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ZAMBIA

HEALTH NATIONAL ADAPTATION PLAN

2017

HEALTH NATIONAL ADAPTATION PLAN

HNAP REPORT PREPARE BY MOH

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ABBREVIATIONS

AF	Adaptation Fund
ACT	Artemisinine combination therapy
AEZ	Agricultural Ecological Zone
AHSB	Annual Health Statistics Bulletin
BCG	Bacille Calmette Guerin
CHAZ	Churches Heath Association of Zambia
CHW	Community Health Workers
CLACC	Capacity strengthening in the least developed countries for adaptation to climate change
CD	Communicable Diseases
CIA	Central Intelligence Agency
CEEEZ	Centre for Energy, Environment and Engineering Zambia
CRS	Catholic Relief Services
CSO	Central Statistics Office
CDD	Cardio Vascular Diseases
DALYs	Disability Adjusted Life Years
DMMU	Disaster Mitigation and Management Unit
DDT	Dichlorodiphyneltrichlorone
DPT- Hep B-Hib	Diphtheria hepatitis-b hemophilus influenza
EPI	Expanded Programme on Immunisation
HMIS	Health Management Information System
HNAP	Health National Adaptation Plan
HRH	Human Resources for Health
GCF	Green Climate Fund
GDP	Gross Domestic Product
GNI	Gross National Index
GRZ	Government Republic of Zambia
HQ	Headquarters
IRS	Indoor Residual Spraying
IPCC	Intergovernmental Panel on Climate Change
IPT	Intermittent Preventative Therapy
ITN	Insecticide Treated Nets
IUCN	International Union for Conservation of Nature
IFRC	International Confederation of Red Cross
HIV/AIDS	Human Ummuno-Virus
LCMS	Living Conditions Monitoring Survey
MACEPA	Malaria Control and Elimination Programme
MDG	Millennium Development Goals
MOH	Ministry of Health
MoFNP	Ministry of Finance National Planning
MTNER	Ministry of Tourism and National Environment
NCDs	Non-Communicable Diseases
NDMP	National Disaster Management Policy

NCHWS	National Community Health Worker Strategy in Zambia
NISIR	National Institute for Scientific and Industrial Research
NHSP	National Health Strategic Plan
NMSP	National Malaria Strategic Plan
IPCC	Intergovernmental Panel on Climate Change
LDC	Least Developed Countries
LDCF	Least Developed Country Fund
LMIC	Lower and Middle Income Countries
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Actions
PHC	Primary Health Care
$PM_{2.5}$	Particulate matter of aerodynamic size of 2.5
PM_{10}	Particulate matter of aerodynamic size of 10
STIs	Sexually Transmitted Infections
TB	Tuberculosis
TDRC	Tropical Disease Research Centre
TFR	Total Fertility Rate
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children Fund
WARMA	Water Regulation Management Authority
WHO	World Health Organisation
ZDHS	Zambia Demographic Health Survey
RCRC	Zambia Red Cross Society
ZVAC	Zambia Vulnerability Assessment Committee

DEFINITIONS

Agro-ecological zones	**G**eographical areas exhibiting similar climatic conditions that determine their ability to support rained agriculture. These are influenced by latitude, elevation, and temperature, as well as seasonality, and rainfall amounts and distribution during the growing season.
Improved water source	A source of water by nature of its construction or through active intervention, is likely to be protected from outside contamination, in particular from contamination with fecal matter.
Improved sanitation	A that hygienically separates human excreta from human contact. It is not necessarily identical with sustainable sanitation.
Hot days/nights	Temperature exceeded on 10% of days/ nights in current climate of the region and season (McSweeney,2009)
Cold days/nights	Temperature below which 10% of days/nights are recorded in current climate of that region and season
Heavy event	Daily rainfall total which exceeds the threshold that is exceeded on 5% for rainy days in the current climate of that region and season
Climate change	UNFCCC refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.
Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Vulnerability	Is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.

EXECUTIVE SUMMARY

Background and context

Climate change and variability poses a challenge to sustainable human development. The effects of climate change on human health are a result of interactions of environmental, social and health system conditions. Addressing the effects from climate change requires adaptation. In order to help the Least Developed Countries (LDCs), which are the most affected, adapt to climate change and variability, in the medium and long term, the United Nations Framework Convention on Climate Change (UNFCCC) recommends that countries draw up their national adaptation plans (NAPs.) The NAP is a multi-sectoral process to which each socio-economic sector in a nation's developmental agenda inputs.

The health sector is highly sensitive to climate change, and to ensure that the health of populations is protected from the effects of climate change, it is imperative to include a health component (the HNAP) in the NAP. Zambia recognises the negative impact of climate change on the development goals of the country and the need to respond to this threat. The government reflects this in the Seventh National Development Plan (7NDP) and other policy pronouncements: National Disaster Management Policy and National Climate Change Policy.

This document is the health national adaptation plan (HNAP) for Zambia. It presents the results of a national consultative process to identify climate risks and adaptation measures relevant to the health sector and also sets out the road map to the implementation of the HNAP.

Methodology

A vulnerability and adaptation assessment exercise was carried out between November 2016 and June 2017. A desk review was conducted and extensive consultations with environmental health experts and other staff within the MoH were held. Relevant documents on climate change in general and its impact on public health and developmental goals of the country in particular were reviewed. Furthermore, ranking of climate-sensitive health risks, and analysis of the available long-term data on climate and climate-sensitive diseases in the country were done. Health data at district and provincial level from 2000 – 2015, together with meteorological variables (temperature and rainfall), were analysed. Consultations with experts were undertaken through interviews with MoH officers at provincial and national offices while the district level consultations were through workshops.

Situation analysis

Burden of climate sensitive diseases:

Malaria, diarrhoeal diseases (non-blood) and respiratory infections (non-pneumonia) together are the major cause of morbidity and mortality. Malaria alone causes the most morbidity and is a major contributor to maternal and child deaths. Respiratory infections and diarrhoea have shown an upward trajectory for the years reviewed although case fatality reduced. Among notifiable diseases, cholera has become endemic in Zambia occurring as annually outbreaks especially in the wet months.

Determinants of health impacting on disease burden

Adverse socioeconomic conditions such as poverty and food insecurity, poor access to safe water and sanitation, illiteracy and poor housing interact in various permutations to impact public health. Nationally, extreme and moderate poverty reduced affects a considerable proportion of the population with the rural population more affected. Both wasting and stunting is prevalent among children under 5 years with children in the rural areas being more disproportionately affected. Chronically malnourished children have reduced ability to resist diseases in general thereby increasing the incidence and severity of climate sensitive diseases among the affected children.

The country's has a large population which is projected to increase from 15.5 million in 2015 to over 23 million by 2030. The high population growth rate will place a huge demand on basic social services such access to safe water and sanitation, adequate housing, education and health services thereby increasing vulnerability to climate change. Most of the population is, and expected to be, in urban areas.

The health system faces serious challenges in providing the care to those in need. The health workforce gap remains wide; both in numbers and inequity in the distribution of the health workers between the rural and urban. Additionally, 50% of the rural populations live more than 5 kilometres from the nearest health facility.

Observed climate variability and health impacts

Zambia has increasingly experienced major climate hazards such as droughts, floods and increasing temperatures resulting in heat waves. Using the period 1970 -2000 as the baseline, precipitations patterns show a general decline in rainfall in most parts of country while parts have had recurrent flooding. The mean annual temperature has increased by 1.3^{o}C from 1960 to 2003.

DMMU assessments between 2004 and 2016 reveal that climatic hazards ranging from droughts to floods have repeatedly occurred in different parts of the country with impact on health of the populations: injuries, community displacement, food-insecurity and malnutrition, increased incidence of malaria, diarrhoea and respiratory infections.

Projected climate change and health impacts

Temperature over the country is projected to increase by 1.2ºC and 3.4ºC by the 2060s and the frequency of hot days are expected to increase and that the southern and western parts of the country are estimated to warm more rapidly than the rest of the country. Rainfall is projected to decrease in AER I and II while AER III will be prone to increased rainfall and flooding events.

The projected increase in temperature and reduced rainfall will foster future outbreaks of diarrhoea diseases and increased food insecurity. In AER III, with projected increased in rainfall and flooding events contamination of water sources will be of concern.

Vulnerability to climate change

Based on available incidence and mortality statistics and feedback from the workshop participants, malaria, diarrhoea diseases, respiratory infections and severe malnutrition were identified as climate sensitive as well as being the major causes of the current diseases burden in the country. Hypertension and other cardiovascular conditions, and asthma were isolated as NCDs that were increasingly gaining public health importance.

Most of the current control measures aimed at the infectious disease were assessed to be highly vulnerable to climate change. These included:

- Vector control (mosquitoes)
- Child health and nutrition
- Waterborne diseases control: Diarrhoea, dysentery and cholera
- Epidemics control
- Water and sanitation for the control of diarrhoeal diseases
- Access to curative services

Adaptation responses

Adaptation to climate change poses a great challenge for most African countries including Zambia. The UNFCCC cites some of the following developmental challenges as contributing to the difficulties with adaptation: low GDP per capita; widespread, endemic poverty; weak institutions; high levels of illiteracy; low access to primary health care; imbalance in women and gender in policy planning; and complex disasters.

Furthermore, the IPCC, in its fifth assessment report (5AR), states with ‘very high confidence’ that “The most effective measures to reduce vulnerability in the near term are programs that implement and improve basic public health measures such as provision of clean water and sanitation, secure essential health care including vaccination and child health services, increased capacity for disaster preparedness and response, and alleviation of poverty”. The report also

recommends that to ameliorate future vulnerabilities countries should promulgate policies that promote health, education, and foster economic development.

Prevalent climatic risks identified for Zambia were droughts, floods, and temperature variability especially heat waves although only drought and floods were considered to have the highest potential to affect individual and public health. Therefore, responses to these climatic two risks were rated high, while the impacts of heat waves/extreme temperatures were considered of low priority. Several adaptation options to the "high priority risks" were considered but only those that were aligned to the overall national developmental priorities both in the medium- and long terms as elucidated in the NDMP, seventh NDP (7NDP) and the Vision 2030 were selected.

As recommended in 5AR, adaptation responses in this HNAP are based on the 10 public health principles and their climate change equivalencies. Applying these principles will meet the measures proposed in the NPCC and other policies/strategic plans. Some of these include: setting up a robust surveillance and early warning system and increased institutional capacity to handle and respond to climate change health risks; a strong laboratory system and a trained health worker force for the early detection, treatment and control of disease outbreaks (emerging or re-emerging); development of appropriate training courses in order to develop capacity and skills in conducting vulnerability assessments, climate change analysis, preparedness and disaster management, and epidemiology, treatment of climate sensitive diseases, health economics and information technology; build community resilience by increasing community awareness regarding climate change risks and their vulnerabilities; and enhanced enforcement of legal requirements that protect public health by reviewing of the public health legal and regulatory framework.

Mainstreaming health sector adaptation responses

The methodological design used in formulating this HNAP captured data from only two sources, existing literature and expert opinion from within the MoH, thus excluding sector-wide and inter-sectoral stakeholders. However, most of the proposed adaptation measures fall outside the mandate of the MoH therefore it is thus important that before the adaptation measures proposed in this report are implemented, the excluded stakeholders should be consulted. The following are the proposed steps to the finalisation of the HNAP and mainstreaming of the responses to climate change:

1. Hold meetings with sector-wide and inter-sectoral stakeholders: The main objective of this meeting will be to screen and select adaptation options for implementation within the HNAP. This meeting will be at liberty to amend, including removal of, the proposed options.

2. Constitute a committee of experts from among the key stakeholders to evaluate the proposed adaptation options (after steps 1. above). The committee's terms of reference will be to:

    a. Review the regulatory implications within the health sector and other sectors resulting from the adoption of the proposed adaptation options.

    b. Consider the entry point of the selected adaptation options into the budgeting and planning process within the MoH and/or other implementing line ministries at all operational levels and the national budget

    c. Cost the selected adaptation options

    d. Formulate process indicators for monitoring and evaluation

3. Ensuring the health-sector's prioritised responses to climate change receive due attention and integrated into the other sectors' adaptation plans by working in collaboration with the Climate Change Department as provided for in the National Policy on Climate Change

1 INTRODUCTION

Climate change, with its impact on human systems, poses a challenge to sustainable human development. It negatively affects human systems; ranging from its impact on agriculture and food security, wildlife and forestry through land degradation, safe water and energy, and health. These effects are happening now and projected to intensify in the future,[1] and thus increasing future human vulnerabilities to climate change. The Intergovernmental Panel on Climate Change (IPCC) projections indicate that climate change will affect temperature, rainfall, frequency and intensity of extreme weather events, and sea level.[2] Watson et. *al* estimates that the earth's surface will be warmer by 1 – 3.5^{o}C by the end of this century.[3] The biggest impact of climate change is expected to be on public health. The effect of climate change on human health, described as direct or indirect, is a result of interactions of environmental, social and health system conditions.[4] Direct effects result from injuries during extreme events such as floods and windstorms; and cardiovascular deaths from heat waves. Indirect impact arises from climate change effects on other systems; droughts potentially leading to water scarcity contributing to crop failure and subsequent malnutrition, and floods leading to increased waterborne and vector borne diseases.

While the impact of climate change on human systems is being felt globally, the Least Developed Countries (LDCs) are negatively impacted the most.[5] The most severe effects are expected to be experienced in the sub-Saharan Africa; related to the geographical location and generally lack of capacity to cope with the consequences.[6] Addressing the effects from climate change requires adaptation and in order to help the LDCs adapt to climate change and variability, in the medium and long term, the United Nations Framework Convention on Climate Change (UNFCCC) recommends that these and other developing countries draw up their national adaptation plans (NAPs.) The NAP is a multi-sectoral process to which each socio-economic sector in a nation's developmental agenda inputs. Given that the health sector is highly sensitive to climate change, and to ensure that the health of populations is protected from the effects of climate change, it is imperative to include a health component (the HNAP) in the NAP.

The HNAP process ensures the mainstreaming of the response of the heath sector to climate change; it ensures that planning for the handling of health risks emanating from climate

[1] *Field et al. Climate change impacts, adaptation and vulnerability. 2014*
[2] *IPCC (2007). Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of Intergovernmental Panel on Climate Change*
[3] *Watson et al. Impacts, adaptation and mitigation of climate change: scientific-technical analysis. 1996*
[4] *Gerland RM. National Policy Response to Climate Change in South Africa. 2014*
[5] *Norford AE. Adaptation to Climate Change in Sub-Saharan Africa: An investigation of capacity building and national Adaptation Programs of Action. 2009*
[6] *Serdeczny et al. Climate change impacts in Sub-Saharan from physical change s to their social repercussion. 2016*

change is integrated within the overall NAP and forms part of a country's broader development plans. The HNAP seeks to reduce risks, while advancing local and national adaptive capacity and resilience in the health system with an overall goal of minimising vulnerability to the negative impacts of climate change. The participation of the health sector will facilitate access by the health sector to national adaptation funds made available through the Least Developed Countries Fund (LDCF), Adaptation Fund (AF), Green Climate Fund (GCF), and other funds. The WHO[7] gives guiding principles for the development of the HNAP and these include some of the following:

> "• Build on existing national efforts towards health adaptation to climate change, including assessments, and development and implementation of policies and programmes at local to national levels.
> • Integrate health adaptation to climate change into national health planning strategies, processes, and monitoring systems.
> • Maximize synergies across sectors, mainly across those that determine health, such as the food, water, energy and housing sectors."

Zambia recognises the negative impact of climate change on the development goals of the country and the need to respond to this threat. The government in the Seventh National Development Plan (7NDP) acknowledges that adaptation to climate change is necessary and states that "Climate Change adaptation and mitigation will, therefore, promote social wellbeing, including better health, growth of the economy and at the same time reduce environmental risks such as shortage of water, air pollution and other effects".[8] The country thus embarked on responding to the impacts of climate change in general, and in particular addressing the impact of climate change on public health through developing the Health National Adaptation Plan (HNAP) that will reflect the health component of the National Adaptation Plan (NAP). This report documents the process undertaken in developing a road map of the HNAP. Furthermore, it demonstrates the impacts of climate variables, like temperature and rainfall and extreme events, on human health and offers adaptation options as a response to the observed and projected climate change impacts on health in Zambia.

[7] *WHO guidelines to protect health from climate change through health adaptation planning. 2014*
[8] *Seventh National Development Plan 2016-2021. Ministry of Finance and national Planning. 2016*

2 METHODOLOGY

A vulnerability and adaptation assessment exercise was carried out between November 2016 and June 2017. The assessment followed the framework suggested in the "*Integrating Climate Change into Development Planning Climate Proofing Manual for Zambia*" (Table 1).[9] The process consisted of a desk review and extensive consultations with environmental health experts and other staff within the MOH. Relevant documents on climate change in general and its impact on public health and developmental goals of the country in particular were reviewed. Furthermore, ranking of climate-sensitive health risks, and analysis of the available long-term data on climate and climate-sensitive infectious diseases in the country were done. District and provincial health data from 2000 – 2015, together with meteorological variables (temperature and rainfall), were analysed. Consultations for expert opinion were undertaken through interviews with Ministry of Health provincial and national level officers while the district level consultations were through workshops. This approach allowed for the mapping of the sector stakeholders, identification of geographical specific climate change related risks and disease burden, analysis of the policy environment, and identification of developmental goals of the country and gaps in existing efforts to cope with climate sensitive diseases in terms of policies and resources.

Two separate questionnaires were developed for MoH HQ staff and provincial health officers, and the district environmental health experts. Whereas the MOH and provincial level questionnaire captured information mainly on policy issues, the district level questionnaire captured community and district level characteristics. The questionnaires were sent out at least 14 working days before the appointment dates to give them ample time to complete the questionnaire. The questionnaire for the district captured information on diseases burden, occurrence of extreme weather events and natural disasters including displacement of populations and identification of vulnerable populations within their localities. Additionally, the officers were required to provide information on stakeholders involved with health issues in the districts as well as providing information on programmes aimed at addressing major health problems in the districts.

Participants to the workshops included Environmental Health, Public Health and/or Surveillance Officers. The workshops were held for 3 days. An effective participatory interactive approach was used during the workshops. On the first day, participants were oriented to the issues of climate change and the impact it has on livelihoods and health of the

[9] *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Integrating Climate Change into Development Planning Climate Proofing Manual for Zambia. 2014*

population. On subsequent days, the participants worked in groups and carried out the following activities:

i. Analyse district disease burden in terms of morbidity and mortality;
ii. Identify priority diseases for control in Zambia by referring to policy documents and disease incidence data;
iii. Identify which of these diseases were climate sensitive and likely to be impacted by climate change;
iv. Analyse climatic change and hazards experienced in their respective districts/provinces;
v. Link the climate hazards and how the occurrence of such hazards would interfere with the goal of controlling the disease burden;
vi. Define current vulnerabilities regarding the identified climate sensitive diseases including identification of vulnerable populations.
vii. Analyse the drivers of vulnerability for the identified vulnerable populations by interrogating characteristics such as geographic, demographic and socio-economic characteristics, and pre-existing disease burden;
viii. Analyse the current state of the programmes/intervention meant to control the health outcome of interest. A qualitative label was attached to each intervention as either being “adequate” or “inadequate”;
ix. Consider the impact of the climate risk if it occurred in their locality in terms of likelihood of excessive disease burden, size of population that would be at risk, disruption to health service delivery, and short- and long term consequences;
x. Analyse ways in which future vulnerabilities might change and ways to reduce the vulnerability;
xi. Propose adaptation measures to address the threat from identified climate risks;
xii. Identify non-health stakeholders who are responsible for the proposed adaptation measures if outside the jurisdiction of the MoH.

Table 1**: Framework for climate proofing Zambia and chapters where details are provided in this document**

STEPS	CHAPTER WHERE PRESENTED
STEP 1: PREPARATION	
1.1Define process governance	Chapter 2: Methodology
1.2 Identify relevant stakeholders	Chapter 2: Methodology
1.3 Identify information sources and collect relevant information	Chapter 2: Methodology
STEP 2: RISK ANALYSIS	
2.1: Select Exposure unit	Chapter 3
2.2 Evaluate current situation	Chapters3 & 4: Background Situation Analysis
2.3Identify climate stimuli and projections	Chapter 5: Observed Climate variability and impacts on human health
2.4 Identify potential bio-physical impacts	Chapter 6: Projected climate change and impacts on human health
2.5 identify potential socio-economic impacts	Chapters 5 & 6
2.6 Identify risk levels	Chapter 7: Vulnerability to climate change
2.7 Identify opportunities	Chapter 7: Vulnerability to climate change
STEP 3: DEVELOPMENT OF ADAPTATION OPTIONS	
3.1 Identify adaptation options	Chapter 8: Adaptation options
3.2 Develop prioritisation criteria	Chapter 8: Adaptation options
3.3 Screen, prioritise and select adaptation options	Chapter 8: Adaptation options
STEP 4: INTEGRATION INTO BUDGETING AND PLANNING	
4.1 identify possibilities for integrating adaptation options into planning and budgeting	
4.2 Investigate finance options	
4.3 Set up monitoring and evaluation system	

3 BACKGROUND INFORMATION

Zambia is a southern sub-Saharan country with a total surface area of 752,614 sq. km. It lies between latitudes 8° and 18° south and longitude 22° and 34° east of Greenwich Meridian. The land is mostly a plateau with an elevation of between 950 and 1500 metres above sea level. According to the 2010 Census,[10] the population stood at 13.1 million and grew to an estimated 15.5 million in 2015.[11] The population is considered young as 45% of the total population was aged less than 15 years in 2010.[10] There has been a continuous rural – urban migration with declining rural population; from 65% in 2000 to 58% in 2015. [10,11]

The climate is subtropical with three distinct seasons: cold-dry from May - July (temperatures: minimum 13°C; maximum 26°C); hot-dry from August-November (temperatures: minimum 26°C; maximum 38°C); and rainy season from November – April (temperatures: minimum 27°C; maximum 34°C). Historical data shows that the rainfall distribution has pronounced in-country variation with a recognised three agro-ecological zones (AEZ) (Table 2). AEZ I is drought-prone and covers southern and Western part of the country. AEZ II, is a medium rainfall areas and covers Southern, Lusaka, Central, parts of Western and Eastern provinces. AEZ III receives the highest annual rainfall, is flood-prone and covers Muchinga, Luapula, Northern, Copperbelt and North-Western provinces. The high altitude areas exhibit cooler temperatures compared to the low altitude areas (Luangwa valley and Zambezi plains).

Table 2: Climatic characteristics of the country based on agro-ecological zones

AEZ	Localities covered (Provinces)	Mean annual rainfall (mm)	Altitude (m above sea level)	Annual mean Temperature (°C)
Zone I	Valleys of Luangwa (Eastern Province), Zambezi (Southern Province) and WesternPlains (Western province)	Less than 800	300 – 900	24.2
Zone II	Central, Eastern, Lusaka,Western and Southern Provinces	800-1000	900 - 1300	21.2
Zone III	Copperbelt, Luapula,Northern and Northwestern Provinces	Above 1000	1100-2000	20.7

Source: Adapted from Kasali G.[12]

[10] *CSO, 2010 Census of Population and Housing. Population summary report. 2010*
[11] *GRZ, Central Statistics Office.Living conditions monitoring survey. 2015*
[12] *Kasali G, Climate change and health in Zambia. Capacity strengthening in the least developed countries (LDC) for adaptation to climate change (clacc). 2008*

Economically, Zambia is considered a lower middle-income country with a total gross domestic product (GDP) $21.15 billion and gross national income (GNI) per capita of $3.[13] Economic activities include mainly mining, agriculture, construction, transportation and communication. Subsistence agriculture, mostly maize production, is the mainstay activities among the rural parts of the country. The agricultural activity is mainly subsistence and heavily dependent on rainfall. Hydropower is the major source of power for the country.

Zambia has set the year 2030 to attain improved living conditions for the entire citizenry through the implementation of the "Vision 2030" policy.[14] Under this policy the country aspires to achieve "a healthy population in which the incidence of major diseases such as tuberculosis and malaria is reduced and the HIV/AIDS pandemic is brought under control with a progressively reduced incidence rate in both urban and rural areas."

The policy document further highlights the following as some of the main objectives:

- To reduce national poverty head count to less than 20 percent of the population
- To reduce income inequalities measured by a Gini coefficient of less than 40; and
- To provide secure access to safe potable water sources and improved sanitation facilities to 100 percent of the population in both urban and rural areas (GRZ, Vision 2030. A prosperous middle-income nation by 2030. 2006).[14]

However, among the threats to the attainment of the aspiration to have a healthy population is the current disease burden that mainly consists of infectious diseases. These include malaria, respiratory infections and diarrheal diseases. These diseases are likely to be affected by climate change and variability.

[13] *World Bank, 2015. Available from www.worldbank.org/en/country/Zambia*
[14] *Republic of Zambia. Vision 2030. 2006*

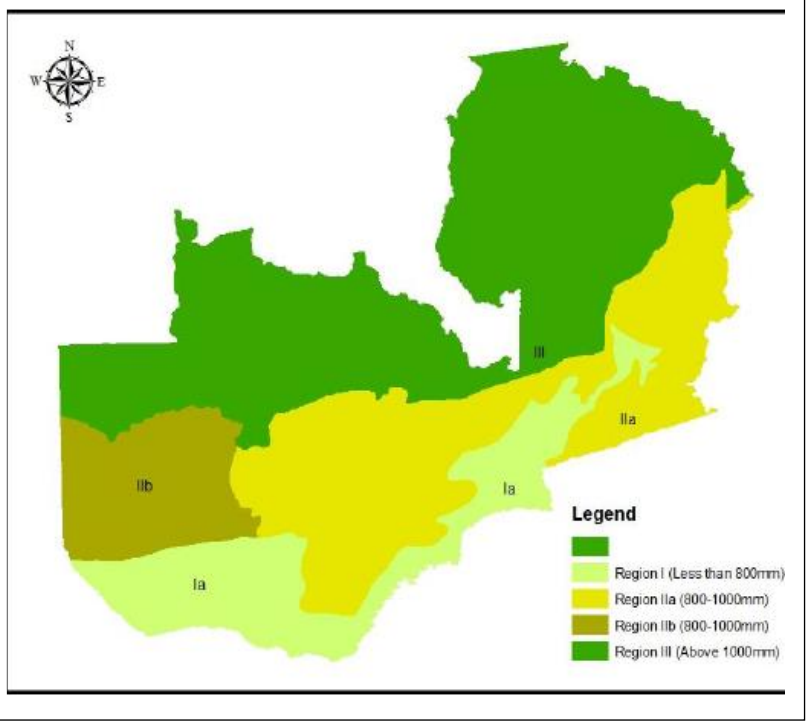
Location: Southern Africa, latitudes 8 ° and 18 ° South and longitudes 22 °and 34 ° East.

Political boundaries: land locked with eight neighbouring countries; Zimbabwe, Botswana, Namibia, Angola, Democratic Republic of Congo, Tanzania, Malawi & Mozambique

Area: 752,614 km^2

Demography: 15.5 million with 58.2% in the rural areas

Climate: subtropical climate with three seasons; cool-dry from May - July; hot-dry season from August-November; and rainy season from November – April. Country is divided in three agro-ecological regions: Zone I is low rainfall and drought prone; Zone II is medium rainfall; and Zone III high rainfall



Energy: Hydro-electricity, charcoal and wood

Economy: Mostly mining and agriculture. Majority of rural population engaged in subsistence farming

Political and administrative structure: 10 provinces with 105 districts

4 SITUATION ANALYSIS

4.1 Key Health Indicators

Morbidity and mortality is largely due to communicable diseases for all age groups. The MoH reported that between 2011 and 2013, malaria, non-pneumonia respiratory infections and diarrhoea together account for the majority of causes of visitation to health facilities and also account for about 40% of total mortality.[15] The report also noted that non-communicable diseases are emerging to be among the top ten causes of mortality. These include severe malnutrition, hypertension and heart diseases, injuries, diabetes mellitus, mental health, cancers, sickle cell anaemia and chronic respiratory diseases.

Recent data from the ZDHS indicate that the country has attained improvements in the health status of its population.[16] Key health performance indicators, and how they measured against the 2015 MDG targets, are shown in table 4 below.

Table 3: Health system performance and attainment of MDG targets

	Year				MDG target#
Performance indicator	2002	2007	2010#	2013	2015
Maternal mortality ratio	729	591	483	398	162.3
Infant mortality rate	95	70	76	45	35.7
Under-five mortality rate	168	119	138	75	63.6
Adult mortality	14.1	12.5	‡	‡	‡
HIV prevalence (%)	‡	14.3	‡	‡	<15.6
Universal access to ARV for those with advanced HIV (%)	‡	79	‡	‡	80
Life expectancy Female Male	‡	‡	‡	65 59	‡ ‡
Malaria incidence (/1000)	‡	‡	330	‡	<225
Malaria case fatality (/1000)	‡	‡	34	‡	11

Source: # MDG target by 2015. UNDP. Millennium Development Goals Progress Report: Zambia. 2013. Other data from HMIS ZDHS 2002,2007,2013-14. ‡ Data not available

[15] *MOH, Annual Health Statistical Bulletin 2013*
[16] *Zambia Demographic Health Survey 2013 – 2015.*

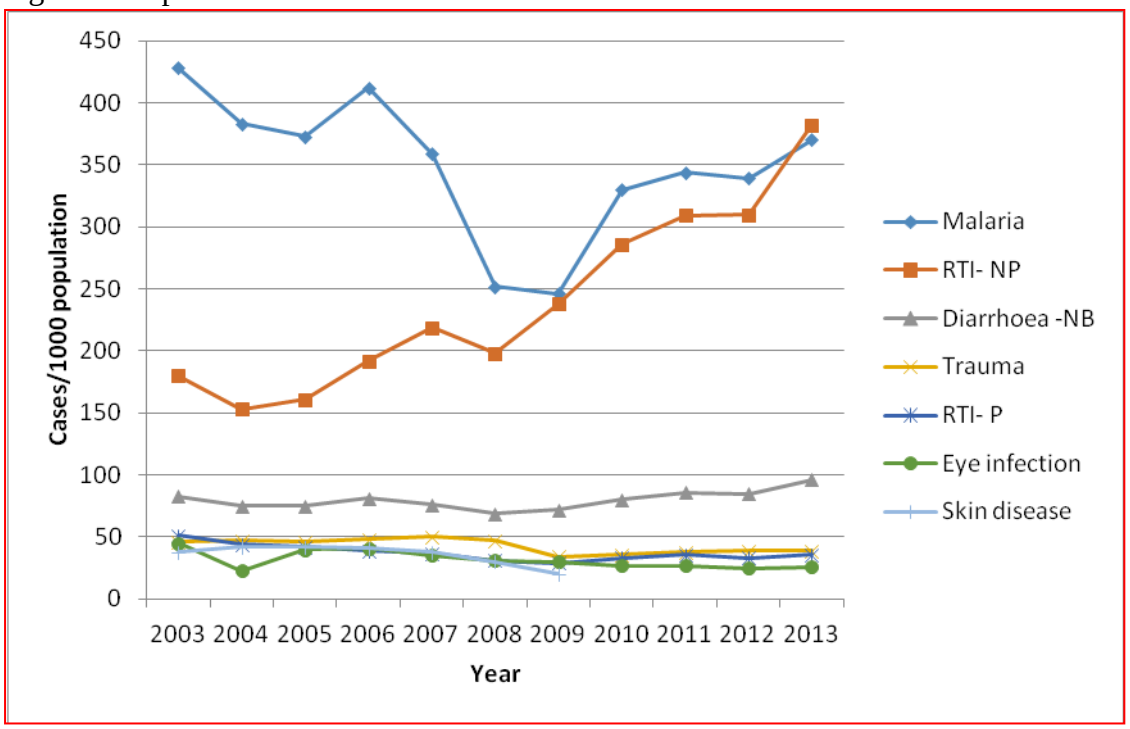
4.2 Burden of climate sensitive diseases

The following sections give a description of each of the disease's current burden; beginning with communicable diseases (CD) followed by non-communicable diseases (NCD). All data presented was obtained, unless otherwise stated, from the Annual Health Statistics Bulletins (AHSB) published by the MOH for the years 2003 – 2013 (Data for 2014 – 2016 was not available). In these bulletins, disease burden is measured as incidence rate, the number of new cases in a given population over a period of time (annually), and the case fatality rate which is the number of deaths per 1000 admissions (or other suitable denominator) for a given disease per year.

4.2.1 Infectious/communicable diseases

Figure 1 shows the trend of the top seven cause of visitation to health facilities. Of these, malaria, respiratory infections and diarrhoea are consistently among the top three in the ten years reviewed. The three diseases show a generally upward trend. The incidence of malaria had decreased tremendously from 400 cases per in 2003 to less than 250 cases per 1000 in 2009; but steadily increased up-to 2013. The incidence of RTI pneumonia more than doubled from just above 150 cases in 2004 to over 360 cases per thousand in 2013.

Figure 1: Top 7 causes of visitation to health facilities 2003 -2013

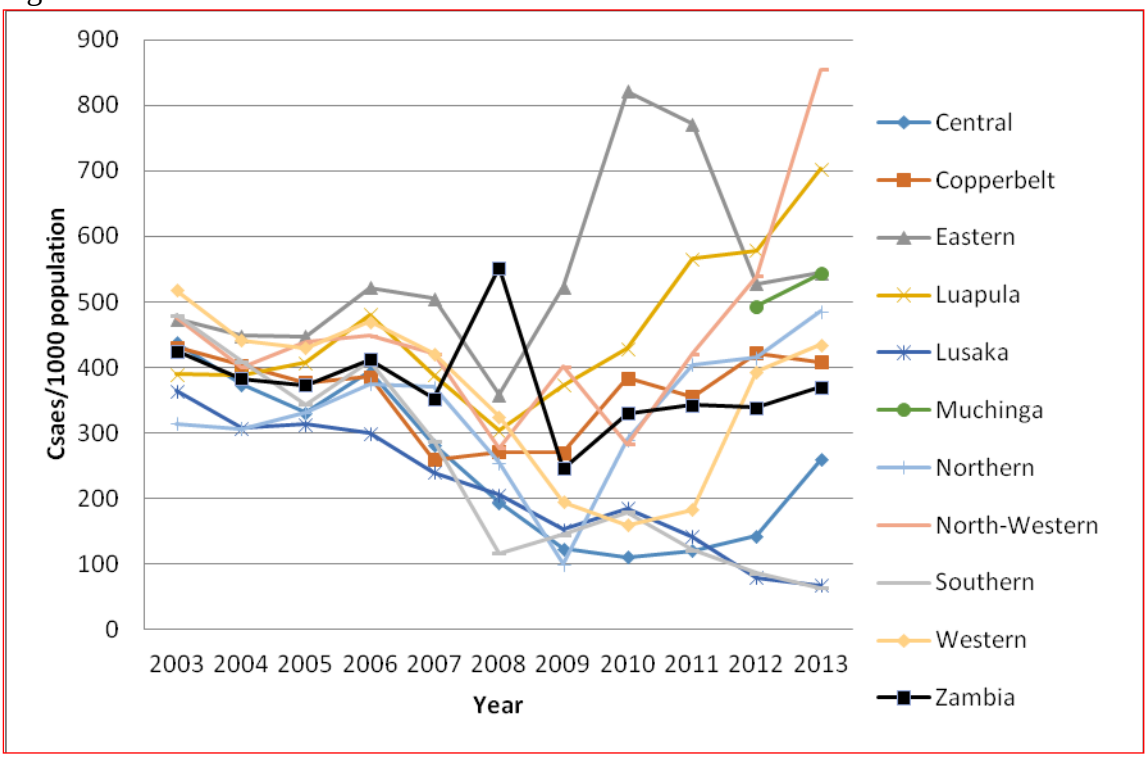


4.2.1.1 Malaria:

Malaria is endemic to Zambia and remains the leading cause of outpatient attendance. The disease caused an estimated 4.2 million confirmed cases and 2,389 deaths in 2015.[17] The whole population is considered at risk. It is a major contributor to maternal and child mortality and as such reduction of malaria transmission was set as a priority in order to attain health related MDGs by 2015 and have a "malaria free Zambia" by 2030.[18]

Malaria incidence has shown a general upward trend after a decrease in the beginning of the period under review: 412 cases per 1000 population in 2006, down to 246/1000 population in 2009 after which it steadily increased to 330/1000 population in 2010 and 370/1,000 population in 2013 (Figure 2). Eastern, Luapula and North-western provinces consistently had the three highest incidence rates while Lusaka and Southern Provinces reported the lowest showing a downward trajectory over the years.[15] The malaria case fatality among patients admitted to health facilities with a diagnosis of malaria show a downward trend, albeit a few spikes, over time; from 40/1000 deaths in 2006 to 21/1000 in 2013.

Figure 2: Malaria incidence 2003 - 2013



Although the incidence of malaria has shown a tremendous decline, there is a great in-country variation. As such three malaria epidemiological zones have been identified as shown in

[17] *WHO. Country profile. http://www.who.int/malaria/publications/country-profiles/profile_zmb_en.pdf?ua=1.*
[18] *MOH. National Malaria Strategic Plan 2011 – 2015.*

Table 5. Whereas the prevalence of the malaria parasite has been reduced to zero in some areas, the eastern and northern lying areas of the country experience high levels of parasitemia and transmission prevalence.

Table 4: Malaria epidemiological zones in Zambia

Epidemiological zone	Province(s)	Parasite prevalence
I	Lusaka and surrounding areas	<1%
II	Central, Southern, North Western, Copperbelt, Western	1 – 14%
III	Eastern, Luapula, Northern (Muchinga)	>=15%

Source: NMSP 2011-2015

The major control measures include case management, using artemisinine combination therapies (ACTs) and prevention of malaria in pregnancy, and vector control (indoor residual spraying [IRS] for dwelling structures and use of insecticide treated nets [ITNs]).[17] Between 2011 and 2013, a total of 7,789,151 ITNs were distributed. However, the malaria indicator survey showed that only 68% of households owned at least one ITN and that where ITNs were available only 49% reported sleeping under a net the night prior to the survey.[19] In the same survey IRS was reported done in only 25% of households. Coupled with the low coverage, the effect of IRS may further be reduced by the emergence of resistance to the commonly used insecticides by the major vector species; between 2010 – 2014 *An. gambiae* and *An. funestus* were reported to be resistant to at least one of the following: carbamates, pyrethroids, organophosphates and DDT.[17]

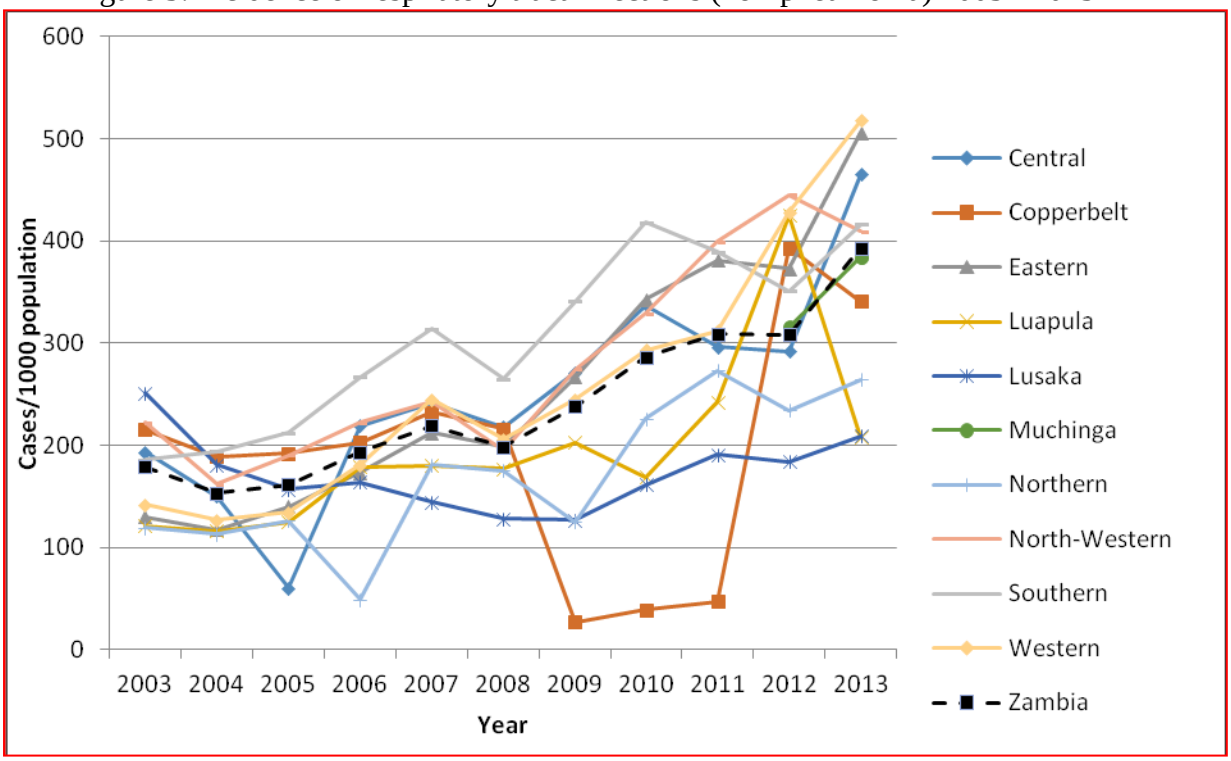
4.2.1.2 Respiratory infections:

Respiratory infections are classified as either non-pneumonia or pneumonia. Non pneumonia infections were, in many of the years under review, third or fourth commonest cause of morbidity and deaths. Except for a minor dip in 2008, the national incidence from 2006 – 2013 has shown an upward trajectory irrespective of age. The incidence rates in the years under review ranged from193/1000 in 2006 to 393/1000 in 2013. Southern, Central, North Western and Western provinces were consistently among the top four reporting high incidences in the period reviewed.

[19] *MOH. Malaria Indicator Survey, 2012.*

Mortality related to respiratory infections continued to reduce despite the increase in incidence. Case fatality was persistently higher in patients aged 5 years and above compared to younger patients.

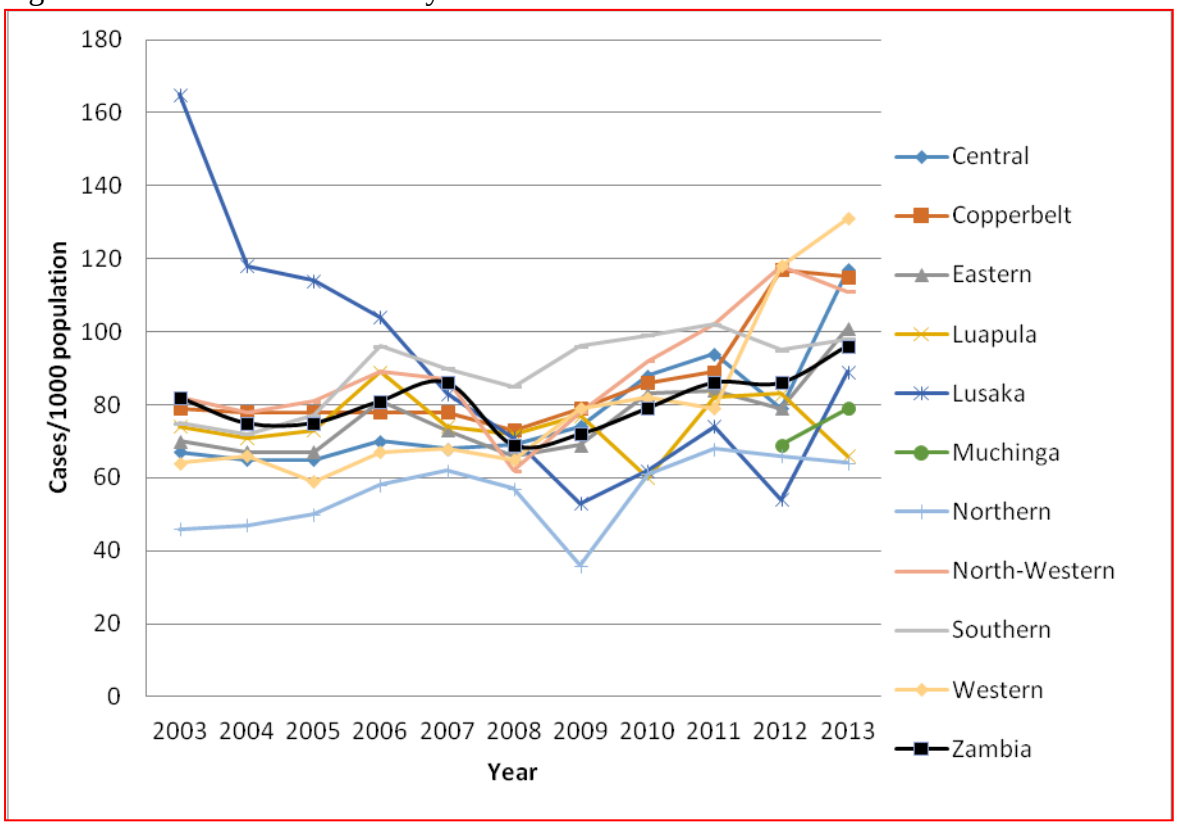
Figure 3: Incidence of respiratory tract infections (non-pneumonia) 2003 - 2013



4.2.1.3 Diarrhoea:

Diarrhoeal diseases are classified as non-bloody or bloody diarrhoea. Non-bloody diarrhoea was the third commonest cause of health facility morbidity. Nationally, the incidence of diarrhoea, for all age groups, ranged from 72- 96 cases per 1000 population in the years 2006 – 2013. When considered by age group, children aged less than 5 years were disproportionately more affected; while between 225 – 285/1000 population were reported among children aged less than 5 years only 35 – 48/1000 individuals aged 5 years and above were affected. Central, Southern, North Western and Western provinces reported, with minor reduction in some years, the highest incidences of diarrhoea diseases in the years reviewed (Figure 4). Notably, Lusaka recorded the largest reduction in the incidence of diarrhoea from close 170/1000 in 2003 to about 90/1000 in 2013.

Figure 4: Incidence of non-bloody diarrhoea 2003 -2013

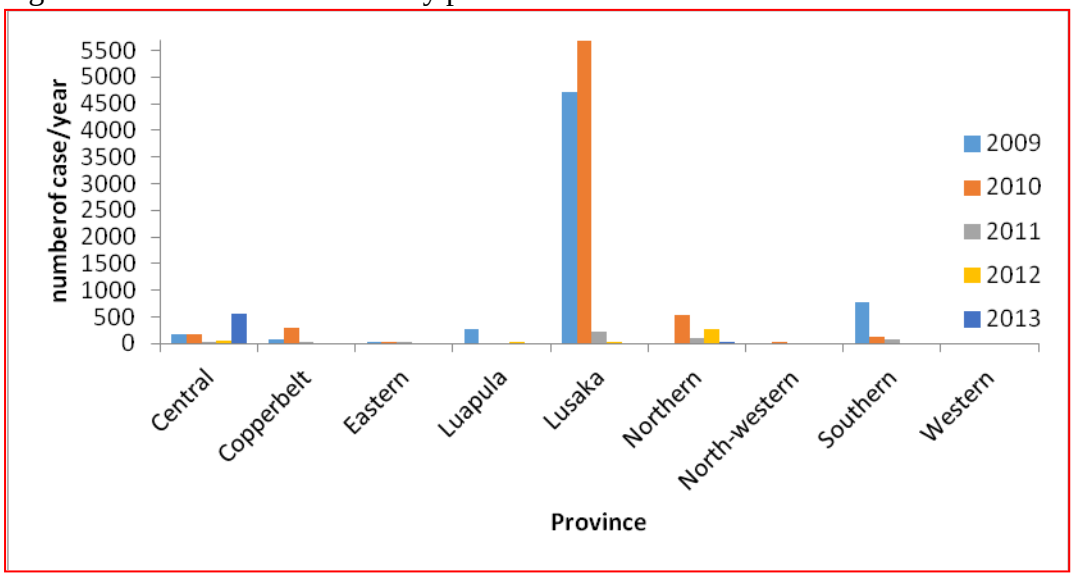


All-age case fatality, among admitted patients, due to diarrhoea showed a downward trend; over 85 deaths per 1000 in 2006-2007 down to 37/1000 population in 2013. Individuals aged 5 years and above were more affected compared to those aged less than 5 years. Case fatality pattern was similar to the distribution observed with incidence; Central, Southern and Western provinces recorded some of the highest number of deaths due to diarrhoea in most of the years included in the review.

Among notifiable diseases, cholera has become endemic in Zambia. The last two decades has had major outbreaks resulting in over 13 000 cases in 1991, 11 659 in 1992, and 11 535 in 1999 being recorded. Since then, outbreaks occur annually in different parts of the country. Lusaka, Central, Copperbelt, Luapula, and Northern provinces have recorded cases. Figure 5 shows the number of cases notified through the HMIS for the period 2009 – 2013 only (2000 – 2008 data was not available). In most of the outbreaks, the index case and the highest number of cases, occured in the densely populated areas of peri-urban Lusaka and Copperbelt or in the fishing areas of Lukanga Swamps in Central province and parts of Luapula and Northern Provinces (Mpulungu).[20]

[20] *Zambia Cholera Outbreak – UNICEF Situation Report #4. 2016*

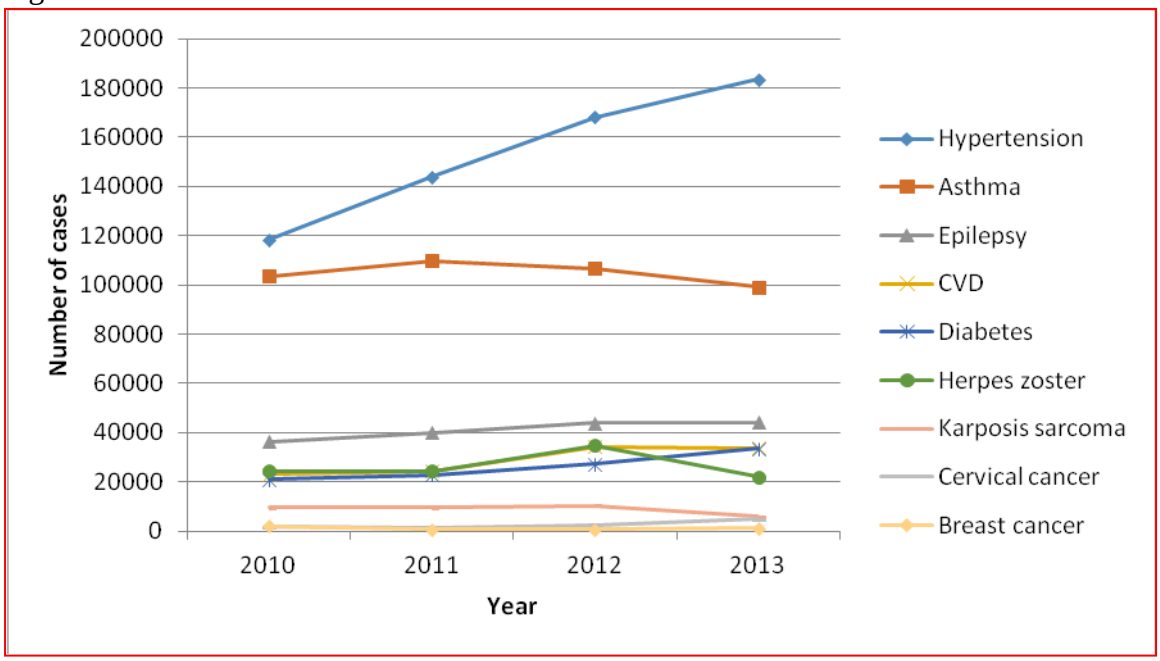
Figure 5: Annual cholera cases by province 2009 - 2013



4.3 Non communicable diseases

Over 70% of number of NCDs reported between 2010 and 2013 were due to hypertension, asthma and cardiovascular diseases. As seen in Figure 6, the incidence of hypertension shows an upward trend, while that of asthma and other diseases is almost constant between 2010 – 2013.

Figure 6: Incidence of non-communicable diseases 2010 - 2013



4.4 Determinants of health impacting on disease burden

Health status is determined by factors that may lie outside the health sector. Adverse socioeconomic conditions such as poverty and food insecurity, poor access to safe water and sanitation, illiteracy and poor housing interact in various permutations to impact public

health. The following sections describe the recent and current status of these determinants in the country.

4.4.1 Poverty

Head count poverty has been reducing although it has remained high. Nationally, extreme and moderate poverty reduced from 60.5% in 2010 to 54.4% in 2015.[11] People in the rural areas remained highly affected with minimal reductions in the five year period; 78% and 77% of rural dwellers lived in poverty in 2010 and 2015 respectively, compared to 28% and 23% of urban dwellers in 2010 and 2015 respectively.[11,21] Poverty was more pronounced in rural provinces with Western, Luapula and Northern provinces recording 80% and above of households being impoverished while 20 and 30% of households in Lusaka and Copperbelt respectively lived in poverty in 2015.[11]

4.4.2 Nutrition

Stunting, a result of chronic malnutrition, is high among children under 5 years; nationally it was 48.6% in 2015. A higher proportion (50%) of rural children were stunted compared to 46.1% in urban areas.[11] Wasting, which is associated with acute malnutrition, was 6.6% nationally but mostly affected rural children (14%) compared to urban children (6%). Stunting was highest in Northern Province (49%) followed by Muchinga Province (44%). Copperbelt, Lusaka, and Western provinces had the lowest percentages of stunted children at 36 percent each. Historically, the extent of total stunting among children has followed a fluctuating course; increased from 46% in 1992 to 53% in the 2002 but declined to 40% in by 2014.[16] The effects of chronic malnutrition include, among others, reduction in the body's ability to resist infection. This may increase the incidence and severity of climate sensitive diseases among the affected children.

4.4.3 Water, Sanitation and hygiene

Access to water and sanitation has been shown to be linked with incidence of food and waterborne diseases. Available data showed minimal improvements in number of households accessing both safe water and sanitation. Nationally, access to safe water increased from 63.0% households in 2010 to 67.7% households in 2015.[16,10] However, there was a great rural-urban disparity with 89.2% and 51.6% of urban and rural households respectively accessing this facility in 2015. The overall access to improved toilet facility was 32.7% and 39.7% of households in 2010 and 2015 respectively.[11] Similar to access to safe and improved

[21] *CSO Living Conditions Monitoring Survey. 2010*

water source, an urban-rural variability was evident with toilet facilities; whereas access increased from 66.0% in 2010 to 72.8% in 2015 for urban households, coverage for rural households remained at 14% during the same period. The same survey reported that the proportion of households with dedicated places for hand-washing was only 57% and 28% in urban and rural areas respectively. By province, only Lusaka and Copperbelt reported proportions over 60%, while ranging from 23% to 36% for the rest of the provinces.

4.4.4 Housing

The quality of housing remains a challenge for most Zambians. According to a recent survey, most housing units are made of earth and sand.[11] The Traditional housing was the most common type of dwellings; over 52% percent of households in rural areas lived in traditional huts. Further, about 30% lived in improved traditional huts and 14.2% lived in detached houses. The report further states that overcrowding, measured as the number of rooms used for sleeping in a household, was found in over 30% of households.[16] Housing units made of traditional materials such as mud, sand and poles are easily damaged in flood situations and offer little ventilation of the indoors leading to increased respiratory infections.

4.4.5 Energy sources

Source of energy for cooking and lighting has been shown to correlate with adverse health effects especially on the respiratory system. There are two main types of energy; clean energy such as electricity and dirty fuels such as charcoal, fossils fuels, animal dung and firewood. According to the LCMS 2015 survey, 71% of the rural population used torches while 68% of the urban population use electricity for lighting purposes. Nationally, charcoal and firewood constituted the main source of energy for cooking; 84% of households in rural areas used firewood while 59% of those in urban areas used charcoal. This indicates that a large proportion of the population, regardless of their geographical location, rely on hazardous sources of cooking energy that has the potential to compromise their health, especially of the respiratory system.

4.4.6 Education and literacy

National estimates indicate that school attendance rates among primary school-age population (7 – 13 years) was 83% while that for secondary school-age population (14 – 18 years) was 76% in 2015.[11]In general, literacy level for those 15 years and above was estimated to be 63%. However, only 56% females compared to 70% males were found to be literate.[22] The

[22] *CIA World factbook www:cia.gov/publications/the-world-factbook/fields/2103. 2011*

ZDHS 13-14 also revealed that a lower proportion of women in rural areas, compared to their urban counterparts, was literate; 54% and 83% respectively.[16] The same survey found that education and wealth were related; 93% of women in the highest wealth quintile and 38% among women from lowest wealth quintile were literate.

4.4.7 Population structure and growth

The estimated population in 2015 was 15.5 million with 58.2% being in urban areas. Over 50% of the urban dwellers lived in slum areas with inadequate access to social services.[11] Half of the population is aged less than 15 years; and of these 17% is under-five years. Despite a reduction in the total fertility rate (TFR) from 5.9 in 2001/02 to 5.3 in 2013/14[16] the population is projected increase to 17.9 million in 2020 and 23.6 million in 2030.[23] The current growth rate is high and seen to be an impediment to national developmental goals. As such, one of the social developmental objectives of the "Vision 2030" is to slow down population growth rate to less than 1.0 by 2030.[14]

4.4.8 Health systems and access to health services

4.4.8.1 Overview

Health care services are provided under a five-tier system; health post, health centre (urban & rural), 1st level, 2nd level and tertiary level hospitals. The bulk of health care services are provided through public health facilities. Of the total 1958 health facilities in 2012, 1592 (81%) were owned and managed by the government, 119 (6%) by faith based organisations and the rest by for-profit organisation and corporations such as mining companies. Those owned by faith based organisations fall under an umbrella organisation (CHAZ) which receives government funding but managed by the owner organisation.[24]

The public health providers fall under the Ministries of Health, Defence and Home Affairs. The MoH provides policy direction. To achieve universal coverage, the government abolished the fee-for-service requirement for the rural areas and later for urban areas for primary health care. Provision of health care in public facilities faces a number of challenges as acknowledged in the National Health Strategy Plan 2011-2015 which states "the health system continues to face major challenges, which include high disease burden, inadequate medical staff, weak logistics management in the supply of drugs and medical supplies, inadequate and inequitable distribution of health infrastructure, equipment and transport, and challenges related to health information systems, inadequate financing, and identified weaknesses in the health systems governance."[25]

[23] *CSO, 2013. Population and demographic projection 2011 - 2035*
[24] *MOH, Annual Health Statistics Bulletin. 2012*
[25] *MOH, National Health Strategic Plan 2011 - 2015*

4.4.8.2 Health workforce

The public health sector has had challenges with inadequate numbers of trained personnel and distribution. The rural areas often lack health workers in sufficient numbers. For example, in 2010 there were 159 health care workers for every 100,000 and 70 per 100,000 population in urban and rural areas respectively, [26] and of the available doctors, nurses and environmental health technicians in 2013, 59%, 42% and 22% respectively were stationed in just two provinces (Lusaka or Copperbelt provinces).[15] Additionally, access to health facilities for rural populations has been a challenge; 99% and 50% of urban and rural populations respectively are within 5km of a health facility.[25]

In addressing the health workforce shortages and access to health care, the government in its 2011-2015 health strategic plan set to achieve, by 2015, the following targets (i) Increase the proportion of rural households living within 5km of the nearest health facility from 54% in 2004 to 70%, (ii) reduce the population/doctor ratio from the current 17,589 to 10,000, and (ii) reduce the population/nurse ratio from the current 1,864 to 700.[25]

By end of 2013, the above targets were not met. In the recent past the government increased the recruitment of health staff. And to further the goal of availing basic health services at community level, the government rolled out the national community health worker programme (NCHWP) to train and assimilate CHW in into the existing health system.[26] Despite these efforts, the health workforce gap remains wide; both in numbers and inequity in the distribution of the health workers between the rural and urban.

The government embarked on improving access to PHC by increasing the number of health facilities through construction of health facilities and hospitals at district and higher levels. This has been coupled with upgrading of existing health facilities; construction of additional structures at existing facilities as well provision of medical equipment to enable them deliver quality health care. To get basic health care as close to the family as possible, the government embarked on constructing 650 health posts throughout the country to reduce the distance to the nearest health facility. In addition to the already existing Zambia Flying Doctor Service, land and water mobile and emergency health care services were commenced in 2011 so as to increase access to quality health care close to the community in the hard-to-reach areas.

4.4.8.3 Health information

To improve the health information system management, Zambia implemented the DHIS2 in 2009. This has enhanced health data capturing and made it accessible to all levels of the health system in real-time; from the district, through provinces to the national level. With training,

[26] *MOH. 2010. National Community Health Workers Strategy*

users can log-on to the system via internet. Decision makers can thus use the data to make evidence-based decisions regarding provision of health care services.

4.4.8.4 Environmental Health

To reduce the disease burden, the government, has shifted focus from curative to preventive medicine. To achieve this goal, managing for a healthier environment will increasingly play an important role. Globally, 23% of deaths in disability adjusted life years (DALYs) in 2012 were attributable to modifiable environmental risks. These risks included, but not limited to, ambient and indoor air pollution, availability of water and sanitation, housing and land use, diet related to environmental degradation, and water and soil pollution with either biological agents or chemicals.[27]

Although data for Zambia is lacking, WHO estimates that as much as 42%, 57% and 35% of malaria, diarrhoea and respiratory tract infections respectively in the sub-Sahara region and other LMIC are attributable to unhealthy environments.[27] Locally, MoH has the mandate to manage the environment at community level through district health offices. However, current performance indicators remain low; the proportion of water samples taken decreased from 14.5% in 2011 to 13.4% in 2013, 59% and 70% of public health premises were inspected in 2011 and 2013 respectively, the proportion of households having ITNs decreased from 68% in 2011 to 39.5% in 2013 while the proportion of structures sprayed against mosquitoes marginally increased from 7% in 2011 to 11.8% in 2013.[15]

4.4.8.5 Medical products, vaccines, technology

Immunizations for the common childhood illnesses serve as an important method of enhancing child survival. The expanded programme on immunisation (EPI) is the main child health intervention in Zambia. The ZDHS 2013-14 reported that 64% and 76% of children aged 12-23 in rural and urban areas respectively had received the basic vaccinations (BCG, DPT-HepB-Hib, Polio, measles).[16] Furthermore, mother's education and wealth were positively related to coverage; 52%, 76% and 81% of children of mothers without any education, secondary education and higher than secondary education received the full basic vaccination package. A similar trend was observed with wealth; higher proportion of children from higher wealth quintiles compared to those from lower quintiles received their full vaccination package.

4.4.8.6 Health financing

Health financing is an important component of the health system as it impacts on the production, delivery, and consumption of health services as reflected in the NHSP. The Government of Zambia has shown commitment to health as demonstrated through a growing

[27] *WHO,2016. Preventing disease through healthy environment. A global assessment of the burden of disease from environmental risks.*

health budget which has been increasing even though the share of the health sector budget compared to national budget has been decreasing over the past five years. The proportion of the MoH budget to the national budget was 9.9% in 2014, 9.6% in 2015 and 8.3% in 2016. The increase in the financial resources to the health sector is largely due to additional donor support. However, most of the donor funds and assistance is directed at specific programmes instead of targeting the entire health sector, which would in the long term impact on mortality and morbidity reduction. In addition, significant amounts of funding provided by NGOs and some CPs are often not accounted for in the budget.

The results of the national health accounts show that Total Health Expenditure (THE) per capita increased to US$73.6 in 2012 from US$51.8 in 2010. The THE per capita has been increasing since 2010. The government contribution within the THE reduced from 50.1% in 2010 to 39.9% in 2011 and 38.1% in 2012 while the donor contribution increased from 39.3% in 2010 to 46.6% in 2011 to 48.0 % in 2012. As a percentage of GDP, THE reduced from 4.2% in 2010 to 3.9% in 2011 and 4.0% in 2012. Government health expenditure (GHE) as a percentage of GDP reduced from 2.1% in 2010 to 1.5% in 2012. Both GHE and THE increased at lower rates than the GDP growth rate (MoH, 2016)

4.4.9 Policy environment

The government has demonstrated a strong commitment to addressing the challenges emanating from climate change and variability. A number of policy pronouncements and enactments have been done. Examples include the current constitution which has addressed the requirement for adaptation to climate change;[28] the Disaster Management Act addressed disaster prepared and provides a framework for response to disasters;[29] National Climate Change Response Strategy (NCCRS);[30] the National Adaptation Programme of Action[31] and the Environmental Management Act.[32] The NCCRS states that "In the medium term, the goal of the strategy is to ensure that climate change is mainstreamed in the most economically important and vulnerable sectors of the economy by 2015. This goal is aligned specifically to the period of the SNDP, however in the longer term the goal is to ensure climate change is mainstreamed in all sectors by 2030".

More recently, the National Policy on Climate Change (NPCC) has been formulated.[33] The NPCC provides a framework for coordinating climate change programmes in order to ensure climate resilient and low carbon development pathways for sustainable development towards

[28] *Zambian Constitution (Amendment Act). No. 2 of 2016. Part XIX, Section 257(G)*
[29] *Disaster Management Act No. 13 2010*
[30] *Government Republic of Zambia. MTENR. National Climate Change Response Strategy 2010*
[31] *Government Republic of Zambia.. MTENR. Formulation of the national Adaptation Programme of Action. 2007*
[32] *Environmental Management Act 2011*
[33] *Government of Republic of Zambia. National Policy on Climate Change, 2016*

the attainment of Zambia's Vision 2030. Furthermore, it requires that climate change concerns are streamlined in all sectoral policies and plans from community to the national level.

In terms of impact of climate change on human health, the NAPA, NCCRS and the NPCC recognise that the health sector is vulnerable to climate change and the NCCRS further states as one of its objective "to protect people and health from climate change". Adaptation efforts prioritised in the NCCRS and the NAPA includes enhancing capacity for adaptation planning, improved data management and use of information for decision making, increased stakeholder participation and community involvement through dissemination of information on climate change. Additionally, the government has proposed the rehabilitation and renovation of health infrastructure.

5 OBSERVED CLIMATE VARIABILITY AND HEALTH IMPACTS

This section is in two parts. The first presents observed climate variability in the country from 1970 – 2000. The second part describes the health impact resulting from this climate variability. This report draws from works accomplished in other studies and information articulated in the NAPA.[31] Additionally, health impacts associated with climate events are derived mostly from vulnerability assessments conducted by the DMMU spanning the years 2000 – 2014 and feedback given at the provincial and districts consultative workshops.

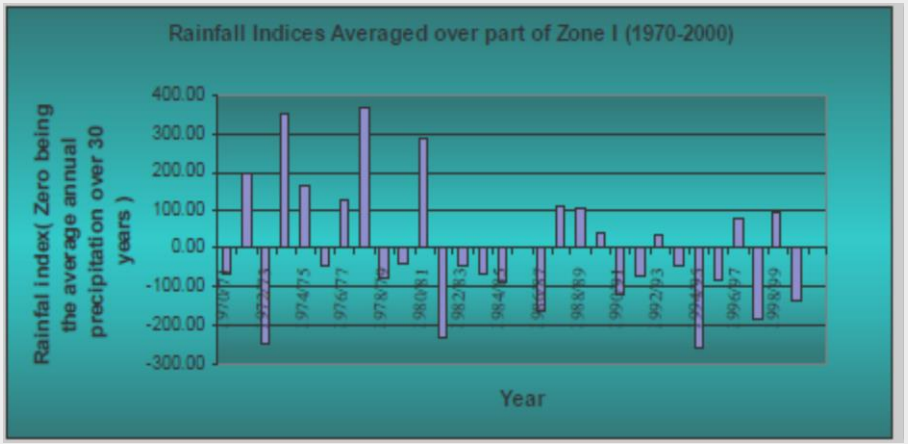
5.1 Observed climate variability

Available meteorological data suggest that Zambia has been undergoing climate variability for some time; increasing temperatures over several decades accompanied with changes in precipitation patterns. The variability in precipitation has manifested in extremes of either drought (and or extended dry spells), floods or a mixture occurring in the same season in different parts of the country being documented.

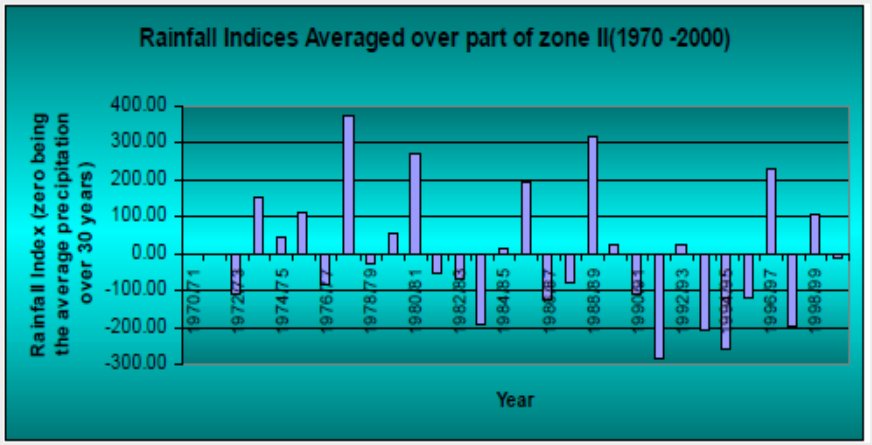
5.1.1 Variability in precipitation patterns

Using the period 1970 -2000 as the baseline, precipitations patterns show a general decline in rainfall in the three agro-ecological regions of the country.[31] As seen in Figure 7, panel A shows that from 1970 – 1980, Zone I experienced above average rainfall which reduced over the subsequent 20 years. There were more seasons with below average rainfall compared to above average. A similar pattern, though to a lesser extent, is seen with zone II (panel B). Agro-ecological zone III (panel C), on the other hand, has more seasons with above average rainfall. Trends show that zone III is the highest rainfall area while zone I is the lowest and that all zones show a tendency to reducing total rainfall (panel D). McSweeney[34] also documented that the country has had a reduction in mean annual rainfall of 1.9mm monthly for each decade since 1960. The largest reduction has been documented for the months of December, January and February.

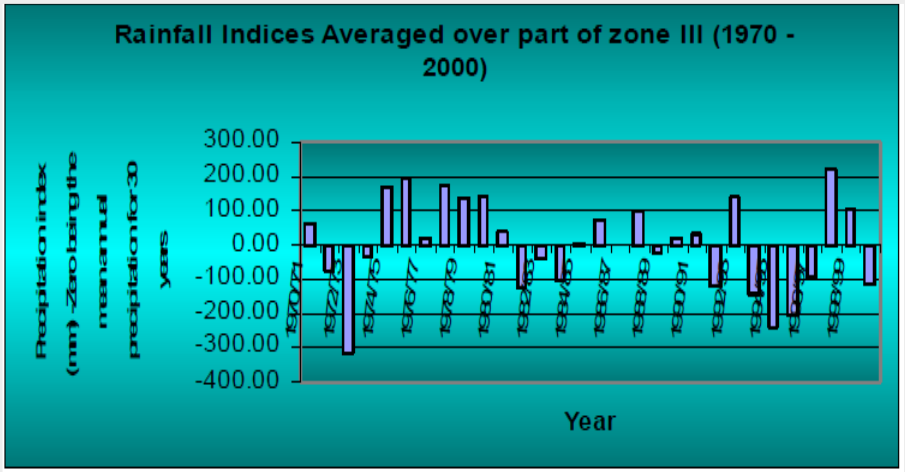
Figure 7: 30 year average rainfall indices for agro-ecological zones



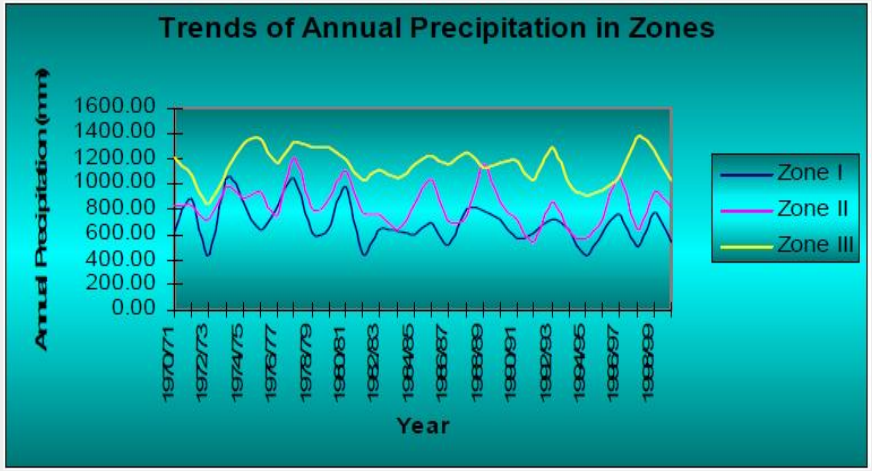
A: Zone I: 17 seasons with below average rainfall in 30 years



B: Zone II: 13 seasons with below average rainfall in 30 years



C: Zone III: 13 season with below average rainfall



D: Trends for all 3 zones: Shows a trend toward reduction

Source: MTENR,2007:

5.1.2 Temperature variability

The mean annual temperature has increased by 1.3ºC from 1960 to 2003. This is associated with an increase in the frequency of hot days per year; by 43 days between 1960 and 2003 while there has been a decrease in the number of cold days.[34]

5.1.3 Community perception of climate variability

Findings from a community survey on climate change vulnerability assessment in four sites in Zambia echoed scientific projections as presented in the NAPA. This survey was carried out in four sites representing the agro-ecological regions.[35] Major climate risks identified by the communities were droughts and shorter rainfall periods, floods were identified as most important in Luapula and Western province communities, and extreme heat was considered as one of the three main hazards by almost all communities. Furthermore, impacts from these risks were identified as follows:

- Social-economic: crop damage or decreased crop yields, reduced fish stocks for fishing communities, reduced charcoal business, decreased human capacity to work in case of extreme heat, decreased income earnings and hunger due to environmental degradation, scarcity and reduced quality of water
- Health: increase in both human (malaria, dysentery and cholera) and livestock diseases were noted.

5.2 Influence of observed climatic conditions on selected diseases

The influence of climatic conditions on selected diseases was investigated. Malaria and diarrhea (non-bloody) were chosen for this assessment as they are shown to be most sensitive to temperature and rainfall changes. The districts included in this analysis were selected from the three agro-ecological zones of Zambia as follows.

District	AER	Rainfall(mm)
Sesheke	I	<800
Mongu	II a	800-1000
Serenje	II b	800-1000
Samfya	III	>1000

[34] *McSweeney C. UNDP Climate Change Country Profile, Zambia 2010*
[35] *Béatrice Riché-IUCN. Forest Conservation Programme. 2007*

The weather parameters considered were monthly temperature and rainfall averaged for the period 2009 to 2016. The climatic and disease burden data was obtained from the Zambia Meteorological Department and MoH respectively. The relationship between disease and climate variables is graphically presented to show the influence of climatic conditions on disease burdens (Figure 8; panel A: malaria; panel B; non-bloody diarrhoea). It should be noted that the effects of factors such as the malaria and diarrhoeal control measures currently in place were not adjusted for in the analysis.

Region I (Sesheke district)

The cases of Malaria increased during the rainy season (December- April) and reduced during the dry cool to hot weather conditions(May to October).The cases of diarrhea (non blood) increased from the period August to November when the temperatures are high and humidity is low.

Region IIa (Mongu district)

The distribution of the disease burden in this area resembles the one in Sesheke. The cases of malaria increased during the rainy season and reduced in the dry cool to hot periods (May to October). Diarrhea (non-blood) cases increased from the period August to November when the temperatures are high and humidity is low.

Region II b (Serenje district)

The cases of malaria increased with the increased rainfall amounts and reduced with the reduction in rainfall. Low temperature months (May to July) recorded lower cases of malaria. Throughout the year the cases of diarrhea were moderate but increased in the dry and hotter month of August to October.

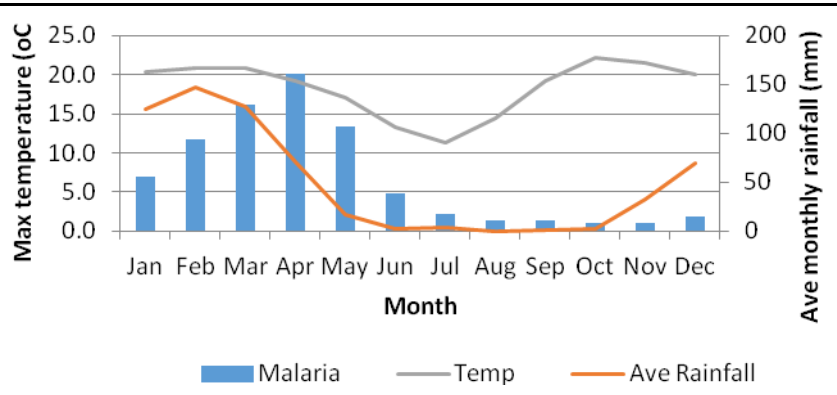
Region III (Samfya district)

The highest number of malaria cases was recorded in this region. Both malaria and diarrhea (non blood) cases showed a relationship with rainfall and temperature; increasing with increasing rainfall and temperature**.**

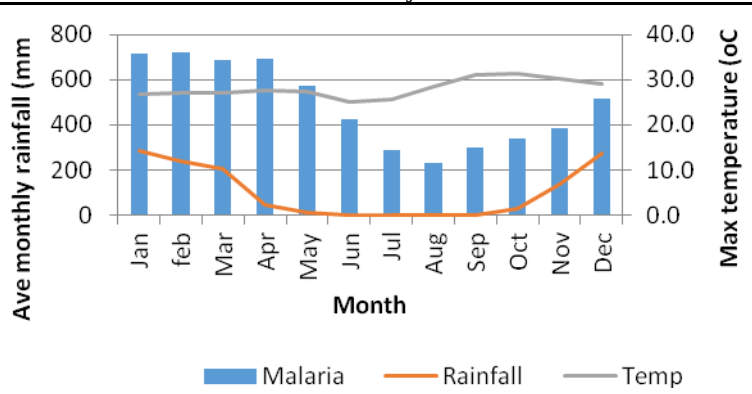
Figure 8: Influence of climatic variables on average monthly malaria and diarrhoea cases for selected districts: averaged for 2009 - 2016

PANEL A: Average monthly rainfall and average maximum temperature versus monthly malaria cases

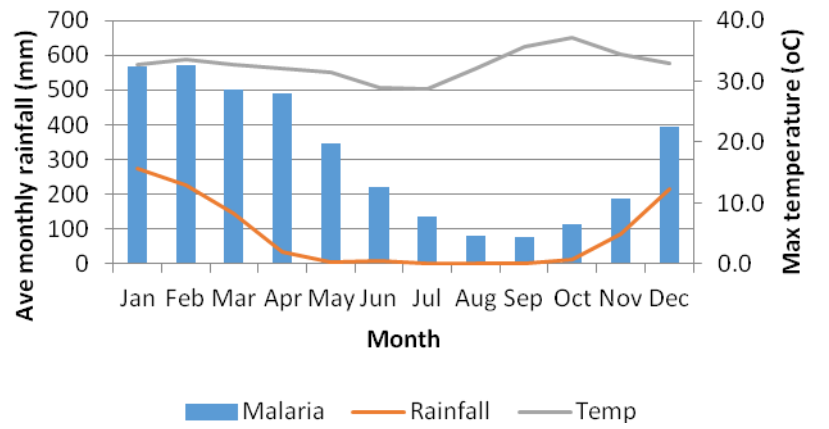
Sesheke



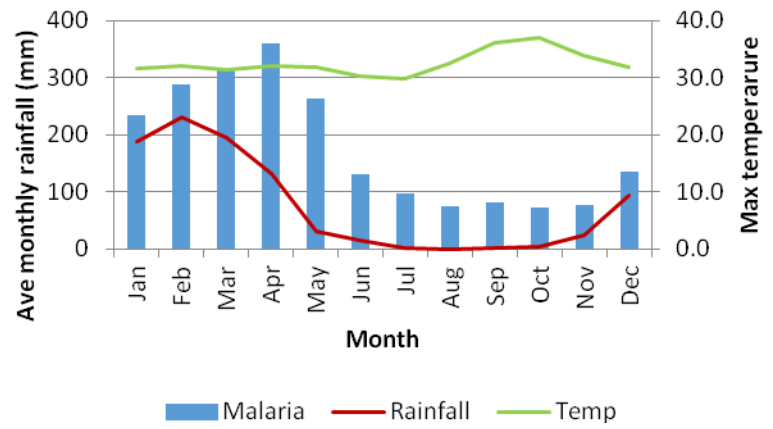
Samfya



Serenje

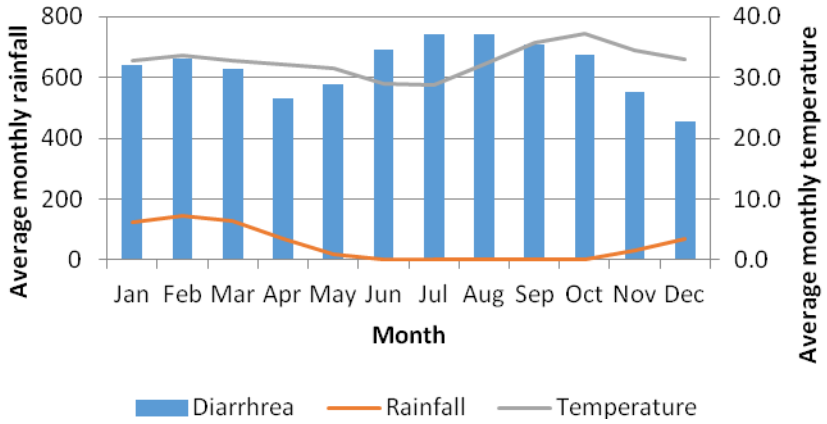


Mongu

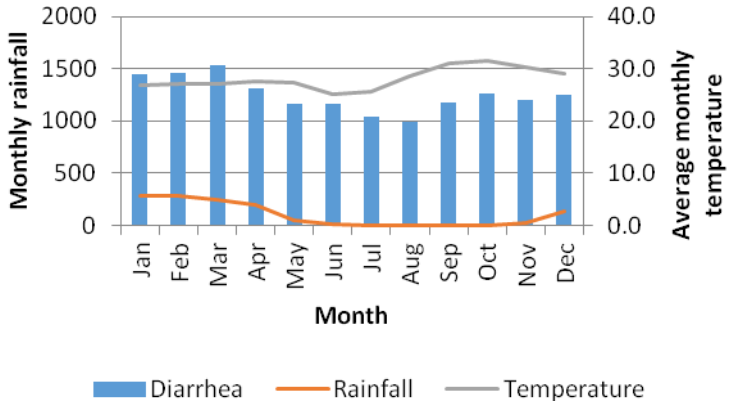


PANEL B: Average monthly monthly rainfall and maximum temperature versus monthly diarrhoea cases

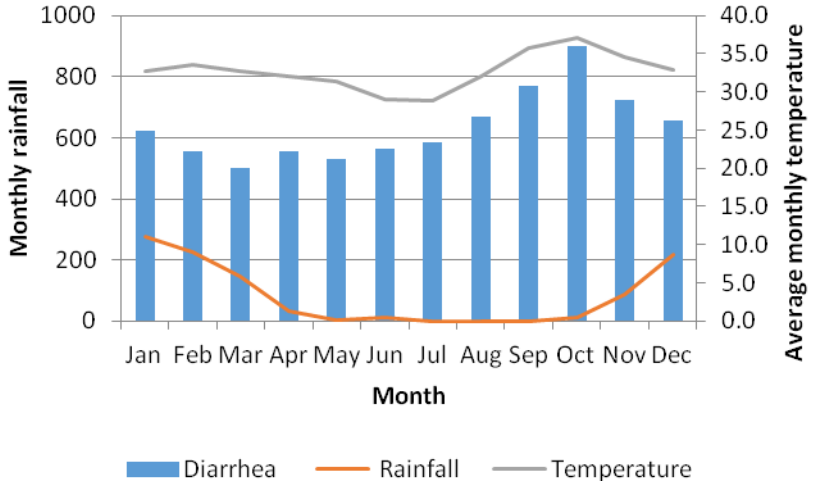
Sesheke



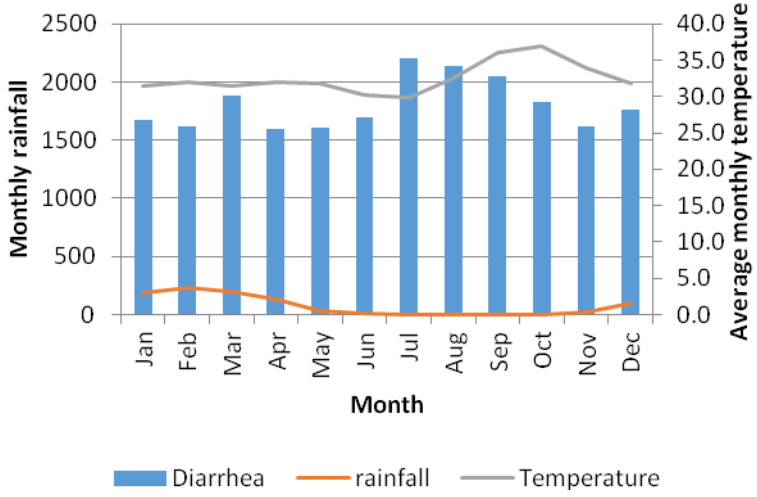
Samfya



Serenje



Mongu



The above findings suggest that temperature and rainfall play a role in the occurrence of malaria and diarrhoea. The intra-seasonal variation indicates that malaria cases are more pronounced in areas with high rainfall, high humidity and temperature. Other factors to investigate were hydrological factors that sustain the stream flow throughout the year and availability of water in the swamps to provide the much needed humidity to sustain the malaria parasite and its reproduction cycle. Dry and hot temperatures tend to reduce malaria cases. Low temperatures inhibit the reproduction cycle of the malaria parasite. In all situations higher cases of diarrhea (non bloody) have been recorded during the dry and hot season suggesting that scarcity of water and high temperatures favour the spread the disease.

Climate Change is expected to reduce rainfall over much of southern half of Zambia and increase temperatures in the same area (NAPA 2007). This will tend to reduce humidity levels and affect the reproduction cycle of malaria parasite and thuslower transmission intensity. In contrast, non-blood diarrhoea cases may show a remarkable increase in Sesheke and Mongu. Samfya will continue experiencing high cases of malaria due to suitable climatic conditions to support the reproduction cycle of malaria parasite and the vector. The increase in temperatures in Serenje district coupled with moderate high rainfall will continue recording the high cases of malaria during the rainy season.

5.3 Health impacts from observed climate risks

According to the Fifth Assessment Report (AR5) of the Intergovernmental Parties to Climate Change (AR5 working group on Human Health: Impacts, Adaptation and Co-Benefits) there is very-high-confidence evidence that "human population are sensitive to shifts in weather patterns and other aspects of climate change".[36] The report further suggests that the effects could be direct ranging from heat waves, floods, droughts or mediated through mechanisms including crop failures, shifting patterns of disease vectors or displacement of populations. The following sections describe the observed deleterious health effects resulting from the recurrent extreme and persistent weather events in the country.

5.3.1 Floods or excessive rainfall:

Floods could occur as short recurrent events or major and prolonged periods. Both ways have the potential to negatively affect populations; destruction of food crops and subsequent malnutrition, increased breeding sites for disease vectors, outbreak of waterborne diseases through contamination of aquifers, injuries, disruption of communication routes and access to

[36] *Smith et.al Human health: impacts, adaptation and co-benefits. 2014*

health facilities and displacement of populations with associated disease outbreaks and emotional/mental distress.

A review of the vulnerability assessments carried out by the DMMU[37,38,3940,41,42,43,44,45,46,47,48] shows that climate change and variability has manifested with recurrent floods and droughts throughout Zambia (Table 5). The health impacts associated with this phenomenon are summarised in Table 6. Localised floods occurred in 2005/06, 2007/08, 2008/09, 2013/14 and 2015/16 rain seasons. Most affected areas were the Eastern, Northern, Luapula, North-western, Copperbelt and Central provinces. The impacts of these floods have been very extensive in some years. For example, in 2013/14 season as many as 3,209,995 people were affected when there were a combination of dry spells and floods occurring in different parts of the country. The assessment also revealed an increase in the incidence of malaria, diarrhoea, malnutrition (stunting and under-weight), respiratory tract-, eye- and skin infections among the affected communities. Non-health impacts included destruction of infrastructure, population displacements and food insecurity. infrastructure, especially of houses, and subsequent population displacement has been associated with physical injuries and mental distress.

Lack of access to safe water and sanitation has also been documented in some years. For instance, in the communities that were affected by floods in 2008/2009 season, 50% of the households used unprotected water sources and 67% used traditional sanitary facilities which became unusable. The water sources in such situations could not be guaranteed to be safe for human use. Additionally, a substantial number of households needed assistance with food.

In 2016, 42 districts experienced delayed onset of rains or prolonged dry spells. There was an associated increase in diarrhoea cases in all the districts while malaria cases were noticeably increased in Luano district. Additional observations in these districts included a high level of food insecurity and stunting in children aged less than 5 years coupled with poor access to safe water and sanitation.

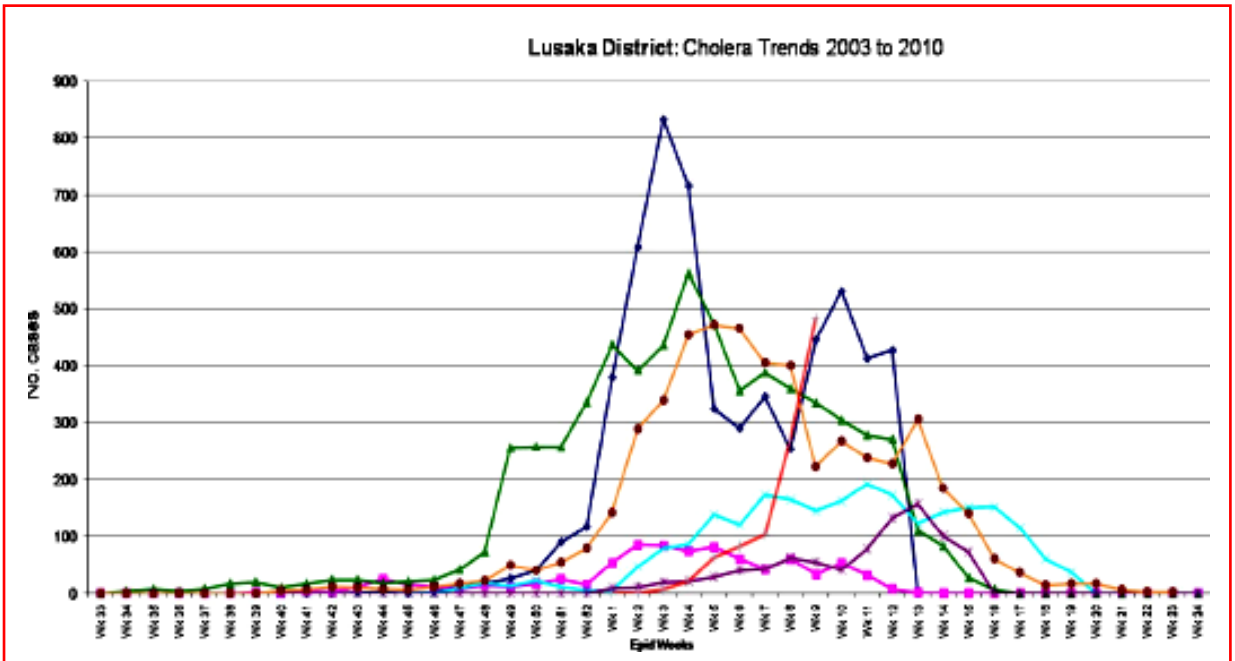
Although not captured in the ZVAC reports, cholera has been reported for almost all the years reviewed. Cholera epidemics are closely related to onset of rain as well as amount. Between

[37] *Zambia Vulnerability Assessment Committee. 2003*
[38] *Zambia Vulnerability Assessment Committee. 2005*
[39] *Zambia Vulnerability Assessment Committee. 2006*
[40] *Zambia Vulnerability Assessment Committee. 2007*
[41] *Zambia Vulnerability Assessment Committee.2008*
[42] *Zambia Vulnerability Assessment Committee. 2009*
[43] *Zambia Vulnerability Assessment Committee. 2010*
[44] *Zambia Vulnerability Assessment Committee. 2012*
[45] *Zambia Vulnerability Assessment Committee. 2013*
[46] *Zambia Vulnerability Assessment Committee. 2014*
[47] *Zambia Vulnerability Assessment Committee. 2015*
[48] *Zambia Vulnerability Assessment Committee. 2016*

2003 and 2010 the majority cholera outbreaks started in October/November and ended in May/June of the following year and a strong association between amounts of rainfall in Lusaka and the number of cases of cholera has been demonstrated.[49] For example, in the flood years of 2005/2006 and 2009/2010 due to excessive rains in Lusaka, 7615 and 6804 cases were recorded. Lusaka, as in most other outbreaks of cholera, accounted for over two third of cases. Figure 8 shows the historical trends of cholera outbreaks in Lusaka; there is an association with wetness as the outbreaks tend to begin in the epidemiological week 46-48 corresponding to November when the rains get established. The peak numbers are seen between epidemiological weeks 2 – 8 (February – March) when the rainfall tends to be highest.

More recently, between 5th February and May 2016, a total of 1179 cases, of which 953 occurred in Lusaka alone, were reported. The highest number of the cases was in March – April reducing as the rains subsided. Like the many others outbreaks before, the majority of cases were from the densely populated areas of Lusaka (Kanyama & Bauleni).[50] These areas have limited access to safe drinking water (use shallow wells) and most households use unimproved pit-latrines leading to faecal contamination of water and food.

Figure 9: Cholera trends by epidemiological week in Lusaka District



Source: WHO. Global Taskforce on Cholera Control. Cholera Country profile; Zambia. 2011

[49] *WHO Global Task on Cholera Control, Cholera Country Profile; Zambia. 2011*
[50] *UNICEF. Zambia Cholera Outbreak Report, SitRep#5. May 2016*

5.3.2 Droughts

Prolonged or recurrent droughts lead to scarcity of water which in turn results in environmental degradation, erosion and failure of food crops. Thus, droughts have the capacity to threaten food security and exacerbate the levels of malnutrition especially among the rural and marginalised populations.

Zambia has experienced repeated droughts which have had serious impact on the health of the affected population. Drought events were documented in 2004/2005, 2007/08, 2013/14, 2014/15 and 2015/16 and 2016 (delayed rainfall on-set). Affected provinces included the Southern province, parts of Eastern, Copperbelt, Western, Central and North-western provinces. In 2004/05 the entire Southern- and parts of Eastern, Central and North-western provinces experienced droughts which left as many as 1,232,666 people food insecure. The 2014/15 and 2015/ 2016 seasons dry spells were extensive and impacted large populations; 48 districts (5,140,795 people) and 41 districts (3,874,878 people) respectively. Prevalent disease among the affected populations included diarrhoea, respiratory tract infections, malaria and malnutrition. The cumulative effect of the dry spells and delayed rainfall led to reduced production of food and resultant high proportion of stunting and wasting among children.

It is evident from the foregoing that both droughts and floods have become almost a yearly occurrence and for most of the affected populations there is no time for recovery from the impact of previous events. This results in increased vulnerability to subsequent climatic risks and worsening of the living conditions. An environment with low access to safe water and improved sanitation facilities serves to magnify the impact of climate risks such as drought or floods. Food insecurity, contributes to poor nutrition and subsequent low immunity especially among the children, women and the elderly. Although not well documented in the reviewed documents, mental stress was shown to occur in such population especially after loss of property, social dislocation and displacement from the usual area of residence.

5.3.3 Temperature:

Increased temperature and likely heat waves may increase mortality due to its direct effects on the cardiorespiratory systems. Other effects may arise indirectly; increased spatial spread of diseases like malaria and infectious respiratory disease as high temperatures favour the proliferation of pathogens, malnutrition, land degradation and crop failure, respiratory problems resulting from polluted ambient air especially in areas with high population densities.

There is a paucity of information regarding the impact of temperature on the local population. The community survey report,[35] however, revealed that the community acknowledged the increase in ambient temperature and described the following impacts on their lives: heat

exhaustion and reduced human capacity to work, reduced quality of safe water for drinking and more human and animal diseases and crop damage.

Table 5: Summary of extreme climate events and impact on health and livelihoods

Event	Year/ season	Extent (Amount of rainfall)	Location	Prevalent diseases	Other conditions	Water and sanitation
			FLOODING			
Localized floods	2005/06	Normal to above normal	E, Co, NW	Diarrhoea, fever, cough	Destruction of infrastructure.	56% used borehole, 46% other source (river, unprotected/protected well, springs
Floods	2006/07	Normal to above normal	W,NW,E,CE,N	-	-	-
Floods/dry spells)	2007/08	Normal	Ce, Co, E, L, NW, S,W Districts-34	-	Food insecurity	-
Floods	2008/09	Normal	Co, E, L, N & NW. Districts-20; HH-2800; Popn-499,227	Malaria, diarrhoea, cough, skin infection.	280 households displaced	50% unprotected waters sources, 67% traditional sanitary facilities
Floods/dry spells	2013/14	Normal/ above normal	E, N, W Distrcits-33; HH 4,252; Popn-3,209,955	Malaria, Diarrhoea, URI, TB, eye infections	Displacement 1,128 HH, 6,768 people due to floods and seasonal storms	66.5 (L); 26% (no SF); 4% (FT); 4 (SP/BL)
			DROUGHT			

Event	Year/ season	Extent (Amount of rainfall)	Location	Prevalent diseases	Other conditions	Water and sanitation
Drought (entire Southern Province)	2004/05	Normal to below normal	E, Co, NW Districts-20	Diarrhoea, cough, fever	1,232 666 people Food insecure, malnutrition	Unprotected sources of water supply
Prolonged dry spells (southern half of Zambia)	2014/15	Normal to above normal	E,Ce,Co, L, M ,NW, S,W. (Districts-48: Popn-5,140,795)	Malaria , ARI, diarrhea:	Malnutrition: Poor housing structures	56.2.% HH (39.8 borehole, PW, PW):accessed IWS; 43.8% (26.8% UPW; 15.6% river, 1.4 other UIWS)
Prolonged dry spell Feb-2015	2015/16	Normal to below normal	Ce, E, L, S. (Districts-41 Popn-3,874,878)	Malaria, diarrhoea, RTI	Malnutrition: 40% stunting under-5 children	Source of water affected by prolonged dry spells, treated water supply (64.5% HH access IWS: 89.5 urban vs. 46.5 rural): 54% HH with no toilets 74.2 rural vs27 urban
Delayed rainfall, Prolonged dry spell	2016	Normal to below normal	42 districts: Ce, E, L, S, W	Malaria (Luano, Chirundu) and diarrhoea and RTI (all districts)	Food insecurity, High proportion of stunting for under-5 children (49.5 %), underweight 14.7%; high levels of wasting	Water and sanitation: 41% borehole, 8% piped water supply, 6% protected well. Higher proportion of population used open defecation method

Source: Zambia Vulnerability Assessment reports 2003 - 2016; DMMU
Ce: Central; Co: Copperbelt; E: Eastern; Lus: Lusaka; Lup: Luapula M: Muchinga; N: Northern; NW: North-western; S: Southern; W:Western
HH: Households; IWS:Improved water sources; RTI: Respiratory tract infection; TB: Tuberculosis; URI: Upper respiratory infection

6 PROJECTED CLIMATE CHANGE AND HEALTH IMPACTS

6.1 Projected climate change for Zambia

6.1.1 Temperature

Using the Hadley Centre Coupled Model version3 (HADCM3) global climate models (GCM), projections indicate an average increase of 2^{o}C in temperature over the baseline between 2010 and 2070 in all the agro-ecological regions.[31] Similarly, McSweeney[34] projects that temperatures over the country will increase by 1.2^{o}C and 3.4^{o}C by the 2060s and the frequency of hot days are expected to increase and that the southern and western parts of the country, AER I and II, are estimated to warm more rapidly than the rest of the country.

6.1.2 Rainfall

Future precipitation projections for the three agro-ecological zones[31], in comparison to the baseline, indicate the following:

i. Zones I and II are more likely to experience climate variability. Overall, there will be reduced precipitation for most of the 60- year period considered. Precipitation will range from a high 560mm in 2059 to the lowest 105mm in 2043. On average, the region will be drier.
ii. Zone III, on the hand, is projected to experience higher monthly rainfall totals compared to the baseline period. It is less likely to experience climate variability.

6.2 Health impacts from projected climate variability

This section discusses the potential future health impacts of climate variability on the major diseases that were identified to be climate sensitive; diarrhea, malaria and respiratory tract infections. Evidence from literature is presented to support the pathways in which the climate risk affects the distribution of the health outcome of interest. Estimating the future impact of climate change on health outcomes is limited by two main issues: the wide uncertainty associated with climate change itself and the fact that climate change affects risk factors in an indirect way.[51] For Zambia, estimating the health impacts is further constrained by lack of data and institutional capacities to model these impacts. Therefore, the WHO global and regional estimates of climate change related causes of deaths in the 2030s and 2050s [52] and evidence from other studies are presented here to support what maybe experienced in the local context.

[51] *Christensen et al. Regional climate Projections 2007.*
[52] *WHO. Quantitative Risk Assessment of the Effects of Clime Change on selected causes of Death in the 2030s and 2015s. 2014*

6.2.1 Diarrhoea:

Rainfall and temperature are associated with transmission of diarrhoeal diseases. Scarcity of water and increased ambient temperatures promotes the occurrence of diarrhoea through favouring of proliferation of organisms and the transmission by hand especially where there hygienic practices are poor. Checkley et al[53] found that for a 5ºC increase above mean ambient temperature, hospital admissions to a diarrheoa unit in Lima, Peru increased by 200%. In another study in the sub-region, reduced precipitation conditions coupled with increasing ambient temperatures were found to increase the incidence of diarrhoea by 20% over the annual incidence.[54] In the Pacific Islands, Singh et al.[55] demonstrated that reduced availability of water led to increased rates of infant diarrhoea while temperature increase was positively associated with occurrence of diarrhoea in general. An assessment for the eastern Sub-Saharan region where Zambia was included, projected that the climate change-attributable cases of diarrhoea will range from 10,997 in 2030 to 6950 in 2050 under base socioeconomic assumptions; and from 11,113 in 2030 to 5403 in 2050 assuming high socioeconomic growth.[52] However, these projections only considered the effect of temperature and omitted the contribution of water scarcity. This region is projected to experience increasing drought situations and temperatures. Zambia has had multiple droughts in the past years while ambient temperatures are expected to rise, therefore, even without reliable estimates, the country will be expected to experience increased number of diarrhoea cases that will be attributable to climate change.

6.2.2 Cholera

The proliferation of *Vibrio cholera*e, the causative organism of cholera, exhibits a positive relationship with ambient and water temperature.[56] Speelmon[57] showed that elevated El Niño related ambient temperature favoured isolation of vibrio cholera in sewerage water and subsequent cholera outbreaks. A Tanzanian study projected that for a 1ºC increase in temperature due to climate change in 2030 would increase the number of cholera cases ranging from 55,000 to 107,000 while deaths will range from 2705 to 5997.[58] In Zambia, Fernandez et al.[59] showed that during cholera outbreaks between 2003 and 2006, a 1ºC rise in temperature followed by a 50mm rise in rainfall above the normal six weeks and three weeks prior to a cholera outbreak accounted for an increase in cholera cases; 5.2% and 2.4% for temperature and rainfall respectively. Sasaki et al.[60] found a strong association between cholera outbreaks

[53] *Checkley et al. Effects of El Niño and ambient temperature on hospital admissions for diarrhoeal diseases in Peruvian children 2000*
[54] *Alexander et al. Climate change is likely to worsen public health threat of diarrheal disease in Botswana. 2013*
[55] *Singh et al. Climate change is likely to worsen public health threat of diarrheal disease in Botswana. 2001*
[56] *Venkateswaran K et al. Ecology of Virtion cholerae non-O1 and salmonella spp and role of zooplankton in their seasonal distribution in Fukuyama coastal waters, Japan 1989*
[57] *Speelmon et al. Cholera Incidence and El Niño–Related Higher Ambient Temperature 2000*
[58] *Trærup Sara L. The Costs of Climate Change: A Study of Cholera in Tanzania 2011*
[59] *Fernandez et al. Influence of temperature and rainfall on the evolution of cholera epidemics in Lusaka, Zambia, 2003-2006: analysis of a time series. 2008*
[60] *Sasaki et al. Impact of Drainage Networks on Cholera Outbreaks in Lusaka, Zambia 2009*

of 2003/04 and 2005/06 in Lusaka with increased precipitation and also insufficient drainage networks in areas affected by the outbreaks.

6.2.3 Under-nutrition

Several studies have demonstrated a correlation of climate change and future food insecurity.[61,62,63] The reduction in food production will indirectly affect the availability of food resulting in under-nutrition. Globally, on base case assumption and without climate change, there will be an estimated 142 million moderately stunted and 58 million severely stunted children in 2030 while in 2050 this will be at 102 million and 31 million for moderate and severely stunted children respectively.[52] Climate change is projected to add a further 7.5million and 10.1million cases of moderate and severely stunted children in 2030 and 2050 respectively. Assuming low or high growth trajectories affect the estimated numbers. For instance, the former, assuming no climate change, increases the estimated numbers to 162 million and 74 million moderately and severely stunted children in 2030 and 216 million and 113 million children with moderately and severely stunted in 2050. Climate change in this scenario is estimated to increase the number by 8.5 and 3.3 million cases of moderate and severely stunted children in 2030 and 2050 respectively.

Children in sub-Saharan Africa countries, together with their Asian counterparts, are considered the most at risk. In these regions, climate change is projected to cause the following by 2050: moderate stunting to increase by 1-29% while severe stunting to increase by 23 – 62% after correcting for the effect of economic growth.[64] Furthermore, WHO projected estimates for the eastern sub-Saharan region show that 31,906 and 28,200 deaths due to under-nutrition among children aged less than five years in 2030 and 2050 respectively will be linked to climate change under low economic growth assumptions.[52] However, under high economic growth assumptions, the estimated number of deaths reduces to 25,492 and 9861 in 2030 and 2050 respectively.[52] In Zambia it is expected that Southern, some parts of Western and Lusaka provinces will experience drier climate resulting in increased food insecurity and malnutrition.[65] The drier conditions, coupled with projected higher temperatures, will interact to increase incidence of diarrhoea. Diarrhoea episodes in turn worsen the burden of undernutrition especially among children. For instance Checkley et al. showed that 25% of stunting at 24 months could be attributed to having had five or more episodes of diarrhoea.[66]

[61] *Adams et al. A reassessment of the economic effects of global climate change on U.S. agriculture.1994*
[62] *Parry et al. Climate change and world food security: a new assessment. Global Environmental Change.1999*
[63] *Parry et al. Effects of climate change on global food production under SRES emissions and socio-economic scenarios 2004*
[64] *Lloyd et al. Climate Change, Crop Yields, and Undernutrition: Development of a Model to Quantify the Impact of Climate Scenarios on Child Undernutrition.2011*
[65] *Ministry of Lands, Natural Resources and Environmental Protection. Second national communication to the UNFCCC. 2014*
[66] *Checkley et al. Multi-country analysis of the effects of diarrhoea on childhood stunting .2008*

6.2.4 Malaria:

Malaria is regarded as the most climate sensitive disease; there is an association between number of cases of the disease and climate variables including rainfall, temperature and humidity. Several studies have demonstrated that increasing temperatures favour both the vector and parasite proliferation leading to potential to epidemics.[67,68] Anopheles gambiae, the principal vector of malaria causing parasites, optimally transmits the parasite between 28 – 30^{o}C . Together with temperature, rainfall impacts on vector population and therefore plays an important role in malaria transmission.[69,70] The fourth assessment of IPCC noted, with high confidence, that the transmission of malaria in Southern and East Africa highlands will be impacted greatly by climate change and variability.[71] The areas, in Zambia, that are projected to have more rainfall and increasing temperatures and are currently experiencing some of the highest transmission rates (Luapula, Northern, Muchinga and Northwestern provinces) thus will be expected to have a pronounced burden of malaria in the future.[65]

[67] *Alonso et al. Epidemic malaria and warmer temperatures in recent decades in an east African highland. 2010*
[68] *Torp Biomed 2012*
[69] *Gillioli G and Mariani L. Sensitivity of* Anopheles gambiae *population dynamics to meteo-hydrological variability: a mechanistic approach. 2011*
[70] *Chaves LF. Indian Ocean Dipole and rainfall drive a Moran effect in East Africa malaria transmission. 2012*
[71] *IPCC 2007: Working Group II to the 4th Assessment Report*

7 VULNERABILITY TO CLIMATE CHANGE

The IPCC defines vulnerability as "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed (the exposure), its *sensitivity*, and its *adaptive capacity*".[72] Many factors contribute to and compound the impacts of current climate variability and a country's ability to cope with climate change. These include poverty, illiteracy and lack of skills, weak institutions, limited infrastructure, lack of technology and information, low levels of primary education and access to health care, poor access to resources, low management capabilities and characteristics of the physical environment.

Based on available incidence and mortality statistics and feedback from the workshop participants, malaria, diarrhoea diseases, respiratory infections and severe malnutrition were identified as climate sensitive as well as being the major causes of the current diseases burden in the country. The majority of childhood deaths are caused by malaria, acute respiratory infections, and diarrhoea. Hypertension and other cardiovascular conditions, and asthma were isolated as NCDs that are increasingly gaining public health importance.

Key health services identified, during district consultations and by experts, as most vulnerable to climate change and variability include the following:

- Vector control
- Child health and nutrition
- Waterborne diseases control: Diarrhoea, dysentery and cholera
- Access to curative services
- Epidemics
- Water and sanitation

The following sections discuss in detail some of the factors identified as critical in determining the current and future vulnerabilities in the health sector.

7.1 Geographical

Agro-ecological zones I and II which together account for a large proportion of Zambia have become drier and projected to experience drier and hotter climate. These regions also account for a large segment of the country's total population. The droughts witnessed in the recent past have often resulted in crop failure and environmental degradation leading to food insecurity and deprivation of the communities of alternative means of survival and therefore drastically

[72] *Intergovernmental Panel on Climate Change (IPCC) Working Group 2, 2001*. Third Assessment Report, Annex B: Glossary of Terms

reducing their coping mechanisms.[35] Under-nutrition, especially among children age less than 5 years, women and the elderly, is thus a clear and present health hazard. This is more so with the AER I, and to a lesser extent AER II, which is projected to experience more severe and prolonged dry spells. In AER III, which is projected to experience more rain and flood risks, waterborne diseases, malaria and food insecurity will be expected to affect large populations. At least 54% of the Zambian population is in the rural areas.[10] This population also is largely poor and depends on rain-fed farming and natural resources for their livelihood. Additionally, flood situations coupled with poor road infrastructure for the rural marginalised communities places a challenge to accessibility to health services. This has the potential to increase the impact of climate change on disease burden. For the urbanised and highly populated areas, floods often lead to increased malaria cases, and diarrhoeal diseases such as cholera. Urban populations are also affected by droughts resulting in scarcity of water, and acting synergistically with poor sanitation and hygiene, lead to increased transmission of diarrhoeal diseases.

7.2 Current disease burden

The existing high burden of diseases like malaria, diarrhoea, respiratory tract infections and under-nutrition exert a severe strain on existing health services. These diseases are also climate sensitive and thus have the potential to increase the demand on curative services and severely impact the ability of the health care system to cope.

7.2.1 Malaria

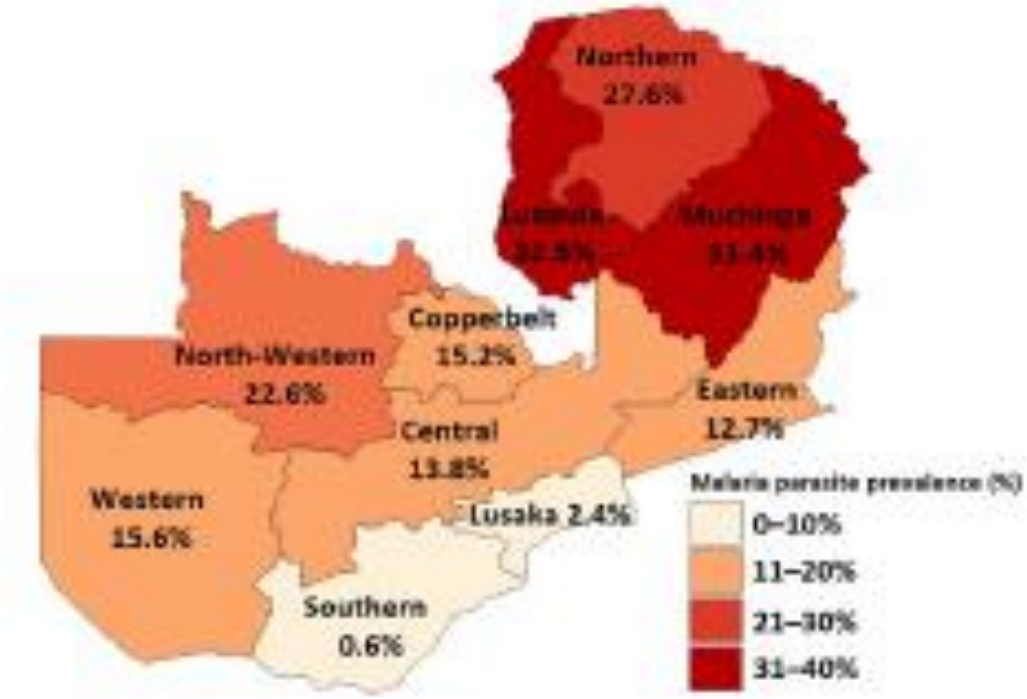
Malaria is the leading health risk; 16.2 million people are at risk and more than more than 4.1 million confirmed cases were recorded in 2015. It is also the leading cause of mortality especially among children aged less than 5 years.[17] Despite the many intervention measures embarked upon, Zambia failed to meet the MDG target of reducing malaria cases. Instead data showed that by 2016 the incidence rate had steadily increased; a recent survey showed that prevalence of parasitemia among children aged less than 5 years had increased from 10.2 in 2008 to 19.4% in 2015 (MIS 2015).[73] This is regardless of the increasing coverage of ITNs and IRS. This observation maybe explained by the low utilisation of the former by the end-users and below optimum coverage of IRS. Workshop participants revealed that IRS application is often impeded by late delivery of commodities to the districts and in some areas suffers non-acceptance by the communities. Most districts indicated that IRS chemicals are often delivered late into the transmission period. This, they argued, reduces the effectiveness of the intervention. Furthermore, the effectiveness of IRS as an intervention may be compromised owing to the emerging vector resistance to DDT, pyrethroids, carbamates and organophosphates documented in the country (WHO Country profile).[17] Additionally, parasite

[73] *MOH. Malaria Indicator Survey 2015*

resistance to the first-line drug artemether-lumefantrine has been reported. All these factors will play together to weaken the responses currently in place.

The burden of malaria is geographically distributed at present (Figure 9). The MIS 2015 report suggests that the northern parts of the country remain highly vulnerable to increased malaria transmission as optimal climatic conditions arise and that parasitemia rates are very high. This entails that responses should be tailored to the prevailing prevalence rates. For instance, in Lusaka the main thrust in dealing with malaria should be case detection and treatment while in the high transmission areas of Muchinga, Luapula, Northern and North-western Provinces case management, IRS and ITN distribution will be needed.

Figure 10: Geographical distribution of malaria disease burden



Source: MIS 2015

7.2.2 Diarrhoeal diseases

Diarrhoeal diseases continue to affect all age groups and are a major cause of visitation to health facilities. However, the mortality rate is higher among under-5 children compared to older patients. The majority of diarrhoeal cases are associated with faecal-oral organisms. Therefore, the key contributing factors to the high incidence of diarrhoea are low access to safe water and inadequate improved sanitation. Currently, there is low access to both of these in the rural areas and among the poor urban populations. Also documented is low hand washing practices and treatment of water for drinking. Some districts mentioned particularly the practice of humans and animals sharing of water points which exposes human water sources to animal excreta. With the current urbanisation rates being experienced in the country, more highly

populated peri-urban settlements will be established leaving many urban poor without access to improved water sources and inadequate sanitation.

Diarrhoea and under-nutrition in children interact in a vicious cycle; under-nourished children are at increased risk of getting and dying from infectious diseases including diarrhoea.[74] On the other hand, infectious diarrhoea, especially if repeated, leads to malnutrition unrelated to food availability. In light of climate change, both drought and flooding episodes, while promoting transmission of food- and waterborne diseases, have led to reduced food availability and thus increased under-nutrition. This is in keeping with findings from vulnerability assessments that have shown a higher incidence of under-nutrition and diarrhoeal diseases in the affected populations.

7.2.3 Respiratory diseases

Precipitation and temperature variability are known to affect the respiratory tract by affecting the intensity of risk factors. Extreme weather events, either as floods or droughts, indirectly could result in increased food insecurity and subsequently under-nutrition. The result of under-nutrition, reduced immunity, places children at increased risk of infectious respiratory diseases and death.[75] In a population where a substantial proportion of children aged less than 5 years is already under-nourished, occurrence of droughts and floods will only exacerbate the food insecurity and malnutrition. The other climate risk, temperature variability, is also known to directly increase the incidence of respiratory infections – the extremely low temperatures are a risk factor for viral infections of the respiratory tract while increased ambient temperatures are associated with increased pollution of the ambient leading to respiratory disorders such as asthma.

A large proportion of urban dwellers living in slums and poorly constructed houses will be affected by climate indirectly. Poor housing, often accompanied with overcrowding and inadequate ventilation, seen in most peri-urban settlements is a known risk factor for pneumonia in under-5 children.[76] During large population displacement, as may occur at times of floods, the resulting overcrowding may increase the risk of respiratory infection such as pneumonia.

Other prevalent unfavourable living conditions that increase vulnerability to respiratory diseases include source of energy, lack of water and poor hand hygiene. Biomass fuel is the primary source of cooking energy for the majority of the Zambian population; more so for the rural compared to the urban households. Estimates show that 4.3 million deaths in 2012 were related to households using coal, wood and biomass stoves; most of these deaths being due to

[74] *Black et al. Maternal and child undernutrition: global and regional exposures and health consequences. 2008*
[75] *Rodríguez L., Cervantes E., Ortiz R. Malnutrition and Gastrointestinal and Respiratory Infections in Children: A Public Health Problem 2011*
[76] *Jackson et al. Risk factors for severe acute lower respiratory infections in children: a systematic review and meta-analysis.2013*

lower respiratory tract infections.[77] Ezeh et.al in Nigeria, found that 43% and 36% of post-natal and child deaths could be attributable to use of biomass fuels.[78] Furthermore, the study demonstrated that children aged less than 5 years in rural and poor households were at increased risk of dying due to use of unclean fuels. Pollution of the ambient air from use of biomass fuels is related to increase in particulate matter of aerodynamic size of $PM_{2.5}$ and PM_{10}. With the projected rise in atmospheric temperatures due to climate change, the effect of these pollutants on the respiratory tract will increase substantially.

Aiello et al, revealed that poor hand hygiene is a risk factor pneumonia. Inadequate hand hygiene practices maybe worsened when the availability of water is compromised during drought conditions.[79] Currently, a substantial proportion of the population in Zambia lacks access to water and there is evidence of below optimum hand hygiene practices among the population. The projected scarcity of water will act synergistically with sub-optimal hygiene practices to increase to the burden of pneumonia.

7.2.4 Under-nutrition

Under-nutrition is high among children and related to the levels of poverty. This condition increases susceptibility to infections and also increases the probability of dying among the affected children compared to those without this condition.

7.2.5 HIV and AIDS

HIV/AIDS has the potential to indirectly contribute to the impact of climate change on communities. Evidence shows that HIV affects agriculture productivity, mainly for the rural poor households that depend on rain-fed agriculture for livelihood. The infected persons are likely to spend fewer hours on agriculture activities due to illness. Adult deaths among the infected have been shown to correlate with reduced agricultural productivity. Additionally, a higher proportion of household income is directed towards meeting the cost health care leaving families less able to cope.[80] These factors interplay to increase the vulnerability of communities and make them less able to adapt to climate change.

7.3 Socioeconomic status

There is a high level of inequality in income distribution in the country. Although the poor are mostly in the rural areas, a substantial proportion of urban populations are equally poor. Most of the rural poor depend on agriculture and other land resources for their livelihood. In the event of drought, these populations easily suffer food insecurity from reduced agriculture yields. Populations living along river banks or in low lying areas have also suffered crop destruction in times of floods. Additionally, women, because they constitute the majority of

[77] *WHO 2014. www.who.int/phe/health_topics/outdoorair/databases/FINAL _HAP_AAP_BoD_24March2014.pdf?=ua=1*
[78] *Ezeh et al. . The effect of solid fuel use on childhood mortality in Nigeria: evidence from the 2013 cross-sectional household survey. 2013*
[79] *Aiello et al. Effect of Hand Hygiene on Infectious Disease Risk in the Community Setting: A Meta-Analysis 2008*
[80] *C. Hamusimbi et. al. Impact of HIV and AIDS on agriculture and food security in SADC: The case of Zambia*

agriculture producers in the rural areas, are disproportionately more vulnerable when there are drought or floods.

Other socioeconomic characteristics that play to increase vulnerability among the poor rural include limited access to health facilities as there is still a substantial proportion living more than 5 Kilometres from the nearest health facility, and low access to safe water and improved sanitation. During floods, health centres may become inaccessible while the risk for contamination of water sources potentially increases leading to diarrhoea outbreaks. In the urban areas, disparity exist between the rich and poor; the latter have inadequate access to safe water and sanitation, use unclean sources of energy resulting in indoor air pollution, poor housing with compromised ventilation and have difficulties disposing of their waste. In these conditions, the incidence of malaria, diarrhoeal diseases including cholera, typhoid and dysentery, and respiratory infections increase. Almost all cholera outbreaks recorded in Zambia have emanated from the densely populated peri-urban areas of Lusaka and spread to affect mostly the poor and marginalised communities in other parts of the country. The residents of these areas often have shallow unprotected wells as source of water and use pit latrines. The minimum recommended distance between water source and pit latrines is in most cases not considered due to poor or unplanned settlements.

7.4 Education and literacy

The rural and poor populations are less likely to be literate. Furthermore, regardless of area of residence women are disproportionately disadvantaged. Women with these attributes are thus more likely to be unemployed and in poor health than others. They cannot seek and use information to better their health, nutrition and education of their families. This makes them and their children more vulnerable to the effects of climate change risks.

7.5 Access to health services

Access to good quality public health services reduces vulnerability to climate change.[81] Pre-existing health and social inequalities shape the incidence of health outcomes emanating from climate change. The poor and marginalised populations are likely to be disproportionately affected by climate change. A substantial proportion of the Zambian population is rural based and only 50% of this population is within 5 kilometres of a health facility.[25] Other hindrances to accessing health services include poor road network and communication, inequitable distribution of number of health workers between urban and rural areas, inadequate essential drugs and medical supplies. Additionally, populations in isolated areas that currently have difficulties accessing health services due to geographic distance and terrain are more vulnerable

[81] *Frumkin and McMichael Climate change and public health: thinking, communicating, acting.2008*

to extreme weather events such as flooding. The most vulnerable among these populations include children aged less than 5 years, women and the elderly.

7.6 Population growth and urbanization

Population projections indicate that from 15 million in 2015, the population will grow to 18 million and 27 million by 2020 and 2035 respectively.[23] The addition of about 12 million people in just 20 years will lead to increased demand on basic services and enhance vulnerability to effects of climate change. Additionally, reducing poverty and fostering sustainable development will be difficult under such high growth rates. This implies that the added population will be largely uneducated, unemployed, and poor and live in unplanned settlements or geographically inhospitable areas as is often seen with the marginalised people. The impact of climate change will be seen as a result of increased disease burden and direct effects such as damage to dwellings and injuries. For instance, rainfall (excess or normal) in a poorly planned settlement with poorly constructed houses and with drainage clogged with solid waste would easily lead to flooding. If the residents of such settlements use unimproved water sources the chance of contamination and diarrhoeal disease outbreaks increase. As is often the case, these settlements also tend to have poorly constructed houses which easily collapse due to water logging. An example in this regard is that Lusaka and similar urbanised cities have been sources of cholera outbreaks in the past while rural populations living along river banks, low lying area or the flood plains of the Zambezi river have often been subjected to flooding with destruction of houses and displacements.

As summarised in Table 6, the expected magnitude of *exposure (*climate variability) to which the health sector will be exposed is considerable; recurrent droughts and floods in different parts of the country and increased temperatures over the whole country are anticipated. Furthermore, the extent of the effect of climate change is expected to be large as Zambia's population and the health sector is highly *sensitive*: a large proportion of the population is rural, poor and depend on land resources for their livelihood, a large portion of the underlying disease burden is climate sensitive and to a large extent related to the physical environment, a growing population that is increasingly putting pressure on and outstripping the ability of government to provide required social services, a poor socioeconomic situation and low levels of resilience of the health system to absorb the current and expected increase in disease burden *(low adaptive capacity).*

Although the vulnerabilities, in this report, have been presented for the whole country and health sector, it is important to recognise that the combination of these factors and the way they interact is unique to geographical areas of interest. Therefore, vulnerability will vary from

region to region within the country and adaptation efforts need to be tailored to the predominant predisposing factors for each region.

Table 6: Summary of selected of drivers of vulnerability for Zambia

Drivers of vulnerability	Characteristic	Climate hazard interacting with the driver	Health condition affected
Geographical	54% rural population, poor, rain-fed substance farming	Droughts/floods	Increased malnutrition, Infectious disease
	Inadequate road network in rural areas	Floods	Inaccessible health services
	Urban poor	Floods	Malaria, diarrhoeal outbreaks
	Inadequate access to improved water/sanitation	Droughts	Food borne diseases
	High altitudes and large water bodies (Luapula, Northern, Muchinga, Northwestern Provinces)	More rainfall and warmer temperatures	Increased malaria, proliferation of diarrhoea causing pathogens
Current disease burden: Heavy burden of infectious disease and under-nutrition	Malaria: Inadequate systems to control: low utilisation of ITNs, low coverage of IRS, emerging parasite and vector resistance	Excessive rain, increased temperatures	Increased incidence of malaria
	Diarrhoea: Inadequate access to water and sanitation especially for the rural poor and urban marginalised communities, unplanned settlements	Floods /droughts	Increased incidence of diarrhoea diseases
	Under-nutrition	Droughts/floods	Increased mortality from other infectious diseases
Population growth and urbanisation	Unplanned settlements and poor housing, low access to basic social services, unemployment and poverty overcrowding	Increased ambient temperature, floods and droughts	Respiratory diseases, diarrhoeal disease outbreaks e.g. cholera in some localities, reduced ability to cope with climate change effects
Health system capacity	Inadequate health workforce/skewed distribution Inadequate health facilities Lack of skills in CC competencies	All	Inability to adequately responds to negative impact

8 ADAPTATION

Adaptation to climate change poses a great challenge for most African countries including Zambia. The UNFCCC cites some of the following developmental challenges as contributing to the difficulties with adaptation: low GDP per capita; widespread, endemic poverty; weak institutions; high levels of illiteracy; low access to primary health care; imbalance in women and gender in policy planning; and complex disasters. Therefore, addressing some or all of the above challenges will improve the countries' adaptation capacity.

The IPCC,[36] in the fifth assessment report, states with 'very high confidence' that "The most effective measures to reduce vulnerability in the near term are programs that implement and improve basic public health measures such as provision of clean water and sanitation, secure essential health care including vaccination and child health services, increased capacity for disaster preparedness and response, and alleviation of poverty". The report further recommends that to ameliorate future vulnerabilities countries should promulgate policies that generally promote health, education, and foster economic development. O'Brien et al.[82] also recommends incremental and transitional adaptation as relevant to adaptation in the health sector. Incremental adaptation is concerned with enhancing the already existing interventions/programmes for climate sensitive disease while transitional adaptation involves the incorporation of such measures as vulnerability assessments and establishment of early warning systems and surveillance into the health system.

8.1 Evaluation of adaptation options

This section presents adaptation responses/needs that were identified during the workshops with district/provincial health staff. The following were the steps used in the evaluation and selection of the proposed adaptation measures:

- Identification of diseases/health conditions that are potentially affected by climatic conditions (risks)
- Assessment of the probability of the climatic risk occurring based on documented past events and projections. A presentation of past and projected climatic changes in the regions of the country was given by the meteorological experts to assist in this step.
- Qualitative assessment of the extent (severity) of impact on health were the climatic risk to occur; that is if the occurrence of the climatic risk is likely to substantially increase the disease burden or have deleterious socioeconomic consequences
- Identification of priority adaptation options for the health sector
- Capacity to apply public health intervention to reduce the impact

[82] *O'Brien et al. Towards a sustainable and resilient future. 2012*

As indicated in earlier sections, prevalent climatic risks identified for Zambia are droughts, floods, and temperature variability especially heat waves. It was generally agreed, at the workshops, that drought and floods had the highest potential to affect individual and public health. Therefore, responses to these climatic risks were rated high, while the impacts of heat waves/extreme temperatures were considered of low priority. It was evident during the workshops and expert interviews that while it was relatively easy to assess the impact of the first two climate hazards, assessing the impact of heat waves/extreme temperatures on the local population proved a difficult task. This was due to lack of data on the impact of heat waves/extreme temperatures. On the other hand, there is a reasonable archived data on the impacts of droughts and floods on the health of the Zambian population; mostly from the vulnerability assessments conducted by the DMMU. It should therefore be said that prioritizing the health impacts of extreme temperatures as low, does not dismiss its relative importance but highlights that more evidence, through more research, is needed in this area. Table 7 shows the health conditions considered likely to be affected by climate change and the priority rating for the need to adapt.

Table 7: Health conditions/diseases vulnerable to climate change and rating for need to adapt

Health conditions	Priority
Communicable	
Water borne diseases:	
Diarrhoea and cholera	High
Schistosomiasis	low
Vector borne disease	
Malaria	High
Malnutrition: under-nutrition	High
Respiratory diseases:	
RTI-NP, Pneumonia	Medium
Asthma	Low
Eye/skin diseases	Low
Non-communicable	
Heat stroke	Low
Injuries	Low
Mental distress/disorders	Low
Non-medical or cross cutting issues	
Population displacement	Low
Lack of information on climate change on	High
Surveillance/early warning systems	High

From the provincial consultative meetings it could be concluded that the common pathway in which the major climatic hazards will impact the health of the population is through water; either relative lack or the excess of it. This is consistent with the observation by Bates that the most impact of climate change on people, ecosystems, and economies will be through water.[83] Both observational records and climate projections provide strong evidence that freshwater resources are vulnerable, with the potential to be strongly impacted. Therefore, access to improved water sources and securing the quality of water will protect the health of populations both in times of drought or floods.

Several adaptation responses to the identified climatic risks were considered during the consultative meetings. Selection of the suggested adaptation options took into account that they should be aligned to the overall national developmental priorities both in the medium- and long terms as elucidated in the NDMP, seventh NDP (7NDP) and the Vision 2030.

The 7NDP places a priority on human development through a number of interventions, in both rural and urban areas, that in several ways will provide an enabling environment to achieve what is being proposed for inclusion in the HNAP. The 7NDP seeks to improve social services provision to the less developed parts of the country as well as enhanced development of the marginalized peri-urban areas. This will entail increasing access to water and sanitation and health services, education and road/railway connectivity. Access to safe water is the most probable and cost effective way of improving health, reduce premature deaths and increasing life-expectancy and gender equality. Additionally, the 7NDP proposes to embark on integrated development of rural areas. This will involve the improvement of agriculture production through increasing water for agriculture by constructing dams, increasing electrification coverage, improved housing, and water and sanitation.

At the consultative meetings a number of vulnerable communities were highlighted in almost all the provinces; these included communities living along river banks that get affected by floods almost yearly. The reason given is that these communities tend to follow the scarce water for them to carry-out farming activities or fishing and indeed use water for their daily survival while other communities are simply located in the low lying areas like the Zambezi plains. These communities are also known not to have proper sanitation facilities and liable to practice open defeacation and contributing to faecal contamination of the scarce water sources. Finding alternative locations in upland areas should be considered for these communities. They should be provided with other means of livelihood. For example, dams for irrigated farming (cash crops and fish farming) should be provided. This would not only improve food security (and reduce under-nutrition) but will protect the families from direct effects of droughts as well as vector borne and diarrheal diseases which have been demonstrated to increase among these

[83] *Bates et al. Climate change and water. Technical Paper of the Intergovernmental Panel on Climate Change. 2008*

communities. For the urban poor, improved housing, waste management and provision of water and sanitation services will address most of the vulnerabilities associated with this segment of the urban population. All these intervention measures are catered for in the 7NDP in the medium term and the vision 2030 in the long term. They remain to be harnessed if a multi-sectoral collaboration among the various stakeholders is built and enhanced in order to take opportunities presented in the development plan. For instance, addressing the burden of under-nutrition will require increasing the availability of proteins for human consumption through promoting fish farming in local communities; this activity is being promoted in the 7NDP for most of the provinces. While this could address malnutrition and provide alternative sources of income, its implementation has the potential to increase vector population and malaria. Therefore, a coordinated approach among stakeholders is needed to maximize benefits arising from the adaptation efforts.

Participants at the workshops further examined existing gaps and limitations which, if unaddressed, would impede an effective adaptation response in the sector. Some are discussed below and summarised in Box 2.

A lack of information on climate change and institutional capacity to adapt was identified to affect the national, provincial and district levels. Lack of capacity was identified in areas such as conducting in-depth vulnerability assessments and identifying vulnerable groups specific to regions, determining disease burden attributable to climate varibility, and ability to analyse the impact of climate change on health in the country. Absence of climate risk and vulnerability information specific to regions and/or populations was seen to be a hindrance to the formulation of clearly articulated climate change policies and implementation of specific and cost effective response measures.

Additionally, lack of knowledge regarding the effects of climate change and health at community level was seen as a major stumbling block to implementing actions aimed at protecting the vulnerable populations from effects of climate hazards. It has been observed several times in the past that communities, to their detriment, resist intervention efforts or are reluctantly to cooperate with health authorities and other stakeholders when there is an imminent climate threat. This attitude was attributed to a lack of information and knowledge in the communities. Addressing this gap requires developing emergency response plans that are disseminated widely to the communities. Communities should know how to reduce the impact of climate hazards and where to get the much needed assistance in times of disaster.

Currently, response to climate variability and extreme weather events is at most reactive. To adequately address the threats from climate change, a proactive approach was proposed. This should be achieved through a well-functioning health system with focussed support to priority activities that are identified through research and in-depth vulnerability assessments. This will

require the setting up of robust surveillance- and early warning systems, building capacity in communities to adapt, enhance research, training and diagnosis of diseases (laboratories), and enhancing inter-sectoral collaboration e.g. the ZMD weather forecasting and early warning should be integrated with the MoH surveillance systems.

The anticipated rise in ambient temperature was regarded by many respondents as a threat to the procurement and storage of medical supplies. Enhancement of cooling facilities, improvement in building standards to harness natural cooling effect in indoor environment and increase in the use of solar energy to power health facilities where there is no electricity were proposed as cost effective ways to adapt. These activities will require an increase in budgetary allocation to the health sector which was described by many respondents as inadequate.

Vulnerability is a function of existing factors such as socioeconomic status of individuals or communities, access to social amenities such as water and sanitation and primary health care. To begin to respond to climate hazards and reduce future vulnerability, respondents proposed provision of safe water and sanitation, improvement of socioeconomic status of the poor especially the rural dwellers and the marginalised urban poor as this group tends to suffer disasters related to other drivers such as settlements in geographically inhospitable areas. Related to this is that planning for settlements, especially with the current high rate of urbanisation, should be enhanced to ensure that social services are provided, the houses meet enhanced building standards that will be resilient to climate risks, and solid waste management is achieved. It is clear that these interventions fall outside the jurisdiction of the MoH, therefore a strong collaboration among the stakeholders cannot be over-emphasised. Other response actions mentioned included increasing access to primary health care by increasing the number of health facilities, increasing availability of trained health workers and requisite essential medicines and other commodities. However, this response should not be instituted as an end in itself, but rather to supplement the efforts in preventative measures outlined earlier.

Respondents identified opportunities in which the proposed actions could be incorporated for immediate consideration and implementation. Advantage can be taken of the annual, mid-term and long term planning activities. For instance, districts health authorities review and formulate their annual action plans which form the basis for subsequent funding of activities. The long term national development goals as articulated in the Vision 2030 and the medium term implementation national development plans have prioritised increasing access to water and sanitation for all and uplifting the socioeconomic status of the poor especially the rural populations. This policy environment should enable the health sector to begin to include some of the proposed responses in the National Health Strategic Plans (NSHP). Through enhanced inter-sectoral collaboration, which was described to be very strong at national level, the MoH

should advocate for the inclusion of interventions such as water and sanitation, waste and environmental management in respective national strategic plans of the other line ministries.

Box 2: Workshop participants views on gaps and limitations adaptation to climate changes and impact on public health

Limitations to implement climate change

- ✓ Lack of information and institutional capacities at national, provincial and district levels
- ✓ Climate change issues in relation to health priorities are not clearly articulated in government plans and policies
- ✓ Poor coordination of activities among the sectors that are affected by climate change
- ✓ Lack of resources including financial and human
- ✓ Lack of knowledge of effects on health of climate change at community level

What is needed to respond to climate change?

- ✓ Encompassing legislation, appropriate infrastructure and equipment
- ✓ Community involvement including orienting Community Health Workers on managing common climate sensitive diseases
- ✓ Develop emergency response plans and disseminate to community and engage them in emergency response education.
- ✓ Temperature control in procurement and storage of medical supplies
- ✓ More focused support to priority activities aimed at addressing impact of climate change. Currently most activities are done routinely. There is need to establish a pro-active, as opposed to current reactive, approach to disaster management
- ✓ A well-functioning health system with adequate resource in terms of medical commodities and equipment for each level of care is essential for the system to absorb shocks from extreme climate risks
- ✓ Increased funding to the health sector: Partners and GRZ was said to be inadequate and should be upped to reach the Abuja target
- ✓ Enhance multi-sectoral collaboration through:
  - Ministries to have institutional focal points and action plans to have specific sections to address climate change issues
  - Provincial planning unit to establish a climate change multi-sectoral steering committee
- ✓ Establish a nationally fully functional early warning system
- ✓ Enhance HMIS to include indicators relating health outcomes and the environment to climate variability

How can current vulnerabilities be reduced?

- ✓ Implementing the most cost-efficient way to reduce vulnerabilities including
  - Provision of social amenities largely water and sanitation and education
  - Improvement of the socioeconomic status of many of the marginalized populations
  - Proper planning of community/settlement with all attendant social services, improve social service delivery
  - Enhanced solid waste management
- ✓ Community sensitization and education about the effects of climate change
- ✓ Other needed actions are:
  - Increase accessibility to Primary health care
  - The functions of MSL need to be decentralized and expanded; mechanisms for the last mile distribution should be put in place

Opportunities for integrating climate change adaptation in current system

- ✓ Incorporation of climate change issues in annual and medium term plans

- ✓ Existing strong inter-sectoral collaboration and coordination of stakeholder in health and other sectors.
- ✓ Existing and functional Health information system (HMIS) which is adequate in identifying disease outbreaks and allows for emergency planning
- ✓ Committed work force of community health workers and presence of partners at national, provincial and the lower level including the community
- ✓ A strong regulatory framework to manage the medical supplies and a procurement that is well managed by Medical Stores Limited

The main barriers to implementation will include:

- ✓ Lack of empirical evidence between the disease incidence and climate change and variability would be a barrier to implementation. There is need for concerted research to generate data to not only show relationships but help in planning response to climate change
- ✓ Lack of indicators for monitoring climate sensitive disease and how they relate to climate
- ✓ Lack of capacity to recognize risks of and implementation of climate change responses
- ✓ Lack of technology to enhance the legal enforcement of laws meant to protect public health e.g. in case of pollutions of the ambient air, water and/ or soils
- ✓ Lack of capacity (human and otherwise) in all sectors responsible for enforcement of laws and standards
- ✓ Inadequate funding or late release of funding for planned activities
- ✓ Inadequate coordination of sectors that are vulnerable to climate change at provincial and district levels
- ✓ Lack of knowledge in communities regarding climate change issues and how communities can do to participate in responding to climate change

8.2 Selection of proposed adaptation measures

As highlighted previously, a number of adaptation measures were proposed to address the identified health risks due to climate change and variability. It was noted, in the consultative meetings, that health risks related to climate change will increase the magnitude and reach of public health issues currently seen in the country. The health sector is refocusing service delivery from curative to prevention approach as articulated in the 7NDP which states "that public health management will be strengthened in to order to prevent disease and as a way of managing health impacts of climate change".

In this report, the proposed adaptation measures discussed in earlier section have been fit into one or more of the 10 principles of public health preparedness as proposed by Frumkin and colleagues.[81]Table 8 presents the 10 public health principles and their climate change equivalencies. Additionally, an attempt is made here to align the proposed actions with the National Policy on Climate Change (NPCC) and the NDMP. The NPCC sets two objectives, among others, that have immediate relevance to responding to climate change and public health viz:

> *"*To promote and strengthen the implementation of adaptation and disaster risk reduction measures to reduce vulnerability to climate variability and change*",*

> "To strengthen the institutional and human resource capacity in order to effectively and efficiently address all aspects of climate change at, national, provincial, district and local levels."

To achieve the above, the government aims to have a robust system for identifying risks and hazards in order to facilitate planning and early warning; a strong surveillance and control system of climate change related pests and diseases; a climate-proofed infrastructure; and a strong community-based risk management activities and use of social safety nets for the most vulnerable. Other measures proposed in the policy include the use of financial instruments such as insurance; increased climate change education, training and public awareness at all levels; promote the use of prediction models and technologies to determine regional vulnerability of the sectors to climate change; and support higher learning and research institutions on climate related applied research.

Applying the public health principles will meet the measures proposed in the NPCC. For instance, a robust surveillance and early warning system and increased institutional capacity to handle and respond to climate change health risks. With this approach the health system will ensure that vulnerable populations are identified early and appropriate intervention measures instituted. Climate change has the attendant risk of disease outbreaks, emerging or re-emerging, thus a strong laboratory system and trained health worker force will be needed. Additionally, appropriate training courses will need to be developed and health workers trained in a range of skills including vulnerability assessment, climate change analysis, preparedness and disaster management, and epidemiology, treatment of climate sensitive diseases, health economics and information technology. This will ensure the availability of a critical mass of trained health workers that will be able to generate information for policy formulation, strategic planning, and implementation and evaluation of programmes. Additional benefits of training include established or enhanced system for provision of medical attention as needed during a disaster. Another co-benefit accruing from this approach is the establishment of continuous medical education in climate change and public health at various levels which will ensure that a critical mass of required health workers with a wide skill base is maintained into the future.

Reduction of vulnerability to climate change will require that the communities in general are made aware of the climate risks. Community structures will need to be enhanced to ensure that the communities are well aware of their vulnerabilities and how they can cope. Lastly, the role of public health practitioners, in collaboration with other government entities and community stakeholders, to enforce legal requirements that protect the public will need to be reinforced. In this regard the 7NDP also recognises the need to strength this particular task and proposes a review of public health legal and regulatory framework to harmonise and make it more relevant in adapting to climate change.

Table 8: Public health principles applicable to climate change response for Zambia

	Public Health principle	Climate change equivalent	Relevance
1	Monitor health status to identify and solve community health problems.	Tracking of diseases and trends related to climate change	Generate data on environmental risks, vulnerability, and disease trends/burden. Will enable to plan, implement, and evaluate response to climate risks
2	Diagnose and investigate health problems and health hazards in the community	Investigation of infectious water-, food-, and vector-borne disease outbreaks	Will allow for rapid diagnosis and reporting of disease (emerging and re-emerging). Determining disease attribution to climate change
3	Inform, educate, and empower people about health issues	Informing the public and policymakers about health impacts of climate change	Communicate with public and policymakers on effects of climate change. Will enhance coping mechanism
4	Mobilize community partnerships and action to identify and solve health problems.	Public health partnerships with industry, other professional groups, faith community, and others, to craft and implement solutions	Identify threats and vulnerable populations at local, designing/implementing adaptive measures e.g water/sanitation, appropriate building standards, proper sites for settlements given the climate hazard, new/improved farming methods
5	Develop policies and plans that support individual and community health efforts	Formulate plans and policies for addressing health risks related to climate change	Harmonise climate change response activities in different sectors so as to identify co-benefits and dis-benefits Allow for setting up of preparedness plans: early warning systems, modalities of identification of vulnerable populations, transport and evacuations plans, identify alternative shelter mechanisms for the displaced
6	Enforce laws and regulations that protect health and ensure safety.	(Little role for public health)	Close the weakness in existing laws and statutes
7	Link people to needed personal health services and ensure the provision of health care when otherwise unavailable	Health care service provision following disasters	Will ensure an effective and coordinated medical system with surge capacity, resilient and able to continue delivery of essential services even in the face of disasters
8	Ensure competent public and personal health care workforce	Training of health care providers on health aspects of climate change	Will ensure a mix of competencies at each level. These should be able to recognize and manage threats from climate change

	Public Health principle	Climate change equivalent	Relevance
9	Evaluate effectiveness, accessibility, and quality of personal and population-based health services	Program assessment of preparedness	Will assist in communication with key stakeholders, regarding effectiveness, accessibility and quality of programs and interventions
10	Research for new insights and innovative solutions to health problems	Research on health effects of climate change, including innovative techniques such as modeling, and research on optimal adaptation strategies	Will generate evidence based actions in response to climate change

Adapted from: Frumkin et al. 2008

8.3 Mainstreaming climate change into the public health

The foregoing sections make a case for the need for the country's health sector to institute adaptation measures to address the current and future threats from climate change. Most of the inputs that form the basis of the proposed adaptation measures are based on review of relevant documents and opinions from environmental experts within the MoH to the exclusion of the sector-wide and inter-sectoral stakeholders. It is thus important that before the adaptation measures proposed in this document are implemented, sector-wide and inter-sectoral consultations are conducted. This is necessary as most of the proposed adaptation measures are outside the jurisdiction of MoH. The following are proposed steps to the finalisation of the HNAP:

1. Validation meeting to present the consultant's findings to the districts and provincial health offices. This meeting will serve to verify if this report reflects the discussions/agreement that took place at the workshops.
2. Hold meetings with sector-wide stakeholders: The main objective of this meeting will be to screen and select adaptation options for implementation within the HNAP. The full options and actions needed, together with time frames, are given in Appendix 9.1. This meeting will be at liberty to amend, including removal of, the proposed options. A list of proposed stakeholders to this meeting is provided in Appendix 9.2.
3. Constitute a committee of experts from among the stakeholders to evaluate the proposed adaptation options (after steps 2. above). The committee's terms of reference will be to:
    a. Review the regulatory implications within the health sector and other sectors resulting from the adoption of the proposed adaptation options.
    b. Consider the entry point of the selected adaptation options into the budgeting and planning process within the MoH and/or other implementing line ministries at all operational levels and the national budget
    c. Cost the selected adaptation options
    d. Formulate process indicators for monitoring and evaluation
4. Ensuring the health-sector's prioritised responses to climate change receive due attention and integrated into the other sectors' adaptation plans by working in collaboration with the Climate Change Department as provided for in the National Policy on Climate Change.[33] Among other responsibilities, this department is charged with "Facilitating the implementation of all climate change programmes/projects in all sectors in collaboration with relevant stakeholders"

9 APPENDICES

9.1 ADAPTATION OPTIONS AND IMPLEMENTATION PLAN: 2018 - 2021

	Priority adaptation option	Action(s) required	Level of implementation	Implementation partner	Time frame	Resource of resources
1	Tracking of diseases and trends related to climate change	Setup robust surveillance, monitoring and evaluation system for climate sensitive diseases	National and community	MoH, ***MTC***, MLG, MF	Short-term	GRZ, external partners, NGOs
		Strengthening of HMIS by integrating health data with meteorological variables	National, provincial, district and community	MoH, ***MF***, MNDP	Medium term	GRZ, external partners
		Set u disease and climate indicators sharing platform among stakeholders at all levels	National, provincial, district and community	MoH, ***MTC*** (ZMD), MLG, MF (CSO), Office of VP	Short term	GRZ, external partners
		Training of health care workers in utilization of HMIS data at National, provincial, district and local for decision making	National, provincial, district and community	MoH, ***MTC***, MLG, MF	Medium term	GRZ, external partners
		Built capacity in health workers to utilize HMIS data for decision making at all levels	National, provincial, district and community	MoH, ***MLG***	Medium term	GRZ, external partners
2	Investigation of infectious water-food- and vector-borne disease outbreaks	Train and recruit more public health specialists	National, provincial, district and community	MoH, ***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, External partners, NGOs
		Setup robust public health laboratory systems	Provincial and district	**MoH, MOHE** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, external partners
3	Informing the public and policymakers about health impacts of climate change	Develop a communication strategy for enhancing literacy in the population regarding impact of climate change on health.	National, provincial, district and community	MoH, ***MIB*** (ZANIS, other media houses), NGOs- FBOs, CSOs, Research institutions	Short term	GRZ, International partners
		Set up a multisectoral dissemination unit at each operational level.	National, provincial, district and community	MoH, ***MIB*** (ZANIS, other media houses), NGOs- FBOs, CSOs, Research institutions	Short term	GRZ

	Priority adaptation option	Action(s) required	Level of implementation	Implementation partner	Time frame	Resource of resources
4	Public health partnerships with industry, other professional groups, faith community, and others, to craft and implement solutions	Setup a multi-sectorial, multidisciplinary unit at each operational level	National, provincial, district and community	MoH and other health sector partners, local government, DMMU, FBO, Research institutes, Engineering institutes	Medium term	GRZ, International partners
		Develop a framework for engaging community, civil society organization, industry and private health care providers in promoting public	National, provincial, district and community	MoH***, MLG,*** NGOS	Medium	GRZ, International partners
5	Formulate plans and policies for addressing health risks related to climate change	Policy review /formulation including that which addresses preparedness plans for climate risks	National	MoH, ***MHI,*** MNDP, MOF, MWDSEP, MOHE (Training and Research institutes Universities, Colleges)	Medium	GRZ, International partners
		Policy and implementation of programmes to improve social-economic status of vulnerable groups	National,	MoH, ***MA***, MCTI, MNDP, MHI, MWDSEP,	Medium	GRZ, external partners
		Enhance implementation of improved agricultural policies	National	MoH, ***MAL***, MNDP, MWDSEP	Medium	GRZ, external partners
		Review of enforcement of environmental laws and legislation	National	MoH***, MJ,*** MLG	Medium	GRZ, International partners
		Develop framework of coordination among various stakeholder in disaster management	National	MoH, **MJ**, MLG	Medium	GRZ, International partners
6	Enforce laws and regulations that protect health and ensure safety	Review of existing public health laws and identify those requiring amendment to make them more enforceable especially waste management, building codes/standards, human settlements and food standards	National	MoH***, MHA***, ZEMA, MOJ	Long term	GRZ, International partners
		Increase health work force in the environmental health department Recruitment of an EHO focusing on climate change and health as this has also been required under the PPCR	National, provincial, district and community	MoH, ***MOHE,*** MoF,	Short term	GRZ, International partners

	Priority adaptation option	Action(s) required	Level of implementation	Implementation partner	Time frame	Resource of resources
7	Build resilient in the community and the health care service provision system (before, during and following disasters)	Enhance food security among poor rural through promoting efficient food production methods e.g. irrigation schemes, fish farming, improved storage of harvests. Training for community resilience	District, community,	MoH**, *MAL***, ML, NGOs	Short term	GRZ, International partners
		Increase access to safe water supply and sanitation	National, provincial, district ad community	MoH, ***MWDSEP***, MLG, WARMA, NGOs	Medium	GRZ, International partners
		Expand and sustain water quality monitoring capacity	District, community	MoH**, *MWDSEP***, MLG, NAWSCO, WARMA	Short term	GRZ, International partners
		Mobilise resources for construction and maintenance of drainage systems especially in urban slums	National	MoH**, *MoF***, MNDP	Short term	GRZ, International partners
		Construction of roads to increase access to health facilities.	National	MoH**, *MoF***, MNDP, MLG, MWS	Long term	GRZ, External partners
		Develop local, and national emergency response systems with ability to do rapid needs assessments.	National, provincial, district and community	MoH**, *VPO*** (DMMU) RCRC, MLG, MOHE (Training and research institutions)	Short term	GRZ, External partners
		Review the Public health Act to incorporate community health structures	National	MoH**, MOJ**, MLG	Short term	GRZ, External partners
		Climate proofing of existing and new health infrastructure and especially at community level	National, provincial, district and community	MoH, **MWS**, MHI	Mediate term	GRZ, External partners
		Strengthen supply chain management especially for essential drugs, vaccines including cold chain equipment and construction of appropriate storage facilities	National, provincial, district and community	MoH**, *MoF***, MWS	Short term	GRZ, External partners, NGOs
		Increase health work force in rural areas especially	National	MoH**, *MoF***, MLG	Medium term	GRZ, International partners
		Realign health delivery system to focus on health promotion, disease prevention and environmental health management	National	MoH**, *MLG***	Medium term	GRZ, International partners

	Priority adaptation option	Action(s) required	Level of implementation	Implementation partner	Time frame	Resource of resources
8	Training of health care providers on health aspects of climate change	Policy and implementation of programmes to assist research and higher education institutions to increase capacity to train appropriate health workforce	National	MoH, ***MOHE*** **(**Training and Research institutes), MoF, MOEST	Medium term	GRZ, International partners
		Curricula development to strengthen in such fields as health economics, health impact assessments, ecology, urban health, and vulnerability assessment and modeling	National	***MOHE,*** Training and Research institutes, MOH, MOF, MOEST	Medium term	GRZ, International partners
		Revise training curriculum for community health workers to include impacts of climate change and adaptation measures	National, provincial, district and community	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, International partners
9	Program assessment of preparedness	Robust surveillance system with information sharing platform in the sector and across sectors	National, provincial, district, community	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, external partners
		Establish surveillance data quality assessments	National, provincial, district, community	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, external partners
		Review the epidemic preparedness and response programme to integrate climate hazards and environmental pollution	National	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR), NGOs	Short term	GRZ, external partners
10	Research on health effects of climate change, including innovative techniques such as modeling, and research on optimal adaptation strategies	Capacity building: strengthen the development of relevant training curricula for the health work force, provide physical and other required infrastructure for research	National	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR)	Medium term	GRZ, International partners
		Strengthen and update HMIS – include indicators of water hygiene and environmental health diseases	National	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR)	Short term	GRZ, International partners
		Mobilize resources for research in food production relevant to the agro-ecological zones; Usage of water for agriculture	national	***MAL***	Medium term	GRZ, International partners
		Conduct national environmental health survey	National	***MOHE*** (Training and Research institutes Universities, Colleges, TDRC, NISIR)	Short term	GRZ, International partners
		Review treatment guidelines for relevant climate sensitive disease	National	***MSDSEP***		

Priority adaptation option	Action(s) required	Level of implementation	Implementation partner	Time frame	Resource of resources
	Mobilise resources for research training and projects	National	***MNDP***, MoF	Medium	

NOTE: MOH is the lead institution in the implementation of all the proposed options
Immediate; within 1 year: Sort term: within 2 years: medium term: within 3 years: Long term: 5 years and beyond: External partners: International funding partners and UN agencies: Bold and italised : main implementing partner;

Appendices

9.2 Sources of information

Information considered in the process of climate change and vulnerability assessment

Type/Source of information reviewed and consulted	Name/Description of source and information obtained
Data	Annual Health Statistical Bulletins (MOH,2000-2013) Notifiable diseases statistics Historical meteorological data from ZMD Historical climate data from World Bank climate portal Quality of housing, Water and sanitation (Census 2010, LCMS) Population /demographic health data (ZDHS 1999 – 2014) Indepth Vulnerability Assessments (DMMU, 2000 – 2014) Zambia Demographic Population Survey (2010 - 2015) National Health Strategic Plan
Policy issues Previous/current activities related to climate change	National Disaster Management Policy (DMMU 2005) National Adaptation Programmes of Action on Climate Change (MTENR, 2007) 2nd National Communication to UNFCCC (2000-2004) National Development plans: 5th, 6th and 7th (MOF, MDP) National Water Policy (MEWD, 2010) National Policy on Climate Change Vision 2030 Seventh National Development Plan (2016 - 2021)
Previous/current activities related to public health	2nd National Communication to UNFCCC (2000 -2004) Intergovernmental Panel on Climate Change (4 & 5 Assessment Reports) Who guidelines to protect health from climate change through health adaptation planning (WHO 2014) World Bank (2015)
International references	World
Research	George Kasali: Climate Change and Health in Zambia (2008) Deursch Gesellschft fur Internationale Zusammenarbert (2014) UNDP. Climate Change Country Profile (2010) Fernandez. Influence of temperature and rainfall on the evolution of cholera epidemic in Lusaka, Zambia (2008) Sasaki. Impact of drainage works on cholera outbreaks in Lusaka, Zambia (2009)

9.3 STAKEHOLDERS IN THE IMPLEMENTATION OF H-NAP

	Name of stakeholders	Role	Stage of engagement
	Major stakeholders		
1	Ministry of Health	Policy guidance	Throughout the process
2	Ministry of Water Development, Sanitation and Environmental Protection	Appropriate legislation and enforcement to protect water sources and quality. Ensure increased availability of water and sanitation access to the poor and vulnerable	Validation and periodically
3	Ministry of local government and Housing	Water and sanitation in rural areas, oversee the municipal housing water and sanitation	Consultative, validation,
4	Ministry of Agriculture and Livestock	Usage of water for agriculture, Collaboration in health and nutrition, improvement in food production by introducing agriculture activities appropriate to agro-ecological zone,	Consultative, validation
5	Ministry of Housing and Infrastructure	Improved housing and appropriate building codes to ensure climate resilience	Consultative, validation
6	Ministry of National Development and Planning	Ensure that that the adaptation responses are included in national developmental goals: both medium and long term	Consultative , validation
7	Ministry of Finance	Financing the health actions	Consultative, validation, periodically
8	Ministry of Gender and Chid Development	Advocacy for adaptation responses that promote the welfare of women and children through policy formulation	Consultative, validation, periodically
9	Ministry of Education	Increase in literacy levels especially among female, Behavioural change, school nutrition	Consultative, validation, periodically
10	Ministry of Works and Supply	Improve road network to increase access to health facilities. Engage in the climate proofing of existing and yet to be constructed health facilities	Validation
11	Ministry of Commence, trade and Industry	Policy and implementation of programmes to improve social-economic status of vulnerable groups	Validation

12	Natural Development and Planning (Planning Department)		
13	Ministry of information and Broadcasting (ZANIS)	Dissemination of information on climate change	Validation, periodically
14	Ministry of Higher Education	Policy and implementation of programmes to assist research and higher education institutions to increase capacity to train appropriate health workforce	Validation
15	Ministry of Chiefs and Traditional Affairs (House of Chiefs)	Advocacy and mobilisation of communities	Initial consultative
16	Ministry of Office of Vice President	DMMU: conducts vulnerability assessments/response to disasters	Initial consultative, periodically
17	Water Utilities companies	Engaged with improvement of provision of water and sanitation in urban areas	Initial Consultative
18	National water Supply and Sanitation Council NWASCO)	Regulation	Initial consultative
19	Ministry of Defence	Involvement in disaster responses	Initial consultative
20	Ministry of Justice	Enactment/law formulation to address issues of climate change and health/environment	Initial consultative, drafting
21	Community Development and Social Welfare		
22	Ministry of communication and Transport (ZMD)	Early warning systems	Initial consultative, periodically
23	NGOs		
	Churches Health Association of Zambia (CHAZ)	Implementation of adaptation responses	Periodical consultative
	World Vision	Advocacy and Implementation	Initial consultation
	Water Aid	Advocacy and Implementation	

	Scaling Up Nutrition (SUN)	Advocacy and Implementation	
	Zambia Red Cross Society	Advocacy and Implementation	
24	International Partners		
	WHO	Technical assistance	Initial consultation,
	UNDP	Technical Assistance	Throughout
	Global Fund (AIDS, Malaria & TB)	Technical assistance	Initial consultation, periodically
	United Nations Joint Programme	Technical assistance	Throughout
25	Research institutions		
	Universities	Training and research	Periodically
	NISIR	Research	Periodically
	TDRC	Research	Periodically

9.4 Questionnaires

MINISTRY OF HEALTH QUESTIONNAIRE

Introduction

Six building blocks have been identified in strengthening health systems in order to improve health outcomes. These are health workforce, service delivery, HMIS, medical/technological supplies, health system financing, and leadership and governance. (WHO everybody's business,2007)

Climate change threatens to increase the frequency of climate disasters like droughts, floods and extreme temperatures. These changes are projected to increase the incidence and prevalence of climate sensitive diseases such as malaria, diarrhoea and respiratory disease. These changes will place an additional burden on the Zambian health system. There is thus a need to adapt in order to absorb the expected increased disease burden.

The table below has the "WHO building blocks" in the first column. For each of these, give an analysis of the present situation and give a qualitative assessment of its adequacy. Furthermore, indicate what would need to be done in order to ensure that the health system is able to cope with expected changes in climate sensitive disease burden.

1. Name of person completing the questionnaire
   ……
   ……
2. Please indicate your designation and profession
   ……
   ……

Health care characteristic	Current status (indicate adequate or inadequate)	Suggestions for climate-proofing
Q1. HEALTH FORCE Indicate whether the workforce is: a. Effective b. Safe c. The quality of personal and non-personal health interventions to those who need them, when and here needed, with minimum waste of resources d. State whether there is accessibility and equity		

Health care characteristic	Current status (indicate adequate or inadequate)	Suggestions for climate-proofing
Q2. Service delivery 1. Is it responsive, fair and efficient to achieve best health outcomes? 2. Does it have sufficient No. of health workers per category? 3. Is it Responsive and productive?		
Health information system		
Medical supplies		
What Technologies are available		
Explain the health systems financing		
Leadership and governance (how is the interrelationship with other stakeholders?)		

Reference: Senegal

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