system to ensure services are planned, delivered and monitored; and iv) facilitating stakeholder participation in service delivery in the health sector. The issues that have been highlighted in the Zimbabwean national health strategy are all critical for the country to adapt to the potential impact of climate change, even though implementation remains a major challenge.

4.2 Review of climate change considerations in regional health sector policies and strategies

SADC has a Protocol on Health, which is a legal instrument for coordinating and harmonising health sector activities in the region (SADC 1999). The protocol was ratified by Member States in 1999, and it addresses a range of issues related to climate change. Even though it does not address the threat of climate change explicitly, it highlights the need for a coordinated approach to disaster risk management, health and communicable and non-communicable diseases, among others. The protocol also led to the establishment of a Health Sector Co-ordinating Unit (HSCU) and a Health Sector Committee of Ministers (HSCM). From the time SADC Health Protocol was declared it took almost ten years to establish an implementation plan for the Health Protocol, as a guide to assist Member States to develop national protocol implementation plans.

SADC also has a Health Policy Framework, whose main goal is to raise the regional standard of health care through promoting, coordinating and supporting Member States to improve access to high impact health interventions. The policy framework recommends the development of policies, strategies and priorities on several health issues such as HIV/AIDS, communicable and non-communicable disease control and health promotion.

SADC's Regional Indicative Strategic Development Plan (RISDP) (SADC 2005) considers health as a priority sector in the context of social and human development, poverty and food security. The RISDP is an implementation framework guiding the regional integration agenda of SADC. It provides strategic direction for SADC initiatives in line with the SADC Common Agenda. The key health issues addressed in the RISDP include HIV/AIDS, which is recognised as a pandemic in the region, and the increasing rates of communicable and non-communicable diseases. The link between health and climate change is not explicitly stated in this framework; however, the threat of climate change is recognised, specifically in relation to desertification.

4.3 Review of health considerations in climate change policies and strategies

The leadership in SADC have shown commitment to addressing climate change, partly because the threat of climate change in the region is being felt through episodes of extreme events such as flooding, droughts and infectious disease outbreaks and the spiralling cost of food and energy (Watson et al. 1998). The cost of climate change partially explains why all the SADC countries have ratified the UNFCCC and the Kyoto Protocol, the two main global climate change conventions which

commit countries to stabilising the concentrations of greenhouse gases in the atmosphere.

As a result of these international commitments, SADC Member States had to develop climate change policies in order to fulfil the commitments they had made. For example in South Africa, following the signing of the UNFCCC convention in 1997, several national policies and processes were initiated to meet the international commitments that the country had made towards combating climate change.

In addition to the international commitments SADC has developed several treaties, protocols and agreements that are used to implement the decisions of SADC leaders (Richards 2010). These instruments, which are mandatory to signatory members, include up to 20 Protocols, with about seven directly related to climate change mitigation and adaptation (Richards 2010).

In relation to the health sector, most of the countries in the region have recognised the potential risks to human health as a result of climate change, and this is clearly reflected in their policy priorities and action plans. For example in Malawi, the NAPA identifies the following interventions as being critical for the water sector: i) improved nutrition for infants and other vulnerable groups; ii) prevention of diseases such as malaria, through increased distribution of insect treated bed nets (ITNs), and diarrhoea; iii) water treatment; and iv) crop diversification and food supplementations for the under-fives. The main shortfall that was acknowledged in Malawi is the lack of an integrated approach to climate change adaptation, with most of the issues being dealt with sectorally instead of adopting an integrated approach.

The South Africa National Climate Change Response Strategy (NCCRS) (Government of South Africa 2004) also identified the Health Sector as a key adaptation sector. To this end the climate change response strategies identified some key interventions linked to the health sector, which include improving the management of respiratory diseases, rolling out public awareness campaigns, strengthening information flows and improving current malaria control measures.

4.4 Review of key arguments for policies on adaptation to climate change in the health sector

From the review it was clear that climate change is already taking place in the Southern African region, with emerging evidence of increased disease prevalence and extreme events, even though the recent flooding in the region has not been explicitly linked to climate change. The recognition that climate change is already impacting the region is partially responsible for driving the policy response, to ensure that countries in the region are prepared to deal with the increased disease burden.

There is a major concern among countries that a 20 percent reduction in productivity as a result of HIV/AIDS will have a devastating impact on the economy of the region. This has led to an integrated approach to managing the disease burden; however, it was only recently that climate change has started to inform this discourse, especially in South Africa. Even though in most of these countries the explicit link between HIV/AIDS and climate change has not yet been well articulated, there is recognition that the vulnerability of the population will be exacerbated by climate change.

As a result of the current change of the climate, adaptation policies are driven by the anticipated changes in disease burden as the changes create suitable conditions for disease transmission across the region. This drive is however also limited by lack of capacity for effective service delivery in the region, as the health sector is already under burden from inadequate infrastructure.

As prevention of health impacts is the primary approach to public health, health sector policies are informed by the need to address the root causes of the potential risk. Hence in addition to adaptation measures, health sector policies call for the urgent need to reduce greenhouse gases, as the most effective way to address the potential increase in the burden of disease in line with public health care principles.

Mitigation measures are, however, longer term and less locally focussed. Acknowledging that climate change is already taking place, the highest priority for the health sector in Southern Africa appears to be on implementing effective adaptation strategies as the most pragmatic approach to addressing the threat of climate change.

4.5 Review of key policy actors and networks involved with adaptation to climate change in the health sector

There are very few actors and players in the Southern African region that are focused exclusively on adaptation to climate change in the health sector. The general approach thus far is to incorporate the health sector into broader adaptation policy processes and strategies. In a review of the current state of knowledge on adaptation in the health sector, Young et al. (2010) reported that most institutions work on crosscutting issues of climate change, with a majority focused on adaptation. In a separate review of health sector adaptation, Dube and Chimbari (2009) also found most work in the region is done through networks based in Europe and the US. Some of the key networks in the region include:

- African Technology Policy System (ATPS), Capacity Strengthening of Least Developed Countries on Climate Change Adaptation (CLACC), Zimbabwe Environmental Research Organisation (ZERO Zimbabwe), Care Zimbabwe and the United Nations

Development Programme (UNDP) Climate Change Adaptation in Africa Programme.

- The second tier of institutions that are involved in climate change policy are the multilateral and bilateral donor agencies such as the UK Department for International Development (DFID), United States Agency for International Development (USAID), Danish International Development Agency (DANIDA) and German Society for International Cooperation (GIZ) among others. Some of these donor agencies have supported key projects that have helped to promote evidence based policy implementation.
- At the regional level, leadership has been provided by bodies such as the African Union, SADC, COMESA and the African Ministerial Council on Water (AMCOW).
- Nationally various government departments in the region are responsible for driving policy development and implementation. Often times, however, there is a tendency to duplicate efforts either between different ministries or at different levels of government.

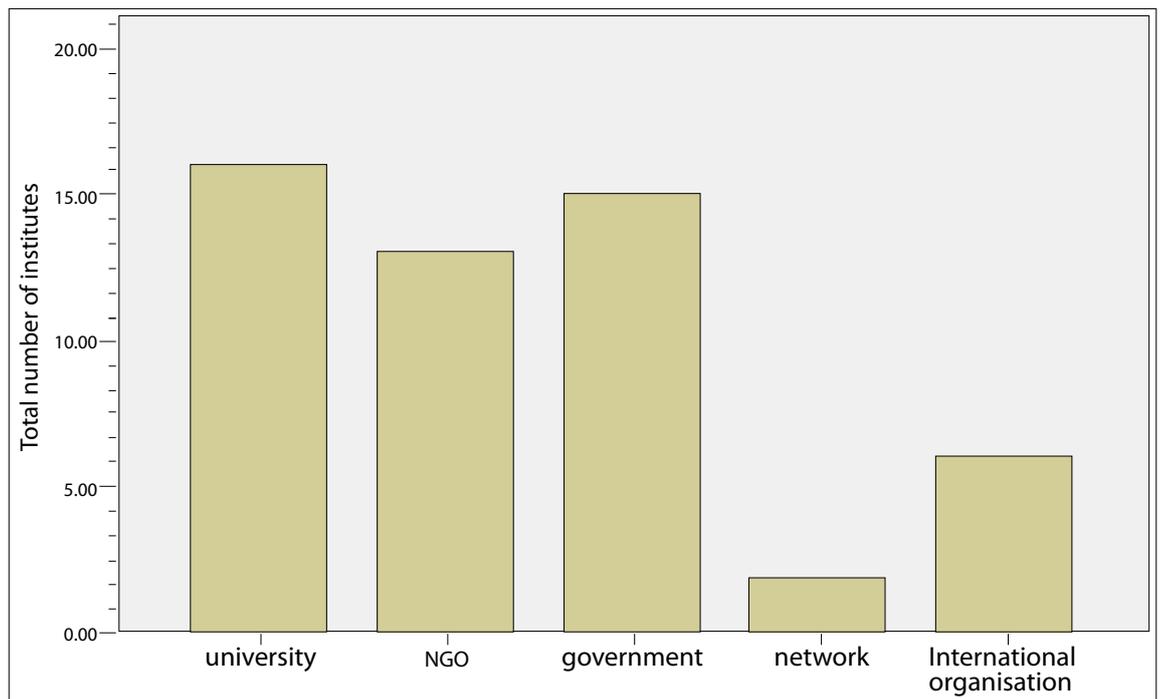
A comprehensive list of key players in the health sector policy in the region is contained in a previous review by Dube and Chimbari (2009). The key institutions that were listed in Malawi for example include the Ministry of Environmental Affairs, which was responsible for spearheading the NAPA development, and the Faculty of Science at the University of Malawi that has conducted extensive research into climate change adaptation and food security. Examples of international organisations in Malawi include CURE International, whose core business is to assist children with disabilities, and Action Aid, focusing on food and water security.

In Zimbabwe the key institutions include ZERO Regional Environment Organisation, whose work is related to adaptation activities in the agronomy sector. Various universities in Zimbabwe such as the University of Zimbabwe and Midlands State University have conducted research on climate change mitigation and adaptation.

In South Africa, leading institutions and actors include the Ministry of Environment and Water Affairs that is leading on policy development and implementation on climate change. The Council for Scientific and Industrial Research (CSIR) and Climate Systems Analysis Group (CSAG) conducts research to document evidence of climate change. The Centre for Occupational Health and Environmental Health Research at the University of Cape Town is one of the very few institutions that are engaged in conducting research on the impact of climate change on the health sector.

Most of the actors and networks involved in adaptation to climate in the health sector operate in a multidisciplinary space with their research spanning all aspects of climate change adaptation. In the region South

Figure 2. Number of institutions where climate change work related to health is being conducted (Dube and Chimbari 2009).



Africa has the largest number of institutions working on climate change issues, and in many cases their work encompasses the entire Southern African region; as a result, other countries in the region that don't have enough research capacity have benefitted from the work carried out by South African research institutions.

In summary, the key institutional actors can be classified as:

Government Actors

Government actors comprise the various ministries and tiers of government. Some of the relevant actors include ministries of health, environment, water, disaster management, irrigation, food security, livestock and fisheries. Most governments also have inter-ministerial committees to coordinate climate change; for example, South Africa has a National Climate Change Committee that draws members from different arms of the government.

Different tiers of government at the provincial and local level may play critical roles. For example, the Western Cape Provincial Government and the Cape Town and Ethekewini Municipalities in South Africa developed both cross-sectoral and specifically health sector adaptation strategies before the national government could develop similar instruments.

Non-governmental organisations (NGOs)

NGOs in Southern Africa play a major role in advancing our understanding of issues that require research, and they often fill a massive gap where public sector resources cannot reach. Prominent NGOs in the region include international entities such as ActionAid, CARE

International and Médecins Sans Frontières (MSF). Each of the countries also have locally established NGOs that have played a key role in service delivery for a long time, often working with the poorest communities or advocating for health services that reach those at the bottom of the social hierarchy.

Funding streams for climate change adaptation are not sector based, and they tend to be lumped with other sectors. During the process of this review, we did not find information on funding that is specifically geared towards financing health sector adaptation initiatives, apart from resources that have already been deployed by the respective governments in the region to undertake climate change adaptation work.

However, it is possible to synthesise the potential avenues through which health sector adaptation funding is run, through a broad overview of the climate finance sector in general. The potential sources of climate finance flows into the region are classified according to the following categories:

- Financing flows under the UNFCCC
- Multilateral and bilateral climate change funds
- Own-country financing
- Private financing

Financing flows under the UNFCCC

The UNFCCC has made substantial financial commitment to support the efforts of developing

countries to adapt and mitigate against the impact of climate change. Cloete et al. (2011) in their review of climate finance stated that during COP15, countries committed to mobilise US\$100bn of scaled up, new and additional funding for climate change mitigation and adaptation activities in developing countries. Under the UNFCCC funding scheme, developing countries and small island states have been prioritised for adaptation finance.

Multilateral and bilateral climate change finance

There are numerous sources of funding that countries in the region could tap into such as the Climate Investment Funds (CIFs), a collaborative effort between Multilateral Development Banks (MDBs) and specific countries (Cloete et al. 2011). The CIFs comprises two funds, namely the Clean Technology Fund (CTF) and the Strategic Climate Fund (SCF). South Africa is one of few countries in the region that was able to tap into the CTF to fund renewable energy projects.

Some of the latest climate funds that have been invested in the region include US\$90m that was recently secured by COMESA, SADC and the East African Community in a tripartite partnership from the government of Norway, the European Commission and the United Kingdom. The funds will be channelled towards financing climate change adaptation and mitigation in the region.

Own- country financing

Most developing countries including those in the region are more inclined towards demanding that the costs of mitigation and adaptation be borne by the developed countries. This is because developing countries face major constraints in their potential to generate own country finances, and these challenges include the inability to raise public funding in developing countries, and the need to focus on immediate developmental objectives (Cloete et al. 2011).

Private financing

Private financing holds massive potential for delivering resources for climate change adaptation and mitigation. It has been reported that the Global Environment Facility (GEF) has been able to secure US\$13.7 million from other sources to leverage their investment. In Southern Africa, however, there is no evidence of significant involvement of the private sector in providing finance. This is partly due to the fact that in many of the countries the private sector is still relatively small and still developing.

4.6 Review of identified or inferred 'missing voices' in research and policy debates

The discourse on climate change and the health sector is still at its very early stages in the region. As a result there is no clear evidence of any inferred 'missing' voices. As a matter of fact, there appears to be a good recognition of the strong gender dimension to the health impact of climate change, and women and children have been shown to be disproportionately impacted by climate change.

However, there appear to be some gaps in mainstreaming indigenous knowledge systems into climate change adaptation in the health sector. Even though there is acknowledgement of the high dependence of many communities in the region on traditional medicines, there is no evidence of how such measures are going to be mainstreamed into policies or strategies for climate change adaptation in the health sector.

4.7 Lessons from efforts to promote research-policy dialogues on adaptation in the health sector

Lessons on research-policy dialogues on adaptation in the health sector have not been well documented in the region, perhaps attributable to the fact that significant research on the health sector is only recently starting to emerge.

Preliminary findings from this review indicate that there is goodwill from policymakers encouraging more research work to be carried out in the health sector in order to inform policies with a strong scientific evidence base.

There is significant 'competition' between the health sector and other sectors such as water and agriculture to be prioritised in the climate change adaptation strategies. This is partly because the health sector impacts of climate change have not been well understood yet; as a result, considerable lobbying and advocacy is still needed before the health sector moves to the top of the agenda in the climate change discourse.

5 Gaps in Climate Change Adaptation Research and Policy in the Health Sector

5.1 Key research gaps

Various studies in the region have identified gaps in the understanding of adaptation to climate change in the health sector. One of these major knowledge gaps is the lack of understanding of adaptation strategies that have proven to be effective elsewhere and could be applied in the region (Myers et al. 2011). Adopting such approaches would help the region to quickly implement adaptation measures cost effectively, without having to develop completely new measures whose efficacy has not been tested.

The region still lacks very basic understanding of locally relevant knowledge on climate change adaptation, because most of the climate change analysis thus far relies on global or regional datasets, whose application for implementing locally driven adaptation measures may be severely constrained. This challenge has been recognised and initiatives such as the promotion of regional downscaling will help to close this gap (Ziervogel and Zermoglio 2009). Regional downscaling simulates global climate change using information from local meteorological stations in the region, to improve on the accuracy of climate change projects. This would make it easier to develop adaptation measures that are driven by local knowledge since the projects are at a relatively fine scale compared to the global projections.

In the health sector, the main knowledge gap is due to the fact that the effect of climate change on disease burden has only been assessed for a very few key infectious diseases (Confalieneri et al. 2007), yet we know that vulnerability of people in the region is not only associated with specific diseases. In addition to this, most of the models that have been used to predict the impact of climate change on specific disease prevalence were not developed and tested in the region. Some of the projections might therefore be entirely inaccurate in assessing the impact of climate change on disease burden in the region.

With improvements in technology, economic development and climate change adaptation, the management of preventable diseases is likely to increase significantly with a resultant improvement in life expectancy. There is uncertainty about how the climate-health relationship will evolve over time; and uncertainty about the extent, rate, limiting forces and major drivers of adaptation.

5.2 Key policy gaps

Most of the discourse on climate change impact on the health sector is still in the academic realm. There is need to move it into the policy arena. As a result, few countries in the region have national climate change health response strategies, and in some cases the strategy is too broad to address issues specific to the health sector.

There is often a lack of coherence in policy development and implementation. For example in South Africa it has been reported that despite a plethora of policy frameworks, strategies and other policy documents it took a long time for the country to have a coherent climate change policy (Richards 2008).

There is need to strengthen evidence based policy implementation. Current policies are not based on strong evidence, as a very small pool of research related to climate change has been carried out for the region. This is because climate change policies do not clearly identify the strategies that need to be implemented to address the situation. For example, the National Water Resource Management Policy of Malawi does not state clearly the kind of strategies that need to be put in place to manage sanitation, placing a huge burden on the implementation of such a policy.

Many climate change adaptation policies are not comprehensive in their approach; for example, the climate change adaptation strategy for Zimbabwe has been criticised for having a very strong focus on rural areas without saying much about urban settings (Brown et al. 2012). This has major implications for the management of diseases as urban populations grow due to rural-to-urban migration.

In a comprehensive review of the researcher-policy maker interface in several countries including Malawi and Tanzania, Stephenson and Hennink (2002) identify the key barriers to research uptake by policymakers, which include limited access to research outputs, poor dissemination skills by researchers and a lack of central points to access information. In many cases the quality of research outputs is very poor; hence, policymakers don't find the information useful for decision-making. Researchers and policymakers are isolated, without a common platform for collaboration or formal communication channels through which research outputs could be disseminated to policymakers in the region.

The key research and policy gaps identified are relatively generic, and apply to various sectors and geographic locations. However in this case it could also be argued that the main drivers of the research policy gaps is influenced by the fact that the integrated health

and climate research agenda is still very new, and most of the research work in both sectors has been conducted in parallel.

5.3 Options and possible policy 'spaces' or opportunities for improved uptake of research findings

There are many opportunities and spaces that exist currently in Southern Africa to overcome some of the barriers to research uptake outlined above. Policymakers in the region have recognised that health is one of the main sectors that will be adversely impacted by climate change; as a result, the potential to utilise research findings to inform policy are very high. To enable the uptake to occur, however, requires building better linkages through partnerships between different institutions such as universities, NGOs and the government, due to the multifaceted nature of the challenge.

The leadership provided through various structures in the region such as SADC and other networks offers a good opportunity for policymakers to engage with researchers and a direct platform for seminal research findings to feed into policy processes in the region. Researchers therefore need to be encouraged to use these existing platforms to showcase their research and help inform policymaking in the region.

The UNFCCC processes and IPCC have made it abundantly clear over the years that science should be at the forefront of policymaking. As a result, scientists have gained tremendous respect from policymakers. This has helped to break down some of barriers that have previously hindered the uptake of research findings by policymakers. Considering that Southern Africa boasts some of the most respected scientists globally in the field of climate change, there is good opportunity for the voice of scientists to be heard by policymakers in the region.

The lack of capacity could be overcome through the implementation of strategic interventions that help in building understanding on climate change. For example, the Climate Systems Analysis Group (CSAG) at the University of Cape Town runs a climate change course that covers all aspects of climate change (CSAG 2013) and is attended by policymakers and researchers from all over Africa. Such initiatives are crucial in bridging the research-policy gaps in the region.

Finally, the Durban Declaration on Climate and Health that was adopted during COP17 helped to rally various voices within the sector, both in the region and globally. Hopefully this will present a good opportunity to mainstream health concerns both in the global climate change discourse and in regional and national processes.

6 Conclusions and Recommendations

This study was a review of climate change and the health sector in Southern Africa, with a focus on understanding the challenges it poses and the state of knowledge in the sector in adapting to climate change. The review also identified research gaps and the options and opportunities for filling those gaps. The evidence gathered from the review indicates that there is a direct link between climate change and disease, that the health sector in Southern Africa is already facing multiple challenges in relation to its burden of disease, and that climate change will merely exacerbate this current situation. The region is faced with a major challenge because of the existing quadruple burden of disease associated with HIV/AIDS, infectious diseases, chronic diseases and intentional and unintentional injuries. The state of health care provision varies widely in the region, depending on the economic conditions of each country. With seven of the region's countries categorised as Least Developed Countries, the current state of health provision in much of the region is inadequate.

The vulnerability of the population to the impact of climate change on human health is dependent on multiple factors including the current state of health care, such as access to primary health care by the community; and the characteristics of the individual affected, such as age, gender and education level. Institutional drivers such as policy responses and governance systems also play a critical role in determining the vulnerability of populations impacted by climate change. Using health expenditure per capita as an indicator of the state of the health care system in the region, it was found that most countries performed dismally, with the exception of a few such as South Africa, Botswana and Mauritius.

For all of the diseases reviewed in this study, namely water and food borne diseases, vector borne diseases and HIV/AIDS, there is significant evidence linking them to the impact of climate change. It was also found that the impact of climate change on the prevalence of these diseases was linked to other factors such as access to adequate water supply and sanitation, reliable food supplies and, in the case of HIV/AIDS, a breakdown in social structures that has led to inadequate use of local knowledge in climate change adaptation.

Several options are available to build adaptive capacity to cope with the impact of climate change on the health sector. Some of these key options include effective planning that takes into consideration the multiple dimensions and pathways through which the impact of climate change will be felt in the sector. For example, ensuring adequate provision of services such as water and sanitation will significantly improve the adaptive capacity of communities impacted by climate change. There is need to develop better surveillance of disease outbreaks to act as an early warning system and enable vulnerable communities to cope.

There are still some knowledge gaps in our understanding of how specific diseases will be impacted by climate change. In addition, most of the research work linking health to climate change research has been conducted outside the region, so there is need for locally driven initiatives which integrate local context in understanding the impact of climate change on the health sector.

Significant progress in responding to climate change is being achieved, with various countries having developed policies and strategies. However, in relation to health the policy responses are still relatively inadequate compared to other sectors such as agriculture and water.

Most countries in the region have health policies but have not adequately incorporated climate change considerations in their implementation. In some cases climate change is recognised as a threat to the health sector, but no comprehensive strategies for managing the health impact of climate change have been developed.

The overall conclusion is that even though the impact of climate change on the health sector has become increasingly apparent in the region, more work still needs to be done to develop the knowledge base, mainstream health considerations into climate change policy and vice versa. Specific recommendations arising from this review include developing and testing approaches to effectively quantify the current impact of climate change on a range of diseases; ensuring that climate change considerations are integrated into all stages of public project design and implementation; and launching a concerted effort to ensure policy alignment both within the health system and in other related sectors.

6.1 Recommendations

Following the completion of this review, a stakeholder workshop was convened to validate the outcomes of the study. The stakeholders were drawn from multiple sectors in the Southern African region, including representatives of various government, universities, research institutions, the private sector and specific interest groups such as farmers. During the workshop, the stakeholders were presented with the outcomes of the study, which was followed by a critical examination of the study to identify gaps and develop recommendations. Following this rigorous consultation process, the stakeholders came up with the following set of recommendations, which they felt if well addressed could significantly improve the understanding and management of the impact of climate change on the health sector in Southern Africa.

1. **Gather more primary data and locally relevant information to improve the evidence base for linking climate change to the occurrence of diseases in the region.**

Even though the impact of climate change on human health is well understood in terms of

the causal pathways, the evidence base to make informed decisions is still lacking. One of the main constraints in building this evidence base is the lack of long-term health data for specific areas, and climate data at a relatively fine scale to link human health to changes in the climate system (CSIR 2010). Most of the documented evidence is at a broad scale, which is unreliable for decision-making. There is a need to gather evidence at fine spatial and temporal scales, to make such information relevant for decision-makers to apply.

2. **Streamline communication of research outcomes to unlock barriers to uptake of research outcomes by policymakers and practitioners.**

This review found very few publications that were specifically targeting policymakers, such as policy briefs, which raises a major concern that current work on climate change and the health sector is not packed in a format that is suitable for policymakers to access. It is therefore important for research outcomes to be communicated in a manner that targets various audiences, such as the science community, government and the general public. These pathways could potentially be unlocked through the use of knowledge brokers such as the traditional media outlets and more recently social media, which has become a very powerful medium of communication.

3. **Promote stronger alignment between the different sectors in trying to understand the impact of climate change.**

The impact of climate change on the health sector should not be viewed in isolation without participation by other sectors such as agriculture and urbanisation, since these are very closely linked to each other. For example, it is well documented that poor health directly impacts on productivity, and rapid urbanisation promotes disease transmission. Adaptation planning therefore needs a holistic approach to develop measures that have multiple outcomes and optimise use of limited adaptation resources.

4. **There is need for strong political support and champions to mainstream health considerations into climate change issues.**

There is an urgent need for strong political support and champions to promote the uptake of health consideration into climate change discourse and planning. The review acknowledged that health dimensions of climate change have not featured as prominently as other sectors such as agriculture and water in various forums including UNFCCC negotiations. This could be partly associated with a lack of political support and champions required to influence such agendas and programmes of work both in national and global platforms.

5. **Need for more coordinated and dynamic adaptation planning that takes cognisance of future uncertainties.**

There was a concern among stakeholders in the region that most of the effort in trying to understand the impact of climate change focused on 'major' diseases such as malaria and HIV/AIDS, which form the basis for adaptation planning. There is a risk that diseases that are neglected now might become of major concern in the future as a result of climate change. It is therefore important to develop climate change adaptation strategies and toolboxes that recognise these future uncertainties and will be responsive to such changing circumstances.

6. **There is need to develop good understanding of the cost of climate change adaptation in the health sector.**

Even though this review did not focus on the cost of climate change adaptation, during consultations with stakeholders in the region there was strong sense that there is a need to develop better understanding of the cost of adaptation in the health sector. Very few studies have been carried out to understand both direct and opportunity costs of climate change in the health sector, which presents a major gap with major implications on climate change adaptation planning.

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