

HEALTH NATIONAL ADAPTATION PLAN-II (2024-2028)

REVISED VERSION



የጤና ሚኒስቴር፣ ኢትዮጵያ
MINISTRY OF HEALTH, ETHIOPIA

**JUNE, 2024
MINISTRY OF HEALTH
ADDIS ABABA**

TABLE OF CONTENTS

Content	Page
LIST OF FIGURES	i
LIST OF TABLES	i
ACRONYMS	ii
FOREWORD	iii
ACKNOWLEDGMENT	iv
DEFINITIONS	v
EXECUTIVE SUMMARY	viii
1. INTRODUCTION	1
1.1. Background	1
1.2 Rationale	1
1.3. Guiding principles	2
2. SITUATIONAL ANALYSIS	3
2.1. Climate Situation in Ethiopia	3
2.2. Policy frameworks	5
2.3. Health risks of climate change	5
2.4. Health impacts of climate change	6
2.4.1. Directs impacts of climate change	6
2.4.2. Indirect impacts of climate change	6
2.5. Zoonotic diseases	10
2.6. Non-communicable Diseases	10
2.7 Mental Health	10
2.8 Stakeholder Analysis and engagement	11
3. NHAP-II: VISION, MISSION AND STRATEGIC OBJECTIVE	14
3.1. Vision	14
3.2. Mission	14
3.3. Strategic objectives	14
3.4. Targets	14
4. KEY INTERVENTIONS	16
5. MONITORING AND EVALUATION	21
Priority Next Steps for Quarter I 2024:	24
REFERENCES	34

LIST OF FIGURES

Figure 1: Geography and climatic zones of Ethiopia	3
Figure 2: major health risks associated with climate change	11
Figure 3: logic model of logic model of h-nap implementation and expected impacts	22

LIST OF TABLES

Table 1: Stakeholders engagement in Health National Adaptation Plan (HNAP) implementation	12
Table 2: Key interventions, activities, subtasks with time frame, budget, M & E for HNAP-Ethiopia	25

ACRONYMS

AMR	Antimicrobial Resistance
CDC	Centre for Disease Control
COPD	Chronic Obstructive Pulmonary Disease
CRGE	Climate Resilient Green Economy
CSA	Central Statistics Agency
EDHS	Ethiopian Demographic and Health Survey
EMI	Ethiopian Meteorological Institute
ENSO	El Niño-Southern Oscillation
EOC	Emergency Operation Centre
EPA	Environmental Authority
EPHI	Ethiopia Public Health Institute
GDP	Gross Domestic Product
GHFs	Green Health Finance
GHGs	Greenhouse Gas
HAP	Household air pollution
HEWs	Health Extension Workers
HIA	Health Impact Assessments
HSTP	Health Sector Transformation Plan
IPCC	Inter-governmental Panel on Climate Change
LDCs	Least Developed Countries
M & E	Monitoring and Evaluation
MOH	Ministry of Health
HNAP	Health National Adaptation Plan
NAP-ETH	National Adaptation Plan
NCDs	Non-communicable Diseases
NTD	Neglected Tropical Diseases
RCCE	Risk communication and community engagement
SAM	Severe Acute Malnutrition
SDG	Sustainable Development Goals
SOP	Standard Operating Procedure
V&A	Vulnerability Assessment
VL	Visceral Leishmaniasis
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
CNCCHA	Committee for National Climate Change and Health Adaptation

FORWARD




It gives me great pleasure to introduce the Health National Adaptation Plan (H-NAP II) for Ethiopia which outlines the coordinated efforts of the Ministry of Health, other government sectors, and development partners to adapt to the anticipated impacts of climate change on the health system.

Climate change poses serious threats to public health, including an increase in the frequency and severity of extreme weather events, the spread of vector-borne, water, and food-borne diseases, and food insecurity. Ethiopia, as a country particularly vulnerable to these impacts, recognizes the need to take a proactive approach to address these challenges.

This plan is the result of a collaborative effort involving experts in climate science, public health, and policy. It provides a framework for aligning interventions and resources to address the health impacts of climate change in a way that builds the resilience of communities and health systems.

This Health National Adaptation Plan will be implemented with the full participation of communities at the grassroots level through a health extension program using health extension workers, health development armies, and villages' leaders, and health development army (HDA). It will be supported and monitored by leadership at all levels so that it will be successful in building a resilient health sector.

Finally, I would like to call all concerned stakeholders for their collaborative effort towards protecting public health from climate change risks. I firmly believe that the Health National Adaptation Plan (H-NAP) offers valuable guidance for future planning and serves as a crucial resource in this endeavour.


Dr Dereje Duguma (MD, MPH)
State Minister, Ministry of Health

ACKNOWLEDGMENT

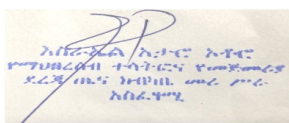


The Health National Adaptation Plan (HNAP) serves as a roadmap to address the health impacts of climate change in Ethiopia. The development of the plan involved the hard work of various agencies, institutions, and individuals.

I want to express my gratitude to the World Health Organization, World Bank, WaterAid and USAID for their indispensable financial and technical support throughout the development of the Health National Adaptation Plan (HNAP).

I would like to acknowledge EPA, EPHI, Haramaya, and Arbaminch Universities for their contribution to the development of this HNAP.

I also acknowledge the contribution of regional health bureau experts in further enrichment and development of the HNAP. Finally, my appreciation goes to the following HNAP development technical working group members and their affiliated organizations for their frequent and unreserved efforts, technical inputs, and comments throughout the development of HNAP.



Name	Organization
Roman Tesfay(MPH)	WB
Stepahn Geoferry(PHD)	WB
Waltaji Terfa (MPH)	WHO
Wondayehu Wube(MPH)	MOH
Ashrafedin Youya (MA,MPH)	MOH
Misganaw Tewachew (MPH)	MOH
Awugchew Teshome (MSc)	Arbaminch University
Yohannes Mulugeta (MPH)	Haramaya University
Getahun Zelalem (MSc)	EPA
Solomon Yimer (MPH)	MOH
Worku Tefera (PhD)	Addis Ababa University
Kefyalew Amene (MPH)	EPHI
Simret Terefe (MSc)	EPA
Keflemariam Tsegaye (MPH)	MOH
Abireham Misganaw	WaterAid
Henok Tadesse (MPH)	EPHI
Marson Wako (MPH)	MOH
Jonathan Drewry (MPH, REHS, DrPH)	USAID
Hiwot Teka (MPH)	USAID

DEFINITIONS

Adaptation: adjustments in human and natural systems in response to actual or expected climatic variation, to moderate harm or exploit beneficial opportunities.

Adaptation options: The array of strategies and measures that are available and appropriate for addressing adaptation. They include a wide range of actions that can be categorized as structural, institutional, ecological, or behavioural.

Anthropogenic: refers to things related to or created by human beings. It is usually used to describe the impact of human activity on the natural environment.

Building codes: a series of ordinances enacted by a state or local governmental entity by establishing minimum requirements that must be met in the construction and maintenance of buildings.

Climate: is the average weather condition for a particular location and period. It is the mean status of long-term weather or the statistical status (month, season, annual, several years, decades, centuries, and even longer). Is average weather occurring over long timeframes (e.g. 30 years)

Climate Change: changes in climate characteristics, including temperature, humidity, rainfall, wind, and severe weather events over long-term periods.

Climate Sensitive Diseases: diseases that fluctuate with climate variability.

Community engagement: is the process of developing relationships and structures that engage communities as equal partners in the creation of emergency response solutions that are acceptable and workable for those they impact

Disaster: an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community.

El Niño: is a climate pattern that describes the unusual warming of surface waters in the eastern equatorial Pacific Ocean. Trade winds and the atmosphere are also impacted by El Niño.

El Niño-Southern Oscillation: A naturally occurring phenomenon involving fluctuating ocean temperatures in the central and eastern equatorial Pacific, coupled with changes in the atmosphere.

Ecosystem: geographic area where plants, animals, and other organisms, as well as weather and landscapes, work together to form a bubble of life.

Emission: substances released into the air and are measured by their concentrations, or parts per million, in the atmosphere

Food insecurity: A person is food insecure when they lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. This may be due to unavailability of food and/or lack of resources to obtain food.

Global Warming: the overall warming of the planet, based on average temperature over the entire surface of the Earth.

Heat Stress: When the body is unable to cool itself by sweating, several heat-induced illnesses such as heat cramps, heat exhaustion, and more severe heat stroke can occur.

Heat Stroke: is the most serious disorder associated with heat stress. It occurs when the body's temperature regulation fails and body temperature rises to critical levels. It is a medical emergency that can lead to death

Climate-resilient health care facilities: They are those that are capable of anticipating, responding to, coping with, recovering from, and adapting to climate-related shocks and stress, so long ongoing and sustained health care to their target populations, despite an unstable climate.

Drought: A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term that requires contextualizing the precipitation deficit should refer to the particular precipitation-related activity.

Health education: is a combination of learning experiences designed to facilitate voluntary actions conducive to health by encouraging behaviour, promoting health, preventing illness, curing disease, and facilitating rehabilitation.

Health promotion: is the process of enabling people to increase control over their health and its determinants, thereby improving their health.

Health system resilience: defined as the capacity of health system, facilities, and populations to prepare for and effectively respond to crises; maintain core functions when a crisis hits; and informed by lessons learned during the crisis, reorganize if conditions require it.

Health impact assessment: is a practical approach used to judge the potential health effects of a policy, program, or project on a population, particularly on vulnerable or disadvantaged groups.

La Niña: refers to the large-scale cooling of the ocean surface temperatures in the same region in the equatorial pacific, coupled with a reversal of the overlying atmospheric conditions.

Livelihood: A means of making a living, that encompasses people's capabilities, assets, income, and activities required to secure the necessities of life.

Mitigation: efforts to reduce/prevent emission of greenhouse gases (GHGs) or to enhance their removal from the atmosphere by sinks.

Population Pressure: the sum of the factors (such as the increase in numbers or excessive food consumption) within a population that reduce the ability of an environment to support the population and that therefore tend to result in migration and expansion of range or extinction or decline of the population.

Resilience: the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

Risk communication: is the real-time exchange of information, advice, and opinions between experts or officials and people who face a hazard or threat to their survival, health, or economic or social well-being.

Disease outbreak: the occurrence of disease cases in excess of normal expectancy and usually caused by an infection, transmitted through person-to-person contact, animal-to-person contact, or from the environment or other media.

Under-nutrition: refers to the proportion of the population whose dietary energy consumption is less than a pre-determined threshold. This threshold is country-specific and measured in terms of the kilocalories required to conduct sedentary or light activities

Universal health coverage: is defined by the WHO as a state in which all individuals and communities can access quality health services without suffering financial hardship.

Vulnerability: the degree to which a system is susceptible to and unable to cope with, adverse effects of climate change, including climate variability and extreme weather.

Risk communication and community engagement (RCCE): refers to the processes and approaches to systematically engage and communicate with people and communities to encourage and enable communities to promote healthy behaviours and prevent the spread of climate-related diseases.

Weather: the fluctuation of temperature, humidity, and wind within a short period of time.
Zoonotic diseases (Zoonosis): an infectious disease that has jumped from a non-human animal to humans. Zoonotic pathogens may be bacterial, viral, or parasitic, or may involve unconventional agents and can spread to humans through direct contact or through food, water, or the environment

EXECUTIVE SUMMARY

Climate Change is a global issue as its effects are multiplicative and exacerbates health inequalities across all nations. It is occurring as a result of anthropogenic factors, in particular, fossil fuel combustion and greenhouse gas (GHG) emissions from energy supply, transport, agriculture, industry, forestry, wastes and buildings.

Climate change affects agriculture, water sources, transportation and communication, health, lifestyle, etc. Developing countries including Ethiopia are more vulnerable to climate change impacts as they have a limited capacity to adapt to climate change. In spite of low global GHG emissions in much of the continent, the risks posed to human health will be heightened in the future despite each countries relatively small contribution to emissions.

Ethiopia is cited as being one of the most vulnerable countries to the impacts of climate change, which poses a setback to the realization of sustainable development goals (SDGs). The climate-related risk includes respiratory disorders linked to the air pollution, meningitis, drought, floods, heavy rains, strong winds, coldness, and heat waves. Annual rainfall and average temperature are critical parameters in the demarcation of many infectious diseases concentrated in the country.

Human beings and livestock are exposed to climate change directly through changing weather patterns, like heat waves and extreme events such as floods, and drought, and indirectly from changes in water, air, food quality and quantity, ecosystems, agriculture, livelihoods, disease transmission, and infrastructure. The direct effect is caused by heat stress and weather-related extreme events that result in increased morbidity and mortality while the indirect effect is caused by climate-mediated change observed in the incidence of climate-sensitive diseases and deaths. The major indirect health effects include under nutrition due to variability in agricultural production and food security. Without the proper adaptation and mitigation strategies, the effects of climate change will worsen in sensitive sectors including agriculture, health, and water.

Ethiopia is prone to natural and human-made hazards like drought, flood, landslide, and conflict. Several parts of Ethiopia like south and east Tigray, East Amhara, East Oromiya, Somali, and Afar were frequently affected by recurring drought. Similarly, people living alongside Lake Tana, Awash River, Baro River, and the lower part of Omo River are affected by overflow flooding.

Moreover, several climate-sensitive diseases such as malaria, cholera, diarrhoea, dengue, yellow fever, and chikungunya are present and substantial evidence that transmission is heightened by climatic factors.

Malaria is expanding to high lands as high land temperatures get warm with climate change and are favourable to mosquito breeding. Cholera outbreaks become frequent following drought and flood occurrence. Dengue fever cases were reported for the first time in 2014 in Afar, Somali, Harar, and Dire Dawa. Similarly, Yellow fever was also reported in South Omo after 60 years. Certain respiratory conditions, such as asthma and allergies, are influenced by climate factors like air pollution, pollen levels, and extreme weather events. Recently, there are cholera outbreaks reported in some of the Woredas in the country.

In order to more directly address the impacts of climate change on different sectors, the country has developed various climate policies and strategies. In 2019, Ethiopia developed its National Adaptation Plan (NAP). Following the development of the NAP, the MOH recognized the need to develop a Health National Adaptation Plan (HNAP) in line with the options and strategic priorities for the health sector identified in the NAP-ETH. The HNAP has been

implemented from 2017 to 2020 to reduce the health impacts of climate change and strengthen adapting capacity to build a climate-resilient health system.

HNAP development and implementation period, there have been significant changes in the health system as well as the occurrence of various diseases, warranting a revision of the H-NAP (2018-2020) and the development of the NHAP-II in order to address the 2024-2028 period. In addition, the HSTP-II is designed and has incorporated many initiatives that expand the role of the health system. Moreover, the emerging and re-emerging climate-sensitive diseases are posing challenges in the prevention and control of effective and efficient interventions.

The occurrence and widespread antimicrobial resistance (AMR) to commonly prescribed drugs pertinent to climate change is becoming widely reported. Thus, multi-face adaptation actions considerably render co-benefits to minimize the scourges of resistance patterns at an alarming rate. Furthermore, the financial resource mobilization and the subsequent delay in implementation, competing priorities of the government were the key issues that call for the current revision of the HNAP for climate change in the health sector.

The overall goal of this HNAP is to improve the health system adaptation to climate change by realizing the following five objectives: 1) to reduce mortality and morbidity of climate-sensitive diseases; 2) enhance early warning and surveillance in the context of health emergency risk management; 3) enhance climate resilient health infrastructure; 4) universal health coverage amidst climate change; and 5) climate change informed Health workforce and community.

The HNAP will be implemented with the following key interventions: 1) strengthening leadership and multi sectoral collaboration for climate change; 2) developing health workforce for climate change and health; 3) strengthening climate risk monitoring and surveillance systems; 4) conducting sub-national vulnerability & adaptation assessments; 5) developing sub-national HNAPs; 6) promoting health and climate research; 7) enhancing health systems resilience and environmental sustainability to climate sensitive diseases and extreme weather events impact; 8) management of environmental determinants of health; 9) climate resilient and sustainable technologies and infrastructure; 10) climate-informed health programmes; 11) strengthen health promotion, education and community engagement in climate and health action; and 12) health financing for climate-related risks that includes applying for different types of Green Health Financing (GHF) approaches.

This HNAP will be implemented from 2024 to 2028. Since most HNAP activities will be mainstreamed into existing initiatives, projects and programmes; the total budget required is estimated to be 19, 994, 5968.00USD.

1. INTRODUCTION

1.1. Background

Climate change is a global phenomenon and all nations face the rising threats that it creates. Researchers believe that climate change is occurring as a result of anthropogenic factors, in particular, fossil fuel combustion and greenhouse gas (GHG) emissions from energy supply, transport, agriculture, industry, forestry, waste, and commercial and residential buildings [1]. It increases heat waves, droughts, flooding, and sea levels around the world. Each country is at risk for future impacts. Despite their limited contribution to global GHG emissions, least developed countries (LDC) are the most impacted countries by climate change [2, 3].

Ethiopia is extremely vulnerable to the impacts of climate change, which poses a setback to realizing the sustainable development goals (SDG). Additionally, there are important health risks linked to climate change in Ethiopia, including morbidity and mortality related to malaria, meningitis, respiratory disorders, heat waves, and floods[4]. Without the proper adaptation and mitigation strategies, the effects of climate change would worsen the situation in sensitive sectors including agriculture, health, and water[5].

Ethiopia has already suffered 10 major droughts since 1980, and the country's annual temperature has been rising by 0.37 degrees Celsius per decade [6]. People are at risk due to the drought's worsening effects on their access to food and water. Under a high emissions scenario, diarrheal deaths attributable to climate change in children under 15 years old are projected to be about 9.6% of the estimated 42,000 diarrheal deaths projected by 2050. Likewise, floods have resulted in loss of life and property as well as in the displacement of people[7].

The country has developed various climate policies and strategies in response to the impacts of climate change in different sectors. In 2019, Ethiopia developed its National Adaptation Plan (NAP-ETH), which provides further details on the country's strategies for adapting to climate change [8]. The NAP-ETH was formulated based on the Climate Resilient Green Economy (CRGE), ratified a decade before and modified through time to accommodate the development trajectory of the country [9]. Following development of the NAP-ETH, the Ministry of Health (MOH) recognized the need to revise the NHAP in line with the options and strategic priorities for the health sector identified in the NAP-ETH. The NHAP has been implemented from 2017 to 2020 to reduce the health impacts of climate change and strengthen adapting capacity.

Recently, the government of Ethiopia has unveiled a ten-year development plan which will run from 2020/21 to 2029/30. The development plan has mainstreamed sustainable development and climate resilient green economy in different sectors. Thus, the HNAP-I requires a revision based on policy and strategic plans of the health sector to address the health impacts of climate change and strengthen the adaptive capacity of the community and the health system by considering the past, present and future health impacts of the changing climate [10].

1.2. Rationale

The initial Health National Adaptation Plan, developed in 2017, embodied a goal to create a climate resilient health system. It drew from the country's CRGE, which aims to actively explore further integration of climate change adaptation into development and sectoral plans. In addition to the HNAP I period coming to an end, there are many changes in the health system and the occurrence of various diseases which has warranted revision of the HNAP (2018-2020)

to NHAP-II for the period (2024-2028). First, HSTP-II is designed and has incorporated many programs and initiatives that expand the role of the health system. Second, the emerging and re-emerging of climate-sensitive arboviral diseases in eastern Ethiopia has challenged the containment and prevention of the disease. Third, the occurrence and widespread nature of antimicrobial resistance (AMR) to commonly utilised drugs pertinent to climate change; thus, multi-faced adaptation actions are needed to minimize the impacts of resistance occurring at an alarming rate.

Furthermore, the lack of financial resource mobilisation, subsequent delays in implementation, competing priorities of the government were the key issues that called required a revised and more feasible adaptation plan for climate change in the health sector.

1.3. Guiding principles

The implementations of the HNAP II are guided by the principles of coherent interventions, stakeholder engagement, gender sensitivity, equitable implementation and partnership. The adaptation options or interventions identified in the HNAP II considered the variations in topography and climate regimes and heterogeneity in social, cultural and economic factors across the country. On the other hand, gender is considered as a key factor in the HNAP, recognizing that women, people with disabilities, children, and elders are particularly vulnerable to the impacts of climate change, due to socio-economic factors that limit their adaptive capacity.

To this end, all the interventions will have a significant contribution in improving the health system. All stakeholders and communities should participate in and benefit from the adaptation actions.

2. SITUATIONAL ANALYSIS

2.1. Climate Situation in Ethiopia

Ethiopia is in the tropical zone lying between the Equator and the Tropic of Cancer. It's located within 3.3°N-15°N and 33°E-48°E, in the Horn of Africa, currently populated around 127 million[11]. It has a land mass of about 1.14 million square kilometres. Ethiopia is cleaved into eastern and western escarpments with high and uneven plateaus and peripheral lowlands by the Great African Rift Valley. Ethiopia is a country with wide range of climatic conditions and biodiversity[12]

There are three climatic zones in Ethiopia according to the elevation/ altitude; such as Kolla, Woinadega, and Dega. Kolla (Tropical zone) - is below 1830 metres in elevation and has an average annual temperature of about 27 degrees Celsius with annual rainfall about 510 millimetres. For example, the Danakil Depression (Danakil Desert) is about 125 metres below sea level and the hottest region in Ethiopia where the temperature climbs up to 50 degrees Celsius. Woinadega (Subtropical zone or temperate zone) - includes the highland parts of the central plateau areas of 1830 - 2440 metres in elevation and has an average annual temperature of about 22 degrees Celsius with annual rainfall between 510 and 1530 millimetres. Dega (or cold zone) occupies the central sections of the western and eastern parts of the north-western plateau with the elevation of mostly above 2400meters in elevations, and daily temperatures range from near freezing to 16 °C with annual rainfall between 1270 and 1280 millimetres[13, 14].

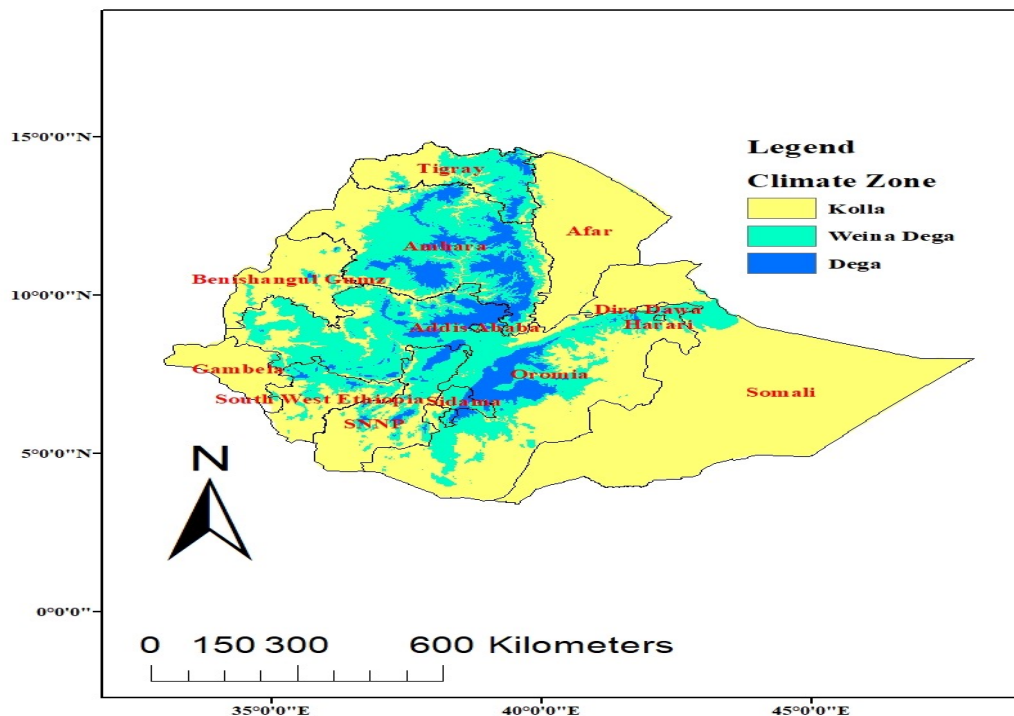


Figure 1: Geography and climatic zones of Ethiopia

According to rainfall distribution pattern, Ethiopia has three Meteorological seasons. Bega is starters from October and ends in January. It is the dry season with frost in the morning especially in January. Parts of Southern and Southeastern Ethiopia are the Bega rainfall benefiting areas. During this season, the daily minimum temperature is recorded up to -5 °C. Belg: it starts from February and ends in May. It is the autumn season with occasional showers. Sections of southwestern, northeastern and central are the main rainfall benefiting areas in belg seasons. During this season, there are high maximum daily temperature records; especially in the month of May. Kiremt is starts from June and ends in September. It is the summer and main rainy season for most parts of Ethiopia (50-80%). Parts of Western, Central, Eastern and Northern are the kiremt rainfall benefiting areas [15, 16].

The mean annual rainfall varies across the country and highlands get more rainfall compared to lowlands. According to the National Meteorological Services Agency, the highest mean annual rainfall of over 2,400 mm is in the south-western highlands of the Oromia Region. The amount of rainfall gradually decreases to about 600 mm in the north areas bordering Eritrea, and it drops to less than 100 mm in the north-east in the Afar Depression, and to around 200 mm in the south-east in the Ogaden Desert. The mountain areas over 3,500 m frequently receive snow and hail, but it usually melts within hours after it falls[15, 16].

The extreme change in seasonal rainfall has implications on malnutrition and vector borne disease outbreaks such as malaria, dengue fever and water borne diseases including cholera and dysentery. Likewise, climate extreme events are expected to become more frequent and intense over the coming decades, posing a severe threat to biodiversity, ecosystems, water supplies, agriculture, and, particularly, human health infrastructure[17-19].

Human activities, primarily through the release of greenhouse gases, have undeniably led to global warming, resulting in a global surface temperature increase of 1.1°C above the 1850-1900 average during the period of 2011-2020 (REF)[19]. The climate varies from hot and arid to cold and humid types. Unpredictable rainfall and rising temperature are signs of the impacts of climate variability and change in various areas of the country. The mean annual temperatures are around 15-20°C in these high altitude regions, whilst 25-30°C in the lowlands. Mean annual temperature has increased by 1.3°C between 1960 and 2006, an average rate of 0.28°C per decade. According to a World Bank 2008 report, Ethiopia's climate is predicted to warm between 0.7°C and 2.3°C by the end of the 2020s and between 1.4°C and 2.9°C by the 2050s[20].

As Ethiopia is a tropical country which is mostly the sun over headed and there is a high amount of evaporation that leads to a high amount of water vapour presence in the atmospheric air. The level of humidity also increased due to the presence of high water vapour in the air[20].

El Niño-Southern Oscillation (ENSO) is extensively influencing the rainfall system of Ethiopia and increasing the magnitude of drought and flood disasters[21]. An El Niño episode is associated with abnormally warm central and east equatorial Pacific Ocean surface temperatures(SST), which enhance belg rainfall and suppressed kiremt rainfall while the opposite phase (La Niña episode) results in reverse impact on seasonal rainfall [22]. As a result, both phases are associated with a characteristic spatial pattern of droughts and floods.

In general, the effect of El Niño in Ethiopia varies from place to place and can lead to drier conditions mainly in north western regions, affecting kiremt season. The typical example of El Niño was the 2015, which affected both belg and kiremt seasons. This 2015-16 El Niño episode caused drought across large parts of eastern, southern, and central Ethiopia [23, 24]. El Niño events are strongly related to increase maximum temperature across the country. At the national level malaria epidemics mostly occur following the main rainy season, Kiremt[4].

2.2. Policy frameworks

The 1995 Ethiopian Constitution illustrated climate change, public health, and the environment in multiple sections of the articles. Article 44 (1) states that all persons have the right to a clean and healthy environment and Article 92 (1) guarantees that the government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment. It also ensures that the design and implementation of programs and projects shall not damage or destroy the environment giving duty to the citizens to protect the environment[25].

Ethiopia's climate change policy framework has evolved since 1994, with submissions of its Initial National Communication (INC) to the UNFCCC, Second National Communication (SNC) in 2001, and launching various plans, including the National Adaptation Plan of Action (2007), Programme on Adaptation to Climate Change and Nationally Appropriate Mitigation Actions in 2010. The country has implemented a Climate Resilient Green Economy strategy since 2011 and has developed tailored sectoral policies and strategies, including the Climate Resilience Strategy (2015) and the National Health Adaptation Plan to Climate Change [26].

Ethiopian Nationally Determined Contribution (NDC) aims to reduce emissions from all sectors by 64% by 2030, following its ratification of the Paris Agreement in 2016. Ethiopia created its National Adaptation Plan (NAP-ETH) in 2017, and subsequent initiatives, including gender analysis, the NAP Implementation Roadmap, and the NAP-ETH Resource Mobilization Strategy, were created between 2018 and 2020. The country has integrated its climate change strategy into the Second Growth and Transformation Plan (GTP II) 2015-2020 which is currently updated to the ten-year perspective development plan (2021 – 2030). The plan has six pillars of which building a climate resilient green economy is one of the key pillars[27].

The policy frameworks for Health National Adaptation Plan II guide and coordinate effort towards mainstreaming climate change adaptation into health and other sector. It highlights the need to update HNAP I (2017 – 2020), to mainstream adaptation actions, conduct vulnerability assessments, build capacity; establish early warning systems, open channels of dialogue with communities at risk as well as assist their efforts in adapting and seek valuable research contributions from partners around the world. This framework is the means by which the country hopes to reduce its vulnerability to climate-related health hazards and develop healthy, sustainable communities.

2.3. Health risks of climate change

At present, climate-related health risks stand as one of the foremost threats to human well-being. Extreme weather events cause breakdown of infrastructure networks and critical services such as electricity, water supply, health and emergency services. Natural disasters like flood, drought, and heat stress occur more frequently due to climate change [28-30].

In Ethiopia, flash and inland flooding has been occurred with various intensities and scales in different occasions. Among places frequently hit by flash flooding are around Lake Tana, middle and lower course of Awash River, lower course of Omo River, sideways of Baro River, lower course of Wabe Shebelle River, and Abay River. Currently, flash floods have displaced millions and damaged infrastructure such as water points, schools and health centres[31, 32].

Floods arise from heavy rainstorms in hilly highlands that lead to water flows that turn dry riverbeds or flood plains into powerful flows disturbing human settlements, croplands and infrastructures. Most of the river areas are at risk of flooding during Kiremt season. Recurring and increasing floods in recent years that affected Afar, Oromiya, Amhara, southern Nations Nationalities and People (SNNP), and Addis Ababa Regions are of consideration due to the changes to human health and well-being that this represents [33].

At the same time, drought has a long history in Ethiopia. In previous decades, the occurrence of

drought was every ten years. However, recently, more extreme and severe droughts have occurred frequently as was observed between 2002 and 2014/15 across the country [34]. It affected East Oromia, East Amhara, East & south Tigray, major parts of Afar, and Somali Regional States [35, 36].

Mean temperature is increasing in the lowlands and highlands of the country. As a result, temperature extremities have been increasing which have a significant impact on human health (i.e. heat stress and heat exhaustion). In particular, the east and west lowlands such as Gode, Dalol, Humera, Gambela, and Metema are known for their extreme heat [7, 17].

Recently heat waves have emerged as a critical factor that is on the rise in Ethiopia, including Afar, Gambela, and Somali Regions [20, 37, 38]. Global evidence highlights that extreme heat can cause mortality and hospitalizations both directly, due to hyperthermia and related acute illness, and indirectly exacerbating preexisting conditions such as cardiovascular and pulmonary illnesses [17].

2.4. Health impacts of climate change

Human beings are exposed to climate change directly through changing weather patterns, such as heat waves and extreme events (floods, drought) and indirectly from changes in water, air, food quality and quantity, ecosystems, agriculture, livelihoods, disease transmission and infrastructure [7]. Additionally; indirect effects caused by climate-mediated change including under-nutrition, increasing incidence of malaria, meningitis, respiratory and diarrheal diseases are the major health threats [39].

2.4.1. Direct impacts of climate change

The rising frequency and intensity of natural hazard-related stressors and shocks increase the risk of direct mortality and/or injury. Ethiopia is already experiencing high riverine and flash flood risk. During the 2020 kiremt season, numerous rivers flood affecting more than 1 million people and displacing 292,863 of them [40].

By 2030, it is projected that there will be an additional 248,200 people per year at risk of riverine flooding due to climate change and more intense rainfall per extreme event [7, 41]. The increased flood risk may increase 1) mortality, either directly from drowning or indirectly through the increased transmission of water borne diseases and 2) morbidity, through injuries as people try to escape the approaching water or are hit by objects in rapidly moving water or by the increased incidence of waterborne diseases [40].

The number of ‘hot’ and ‘very hot’ days are increasing which will increase heat stress, heat exhaustion and heat stroke, posing major health threats to the elderly, those with co-morbidities (e.g. cardiovascular problems), and young children [42]. In Ethiopia, the “extreme heat” hazard is ranked as “high” and is expected to occur at least once every five years [40]. Heat-related deaths among elderly people (65+) are projected to reach over 65 deaths per 100,000 people by 2080 compared to the estimated baseline of less than 3 deaths per 100,000 people per year [7, 41, 43]. Workers engaged in outdoor jobs in low-altitude areas – e.g. farmers and builders – are likely to be adversely affected by exposure to heat [44].

2.4.2. Indirect impacts of climate change

2.4.2.1. Diarrheal Diseases

Climate change is increasing the magnitude of diarrheal diseases. Temperature and rainfall, in particular, play a major role in the transmission of diseases; influence the transport and dissemination of infectious agents, particularly through water and sanitation systems.

Cholera is one of the acute diarrheal illnesses caused by vibrio cholera, of usually sero-group 01 [45-47]. Globally, diarrhea is the leading cause of morbidity and mortality among less than 5

years old children, and it contributes to the deaths of approximately one million children every year.

In the African region, under climate change, an extra 48,000 deaths will occur in children aged below 15 years, mainly due to diarrheal diseases and 33,000 deaths by 2030 and 2050, respectively (WHO, 2014). Besides, increased frequency of floods, which increase under the changing climate, exacerbates challenges with water pollution and subsequently will increase the risks of diarrheal diseases [48]. The East Africa sub region is projected to be more adversely affected by cholera, particularly during and after El Niño events [49]. It is estimated that 20,000-30,000 additional cholera deaths will be attributed to climate change in children below 15 years[7].

In Ethiopia, diarrhoea is the leading cause of death and the second leading cause of premature loss of life in Ethiopia, all ages [50, 51]. In Ethiopia, it is estimated that about 70 million people are at risk of cholera, of those, an estimated 275,221 cases and 10, 458 deaths occurring annually. This represents an incidence rate of 4 cases per 1000 population [49]. Currently as of January 21, 2023 active cholera outbreaks are ongoing in all regions of Ethiopia except Gambela. The index case was from Harana Buluk Woreda in, August 27, 2022 & the first outbreak was confirmed on Sep 9, 2022 [52, 53]. Nationally 89 Woredas are affected with the cumulative case of 24,269 and 341 deaths [54]. The use of unsafe water from contaminated water sources, limited access to water and sanitation (WASH) services, poor hygiene practices, including open defecation and lack of water treatment options are among the factors that have contributed to the rapid spread of the disease across all affected Woredas[53].

2.4.2.2. Respiratory Disease

Indoor and outdoor air pollution is important causes of respiratory diseases. Extreme heat and humidity trigger asthma symptoms; and cold weather, by increasing cold exposure, will increase overall respiratory infections in individuals with underlying chronic obstructive pulmonary disease [55]. Most air pollution-related deaths are from heart disease and stroke, followed by chronic obstructive pulmonary disease (COPD), acute and chronic respiratory illness and cancers.

In Ethiopia, indoor air pollution is the 2nd and ambient air pollution is the 13th risk factor for disease burden [56]. From all environmental risk factors for disease burden, air pollution is the leading followed by WASH. According to a WHO report, the country has reported the highest number of air pollution related deaths followed by Kenya and Uganda [57].

Upper and lower respiratory infections are common in early childhood and may be exacerbated by air pollution. Respiratory illness among children are one of the leading causes of hospital admissions and deaths in Ethiopia, and chronic obstructive lung disease is a growing concern among women, who are most heavily exposed to household pollution due to cooking with biomass fuel [58]. In 2019 only, the number of deaths attributed to air pollution from various diseases is 77, 020 of which 67, 826 deaths are due to household air pollution from solid fuel use. More than 95% of all households and 75% of the urban residents primarily use solid fuels for cooking. It is estimated that 63% of 36,800 child deaths occurring annually in Ethiopia due to acute lower respiratory infections is attributable to household air pollution [59]. In Ethiopia top twenty specific leading causes of death regardless of age and sex, Lower respiratory infections are the top three causes of death [51].

The association between under-five mortality and household air pollution exposure was statistically significant in one-thirds (33%) of the mortality reported in exposed categories[58]. National survey, EDHS 2016, revealed that most of the Ethiopian households (92.1%) use biomass for cooking and estimated to account 4-6% under five-year age mortality[59]. The rest of the cooking energy sources are (3.2%) and charcoal (4.7%), which is estimated to contribute 2-4% and 4-6% mortality respectively[60].

On the other hand, meningitis is one of the climate sensitive diseases that has repeatedly occurred in Ethiopia. Dusty winds and respiratory infections are the peculiar features of the dry season. This weather is common in Rift Valley and adjoining areas during the drier season. Although projection specific to climate and meningitis prevalence in Ethiopia is absent. As dryness prevails with rising temperatures and increased environmental changes, the likelihood of future meningitis will likely be higher.

Measles is one of the primary causes of infant mortality in Ethiopia with nearly 70% of the reported cases of Measles being among children under the age of 15 years. Some modelling studies have indicated that there could be as many as 1.5 million cases of Measles in all age groups and 70,000 deaths in Ethiopia annually. In Ethiopia, measles cases are endemic to the country and reported every year.

As of May, 2023 the annual number of confirmed measles cases has increased to 6933. The increase has been significant from 1953 in 2021 to 9291(>375%) in 2022[61]. Whilst there is association between climate variability and the occurrence of Measles outbreaks (e.g. a low relative humidity was found to be a risk factor for Measles morbidity), the links between Measles and climate change are more directly mediated by the dynamics of displaced populations (Yang et al. 2014). For example, a prevailing drought in the Horn of Africa in 2011 led to an influx of mostly unvaccinated refugees from Somalia which led to an increase in Measles cases in Ethiopia[62].

2.4.2.3. Under nutrition

Climate change affects nutrition through various causal pathways that impact food security, sanitation, water and food safety, health, maternal and child health care practices. Climate change is predicted to increase the risk of hunger and under-nutrition over the next few decades (82). According to the IPCC, under-nutrition linked to extreme climatic events may be one of the deadliest consequences of climate change (6). A study which assessed the prevalence of rural and urban food energy deficiency in selected African countries highlighted Ethiopia as h among the most food insecure countries in the study[63].

Climate change worsens unsustainable food systems by directly impacting soil fertility, rain patterns, crop yields and food production, food-nutrient and anti-nutrient composition, and nutrient bioavailability. These changes decrease macro and micronutrients available in the global food supply. Further problems arise from indirect impacts such as pests that result in increased occurrence of spoilage and food safety hazards at various stages of the food chain from primary production to post-harvest protection through to consumption[63]

The risk of food insecurity and under-nutrition is highly likely to increase due to higher temperatures, land and water scarcity, flooding, drought and displacement which, together, will negatively impact agricultural production [64, 65]. In particular, there is high confidence that traditional pastoralist systems are highly vulnerable to the impacts of climate change and that poorer regions will bear the brunt of food insecurity[66, 67]

In Ethiopia, the rain-fed agriculture is vulnerable to below normal rainfall distribution, which commonly affects food production and causes food insecurity, leading to under nutrition due to inadequate nutritional intake and disease. This is heightened in households relying on subsistence farming [68].

Children under five and pregnant women are more likely to be undernourished if they are born in a drought season in Ethiopia [69]. Severe acute malnutrition is believed to affect approximately 400,000 children and at least 2.7 million more children suffer from moderate acute malnutrition in the country[70]. On the other hand when there is food shortage, women will preferentially feed members of their families first, increasing the women's risks of under nutrition[70, 71].

2.4.2.4. Vector-borne diseases

Climate change creates a strong influence on the life cycles of the vectors; hence, vector-borne diseases such as Chikungunya, Dengue Fever (DF), Leishmaniasis, Malaria and Yellow Fever are highly sensitive to changing climatic conditions posing significant public health impacts. They are influenced by population growth, urbanisation and control measures. Regarding the geographical locations of vulnerable groups, the landscapes which are highly susceptible to climate-sensitive disease are the lower and middle regions of the country, such as the west, eastern and north eastern part of Ethiopia [72].

Rising temperatures impact the geographic distribution of mosquitos resulting in their spreading from lower altitudes to higher altitudes that were previously too cold for endemic levels of mosquitoes [73]. In addition, increased extreme rainfall resulting in floods and post-flood stagnant water is a major factor that also facilitates the spread of malaria by creating breeding sites of mosquito larvae[74].The earlier onset of the rainy season could increase the density of mosquito vectors that will further exacerbate the risk of disease spread. People working in fields inundated with standing flood water and without effective protection may experience higher exposure to mosquitoes [75].

Ethiopia has the highest rates of malaria cases and deaths among fifteen countries. In 2020, it accounted for 1.7% of global malaria cases and deaths, and 1.5% of malaria deaths [76]. In Ethiopia both adults and children are equally at risk for malaria infection and disease due to its unstable nature. Populations in the western lowlands and southern Ethiopia are highly exposed to Malaria [77]. However, populations in the previously malaria free highlands are more vulnerable to the disease as they have a lower immunity and show weak coping strategies compared to populations in endemic areas [78].

Currently, approximately 70% (76 million people) of the total population (109.2 million people) are exposed to mosquitos carrying malaria. By 2070, almost 130 million people are projected to be at risk of Malaria assuming a high emissions scenario [79].

Globally, DF incidence has increased 30-fold over the last 50 years, with increasing geographic expansion to new countries and, in the last decade, from urban to rural settings [80].In 2013 DF was first detected in Ethiopia, with over 12,000 DF cases reported.Since this time, outbreaks have been confirmed in the Northern and Eastern parts of the country. The first confirmed outbreak occurred in Dire Dawa, demarcated as both a city and a region and located in central-eastern Ethiopia. The outbreak impacted over 11,000 people[80]. The following year, in 2014, outbreaks occurred again in Dire Dawa, as well as in the south-eastern portion of the country in Somali Region and Afar Region, which is located in northern Ethiopia [80, 81]. Outbreaks have since occurred on a yearly basis in Somali and Dire Dawa, indicating that the virus has become well established within these portions of the country [82]. Additional evidence of DF in northern Ethiopia was detected in Tigray and Amhara parts of Ethiopia [83]. Chikungunya, another mosquito-borne disease, is of growing concern in Ethiopia and may not be gaining the attention needed. Data was not available on the projected incidence as a result of climate change [84].

Yellow Fever also has re-emerged as endemic in Ethiopia since 2013 (following 65 years of zero cases). Climate change is predicted to affect the magnitude of the disease burden along with its distribution via mosquitoes [85].

Leishmaniasis is transmitted by the bite of infected female sand flies and is caused by protozoan Leishmania parasites. Kala-azar (one of the main forms of Leishmaniasis) is fatal if untreated in over 95% of cases. Changes in temperature as well as rainfall and humidity affect the developmental cycle of Leishmania protozoan as well as the sand flies and reservoir hosts, meaning that climate change is likely to influence the distribution of this disease into areas in which it was not previously endemic; for example, into the highlands as well[86].

About 4,500 cases are reported yearly in Ethiopia. The disease is spread from hot to adjacent mid-highland zones, which has a potential to reemerge[87]. According to a previous projection more than one-thirds of Ethiopia's total land mass is at high and very high risk of visceral leishmaniasis endemicity, and above 3.2 million people live in areas at risk [88].

2.5. Zoonotic diseases

Climate change is a subset of the larger set of ecosystem change that is promoting the emergence and re-emergence of animal diseases. It affects livestock health through several pathways.

These includes effects on pathogens, such as higher temperatures affecting the rate of development of pathogens or parasites; effects on hosts, such as shifts in disease distribution that may affect susceptible animal populations; effects on vectors, such as changes in rainfall and temperature regimes that can affect both the distribution and the abundance of disease vectors; and effects on epidemiology, like altered transmission rates between hosts, food safety and animal production [89]. Hence, the spread of zoonotic diseases is a high risk in Ethiopia due to direct contact with livestock or domestic animals. Furthermore; based on a zoonotic disease prioritization process conducted by CDC, five from 43 potential zoonotic diseases were selected for the target prevention and control activities; these include rabies, anthrax, brucellosis, leptospirosis, and echinococcosis[90].

2.6. Non-communicable Diseases

The links between climate change and non-communicable diseases (NCDs) may be direct (e.g., impacts of heat or inclement weather on physical activity or underlying chronic disease) or indirect (e.g., impacts on global agriculture, trade, and food security), are not easy to unravel, and are largely unreported for Africa Women, children, the elderly, immune-compromised people and those with low socioeconomic status are the most vulnerable to NCDs impacted by climate change[91].

NCDs and climate change are intrinsically linked, and can be addressed in tandem. Key areas for co-benefit action exist across energy production, transport systems, and food systems. These sectors are leading sources of emissions which contribute to air pollution and global warming.

Outdoor air pollution alone is responsible for 3.7million deaths annually, due to cancer, respiratory disease, and cardiovascular disease. Emissions can be reduced through transitioning from fossil fuels to renewable energy, promoting active transport such as walking and cycling, and enabling access to locally produced, unprocessed, plant-based diets. These latter two interventions also serve to combat physical inactivity and poor nutrition.

2.7. Mental Health

Mental health is a crucial public health concern, which is principally exacerbated in settings experiencing more frequent climate-related disasters. Mental health is a crucial public health concern, which is principally exacerbated in settings experiencing more frequent climate-related disasters.

Direct effects of climate change on mental health can arise when people are exposed to more frequent, more severe, and longer-lasting natural disasters and extreme weather. Likewise, high temperatures are strongly associated with adverse mental health outcomes and suicide[92].

Climate change impacts mental health in two ways; first, direct physiological effects on the brain are hypothesized to influence emotional control, aggression, and violent behaviour. This

direct effect appears to increase suicide rates on hot days. Second, high temperature generates negative economic shocks on people who are dependent on agriculture. These economic losses have been shown to translate into increased suicide risk [93].

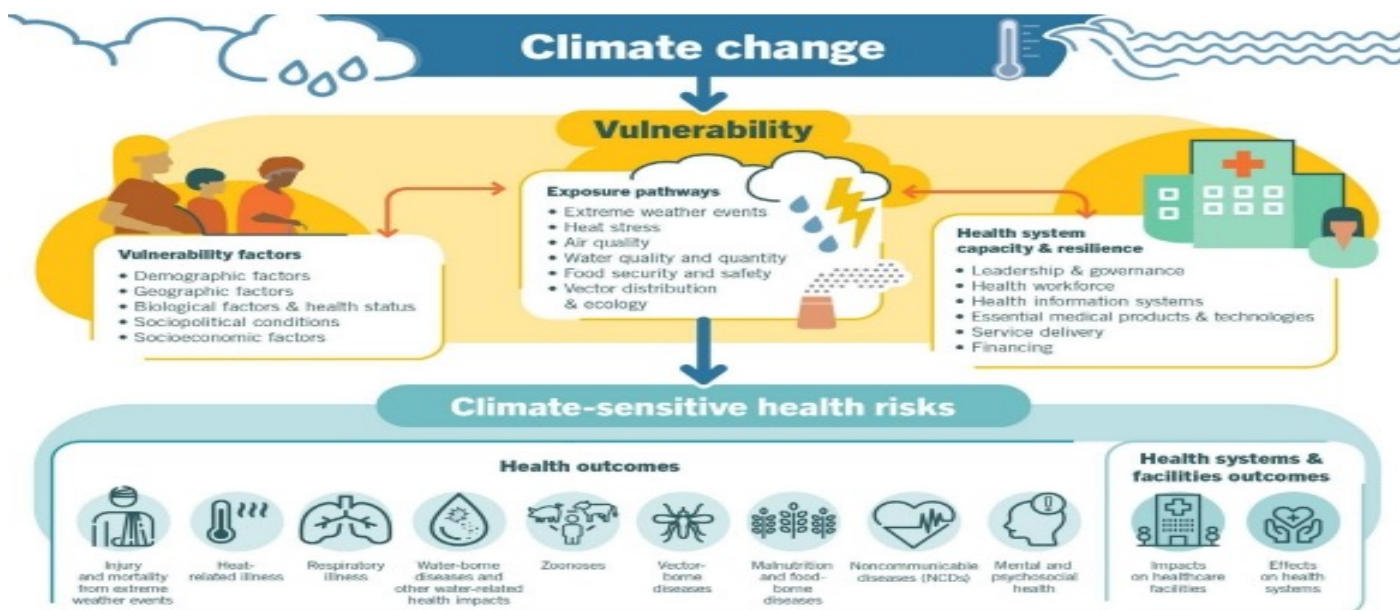


Figure 2: Major health risks associated with climate change (Source: WHO, Quality Criteria for Health National Adaptation Plans, 2021)

People in drought prone areas of the country are suffering from mental disorders as they are struggling to find water in their living areas. In particular, pastoralist communities are the most vulnerable ones to mental health problems due to drought induced water scarcity [94]. In this regard, prioritising health related adaptation intervention through understanding local cultural and social contexts is crucial to reduce the climate change impacts on mental health.

2.8. Stakeholder Analysis and engagement

Changing climate is affected by the sectors or systems including agriculture, water, transport, industry and environment.

The Ministry of Health identified key sectors and systems what climate hazard each of the sectors could contribute in ether emission of GHGs and/or improve adaptive capacity.

Table 1: Stakeholders engagement in health national adaptation plan (hnap) implementation

Actors	Roles and responsibilities (key activities)
Inter-sectoral steering committee	<ul style="list-style-type: none"> • Provide direction in the implementation process and make a decision for the implementation of HNAP • Oversee cross-regional and cross-sectoral issues related to the implementation of HNAP
Ministry of water and Energy	<ul style="list-style-type: none"> • Share relevant data/information on water and sanitation, water quality, and other health related issues • Provide technical support in conducting climate related diseases surveillance and related issues
Ministry of Finance	<ul style="list-style-type: none"> • Allocate adequate budget for HNAP implementation • Monitor and control finance utilization for the project implementation
Ethiopian Environmental Protection Authority	<ul style="list-style-type: none"> • Ensure the integrations of key intervention of the health sector's adaptation plan and facilitate the implementation process • Provide technical support for actors in the health sector • Conduct monitoring and evaluation to ensure proper implementation of HNAP
Ministry of Education	<ul style="list-style-type: none"> • Ensure the climate change and health issues are integrated in the curriculums of education
Ministry of agriculture	<ul style="list-style-type: none"> • Conduct emergency preparedness collaborating with Ministry of Health in response to climate change impacts on health • Provide relevant information on zoonotic and vector borne diseases prone areas to strengthen health sector early warning system • Provide information about the conditions and coverage of reservoirs in various areas of the country to prevent climate related zoonotic diseases
Ministry of transportation and logistics	<ul style="list-style-type: none"> • Provide data/information on GHGs emission from the transport sector including vehicles and road construction to prevent respiratory diseases induced by air pollution • Greening transport and promote environmentally friendly transportation technologies and methods
Ethiopian Meteorological Institute	<ul style="list-style-type: none"> • Provide weather and climate data • Conduct timely forecasting in a permanent way • Share area specific and timely early warning information/ data • Collaborate with Ministry of Health on Climate Sensitive diseases (CSD)
Ethiopia Disaster risk Management commission	<ul style="list-style-type: none"> • Conduct national disaster risk assessment and share the assessment reports to MOH • Provide technical support in public health emergency responses and climate induced disease outbreaks

Actors	Roles and responsibilities (key activities)
Ethiopian Pharmaceutical supply Services (EPSS)	<ul style="list-style-type: none"> • Provide adequate medical equipment and supply for time of emergency (i.e. climate related disease outbreak)
Ethiopian Public Health institute	<ul style="list-style-type: none"> • Provide data on climate sensitive disease surveillance, WASH, environment and zoonotic diseases for early warning system and decision-making process • Provide information and risk mapping on disease epidemiology indicating areas prone to climate sensitive and zoonotic diseases • Establish/revitalize National Emergency Operation Centers (NEOC) during health emergencies
Regional Health Bureaus and City Administrations	<ul style="list-style-type: none"> • Supervises the implementation of programmes at all levels in the region, prepares reports, and submits to relevant MOH • Performs quarterly monitoring missions, as required • Conduct periodic joint monitoring missions, as required by the HNAP • Establish/revitalize Emergency operation Centers (EOC) during health emergencies • Facilitate capacity building and resource mapping at the regional and city administration level
Media	<ul style="list-style-type: none"> • Awareness creation and information dissemination on climate change, climate sensitive disease, and health
Universities	<ul style="list-style-type: none"> • Human resource development for climate and health • Improve knowledge and skill of health professionals on climate and health through tailored trainings • Conduct and disseminate research on the climate change and health.
Civil societies	<ul style="list-style-type: none"> • Support government efforts through advocate and awareness creation.
Development Partners	<ul style="list-style-type: none"> • Mobilize and allocate resources to implement HNAP • Involve in monitoring and evaluation of HNAP

3. NHAP-II: VISION, MISSION AND STRATEGIC OBJECTIVE

3.1. Vision

To protect human health from the potential impacts of climate change in Ethiopia through building a climate resilient health system.

3.2. Mission

To strengthen a climate resilient and adaptive health system in Ethiopia that safeguards the well-being of its citizens through multi-sectoral coordination, capacity building, evidence generation, and community engagement.

3.3. Strategic objectives

The overarching objective of HNAP-II is to reduce mortality and morbidity of climate related health risks, improve health system adaptation to climate change and ensuring universal health coverage by realizing these eight strategic objectives to:

1. Strengthen multi-sectoral collaboration for better climate and health governance and leadership.
2. Develop the capacity of health and non-health sectors to adapt, anticipate and mitigate impacts of climate change on health.
3. Strengthen climate risk monitoring and integrated surveillance system for tracking, early warning and responding to climate induced health hazard
4. Generate and utilize evidence on the health risks and effects of climate change at national and sub national level through continuous assessment and research;
5. Protect human health from adverse effects of climate change through mainstreaming climate change in all programs in health and health determining sectors through health in all policy.
6. Strengthen climate-resilient and sustainable infrastructure and technologies for health
7. Strengthen community engagement about climate change and its effect on health; through public awareness.
8. To ensure sustainable financing for climate and health through enhanced capacity to access available climate fund.

3.4. Targets

The implementation of climate change and health adaptation strategies and action plans (2024-2028) aims to meet following targets by 2028:

- Establish/revitalize multi-sectoral Climate and Health coordination mechanism (steering committee and Technical Working Groups) at national and all regions with specified role and responsibilities.
- Develop capacity of at least 3000 health professionals on climate change and health related subjects.
- Develop capacity of at least 20000 community health workers, community representatives and volunteers on climate change and health related subject

- Introduce and deliver courses on climate change and its effects on health in school and university curriculum.
- Establish online training system on climate change and its effect on public health related subject
- Establish 28 new Climate Sensitive Diseases (CSD) and non-communicable climate induced health problem sentinel sites in Ethiopia
- Ensure the application of EWARS plus prediction tool to forecast the occurrence of climate sensitive diseases outbreak by all regions and CSDS sentinel sites
- Ensure the functionality of all national and regional public health laboratories without interruption including referral sample testing
- Conduct subnational vulnerability and adaptation assessment in all regions and city administrations
- Develop subnational health adaptation plan for all regions and city administrations
- Conduct at least 20 national and subnational level researches on climate change and health related subjects; publication and advertisement of research reports and articles.
- Produce 10 policy brief from research finding on climate change and health related topics
- Develop an Emergency Preparedness and Response plan (EPRP) for all priority one Woredas related to climate change risk
- Implement climate resilient water safety plan and environmental determinants of health in all Woredas of the country
- Avail climate resilient technologies and infrastructure in all health centre and hospitals found in priority one Woredas for climate change risk
- Conduct social and community mobilization in a quarterly basis to mitigate consequences of climate change in all Woredas of the country
- Ensure all health programs and donors (governmental and non-governmental) have integrated climate change in their activity and allocated a budget to support the adaptation and mitigation effort
- Develop capacity of 150 health professionals on grant hunting and writing to mobilize resources supporting climate change adaptation and mitigation effort

4. KEY INTERVENTIONS

In Ethiopia, a comprehensive Health National Adaptation Plan (HNAP) has been meticulously crafted, aligning strategic objectives to combat the intersecting challenges of climate change and health risks. This plan intricately weaves together ten key interventions, each a vital thread in the tapestry of fortifying the nation's resilience.

At its core, the plan rallies for strengthened multi-sectoral collaboration, ensuring the health sector's representation in national climate governance structures (Intervention 1: Strengthening Leadership and Multi-sectoral Collaboration for Climate and Health). Through concerted efforts, stakeholders advocate for the inclusion of health in steering committees and contribute substantially to national climate strategies.

Simultaneously, a concerted effort emerges to bolster the capacities of both health and non-health sectors (Intervention 2: Developing Climate Change Informed Health Workforce and Community). Training modules on climate and health become a cornerstone, permeating not only through the health workforce but also reaching the grassroots by integrating this essential knowledge into school and university curricula. This proactive approach transcends boundaries, enriching communities and fostering a climate-informed society.

The plan's foresight extends to the foundation of resilience - a robust monitoring and surveillance system (Intervention 3: Enhancing Climate Risk Monitoring and Integrated Surveillance Systems). By expanding sentinel health facilities and integrating climate-sensitive disease surveillance, Ethiopia fortifies its ability to track, respond, and mitigate climate-induced health hazards. Furthermore, the establishment of early warning systems becomes pivotal, disseminating critical information to healthcare professionals and the public, fostering preparedness and swift response.

In the pursuit of knowledge, the plan lays emphasis on generating evidence through dedicated research endeavours (Intervention 5: Strengthen Health and Climate Research). This evidence, disseminated through engagement platforms and advocacy, becomes the bedrock for informed decision-making. It not only guides health programming but also influences policy at both national and sub-national levels.

A cornerstone of this integrated plan lies in mainstreaming climate change considerations across all health programs and sectors (Intervention 8: Mainstreaming Climate Change across Programs in Health and Health-Determining Sectors). Initiatives to manage environmental determinants of health echo the interconnectedness of climate and health.

Investments in climate-resilient infrastructure and technologies emerge as practical solutions (Intervention 7: Initiate Climate-Resilient and Sustainable Technologies and Infrastructure). Pilot projects in high-risk districts showcase the transformative power of low-carbon solutions and resilient infrastructure, setting a precedent for future endeavours.

Public engagement becomes a catalyst for change (Intervention 9: Rise Awareness of the General Public on Climate Change and Its Health Risks). By disseminating informational materials, mobilizing communities, and raising public awareness, the plan ignites a collective consciousness, rallying citizens to be active participants in safeguarding their health amidst a changing climate.

Yet, none of these efforts could materialize without sustainable financing (Intervention 10: Strengthen Financing for Climate and Health). The plan's advocacy to access available climate funds, integrate climate issues into funding mechanisms, and ensure equitable distribution of resources underlines its commitment to a sustainable and equitable future.

Together, these interventions form a cohesive narrative - a symphony of coordinated efforts converging towards a common goal: building a resilient Ethiopia where the nexus of climate change and health is met with proactive, integrated, and sustainable solutions. This Health National Adaptation Plan stands not merely as a document but as a testament to Ethiopia's dedication to safeguarding its population against the challenges of a changing climate.

Each Intervention, woven into the fabric of the HNAP, contributes a vital thread to the tapestry of a climate-resilient healthcare system. Each of these key interventions are discussed in detail in the following sections.

Intervention 1: Strengthening multi-sectoral collaboration for climate change and health

The will of political leadership to address the health risks of climate change are essential to ensure implementation across the full range of programs for climate-sensitive health risks. This includes ensuring collaboration among all relevant health divisions within the health sector and other relevant sectors. Climate change and health focal points will be designated within the ministry of health with a specific program of action and appropriate budget.

The Ministry of Health will be represented in the National Climate Change Steering Committee. During the five-year period, the steering committee will establish a technical working group to give technical support to the ministry of health.

The Steering committee (SC) will guide the implementation of these stated 11 interventions through the engagement of stakeholders. The SC will also design the data management and develop a framework for an integrated and comprehensive adaptation action and specific interventions for the health sector.

Cross-sectoral collaboration will be strengthened and synergies maximized to ensure that decisions taken in other sectors protect and promote health. For example, the sectors such as Environment, Agriculture, Transport, Water, Industry, etc. are key stakeholders that the health sector must involve in its efforts in the implementation of solutions to minimize health impacts of climate change.

Intervention 2: Developing Climate Change Informed Health Workforce

This intervention is aimed at creating a climate informed health workforce by strengthening professional capacity to anticipate and mitigate climate related health risks. Technical and professional capacity will be developed through continuous training, education and mentorship to understand and use climate information for health decision making as well as adaptation actions. To achieve this training guide will be prepared, Training of Trainers (ToT) will be provided for regional experts. Climate change and health leadership program will be initiated to enrol agents of change working in climate and health. Furthermore, training will be cascaded to health professionals at primary health care units.

Advocacy will be conducted for higher education institutions and health curriculum module on climate change and health for pre-service training be developed and institutionalized. In addition, the training material will be adapted to fit the MoH Continues Professional Development (CPD) platform. Training manuals & materials will be adopted for use online and the information can be available on website to inform health authorities, members of parliaments, policy-makers and implementing adaptation actions.

Intervention 3: Strengthening Climate Change Risk Monitoring and Surveillance System

Understanding the trends of hazards, diseases and their determinants help the early detection of potential disease and other health emergencies to facilitate timely intervention that

minimize negative health outcomes associated with climate change. Currently, sectors including health, agriculture, environment and meteorology conduct monitoring and surveillance but in a fragmented manner.

Thus, this plan of action will strive to identify and integrate monitoring, surveillance and related tasks of priority health determining sectors with the consideration of health in all policies.

Currently, there are a total of 14 Climate Sensitive Diseases Surveillance (CSDS) sentinel sites in the country. This plan will strengthen the existing sentinel sites and establish 28 new sentinel sites to have a total of 42 sites.

In this key intervention, health data will be organized to include temporal and spatial scales to be integrated with health determinant data collected from priority sectors and support the assessment of climate change and associated health impacts. This data will help to identify 'hotspots' for climate health risks and profiles that can be used for monitoring seasonal weather and climate.

The use of the Early Warning, Alert and Response (EWARS plus) tool to proactively predict the probability of climate sensitive diseases outbreak occurrence by integrating the data collected from various sectors is also one of the targets in this key intervention. The expansion and strengthening of existing laboratory capacity to test samples taken from suspected cases of climate change induced health problems is also a concern of the plan. MOH will scale up this surveillance and forecasting exercise by advancing the multi-sectoral coordination, coverage and data use taking spatial and temporal parameters into account.

Intervention 4: Sub-national Vulnerability & Adaptation Assessment

These assessments (might reference the WHO V&A guide) are critical to the HNAP process and assess which populations and geographic regions are currently and will be (through use of Health Impact Assessment (HIA) processes most vulnerable to climatic variability and change at sub-national level. It also aims to identify critical gaps in the health systems to protect populations, and will provide specific interventions to provide a timely response. The V&A will be prioritized for the most climate vulnerable regions and examine critical health risks related to heat stress, nutrition and vector-borne diseases separately, and consider how they interact with each other and with changes in other determinants. The vulnerability assessment process will involve a range of stakeholders and use information from various sources. The sub-national vulnerability and adaptation assessment as well as sub-national health adaptation plan is expected to be cascaded to regions and districts.

Sub national authorities and consultants will conduct vulnerability and risk assessment by identifying key climate hazards, develop and endorse sub national health adaptation plans, training & workshops for the health workforce.

Intervention 5: Strengthening Health and Climate Research

Developing research capacity on climate and health signifies a critical stride towards understanding, mitigating, and adapting to the evolving nexus between climate changes and public health. This activity encompasses a multifaceted approach aimed at fostering a robust research environment primed for investigating the complex interplay between climate dynamics and health outcomes. Initiatives within this activity include fortifying academic and institutional capabilities to conduct high-quality research on climate-related health concerns. This involves investing in training, knowledge-sharing platforms, and collaborative networks aimed at empowering researchers and institutions to delve deeper into this field. It also involves facilitating interdisciplinary collaborations, encouraging the convergence of various scientific disciplines to tackle the multifaceted nature of climate and health challenges.

Furthermore, this activity strives to stimulate innovation, promoting the development of novel methodologies, technologies, and tools specifically tailored to address the unique challenges posed by climate change on public health. Ultimately, building research capacity in this domain is pivotal for informing evidence-based policies, interventions, and strategies that can safeguard communities against the health impacts of a changing climate.

Research, findings, dissemination, advocacy, and learning from practical experience, aims to enhance the country's preparedness and response to the challenges posed by a changing climate in the context of public health.

This intervention involves the generation of evidence regarding the intersection of climate and health. Small research grants will be provided to support the execution of these vital research projects to better understand how climate change affects public health.

The dissemination of research findings is to ensure that the knowledge is put to practical use. The result and findings will be disseminated through knowledge exchange events organized at different level. Among these would be to establish in Ethiopia an annual climate change and health symposium to highlight the need for additional research, leverage research funding and support research institutional development around climate and health. These events will serve as platforms for communicating research priority areas to relevant stakeholders in the health sector and beyond.

The intervention also emphasizes the importance of advocating for the use of available evidence in health program planning and resource allocation. This implies that the research findings should directly inform the design and implementation of public health programs to better address climate-related health challenges.

Intervention 6: Promote management of environmental determinants of health

Management of environmental determinants of health is one of the key interventions aimed at building climate-resilient health systems to protect public health and improve the well-being of populations from climate change and related environmental risks. This area focuses on addressing the environmental factors that can have a negative impact on human health, such as air pollution, food, water/sanitation safety and waste management. In order to address the environmental determinants of health the implementation and monitoring of climate-resilient water safety plans, climate-resilient sanitation safety planning, air quality monitoring, and mainstream health impact assessment (HIA) in environmental and social impact assessment (ESIA), including climate risks. Some of the most effective actions that can be taken by health systems are in collaboration with other sectors, i.e., through promoting a "health in all policies" approach.

Intervention 7: Strengthen Climate-resilient and sustainable infrastructure and technologies for health

One important component of this plan is the provision of climate resilient health infrastructure and services. This includes ensuring that the location of health facilities and the building codes that are applied account for current and projected future climate risks, such as the potential for increased frequency and intensity extreme weather events such as heat, flooding/storms, and drought. It also includes consideration of climate resilience of essential environmental services to health facilities, such as water and sanitation services which may be compromised by flood or drought, and electricity supply that may be cut off during extreme weather events. The ministry of health will develop climate-resilient standards for health facilities including building codes and SOPs for green procurement in order to improve the quality of services, reducing the costs of maintenance and rebuilding infrastructures.

Use of technologies with lower energy demand can simultaneously increase resilience and decrease the impact of the health sector on the environment, such as reduced emissions of climate-altering pollutants associated with energy generation.

Selecting, piloting and establishing or upgrading climate resilient health facilities to sustain essential health services in selected high-risk districts and implementation of agreed interventions in each agro ecological zones of the country is one of the tasks which will be cascaded by the Ministry of Health. It is also anticipated that these will focus on low-carbon and resilient energy sources, energy efficiency interventions and climate resilient WASH capabilities in a manner that foster collaboration between key stakeholders notably the energy, water and other sectors.

Intervention 8: Mainstreaming climate change across programs in health and health determining sectors

Climate informed programming will continually review and adjust service delivery according to new information. Thus, mainstreaming of climate resilience in health programs and evaluation of ongoing programmatic implementation arrangements and interventions to assess the level of climate informed approach are planned as key activities to ensure climate informed health programs.

Mainstreaming of climate resilience agenda to health programs, from planning to grass roots implementation, is essential to ensure health program climate resilience and adaptation. In this regard, development of SOPs, which address climate resilience, customized to specific health programs including, but not limited to; FP/MNCH/SRH, water and sanitation, occupational health, nutrition, communicable and non-communicable disease control, mental health and health information and statistics, and public health emergency response that will lay the groundwork for mainstreaming. Subsequently, the establishment of mechanisms and platforms for the alignment or on-going review of strategic and operational plans and implementation arrangements of programs, with regard to current and projected (future) climatic conditions and strategic directions, will underpin long-term climate informed health programs.

Intervention 9: Awareness creation, and community engagement for climate and health

This intervention provides Social Behaviour Change Communication to engage communities in understanding the linkages between climatic impact on their health, well-being and livelihoods. It provides the health workforce with the skills and capacities to support health promotion and include climate and health in community engagement platforms and tools. This will reduce the impact of climate induced health problems by engaging the community through capacity building and integration into existing community resources.

The community will be engaged in the planning, implementation, monitoring and evaluation of climate and health actions through participatory approaches. This includes the development of awareness and community engagement materials on climate change and health, developing timely message delivery mechanisms, strengthening school health initiatives to obtain and disseminate climate and health information by using a variety of communication channels such as social media (Face book, telegram, WhatsApp etc), community meeting, radio, television, local communication platforms (dagu, ware etc) etc, to reach a wider audience will help to build trust and increase community participation.

MoH will coordinate climate change and health stakeholders for SBCC/RCCE including key influencers, and available community structures, Civil Society Organizations (CSOs) and public institutions, media, partners, community volunteers, Health Extension Workers etc. This will be facilitated by defined roles and responsibilities through guidelines and SOPs to ensure the

public's right to information and informed decisions to mitigate the impact of climate change on their own health.

Intervention 10: Strengthen financing for climate and health

Financing for climate and health is crucial in addressing the pressing challenges we face today. As the world grapples with the impacts of climate change and the health consequences it brings, it is imperative to allocate sufficient resources to mitigate and adapt to these issues.

Effectively protecting health from climate change will incur financial costs for health systems. In order to mobilize resources to these issues and above-mentioned interventions, assessments of resource requirements, available finance, finance gaps and opportunities to fill them, are all needed. Resource requirements can be assessed through budgeting of interventions selected in the previously described components, and compared with existing budgets and funding sources to identify shortfalls that need to be addressed through mobilization of new resources.

A comprehensive approach to financing health protection from climate change will first build on core investments in the health sector, such as investments to ensure adequate numbers of trained health personnel, and basic health infrastructure and services, which also help to address climate change risks. Moreover, resources can be mobilized through the NDA and other funding by the integration of climate and health into other climate funding proposals including investments in key health determining sectors.

Managing the finances in the Climate Change Fund, which are provided by the Government of Ethiopia, bilateral and multilateral agencies, under the international climate change and health funding sources that have been identified through the HNAP process are such as the Global Environment Facility (GEF), Green Climate Fund (GCF) by integrating climate considerations into proposals.

Through advocacy work decision-makers and planners in the Ministry of Health and Ministry of Finance are made aware of the intricate connection between climate and health.

Simultaneously, climate and health criteria are embedded in the selection process for investments and projects in sectors significantly influencing public health determinants. Advocacy work will be carried out for the inclusion of the health sector in global climate funds allocated to the country. This advocacy effort aims to secure dedicated funding streams specifically tailored for climate-resilient healthcare initiatives at the national level. By ensuring that these funding streams are accessible and available, Ethiopia guarantees a sustainable financial foundation for ongoing climate adaptation efforts within its healthcare sector. This strategic approach not only strengthens the healthcare system but also enhances the nation's overall resilience to climate-related health risks.

5. MONITORING AND EVALUATION

The MOH will be in charge of overseeing the proper implementation, effectiveness, progress, and impact of the HNAP through a robust M&E system. Regional and city administration health bureaus will facilitate and send monitoring and evaluation reports to the MOH. The below monitoring and evaluation framework show activity indicators linked with inputs output and outcome.

The HNAP evaluation will be conducted periodically to assess its effectiveness, efficiency, and sustainability. The appropriate evaluation methods, including impact evaluation or cost-effectiveness analyses, to generate evidence on the outcomes and benefits of specific interventions will be conducted. To ensure coordination of activities and avoid duplication of efforts, the HNAP monitoring and evaluation will be integrated with national monitoring and evaluation systems.

HNAP Monitoring and Evaluation framework								
Input		Activity		Output		Outcome		Impact
Policies and Strategies	→	Creating Functional National Technical Working group	→	Functional NHAP-TWG	→	Conducive environment created to implement NHAP	→	Climate change posed morbidity and mortality reduced
		National Vulnerability and adaptation Assessment		Vulnerability and adaptation Assessment Report				
		Developing National Health Adaptation Plan		endorsed NHAP				
Institutional arrangement	→	Strengthening multi-sectoral collaboration	→	functional laboratory service	→	Conducive environment created to implement NHAP	→	Climate change posed morbidity and mortality reduced
		Strengthening/ establish technical working group (TWG)		Established & functional TWG				
Train Technical Persons	→	Creating awareness on health effects of climate change and Adaptation options	→	People awarded of climate change's Health effect and adaptation options	→	Incidence and prevalence of climate sensitive health outcome	→	Climate change posed morbidity and mortality reduced
		Promoting climate resilient sanitation facilities		people encouraged to have climate resilient Sanitation facilities				
Training Materials	→	Expanding health services accessibility to natural disaster exposed areas	→	People have more access to health services	→	Incidence and prevalence of climate sensitive health outcome	→	Climate change posed morbidity and mortality reduced
		Adopt the prepared climate change and health training material to fit online training system (Blended)		Adopted training materials				

Figure 3: Logic model of h-nap implementation and expected impacts

Input		Activity		Output		Outcome		Impact
Training Materials	→	Promoting household water treatment and safe storage	→	households practiced water treatment & proper storage of water	→	incidence and prevalence of climate sensitive health outcome		
		Expanding the existing Climate and health sentinel surveillance	→	Climate and health sentinel surveillance expanded and conducted				
Manuals and guidelines	→	Revising and applying climate resilient health facilities building codes	→	the new building codes applied to building or renovating health facilities				
		Promoting climate change mitigation initiatives		people encouraged to practice mitigation activities				
Strengthen Health and climate research	→	Generate evidence on climate and health	→	Evidence generated				
		Document lessons learned		Lesson documented				
Promote the management of environmental determinants of health	→	Promote climate resilient sanitation safety planning	→	Sanitation safety plan prepared	→	People satisfied with health services provided		
		Promote and monitor air quality		Air quality monitoring conducted				
Budget	→	Expanding Community Health Insurance with priority to drought and flood	→	people encouraged to have health insurance				
		Develop health-specific funding mechanisms for climate change		Fund generated/collected				
		Promoting family planning through HEP and HDAs		people inquired to have contraceptives				

Priority Next Steps for Quarter I 2024:

1. Establish quarterly climate and health working group made up of ministry representatives and external organizations with an emphasis on climate and health
2. Determine during the first meeting of the national climate and health working group 4-5 technical working groups that will form and work more independently on core areas (e.g. capacity development, V&A assessment and research, financing, ...)
3. Follow-up on World Bank/USAID opportunities to support workforce development through climate and health leaders' program, JLN, and others
4. Next steps for malaria early warning systems to be funded, strengthened and expanded
5. Priorities Ethiopian regions for the initial V&A assessments to be carried out, collect existing relevant assessments and seek out funding mechanisms
6. Begin the process of planning a climate and health symposium in Addis Ababa for 2025 targeting dates, key institutions, etc.
7. Develop a strategic plan to promote CR WSP in existing and future projects
8. Set targets for refurbishing and funding climate resilient health care infrastructure
9. Determine first health program areas for mainstreaming and complete process in YR1
10. MOH development of national plan for integration of climate change and health into SBCC/RCCC with focus on most promising initial interventions and inclusion in HEW training plans and community engagement strategies
11. Develop a plan for establishing a logical pipeline of proposals that gradually increase availability of climate and health financing for Ethiopia.

TABLE 2: Key interventions, activities, subtasks with time frame, budget, M & E for HNAP-Ethiopia.

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E	
1. Strengthening Leadership and multi-sectoral collaboration for climate and health	1.1. Ensure that health sector is represented in the national climate governance structures such as CRG Steering Committee (SC)	Advocate and Ensure MoH leaders for representation of health sector in National Steering committee	1st quarter of 2024	2	0.036	ToR signed - SC first meeting held	
		Revise MoU of the SC to include Health Sector		2	0.036		
		Facilitate health sector contribution for the National Determined Contributions (NDCs)		4	0.071	Estimated health contribution of	
	1.2 Establish Multi-sectoral Climate and Health Technical Working Groups (TWG) with specified role and responsibility		Conduct Stakeholder mapping workshop	1st quarter of 2024	7	0.125	Stakeholders identified ToR Signed
			Agree ToR between key stakeholders		4	0.071	
			Undertake regular meetings		16	0.286	
			SC to identify TWG thematic areas for working groups		6	0.107	ToR signed - SC first meeting held
2. Developing Climate change informed Health workforce and community	2.1. Develop and endorse climate and health training guide	Identify key contents to be included	2nd quarter of 2024	6	0.107	Finalized training guide	
		Organize training guide development workshop		8	0.143		
		Finalize and endorse training guide		8	0.143		

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
2. Developing Climate change informed Health workforce and community	2.2. Provide Training of Trainers (ToT)	Provide training to sufficient numbers of regional experts (in 5 cohorts)	3rd quarter of 2024-4th quarter of 2025	16	0.286	# of regional experts trained
	2.3. Cascaded basic training to health professional at primary health care unit and communities	Conduct training in cluster in order to address all districts (50 training sessions)	1st-4th quarter 2025	50	0.893	At least one workshop delivered per region
	2.4 Introduce and update climate and health in into schools and university curriculum	Prepare module for pre-service training of health science curriculums	3rd quarter of 2024	20	0.357	Training modules
		Conduct advocacy workshop for higher academic institution	4th quarter of 2024	20	0.357	# of academic institutions
	2.5 Adopt the prepared training material on climate and health to fit online training system (blended)	Adopt training guide materials for online use	3rd quarter of 2024	5	0.089	Website launched
		Design and launch webpages		8	0.143	
3. Enhancing climate risk monitoring and Surveillance System	3.1. Expand existing sentinel health facilities to include additional 28 new sites (2 per region and city administration)	Identify sentinel sits	4th quarter of 2024	4	0.071	# of identified sentinel sites
		Fill equipment gaps	1st quarter of 2025	84	1.499	# of fully equipped sites
		Recruit national and regional TA	1st quarter of 2025	42	0.750	# of recruited TA
		Train public health surveillance officers and assign focal person	1st quarter of 2025	28	0.500	# of trained person
		Conduct supportive supervision for sentinel facilities over 2 years	1st to 4th quarter of 2025	84	1.499	Rounds of supportive supervision
		Evaluate and improve	4th quarter of 2026	5	0.089	

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
3. Enhancing climate risk monitoring and Surveillance System	3.2. Extend the climate sensitive diseases surveillance system to include non-communicable disease health risks	Avail reporting formats, case definition and related supplies	2nd quarter of 2024	5	0.089	Availed information sheets
		Agree and design data management and sharing framework -including digitalization and integration with DHIS2	3rd quarter of 2024	6	0.107	Designed data management framework
		Support operation of surveillance system over 2 years	4th quarter of 2026	42	0.750	Sessions of supportive supervision
		Evaluate and improve effectiveness of climate sensitive diseases surveillance system	1st quarter of 2027	5	0.089	
	3.3. Strengthen climate and health Early Warning System (EWS) capacity	Avail capacitated computer and server to run the tool (EWARS+) tool	3rd quarter of 2024	84	1.499	#. of capacitated computer and server
		update the outbreak forecasting tool	4 quarter of 2024	4	0.071	Updated tool
		Provide training on tool utilization	1st quarter of 2025	20	0.357	# of trained personnel
		Review implementation of early warning system	4th quarter of 2026	8	0.143	
		Disseminate messages on climate and health risks to healthcare professionals and direct to the public - e.g. television, radio, phone alerts etc.	2024-2028	4	0.071	Massage dissemination sessions

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
3. Enhancing climate risk monitoring and Surveillance System	3.4 Establish seasonal (quarterly) climate and health analysis and forecast	Agree structure of reporting and contributing analysts	First bulletin Dec 2024 - quarterly thereafter	5	0.089	Endorsed structure
		Disseminate seasonal forecast	First bulletin Dec 2024 - quarterly thereafter	40	0.714	Seasonal forecast shared
		Strengthen inter-sectoral data sharing	quarterly 2024-2026	5	0.089	Data sharing sessions
	3.5. Strengthen existing laboratory services and related suspected sample collection and referral system	Ensure availability of reagent for testing suspected arbovirus samples	3rd quarter of 2024	25	0.446	Availability of reagents
		Provide training for sample collector and sentinel site surveillance officers	4th quarter of 2024	8	0.143	Trained personnel
4. Conduct sub-national vulnerability & Adaptation assessments and develop sub-national HAP	4.1. Conduct sub-national vulnerability and adaptation assessment	Develop assessment tools and conduct workshop to prepare assessment tools, pre-test and standardize tools,	Sep.-Oct. 2024	6	0.107	Prepared assessment tool
		provide training workshop for data collectors	Nov. 2024	6	0.107	Data collectors trained
		Conduct vulnerability and risk assessment by identifying key climate hazards, identifying vulnerable areas/health systems/ healthcare facilities/ community, vulnerability and risk assessment mapping, determine adaptive capacity	1st- 3rd quarter of 2025	22	0.393	VA report
		Dissemination workshop	4th quarter 2025	4	0.071	Workshop report

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
	4.2 Develop and endorse sub-national Health Adaptation plan	Conduct consultative workshop	4th quarter 2025	4	0.071	Workshop report
		Develop and endorse sub-national HAP	4th quarter 2025	40	0.714	Sub-national HNAP endorsed
5. Strengthen Health and climate research	5.1 Generate evidence on climate and health	Deploy TWG to define and endorse multidisciplinary national research agenda on climate change and health.	1st quarter of 2025	6	0.107	Synthesised evidence, identified PH intervention
		Provide small research grants: Small research grants will be allocated to encourage and support studies focusing on climate and health issues.	annually 2025-2028	20	0.357	# of small research grants
	5.2 Disseminate available evidence on climate and health	Organize national level knowledge exchange event (e.g., a regular climate and health conference or symposium)	Annually from 1st quarter Of 2025	5	0.089	# of knowledge events held
		Conduct advocacy engagements (regional knowledge sharing - attendance and key conferences outside Ethiopia)	annually 2025-2028	4	0.071	Advocacy efforts evaluated in formal report
	5.3 Ensure utilization of climate and health evidence in health programming and planning	Ensure use of available evidence for health program planning and resource allocation	annually 2024-2028	4	0.071	# of researches utilised

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
6. Promote the management of environmental determinants of health	6.1 Implement climate resilient water safety plans	Raise public awareness on protection of water sources from open defecation	2026-2028	7.5	0.134	# of people reached
		Provide training on regular water quality monitoring and surveillance	1st quarter of 2026	8	0.143	# of trained of personnel
		Implement regular water quality test	quarterly 2025-2028	28	0.500	# of tests
		Procure water quality test kits and reagents	4th quarter of 2024	16	0.286	Test kits & reagents
		promote household water treatment	quarterly 2025-2028	8	0.143	# of HHs addressed
	6.2 Promote climate resilient sanitation safety planning	Provide training on sanitation safety planning (develop training manual and provide training) in (10 cohorts)	2026-2028	9	0.161	# of trained personnel
		Ensure sanitation strategies (like ODF, STIDU-Ethiopia) are climate resilient	2nd quarter of 2025	14	0.250	# of guidelines
	6.3 Promote and monitor air quality	Provide training on air quality monitoring	3rd quarter of 2025	14	0.250	# of trained personnel
		Raise public awareness on effect of air pollution		5	0.089	# of trained personnel
		Advocate on review and update of regulations on emission reduction measures		8	0.143	# of advocacy events
		Strengthen implementation of National Air Quality and Health Guideline		4	0.071	# of guidelines implemented

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
6. Promote the management of environmental determinants of health	6.4 Mainstream Climate and Health issue in environmental Impact Assessment	Advocate for integration of health impact assessment (HIAs) guidelines, and governance necessary for health sector engagement in the environment and social impact assessment (ESIA) Review and strengthen the joint implementation of ESIA	4th quarter 2025	8	0.143	# of signed MOU
7. Initiate Climate resilient and sustainable technologies and infrastructure	7.1 Promote climate resilient health infrastructure and technologies	Implement 'Guiding Criteria for Climate Resilient Healthcare Facility in Ethiopia'	4th quarter of 2024	5	0.089	# of health facilities implementing the criteria
	7.2 Pilot climate resilient health facilities and supporting systems in selected high-risk districts	Implement agreed interventions in the selected districts (one in each agro-ecological zones) -it is anticipated that these will focus on low-carbon and resilient energy sources, energy efficiency interventions and climate resilient WASH capabilities in a manner which fosters collaboration between key stakeholder sectors (namely energy and water and perhaps more).	2025-2028	84	1.499	
8. Mainstreaming climate change across programmes in health and health determining sectors	8.1 Conduct advocacy workshop for health players and managers to mainstream climate in their respective programs	Ensure integration of climate resilience issue in health programs such as MNCH/SRH, communicable and non-communicable disease prevention, Mental Health, Health statistics and information	2nd quarter of 2025	8	0.143	# health programs mainstream climate resilience

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
	8.2 Conduct advocacy workshop for health determining sector planners and managers to mainstream climate in their respective programs	Ensure integration of climate resilience issue in health determining sector programs such as water, agriculture, trade, industry,	2nd quarter of 2025	2	0.036	# of sectors mainstream health in their plan
9. Raise awareness of the general public on climate change and its health risks	9.1 Prepare and disseminate climate and health IEC/BCC material	Prepare climate and IEC/BCC material	quarterly 2025-2028	6	0.107	
		Disseminate climate and health IEC/BCC material		4	0.071	# of IEC/BCC materials
	9.2 Conduct social and community mobilization	Consult community and plan community mobilization	quarterly 2025-2028	5	0.089	Consultations
		Conduct community mobilization		4	0.071	# of events conducted
10. Strengthen financing for climate and health	10.1. Develop capacity for accessing available climate funds	Conduct resource mapping/assessment	1st quarter of 2025	2	0.036	Assessment report
		Train health professionals and consultants to develop and submit proposals for building climate-resilient health systems to international climate change and health funding sources (e.g. GEF, GCF, bi-lateral donors) (in 5 cohorts)	quarterly 2025-2028	10	0.179	# of health professionals trained

Key Interventions	Activities	Subtasks	Timeline	Budget (Birr m)	Budget (USD m)	M&E
	10.2. Ensure climate change considerations are included in proposals funded by health funding mechanisms	Advocate health sector planning unit (strategic affairs unit) to consider climate and health issue as cross-cutting issue and addressed in health planning and programming	annually 2024-2028	4	0.071	Advocacy event conducted
	10.3. To incorporate health and climate change considerations in projects and programmes to make funding available for sectors influencing health	Advocate importance of climate burden on health to ministry of health and ministry of finance decisions makers and planners	annually 2024-2028	4	0.071	# of higher sectoral officials participated
		Ensure consideration of climate and health issue as criteria for selecting investments/projects in key health determinant sector.	annually 2024-2028	4	0.071	# of sectors incorporating criteria in their plan
	10.4. To ensure availability and accessibility of climate change funding streams at the national level.	Advocate to ensure the health sector benefited from global climate fund the country receive	annually 2024-2028	3.5	0.062	# of advocacy events
				1088	19.421	
Total budget Birr (m)	1084					
Total budget US\$ (m)	19.9945968					

REFERENCES

1. Nadeau, K.C., et al., Climate change: A call to action for the united nations. 2022, Wiley Online Library. p. 1087-1090.
2. Blasiak, R., et al., Climate change and marine fisheries: Least developed countries top global index of vulnerability. *PloS one*, 2017. 12(6): p. e0179632.
3. Greene, L.A., EHPnet: United Nations Framework Convention on Climate Change. 2000.
4. Woyessa, A., et al., El Niño and other climatic drivers of epidemic malaria in Ethiopia: new tools for national health adaptation plans. *Malaria Journal*, 2023. 22(1): p. 1-19.
5. Gemedo, D.O. and A.D. Sima, The impacts of climate change on African continent and the way forward. *Journal of Ecology and the Natural environment*, 2015. 7(10): p. 256-262.
6. OCHA Services Relief Web. Extreme drought, worsened by global climate change rages through Ethiopia. 2021 [accessed 1 April 2023]; Available from: <https://reliefweb.int/report/ethiopia/extreme-drought-worsened-global-climate-change-rages-through-ethiopia#:~:text=Ethiopia%20has%20already%20endured%2010,second%20half%20of%20the%201990s.>
7. World Health Organization. Climate Change to Impact on Human Health in Ethiopia. 2015 [assecced 07 April 2023]; Available from: <https://www.afro.who.int/news/climate-change-impact-human-health-ethiopia>.
8. Network, N.G., IISD Head Office. 2018.
9. OCHA Services Relief Web. Ethiopia Launches 15 Year National Adaptation Plan to Address Climate Change. 2017 [assecced 2 April 2023]; Available from: https://reliefweb.int/report/ethiopia/ethiopia-launches-15-year-national-adaptation-plan-address-climate-change?gclid=Cj0KCQjw_r6hBhDdARIsAMIDhV9s2GoDrN9P5mEkR3Ri9vIFBYvq3DhU1-twehhVvf8vkQtaJpju-fMaAqf5EALw_wcB.
10. Ethiopian Environmental Protection authority, Ethiopia's Climate Resilient Green Economy: National Adaptation Plan. 2019, Ministry of Health
11. Ethiopia Demographics. Population of Ethiopia (2023). 2023 [accessed 12 October 2023]; Available from: <https://www.worldometers.info/demographics/ethiopia-demographics/>.
12. Teshome, A., et al., Skill Assessment of North American Multi-Models Ensemble (NMME) for June-September (JJAS) Seasonal Rainfall over Ethiopia. *Atmospheric and Climate Sciences*, 2021. 12(1): p. 54-73.
13. Cole, J.Y., The Library of Congress becomes a world library, 1815-2005. *Libraries & culture*, 2005: p. 385-398.
14. Knowlton, S.A., Three decades since prejudices and antipathies: a study of changes in the library of congress subject headings. *Cataloging & Classification Quarterly*, 2005. 40(2): p. 123-145.
15. Gonfa, L., Climate classifications of Ethiopia. 1996.
16. Walker, S., et al., The use of agroclimatic zones as a basis for tailored seasonal rainfall forecasts for the cropping systems in the Central Rift-valley of Ethiopia. *Insights and Tools for Adaptation: Learning from Climate Variability*, 2003: p. 1-7.
17. Patz, J.A., et al., Impact of regional climate change on human health. *Nature*, 2005. 438(7066): p. 310-317.
18. Rossati, A., Global warming and its health impact. *The international journal of occupational and environmental medicine*, 2017. 8(1): p. 7.
19. World Health Organization. Climate change. 2023 [assecced 23 December 2023]; Available from: <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>.
20. Simane, B., et al., Review of climate change and health in Ethiopia: status and gap analysis. *Ethiopian Journal of Health Development*, 2016. 30(1): p. 28-41.

21. Haile, B.T., et al., Analysis of El Niño Southern Oscillation and its impact on rainfall distribution and productivity of selected cereal crops in Kembata Alaba Tembaro zone. *Climate Services*, 2021. 23: p. 100254.
22. Kashki, A., M. Karami, and S.M. Hosseini, Analysis of El Niño–Southern Oscillation and its impact on precipitation distribution over Iran. *Arabian Journal of Geosciences*, 2022. 15(14): p. 1295.
23. Kasie, T.A., et al., The impact of the 2015 El Niño-induced drought on household consumption: Evidence from rural Ethiopia. *Climate and Development*, 2020. 12(9): p. 854-863.
24. Gleixner, S., et al., The El Niño effect on Ethiopian summer rainfall. *Climate Dynamics*, 2017. 49: p. 1865-1883.
25. Federal Democratic Republic of Ethiopia, FEDERAL NEGARIT GAZET A OF THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA. 1995.
26. Federal Ministry of Health, National Health Adaptation Plan to Climate Change (2017-2020). 2017, Federam Ministry of Health.
27. Federal Democratic Republic of Ethiopia, UPDATED NATIONALLY DETERMINED CONTRIBUTION. 2021.
28. Benavot, A., The invisible friend: Adult education and the Sustainable Development Goals. *Adult education and development*, 2018. 58: p. 4-9.
29. Rockström, J., et al., Climate change: The necessary, the possible and the desirable Earth League climate statement on the implications for climate policy from the 5th IPCC Assessment. *Earth's Future*, 2014. 2(12): p. 606-611.
30. Clarke, L.E., et al., Assessing Transformation Pathways. In: *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. 2015, Pacific Northwest National Lab.(PNNL), Richland, WA (United States).
31. Velpuri, N.M. and G.B. Senay, Assessing the potential hydrological impact of the Gibe III Dam on Lake Turkana water level using multi-source satellite data. *Hydrology and Earth System Sciences*, 2012. 16(10): p. 3561-3578.
32. Muala, E., et al., Estimation of reservoir discharges from Lake Nasser and Roseires Reservoir in the Nile Basin using satellite altimetry and imagery data. *Remote Sensing*, 2014. 6(8): p. 7522-7545.
33. Mulugeta, M. and B. Woldesemait, The impact of resettlement schemes on land-use/land-cover changes in Ethiopia: a case study from Nonno resettlement sites, central Ethiopia. *Journal of Sustainable Development in Africa*, 2011. 13(2): p. 269-293.
34. Kassaye, A.Y., et al., Quantification of drought severity change in Ethiopia during 1952–2017. *Environment, Development and Sustainability*, 2021. 23: p. 5096-5121.
35. Degefe, D., et al., Agricultural drought projection in Ethiopia from 1981 to 2050: Using coordinated regional climate downscaling experiment climate data for Africa, in *Extreme hydrology and climate variability*. 2019, Elsevier. p. 311-323.
36. OCHA Services Relief Web, SITUATION OVERVIEW. 2023: OCHA.
37. Alliance African Climate Change Resilience, Climate trends in Ethiopia: Summary of ACCRA research in three sites. 2011.
38. Alliance Africa Climate Change Resilience, Climate Trends in Ethiopia. 2011.
39. Kinay, P., et al., Direct and indirect health impacts of climate change on the vulnerable elderly population in East China. *Environmental Reviews*, 2019. 27(3): p. 295-303.
40. WHO and UN, CLIMATE CHANGE IMPACTS: ON HEALTH. 2021.
41. Azamjah, N., Y. Soltan-Zadeh, and F. Zayeri, Global trend of breast cancer mortality rate: a 25-year study. *Asian Pacific journal of cancer prevention: APJCP*, 2019. 20(7): p. 2015.
42. Filho, W.L., et al., A comparative analysis of climate-risk and extreme event-related impacts on well-being and health: Policy implications. *International journal of environmental research and public health*, 2018. 15(2): p. 331.
43. Hedegaard, H. and M. Warner, Suicide mortality in the United States, 1999-2019. 2021.
44. Angood, C., Stunting in protracted emergencies. 2016.

45. Safronetz, D., et al., Vectorborne infections, Mali. *Emerging Infectious Diseases*, 2016. 22(2): p. 340.
46. Tassoni, L., et al., Genetically different highly pathogenic avian influenza A (H5N1) viruses in West Africa, 2015. *Emerging Infectious Diseases*, 2016. 22(12): p. 2132.
47. Dennis, S. and D. Fisher, Climate change and infectious diseases: the next 50 years. *Ann. Acad. Med. Singap*, 2018. 47(10): p. 401-404.
48. Weill, F.-X., et al., Genomic history of the seventh pandemic of cholera in Africa. *Science*, 2017. 358(6364): p. 785-789.
49. Ali, S., et al., Twenty first century climatic and hydrological changes over Upper Indus Basin of Himalayan region of Pakistan. *Environmental Research Letters*, 2015. 10(1): p. 014007
50. Yigezu, A., et al., Burden of lower respiratory infections and associated risk factors across regions in Ethiopia: a subnational analysis of the Global Burden of Diseases 2019 study. *BMJ open*, 2023. 13(9): p. e068498.
51. Ethiopian Public Health, Ethiopia Health Atlas: Burden of Disease Unit (BoD), National Data Management Center (NDMC) for health, 2019. Ethiopia Public Health Institute. 2021, EPHI.
52. World Health Organization, Weekly Bulletin on Outbreak and other Emergencies: Week 1: 26 December 2022 to 1 January 2023. 2023.
53. World Health Organization, Weekly Regional Cholera Bulletin: 15 March 2023. 2023.
54. Ethiopian Public Health Institute, Bacterial Disease Surveillance and Response WePower BI Desktop ekly SITREP, Ethiopia. 2023.
55. Wood, A.M., et al., Outdoor air pollution is associated with disease severity in a1-antitrypsin deficiency. *European Respiratory Journal*, 2009. 34(2): p. 346-353.
56. Roth, G.A., et al., Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. *Journal of the American College of Cardiology*, 2020. 76(25): p. 2982-3021.
57. Hänninen, O., et al., Environmental burden of disease in Europe: assessing nine risk factors in six countries. *Environmental health perspectives*, 2014. 122(5): p. 439-446.
58. Shi, T., et al., Global, regional, and national disease burden estimates of acute lower respiratory infections due to respiratory syncytial virus in young children in 2015: a systematic review and modelling study. *The Lancet*, 2017. 390(10098): p. 946-958.
59. Tekile, A.K., A.A. Woya, and G.W. Basha, Prevalence of malnutrition and associated factors among under-five children in Ethiopia: evidence from the 2016 Ethiopia Demographic and Health Survey. *BMC research notes*, 2019. 12(1): p. 1-6.
60. Bickton, F., et al., Evidence for pulmonary rehabilitation in chronic respiratory diseases in sub-Saharan Africa: a systematic review. *The International Journal of Tuberculosis and Lung Disease*, 2020. 24(10): p. 991-999.
61. World Health Organization. Measles - Ethiopia. 2023 [accessed 21 December 2023]; Available from: <https://www.who.int/emergencies/disease-outbreak-news/item/2023-DON460>.
62. Tadesse, M., et al., Countdown to 2015: Ethiopia's progress towards reduction in under-five mortality: 2014 country case study. 2015.
63. Owino, V., et al., The impact of climate change on food systems, diet quality, nutrition, and health outcomes: A narrative review. *Frontiers in Climate*, 2022. 4.
64. Food and Agriculture Organization of the United Nations (FAO), Climate change and food security: risks and responses. 2015.
65. World Health Organization. Impact of natural disasters - Drought: impact on people. 2023 [accessed 23 October 2023]; Available from: https://www.who.int/health-topics/drought?gclid=CjwKCAjwkNOpBhBEEiwAb3MvvUDzcBNuOoOMr003CmdBvJGzPg_pgZIGT3zR16eNtwYJ6jHBfGOFupxoCkKcQAvD_BwE#tab=tab_1.
66. Program, W.F., Climate impacts on food security and nutrition: A review of existing knowledge. 2012.
67. Tilly Alcayna, et al., CLIMATE CHANGE IMPACTS ON HEALTH: ETHIOPIA ASSESSMENT. 2021, Red Cross Red Crescent Climate Centre

68. Mekonnen, A., et al., Climate change impacts on household food security and farmers adaptation strategies. *Journal of Agriculture and Food Research*, 2021. 6: p. 100197.
69. Gelebo, D.G., et al., Prevalence of undernutrition and its associated factors among pregnant women in Konso district, southern Ethiopia: a community-based cross-sectional study. *BMC nutrition*, 2021. 7: p. 1-13.
70. Schrier, L., et al., Medical care for migrant children in Europe: a practical recommendation for first and follow-up appointments. *European journal of pediatrics*, 2019. 178: p. 1449-1467.
71. Reddy, G., Food security and the humanitarian-development nexus in disaster response. 2020.
72. Zegeye, H., Climate change in Ethiopia: impacts, mitigation and adaptation. *International Journal of Research in Environmental Studies*, 2018. 5(1): p. 18-35.
73. Colón-González, F.J., et al., Projecting the risk of mosquito-borne diseases in a warmer and more populated world: a multi-model, multi-scenario intercomparison modelling study. *The Lancet Planetary Health*, 2021. 5(7): p. e404-e414.
74. Ashton, R.A., et al., School-based surveys of malaria in Oromia Regional State, Ethiopia: a rapid survey method for malaria in low transmission settings. *Malaria journal*, 2011. 10: p. 1-13.
75. Aliyu, A., K. Liman-Hamza, and A. Lawal, Floods in Sub-Saharan Africa; Causes, Determinants and Health Consequences: Floods in Sub-Saharan Africa. *Nigerian Medical Journal*, 2023. 64(1): p. 13-24.
76. Monroe, A., et al., Reflections on the 2021 World Malaria Report and the future of malaria control. 2022, BioMed Central.
77. Steketee, R.W., et al., World Malaria Day 2021: commemorating 15 years of contribution by the United States President's malaria initiative. *The American journal of tropical medicine and hygiene*, 2021. 104(6): p. 1955.
78. Kiszewski, A.E. and A. Teklehaimanot, A review of the clinical and epidemiologic burdens of epidemic malaria. *The Intolerable Burden of Malaria II: What's New, What's Needed: Supplement to Volume 71 (2) of the American Journal of Tropical Medicine and Hygiene*, 2004.
79. Organization, W.H. Global Malaria Programme. 2023 [Accessed 22 October 2023]; Available from: https://www.who.int/news-room/questions-and-answers/item/malaria?gclid=CjwKCAjwkNOpBhBEEiwAb3MvveBkDLXHLva8m4d7VSxS9HpNK6Sr54hjNo3K_Z141bsteZmBhz5lrhoCRL8QAvD_BwE.
80. Gutu, M.A., et al., Another dengue fever outbreak in Eastern Ethiopia—An emerging public health threat. *PLoS Neglected Tropical Diseases*, 2021. 15(1): p. e0008992.
81. Mera, G.A., Drought and its impacts in Ethiopia. *Weather and climate extremes*, 2018. 22(June): p. 24-35.
82. World Health Organization, Weekly bulletin on outbreak and other emergencies: week 28: 07-13 July 2018. *Weekly Bulletin on Outbreaks and other Emergencies*: 1-23, 2018.
83. Mekuriaw, W., et al., Epidemiological, Entomological, and Climatological Investigation of the 2019 Dengue Fever Outbreak in Gewane District, Afar Region, North-East Ethiopia. *Insects*, 2022. 13(11): p. 1066.
84. Waldetensai, A., et al., Aedes mosquito responses to control interventions against the Chikungunya outbreak of Dire Dawa, Eastern Ethiopia. *International Journal of Tropical Insect Science*, 2021: p. 1-10.
85. Oyono, M.G., et al., Epidemiology of yellow fever virus in humans, arthropods, and non-human primates in sub-Saharan Africa: A systematic review and meta-analysis. *PLoS neglected tropical diseases*, 2022. 16(7): p. e0010610.
86. Silva Nunes Bezerra, G., et al., Loop-mediated isothermal amplification methods for diagnosis of visceral leishmaniasis (kala-azar)—a systematic review. *Expert Review of Molecular Diagnostics*, 2020. 20(5): p. 455-465.

87. Gebremichael Tedla, D., F.H. Bariagabr, and H.H. Abreha, Incidence and trends of leishmaniasis and its risk factors in Humera, Western Tigray. *Journal of parasitology research*, 2018. 2018.
88. Tsegaw, T., et al., Identification of environmental parameters and risk mapping of visceral leishmaniasis in Ethiopia by using geographical information systems and a statistical approach. *Geospatial health*, 2013. 7(2): p. 299-308.
89. Zinabu, S., et al., Review on the relationship of climate change and prevalence of animal diseases. *World Journal of Veterinary Science*, 2018. 6: p. 6-18.
90. Epiz, R.S.T.O.I., One Health collaborations for zoonotic disease control in Ethiopia. *Rev. Sci. Tech. Off. Int. Epiz*, 2019. 38(1): p. 51-60.
91. Milanzi, E.B., et al., Air pollution and non-communicable diseases in Sub-Saharan Africa. *Scientific African*, 2021. 11.
92. US Global Change Research Program, Impacts of climate change on human health in the United States: a scientific assessment. 2018: Skyhorse Publishing.
93. Burke, M., et al., Higher temperatures increase suicide rates in the United States and Mexico. *Nature climate change*, 2018. 8(8): p. 723-729.
94. Cooper, S., et al., Environmental associated emotional distress and the dangers of climate change for pastoralist mental health. *Global Environmental Change*, 2019. 59: p. 101994