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CLIMATE CHANGE IMPACTS ON HEALTH:

KENYA ASSESSMENT

IFRC

Climate Centre

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EXECUTIVE SUMMARY

The global climate crisis will affect Kenya through increased temperatures over most regions increasing the number of 'hot' days (i.e. above 30°C) (certain); small increases in total rainfall in the rainy season (uncertain); and increases in the number of days with extreme rainfall leading to floods (likely). The climate crisis has the potential to deepen existing health vulnerabilities and create new ones, especially as Kenya hosts one of the largest refugee populations in Africa. The National Programme of Adaptation and the Intended Nationally Determined Contributions place a priority on climate change adaptation in the health sector.

The most urgent risks of the climate crisis to human health in Kenya are the geographic expansion of climate sensitive vector-borne diseases, an increase in waterborne diseases, and the nutrition implications of food shortages due to longer drier spells, increased land-surface temperature and water scarcity impacting agriculture.

Climatic stresses and shocks will also influence migration. Severe and frequent drought and floods in the region as well as conflicts have caused displacement and increased in-migrant refugees from neighboring countries (such as Ethiopia, the Democratic Republic of the Congo (DRC), Somalia and South Sudan). In Kenya, extreme climate conditions such as prolonged droughts, flash floods and epidemics are already affecting many rural communities and have the potential to undermine coping capacity and spiral these populations into crisis.

In addition, changes in access to agriculture for food and income has left women particularly vulnerable to transactional "fish for sex" relationships and may be linked with an increasing incidence of Female Genital Mutilation (FGM) in northern Kenya as young women are sent across the border to Ethiopia for cutting ceremonies and return to Kenya to be married in exchange for a dowry.

The urgency to act is clear. The purpose of the report is to act as a reference document on the likely impacts – direct and indirect – of the climate crisis on the wellbeing of people in terms of their health and livelihoods. The intention is that this report can act as a springboard for planning and implementing activities and programmes focused on climate action and adaptation. Some recommendations and opportunities for action have been offered, however, these should be considered as only a starting point to further complement and expand existing programmes and projects. Cross-sector and widespread collaboration between National Societies, government agencies and services, the private sector, NGOs, civil societies and our communities is key as no one organization alone can tackle the increased risks posed by climate change nor alleviate the exacerbated risks of vulnerable populations. Together, acting now, with the evidence at hand, it is possible to avert the most dire consequences of the climate crisis.

PHENOMENON AND DIRECTION OF TREND	LIKELIHOOD OF FUTURE TREND	MAJOR PROJECTED IMPACTS PER SECTOR	
		HEALTH (INCL. WASH)	SEXUAL AND REPRODUCTIVE HEALTH AND RIGHTS
SLOW ONSET/ STRESSORS			
Small increase in total rainfall in rainy and dry seasons over the long-term. Truncated rains (in March–May) in southern Kenya, October–December monsoon season lengthened in southern Kenya (IPCC 2018)	Uncertain	Rainfall patterns may influence vector-borne diseases (e.g. from mosquitoes); however, the attribution of increased Malaria cases as a result of climate change is low (IPCC 2018)	
Increased annual temperatures over most regions; more "hot" days	Certain	Number of heat-related deaths in the elderly increases; vector-borne diseases (Chikungunya, Dengue Fever, Malaria and Yellow Fever) expand in geographic scope, and transmission may increase with longer favourable warm conditions. The attribution of increased Malaria cases as a result of climate change is low (increases in Malaria are more likely due to drug resistance, demography and livelihood changes (IPC 2018); the transmission of Chikungunya, Dengue Fever and Zika Virus by *A. aegypti* peaks around 29°C.	Pregnant women at risk of heat strain and heat exhaustion.

PHENOMENON AND DIRECTION OF TREND	LIKELIHOOD OF FUTURE TREND	MAJOR PROJECTED IMPACTS PER SECTOR	
		HEALTH (INCL. WASH)	SEXUAL AND REPRODUCTIVE HEALTH AND RIGHTS
Reduction in rainfall (especially in the south-central region), increased number of dry days, elongated dry periods, and the increasing frequency of droughts especially in Tigray, Afar and Somalia as well as central and northern parts of the country in February–May.	Certain	Water storage in containers may lead to breeding sites for mosquitoes and increase vector-borne disease transmission; crop yields decrease as 95 per cent of crops are rainfed impacting food security, causing food price spikes and negatively impacting nutritional status; increasing waterborne disease transmission; increasing chronic undernutrition; populations in arid and semi-arid land may face water scarcity (which could exacerbate tensions and conflict) and be forced to migrate. Drying conditions in combination with strong winds (typical of eastern Kenya in August) creates dusty conditions that increase the cases of respiratory diseases (such as Meningitis).	Pregnant and lactating women are particularly vulnerable to changes in food availability and undernourishment; reduced food availability may force women into transactional sexual activities e.g. 'fish for sex'; loss of livelihoods and crop yields means daughters are married in exchange for dowries and FGM may increase at an earlier age in order to marry girls off
Sea level is rising causing inundation of coastal areas	Certain	Sea-level rise is going to affect 10,000–86,000 people by 2030 (especially in Mombasa, but in part linked to an increase in population size) (IPCC 2018)	
RAPID ONSET/ SHOCKS			
Increased number of days with extreme rainfall increasing the chances of flash floods	Certain	Increase in waterborne diseases, especially in children under five years old in populations living in coastal areas; Cholera is linked to more extreme El Niño years; displacement of populations into camps could lead to a rise in communicable diseases.	

1. INTRODUCTION

1.1. POLICY LANDSCAPE

As a minimal contributor (to historical and ongoing global greenhouse gas (GHG) emissions), Kenya will continue to place priority on adaptation rather than mitigation of climate change effects (Ministry of Environment and Natural Resources 2015; 2016). In this context, health is highlighted as a priority sector, and there is explicit reference to strengthening the integration of climate change adaptation into the health sector. Additionally, mainstreaming climate change adaptation in the water sector – including the implementation of the National Water Master Plan – is a national priority (Ministry of Environment and Natural Resources 2015). The implementation of the Nationally Determined Contributions (NDCs) is intended to counteract the compounding effects of poverty as well as alleviating the financial limitations of the country's adaptation plans (*ibid*). As such, the National Adaptation Plan (NAP) reiterates a commitment to low carbon and climate resilient development which mitigates the impacts of climate change on "climate sensitive sectors" such as agriculture, tourism, energy and health (Ministry of Environment and Natural Resources 2016).

2. CLIMATE PROJECTIONS

2.1. GENERAL CLIMATE

Kenya has a number of different climatic zones due to its varied topography and proximity to the Indian Ocean. Coastal areas along the Indian Ocean have a tropical climate. In eastern Kenya, conditions are arid or semi-arid. The areas on the eastern edge of the Rift Valley include a highland plateau with a more temperate climate. The mountains in this area generally receive substantial rainfall, though there are dry areas throughout the valley. Western Kenya, along Lake Victoria, is generally wet, while the northern and northeastern areas, including Lake Turkana, are arid. Most parts of the country have two rainy seasons: the long rains in March–May and the short rains in October–December.

Table 1. Seasonal calendar

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
		Long rains			Dry season				Short rains		

2.2. EXTREME WEATHER AND CLIMATE

Kenya experiences various climate and weather extremes including prolonged droughts; frost in some of the productive agricultural areas; hailstorms; extreme flooding leading to fluctuating lake levels; and drying of rivers and wetlands. These extremes can lead to large economic losses and adversely impact food security. Notably, Kenya experiences major droughts every decade and minor ones every three to four years, which have led to significant crop failures and higher food prices. At the other extreme, Kenya also experiences severe riverine and flash flooding, particularly during the rainy seasons. Both lead to devastating impacts on lives, livelihoods and infrastructure (Opere 2013). Year to year variability of Kenya's climate is notably driven by the cyclical nature of ocean phenomena such as the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). El Niño years are generally wetter than average in Kenya, bringing more flooding, while La Niña years are drier and can prolong drought events (NEMA 2015). The positive IOD has been linked to increased rainfall and severe flooding, such as occurred in 2019 (IFRC 2019) while a negative IOD leads to drier than usual conditions.

2.3. CLIMATE CHANGE AND VARIABILITY

OBSERVED CHANGES	CLIMATE PROJECTIONS
RAINFALL	**RAINFALL**
Historic patterns in rainfall vary in both space and time, making it challenging to unpick the observed trends. Since the 1960s, the northern regions of the country have seen increases in annual rainfall (i.e. they have become wetter), while the southern regions have become drier on average (NEMA 2015). The number of extreme rainfall events have also increased. Overall, annual rainfall has increased slightly year after year by 0.2–0.4 per cent (Thorton *et al.* 2006).	Rainfall projections over Kenya are highly uncertain. Generally, rainfall is expected to increase, and to increase the most during the short rainy season that runs from October–December. It is highly likely that heavy rainfall events will increase in intensity (NEMA 2015).
TEMPERATURE	**TEMPERATURE**
The observed changes in temperature are clearer. Since the 1960s, the country has seen an increase of annual average temperatures of 1.0°C, a rate of 0.21°C every decade (NEMA 2015). This means an increase in the number of 'hot' days (>30°C).	Temperatures will continue to increase. Mean annual temperatures will increase to 0.8–1.5°C by 2030 (compared to baseline and depending on the emission scenario). The number of 'hot' days and nights (falling within the 10 per cent of average temperatures) are also projected to increase, with some climate models predicting that there will be no cold days or nights by the 2090s. Additionally, temperature increases may be more significant in the dry seasons (June–August) (NEMA 2015).

3. AT-RISK POPULATIONS

The risk certain populations face to climate impacts is mediated by a combination of social, economic and political factors. Populations, and the people within them, may face heightened exposure to natural hazards and weather events, or barriers that limit their individual coping capacities. In general, people living in poverty, people who have been displaced, and often women, children and the elderly are disproportionately at risk of climate change impacts due to their limited access to knowledge, technology and financial resources. An exclusive dependence on rainfed agriculture as well as livestock, coupled with limited access to markets, means that rural households are particularly vulnerable to droughts. According to the Kenyan Constitution (2010), the following groups are considered marginalized: pastoralists (such as the Maasai/ Samburu/Turkana); communities living in arid and semi-arid regions (such as Mandera, Marsabit, Turkana, Wajir and West Pokot), and indigenous communities (Ogiek, Sanya, Sengwer and Yaaku Waata). Specifically, in this scoping assessment, existing evidence on the impacts of climate change on certain health outcomes are identified for the following populations:

- The elderly (see mortality/injury)
- Informal settlement dwellers (see mortality/injury, WASH)
- Children (see infectious diseases, WASH, undernutrition, mental health, SRHR)
- Displaced populations (see displacement and migration; WASH)
- Female-headed households (see food security and undernutrition)
- Women (see SRHR)

Whilst it is known that people with disabilities may experience impacts from climate change differently and more severely than others, there was limited data and research available on these interactions in Kenya. The United Nations High Commissioner for Refugees (UNHCR) has highlighted that people with disabilities are among those that suffer the highest mortality and morbidity in an emergency, or when access to healthcare and social protection systems is disrupted. In particular, people with multiple vulnerabilities, such as women and girls with disabilities, are at heightened risk of abuse, violence and sexual exploitation during periods of stress or crisis (UNHCR 2020).

4. HEALTH IMPACTS

Health is impacted by a number of socioeconomic as well as environmental factors. This report and section focuses only on how climate change will contribute to adverse health outcomes. Other factors – such as population growth, global recessions, international trade, conflict etc. – also intersect with the climate crisis and influence health; however, these are beyond the scope of this research. This report synthesizes the existing evidence on the impacts of climate change on health in terms of 1) direct mortality and injury (from natural hazards) and indirectly mediated through the environment via 2) vector-borne diseases, 3) waterborne diseases, 4) malnutrition and food insecurity, as well as considering 5) displacement. Additionally, the evidence of impacts on mental health are presented, alongside those on critical infrastructure and health systems. Particular focus is given to the possible links between the changing climate and sexual and reproductive health and rights (SRHR). The most urgent risks to human health identified in this report as a result of the changing climate include an increase in vector-borne and waterborne diseases, and the nutrition implications of food shortages due to longer drier spells as well as the increased land-surface temperature and water scarcity impacting agriculture.

4.1. DIRECT INJURY AND MORTALITY

Kenya faces a number of climate-induced natural hazards, such as coastal storms (especially affecting fishermen), flooding, droughts, extreme heatwaves and strong winds/windstorms, which can directly cause fatalities (Awuor *et al.* 2008; Parry *et al.* 2012). Floods, droughts and increasing ambient temperatures pose the greatest threats to Kenyan communities (Marigi 2017).

Floods. Under high emissions scenarios, the country could see an additional 75,100 people at risk of riverine flooding by 2030 (WHO 2015). Under the same high emissions scenarios, the number of people at risk of flooding due to sea-level rise will increase, and towards the end of the century (2070–2100) an annual average of 503,600 people could face sea level flooding (WHO 2015). Flooding can lead to drowning or injuries from objects in fast flowing water as well as adverse health outcomes due to waterborne diseases.

Higher temperatures. Heat-related deaths disproportionately affect the elderly (65+) and those living in urban settings. Under a high emissions scenario, heat-related deaths in the elderly are expected to increase from a baseline of two deaths per 100,000 people annually (1961–1990 annual average) to 45 deaths per 100,000 people per year by 2080 (WHO 2015). Increased temperatures have also been associated with mortality in children (Egondi *et al.* 2012). The interaction of rising temperatures and air pollution in urban areas is known to cause an urban heat island effect, which particularly affects the health of populations living in informal settlements who tend

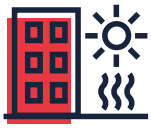
to have less vegetation in their neighbourhood to act as a natural cooling system (Egondi *et al.* 2012; Scott *et al.* 2017). Kenya has many high-altitude regions, and may see less of an impact of heat on its workers compared to other countries in sub-Saharan Africa (ILO 2019).

Changing seasons and rainfall patterns. These changes are affecting land and water resources, which have been linked with violent conflicts and increased mortality rates (Opiyo 2014).

Air pollution. The burning of fossil fuels is contributing to GHG emissions as well as adversely impacting people's respiratory health and chronic diseases. Weather dynamics, influenced by the changing climate, interact with pollutants in the air, either keeping pollutants circulating or blowing them away from major urban areas. Acute lower respiratory infections in children under five years old and deaths from Ischaemic Disease, Stroke, Lung Cancer and Chronic Obstructive Pulmonary Disease in adults have been attributed to household air pollution and GHG emissions (WHO 2015). The overall trend is that continuing to emit these pollutants will continue to negatively affect human health.

By 2030, 75,100 additional people per year will be at risk of RIVERINE FLOODING

By THE END OF THE CENTURY, 503,600 additional people will be at risk of COASTAL FLOODING



By 2080, HEAT-RELATED DEATHS among elderly people (65+) will reach over

65 deaths per 100,000 (*WHO 2015*)

4.2. INFECTIOUS DISEASE PATTERNS

Vector-borne diseases

Vector-borne diseases, such as Chikungunya, Dengue Fever, Malaria, Rift Valley Fever and Yellow Fever, pose significant health impacts and are highly sensitive to changing climatic conditions (temperature, precipitation, humidity), which exert a strong influence on the life cycles of the vectors (such as mosquitoes). Vector-borne diseases are also influenced by anthropogenic factors – population growth, urbanization and control measures – although these are not the focus of this research. Climate change is likely to impact vector-borne diseases in many ways including expanding to new areas and increasing the magnitude, duration and frequency of disease outbreaks.

Malaria causes the largest disease burden in Kenya. The disease is endemic in certain parts of the country, particularly in the wet and humid areas of coastal Kenya and the Lake Victoria Basin. Highland Malaria, which was previously rare in the country, has been aggravated by climate variability over the last 20 years (Wandiga *et al.* 2010). Major Malaria outbreaks are associated with unusually wet and warm climate events related to El Niño and positive IOD reversals, typically in July–September (two months after peak rainfall in April as part of the March–April–May (MAM) rainfall pattern). Some uncertainty exists with regard to factors driving an increase in Malaria transmission. The Intergovernmental Panel on Climate Change (IPCC) uses research which shows that the majority of increases in Malaria cases in Kenya are less related to climate change and more to do with drug resistance, changes in livelihoods and demography (Niang *et al.* 2018). More recent studies, however, suggest that the shifting seasonality of Malaria transmission – extending from the usual 2–3 months (July–September) to 4–6 months (July–December) due to longer high temperature seasons – is projected to put 50.6–62.1 million people at risk of endemic transmission by 2030 in eastern Africa (Ryan *et al.* 2020; Mordecai *et al.* 2020).

Dengue Fever. may increase as the direct effects of warming temperatures and increased rainfall are likely to increase the environmental suitability for Dengue Fever (Mordecai *et al.* 2020). The thermal optima for the transmission of Dengue Fever via *A. aegypti* is 29°C (Mordecai *et al.* 2020). In 2019, 10–20 per cent of children showing fever symptoms for much of the year in Kenya tested positive for dengue virus infection (Mordecai *et al.* 2020). The vectorial capacity (the total number of potentially infectious bites that could arise from mosquitoes biting a single human on a single day) will increase slightly towards 2070 from a mean relative of 0.59 to about 0.68 (WHO 2015).

Other vector-borne diseases:

- **Yellow Fever** Fever is projected to increase under both low and high emissions scenarios for Africa in general, with dramatic increases in East and Central Africa. For these regions (which include Kenya) the number of deaths per year from Yellow Fever

under low emissions scenarios in 2050 is expected to increase by 10 per cent (Gaythorpe *et al.* 2020). Under high emissions scenarios, in the longer term (2070) the burden of Yellow Fever is expected to increase by 40 per cent (Gaythorpe *et al.* 2020). Climate change will, therefore, increase the magnitude and distribution of Yellow Fever in the East Africa region, but there is no Kenya-specific data.

- **Chikungunya** outbreaks have occurred after long periods of drought in Kenya which led to water conservation measures that involved storing water in containers for a long period of time. The water stored in containers provided optimum breeding grounds for mosquitoes that led to the outbreaks. As drought events are predicted to increase with climate change in the future, Chikungunya prevalence may increase and become endemic where there is inadequate drainage and stagnant water (Meason and Paterson 2014; WHO 2018).
- **Leishmaniasis** a commonly neglected vector-borne tropical disease, is transmitted by freshwater snails to humans and will be influenced by changes in temperature, precipitation, drought and flooding (Adekiya *et al.* 2019). Increased rainfall and flooding may lead to infected snails being washed into new water sources, thereby infecting them. Conversely, prolonged dry periods (as experienced between 2001 and 2009 in coastal Kenya) lead to the death of infected snails, reducing the transmission of the disease in the area (Adekiya *et al.* 2019). The disease continues to be at risk of being ignored and is commonly referred to as one of the "diseases of poverty" (KI 8). This is because it typically affects poor people living in marginalized areas with limited access to public healthcare facilities.

Zoonotic diseases

The spread of zoonotic diseases, such as Rift Valley Fever (RVF), is a high risk in Kenya where people and livestock interact frequently. Outbreaks of RVF are closely associated with periods of above-average rainfall that occur during the "warm phase" of the ENSO phenomenon (WHO 2018). Extreme El Niño events are more likely as a result of climate change (Wang *et al.* 2019). Satellite monitoring of vegetation exposed to increased levels of rainfall can be used to forecast the risk of a RVF outbreak two to six weeks in advance (WHO 2018; Anyamba *et al.* 2009). Nomadic communities who move with livestock are at particular risk of RVF as well as sedentary farmers and herders (WHO 2018).

Communicable diseases

Communicable disease outbreaks are primarily caused by displacement (including cross-border displacement) and the disruption of routine immunization services. A number of communicable diseases – i.e. those passed from human to human without an intermediary – may have direct links with climate change, and certainly have indirect links as climate change influences human behaviour, including migration (forced or otherwise).

Measles outbreaks are common in refugee camps due to the immigration of people from low Measles vaccination areas. In Kenya, the Dadaab Refugee Complex experienced a significant Measles outbreak in 2011 following an influx of refugees from Somalia who were escaping civil unrest, extreme drought and a severe famine (World Bank 2013; UN 2011). This led to a mass exodus of over 1.5 million people who fled to refugee camps in Kenya and Ethiopia. Consecutively, Measles outbreaks and deaths were reported in the camps.

Meningitis Kenya lies outside of the 'Meningitis Belt' of sub-Saharan Africa.

4.3. WATER, SANITATION AND HYGIENE (WASH)

Water supply and sanitation systems

Climate change exacerbates the challenges of accessing safe drinking water for most people in rural areas, and especially those in arid and semi-arid regions. A health survey in 2014 indicated that only 59 per cent of households in rural Kenya have access to improved water sources, and only 10 per cent have a place to wash their hands with soap (KNBS 2014). Groundwater sources are being depleted as a result of urbanization and population growth. For example, major cities like Nairobi are experiencing falling water tables and aquifer depletion (Foster *et al.* 2018; Adelana and MacDonald 2008). The lack of a sufficient and consistent water supply by service providers in Kenya has forced Kenyans to resort to private groundwater supplies in many urban and rural areas.

Waterborne diseases

Diarrhoeal diseases account for 15 per cent of morbidity in children under five years old and is a compound risk as it is linked with malnutrition and potentially lifelong consequences (KNBS 2014; WHO 2017). Climate change is projected to contribute to 9.1 per cent of 13,800 diarrhoeal deaths in children under 15 years old in 2030 and, by 2050, to contribute to 13 per cent of diarrhoeal deaths (WHO 2015). Communities living in coastal regions have historically been particularly affected by diarrhoeal cases after massive flooding (e.g. during the 1997/98 El Niño, more than 15,000 cases were reported in the coastal region that experienced massive flooding compared to Nairobi which recorded only 250 cases (Nyamogoba *et al.* 2002). Additionally, the coastal towns of Mombasa and Malindi have a high correlation between flooding and an increase in diarrhoeal disease (Okaka and Odhiambo 2018).

Cholera is a specific type of acute and deadly diarrhoeal disease. Outbreaks in Kenya have been increasing since 2007 and are significantly associated with floods events linked to El Niño (Stoltzfus *et al.* 2014). In 2004–2014 there was a significant increase

in the incidence of Cholera in East Africa during El Niño years, compared to non-El Niño years (Moore *et al.* 2017). Climate change is unequivocally altering the historic properties of El Niño events and it is predicted that there will be more frequent extreme El Niño events that, consequently, risk increasing the Cholera burden in East Africa (Wang *et al.* 2019; Moore *et al.* 2017).

4.4. FOOD INSECURITY AND UNDERNUTRITION

Climate change-induced undernutrition will continue to occur in areas that are already food insecure across the globe (IPCC 2018). Kenya's Global Hunger Index Score is 23.7 which places it in the lower end of the 'serious' category (GHI 2020). The risk of food insecurity, and undernutrition, is highly likely to increase due to higher temperatures, land and water scarcity, flooding, drought and displacement, which combined will negatively impact agricultural production (IPCC 2018; WHO and UN 2015). Since 2015, there has been an increase in the percentage of the population who lack the adequate consumption of calories, which has coincided with the 2016–2017 drought that affected the Horn of Africa and caused significant drops in agricultural production and subsequent spikes in food prices (FAO 2018a; FEWS.net 2013).

Food security

Kenya – in which 80 per cent of the land is either arid or semi-arid – is one of the most drought-prone countries in the world (WFP 2020). During droughts, agriculture is the first sector to be affected and is also the one that absorbs the greatest impact as 95 per cent of crops are rainfed (FAO 2018b; WFP 2018). A decrease in agricultural production has ramifications on food prices, and can exacerbate food insecurity and undernutrition for both rural and urban populations (especially the urban poor) (Awuor *et al.* 2008). Projected future climate change scenarios show up to a 69 per cent decline in crop yields by the year 2100 (affecting maize production most acutely), which will significantly affect food security (Yator 2016).

> *We are seeing rising cases of malnutrition along the Nyando and Ahero Plains where rice production, through rainfed irrigation, has been affected by climatic changes" (KI 2).*

Changing rainfall patterns and decreasing water stocks, amongst other stressors (such as soil fertility decline and erosion, land pressures as well as social determinants), are straining the livelihood opportunities for smallholder farmers in Kenya (Andersson and Gabrielsson 2012). More than 50 per cent of smallholder rural producers in Kenya also have to buy staple food such as grains and, as such, they are sensitive to food spikes (Niang *et al.* 2018). Female-headed households, in particular, are highly vulnerable to the loss of subsistence crops and food spikes as they tend to have fewer

assets and smaller amounts of land (Niang *et al.* 2018). Livestock farming is also being impacted as droughts increase, killing off cattle (Watson *et al.* 2016; Gachathi and Eriksen 2011).

Undernutrition

The following groups are most vulnerable to undernutrition due to climate change:

- **Pastoralist communities** in arid or semi-arid northern counties (Mandera, Marsabit, Turkana, Wajir and West Pokot) who have high rates of poverty face some of the highest prevalence of wasting (a sign of acute malnutrition) (Welthungerhilfe 2019). Nationwide, the prevalence of wasting is currently at 26 per cent and stunting at 4 per cent (WFP 2020).
- **Women** face an increased risk of micronutrient deficiency during pregnancy (Harika *et al.* 2017).
- **Poor communities:** those living in both rural (Kitui county and West Pokot county) and urban settings are vulnerable to food price spikes as well as illnesses and diseases due to a lack of adequate water, sanitation and hygiene, leading to a high prevalence of stunting (a sign of chronic undernutrition) (see WASH and waterborne diseases) (Welthungerhilfe 2019).
- **Children under five years old:** Undernutrition and its lifelong consequences (reduced mental and physical development) disproportionately impact children under the age of five. In addition:
  - the educational attainment of children's mothers is associated with the prevalence of stunting; the "stunting rate of children whose mothers have had no formal education was 31 per cent, while that of children whose mothers have had secondary education or higher was just 17 per cent" (KNBS *et al.* 2015).
  - children's nutrition is also associated with mothers' nutritional status – there is a positive correlation between the mother's nutritional status and that of her child (Gewa *et al.* 2012).

> *When you improve on nutrition then you directly improve the health of the population." (KI 8)*

4.5. DISPLACEMENT AND MIGRATION

> *Floods and droughts have been known to cause displacement in the country. Nomadic communities are often displaced during long periods of drought." (KI 13)*

The droughts and floods pose challenges to large swathes of the population, both within Kenya and across the border in neighbouring countries, who are forced to migrate due to water scarcity as well as excessive water (Jancloes *et al.* 2015). In the first half of 2018 alone, flooding displaced more than 300,000 people and damaged cropland and livestock (IDMC 2018; Relief Web 2018). Violent conflicts related to scarce grazing land and water as well as increased civil conflict in the neighbouring Horn of Africa are leading to increased displacement and migration in the region (Opiyo 2014). Displaced people are further exposed to increased health risks and disease outbreaks due to the high demand for healthcare services in the country (Abu and Elliott 2020). All of these extreme weather events are projected to increase with climate change, which may exacerbate issues of displacement and migration within Kenya and from across the borders.

4.6. MENTAL HEALTH

> *We also need to focus on a new dimension of mental health issues caused by climate change impacts. Some pastoralists say 'When a camel dies, that's the end of life'. They are not talking about just the camel's life, some of them may commit suicide from losing their only source of livelihood." (KI 7)*

Extreme weather events have direct and indirect impacts on mental health. Yet there is a gap in the literature at the intersection of climate change and mental health in Kenya. Studies engaging Kenyan farmers on their perceptions of the impacts of climate change (in 2009–2015) showed that they perceive these impacts as having a direct risk to their livelihoods and reported feelings of despair and irritation (Mwaniki and Ngibuini 2020). These communities were very inclined to participate in adaptation strategies, which may present an opportunity to incorporate mental health awareness and interventions as an adaptation measure in national programming.

CASE STUDY: KISUMU – AN URBAN-SPECIFIC CLIMATE–HEALTH PERSPECTIVE

Kisumu, situated on Lake Victoria, is Kenya's third largest city. As of the 2019 census, it had a population of over 610,000 inhabitants – the majority of whom live in slums on the urban fringes (peri-urban areas) of the city (Cowburn *et al.* 2018). It's location on Africa's largest lake predisposes the city to floods, especially around Dungaree Beach and Nyalenda (KI 1; UNISDR 2020). The high percentage of informal dwellers, who lack access to improved water sources and sanitation systems, experience numerous health problems, especially during floods and droughts (UN Habitat 2006; KI 4). In general, young children, the elderly, people with disabilities and the urban poor living in informal settlements are the most vulnerable to the effects of climate change in Kisumu (KI 1, KI 3; KI 4). Key informants also stressed the specific toll and challenges women and girls experience as a result of changing weather patterns in the city:

> *"When we have a shortage of water, it has an impact on their health in terms of hygiene (menstrual management and household cleanliness). The women and girls bear the biggest burden in terms of household chores and economic challenges that arise from moving in search of clean water for their families." (KI 4))*

Whilst the city boasts a decentralized meteorological service, heat is not tracked across the city as historically temperatures have not reached beyond 35–40°C (KI 5; KI 1). However, key informants highlighted that they have felt the heat increasing in the city and this may well become a future concern:

> *"I have also seen Kisumu grow hot over the years to a point where we had heat stress and staying indoors was very uncomfortable. Heat stress is an issue that is slowly creeping in." (KI 3)*

The interaction of heat and changing rainfall patterns (floods or droughts) are associated with spikes in cases of Malaria and Diarrhoea (KI 1, KI 2, KI 3, KI 4). The proximity to Lake Victoria provides a breeding ground for mosquitoes (KI 2) and when there is high rainfall, which may lead to flooding, as happened in April–June 2020, high cases of Malaria are reported (KI 2; KI 4). As key informants explained:

> *Issues of flooding have been on the rise recently. There have been rising water levels in the Lake leading to backflow which has displaced families living around the lake and carried away their crops and livestock. This has led to food insecurity in the area and contributed to malnutrition. In addition, this also contributes to diarrhoeal diseases as the flooding carries away even the existing toilets and there is contamination of clean water for domestic use." (KI 2)*

> *The disease patterns are linked to changes in rainfall patterns – reduced rain has an impact on on agricultural production which has a knock-on effect on food security and undernutrition; if water sources are drying up, then people more likely to drink dirty water or reduce their daily hygienic practices; conversely, flooding causes problems for sanitation systems, often resulting in toilets becoming flooded and contaminating water" (KI 3))*

Floods along with dry spells leading to droughts can cause an increase in diarrhoeal diseases, including Typhoid Fever and Cholera, which influence the prevalence of malnutrition, especially in children under five years old in poor neighbourhoods such as Nyalenda and Obunga (KI 3; KI 4). The concerns over water quality, access and security is an issue that may not be getting as much attention as it warrants (KI 2). Furthermore, water issues have a knock-on effect on the socioeconomic status and, in turn, health, of those (especially poor women) living around the Lake. As explained:

> *We have also seen increased incidences of HIV along the beach areas, which are linked to people's socioeconomic status around the Lake. When water levels decrease, aquatic life is affected and fish production becomes low. We then see rising cases of "fish for sex" along the beaches in a bid to cope with the affected socioeconomic status resulting from low fish production and reduced income." (KI 2))*

Water was raised as one of the main issues facing Kisumu. The Kisumu Water and Sanitation Company Limited is working with NGO partners as well as UNICEF and the Kenya Red Cross Society (KRCS) to address issues related to water improvement and access (KI 4; KI 1). However, it was felt that issues of water and sewage (WASH) were not well linked with health initiatives in the city (KI 1).

4.7. CRITICAL INFRASTRUCTURE

> *Kenya's adaptive capacity is weak since there isn't a climate–health linkage in the health system." (KI 6)*

Kenya's health system is decentralized and comprises both public and private healthcare. It ranks the second highest in the 54 African countries for overall Global Health Security, but there are only 20.4 doctors per 100,000 people (GHSI 2019). Floods – especially coastal flooding – have the potential to impact critical infrastructure.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5. SEXUAL AND REPRODUCTIVE HEALTH AND RIGHTS

> *There are increased early marriages during drought which magnifies the vulnerability of young girls during disasters." (KI 13)*

Climate change already is, and will continue to, affect men and women as well as boys and girls differently. Key areas of concern from global studies have shown how a changing climate is altering the dynamics and risk of negative maternal health outcomes, forced child marriages, human trafficking, sexual exploitation and gender-based violence (Castañeda Carney *et al.* 2020; Women Deliver 2021).

Some key trends bear consideration with regards to SRHR and climate change:

- **Accessing sexual and reproductive health services:** Floods and other extreme events may limit women's access to healthcare facilities or interrupt supplies of contraceptives or medication.

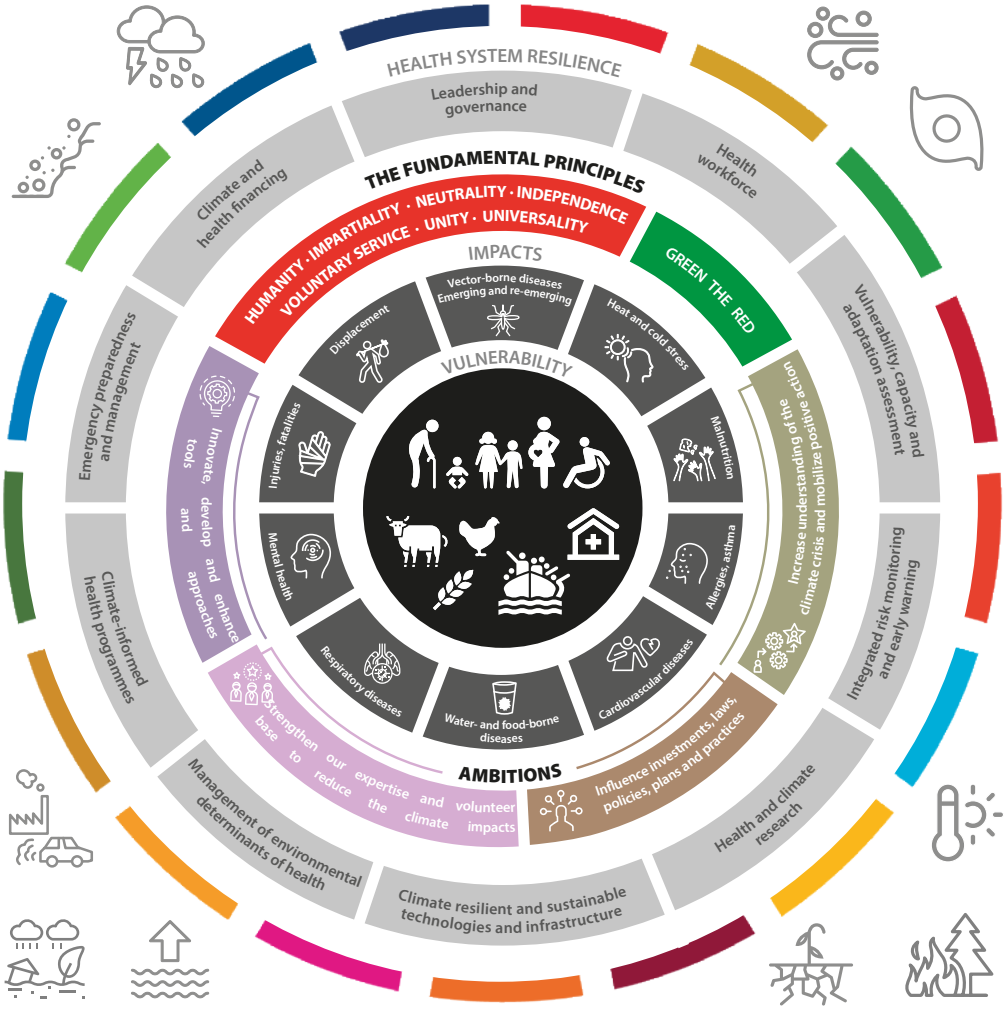
- **Sexual and reproductive health:** A study conducted along Lake Victoria shows that changes in access to agriculture for food and income left women particularly vulnerable to transactional "fish for sex" relationships, in areas where there is a high prevalence of HIV (Fiorella *et al.* 2015). Additionally, an investigation funded by the Pulitzer Center suggests that the impact of drought on livestock and food production has an increasing affect on the incidence of female genital mutilation (FGM) in Kenya as young women are sent across the border to Ethiopia for cutting ceremonies and return to Kenya to be married in exchange for dowry (Wadekar 2020).

- **Maternal health:** Climate change disproportionately impacts children's health, women's antenatal health, adolescent sexual health and family planning considerations in Kenya. Changing patterns of rainfall and temperature impact food availability which affects mothers' diets, and, consequently, birth weights (Bakhtsiyarava, Grace, and Nawrotzki 2018).

6. RECOMMENDATIONS AND OPPORTUNITIES

This section is based upon the findings in this assessment and inspired by the *IFRC Position paper on health and climate (2021)*, which includes a roadmap to address climate change-related health risks. Figure 1, explains how local action, centred around vulnerability, is key for delivering national and international ambitions on climate change, the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction. Each recommendation is supported by the evidence of a gap or opportunity for further work to strengthen programming on the health–climate change nexus.

Figure 1: Addressing the drivers of health and climate vulnerability at the community level (reducing vulnerabilities (centre) and strengthening community resilience through IFRC action on the ground will support health systems' resilience as well as country progress towards the Sendai Framework for Disaster Risk Reduction as well as the Sustainable Development Goals (outer ring))



RECOMMENDATION 1: Continue to increase knowledge and awareness of the impacts climate change will have on health through effective communication and the translation of findings at the local level for communities, local government and CSOs.

Gap: The impacts climate change will have on health outcomes are not always well understood outside of practitioner's circles, yet knowledge of the impacts is key to spur the necessary local action of communities, grass root organizations, CSOs and local government. Often, this knowledge is lacking because complex information is not translated in terms of lived experience or risk to health and well-being for communities and individuals.

Opportunity for action: There are three key opportunities for action. 1) In climate awareness training at all scales, especially the local, continue to translate the impacts of the projections on health into simple, understandable information, possibly via the use of tools and games developed by the Red Cross Red Crescent Climate Centre. Examples of simplified explanations could be that increased temperatures mean that more days are likely to reach temperatures that are very uncomfortable. Heat can be deadly to the elderly and people with underlying conditions like heart problems (problems that people may not know they have). Heat can also make it harder or more unpleasant to work, especially outdoors, which can put a real strain on the body. Heat at night can also stress the body and make one less able to work the day after, which can affect productivity and income. Warmer temperatures also typically increase the growth of bacteria that can cause Diarrhoea. 2) Work with communities, volunteers and local healthcare workers or health departments to systematically collate local data, evidence and stories on the health impacts of climate change in order to channel this upwards into policy discussions on health system strengthening. 3) Ensure that climate information reaches the 'last mile' and that local communities, CSOs and government have access to climate information in a timely manner as well as the knowledge of key, early public health actions to initiate through the sharing of good practice in climate–health risk assessment (i.e. knowledge mobilization).

RECOMMENDATION 2: Scale-up climate-smart programming and preventative health activities that adopt a multi-hazard Early Warning Early Action approach to preparedness.

Gap: Relatively few Early Warning Early Action programmes are in place across Kenya. Local capacity to conduct data collection, monitoring and evaluation – in order to develop early warning systems and responsive infrastructure – is limited by a lack of expertise, research and financial capacity across sectors. There is a silo between climate and health practitioners which compounds this issue.

Opportunity for action: 1) Climate-smart programmes and projects can be introduced and scaled up significantly. These programmes need to adopt a **multi-hazard Early Warning Early Action approach** to preparedness and prioritize risk-informed early action programming (such as forecast-based action/financing, ideally using an impact-based forecast that provides a warning about what the weather will do, rather than only an indication of the parameters of the hazard). The programmes also need to systematically integrate **medium- and long-term climate information to anticipate, prepare for and reduce the health impacts in high-risk areas.** Materials to advance climate risk management, including climate-smart health programming, can be found in the Climate Training Kit. 2) These programmes must seek to continually identify and adapt to specific drivers of vulnerability for health as well as the social and economic impacts of environmental and climate change. They must also develop stronger analytical capability for integrated health and climate risk assessments (using an all-hazard approach) at the local level. 3) Programmes should increase the integration of DRR and public health work, and liaise with communities to holistically map the interactions in their environment to identify where health risks specifically, and risks in general, can be reduced. For example, by identifying areas at risk of flash floods and mapping the essential assets that could be affected – e.g. cropland or key roads; building preparedness into the communities using climate information – e.g. weather bulletins and river monitoring or the stocking of sand bags to help stem the flow of water; and investigating if there are non-climatic factors that may be exacerbating the risk of flooding – e.g. poor solid waste management clogging drainage.

RECOMMENDATION 3: Support the implementation of anticipatory forecast-based actions by scaling existing Forecast-based Financing programmes.

Gap: Relatively few Early Warning Early Action programmes that use forecast-based measures for health are in place across Kenya.

Opportunity for action: The relationship between disease outbreaks/burden and climate change/climate variability, coupled with the predictability of climate variability events like ENSO, provide good opportunities for humanitarian organizations to strengthen their health preparedness activities, including the development of Early Warning Early Action measures. Organizations should explore the introduction, or scaling up, of anticipatory actions (forecast-based financing or impact-based forecasting) for floods and droughts and the health risks they pose. For example: 1) interventions for vulnerable urban communities to buffer the increasingly high prices before or during food shortages (e.g. cash for work); 2) food distribution for displaced communities; 3) identifying and disseminating the necessary anti-Cholera outbreak packages prior to exceptionally heavy rainfall predictions; 4) identifying and communicating evacuation/access routes for critical healthcare facilities ahead of heavy rains; 5) introducing a heat action plan for the most vulnerable regions to reduce the impact of heat on the most vulnerable people.

RECOMMENDATION 4: Advocate for increased access to climate and health financing to reduce future vulnerabilities.

Gap: Climate and health financing remains limited or siloed between departments within the National Society.

Opportunities for action: 1) KRCS should advocate for increased access to climate and health financing in order to invest in climate and health research and action. In particular, the research should focus on the link between climate change and mental health; the impacts of heat risks in informal settlements; and the influence of climate change on SRHR. 2) KRCS should also Integrate climate risk management into all social protection programmes that provide consistent support to people known to be vulnerable to climate change. This approach would enable the programmes to function well during times of climate shocks and potentially to provide additional support during times of acute need (or in anticipation of acute need). 3) Climate and health financing could also be used in building back better (and greener) approaches to reduce future vulnerabilities (e.g. addressing the root causes of risks arising from ecosystem degradation or the drivers of environmentally motivated, voluntary and involuntary, displacement). This engagement should be guided by the Green Response Framework, “Green the Red'', and incorporate environmentally sustainable practice into all operations, programmes and advocacy work in order to “do no harm” both now and in the future.

RECOMMENDATION 5: Employ a One Health approach for the routine monitoring of health risks.

Gap: The spread of zoonotic diseases is a high risk in Kenya, which has a largest livestock population in the world. Over 70 per cent of emerging and re-emerging diseases are of vector-borne or zoonotic origin, which calls for the effective **routine monitoring of evolving risks and vulnerabilities using a One Health approach** (plant, animal and human health surveillance and response).

Opportunity for action: One Health approaches strengthen the ability of communities, National Societies and other partners to detect, respond to and prevent disease threats and play a significant role in preparing for future risks. One Health adopts a whole of society, all-hazard approach to epidemic and pandemic preparedness through community health promotion activities and community-based surveillance (CBS). The approach builds the greater buy-in and sustainability of those involved and leads to improved community engagement in human and animal disease prevention. It also alerts local health authorities earlier, and ensures earlier action for the timely control of possible outbreaks. Overall, it reflects **the interconnected nature of human and animal health as well as the environment**, which is often considered to be the neglected component of the triad.

RECOMMENDATION 6: Integrate mental health and coping with stress into all programmes

Gap: : The mental health impacts of climate change are under-researched in Kenya.

Opportunity for action: Identify and work with groups (e.g. farmers) who are seeing significant changes in their environment or experiencing cyclical losses, e.g. repeated dry seasons; broaden existing climate–health monitoring and intervention efforts to include mental health.

RECOMMENDATION 7: Enhance the capacity to undertake integrated health and climate risk assessments and action (using an all-hazard approach) for highly vulnerable or at-risk groups.

Gap: Data on the specific drivers of vulnerability and risk for different groups is limited, e.g. women and especially female-headed households, people living with disabilities, or displaced populations from across borders.

Opportunities for action: 1) Work with communities to identify specific health impacts of environmental and climate change on vulnerable people, such as female-headed households, outdoor workers, people living in informal settlements, households with people with disabilities and displaced people. 2) In the face of climate-induced stresses and displacement, urgent attention must be given to increasing knowledge and awareness of sanitation, hygiene and SRHR among vulnerable communities in informal settlements as well as in displaced communities, before and during the climate-related event. The message should be easy to understand and shared on widely accessed media – if phone utilization is high and phone signal coverage is good, then public health SMSs could be issued to help keep people aware of key hygiene practices. 3) Volunteers working closely with at-risk communities can amplify at higher levels within their organization the voices and experiences of, for example, women and girls who are displaced, so there is a better understanding of the unique challenges they face as a result of the climate impacts. Piloting evidence-based projects that safeguard women and girls – for example, by supporting and empowering women with livelihood options and education – will help to avoid adverse coping strategies during crises.

RECOMMENDATION 8: Continue to foster cross-sector collaboration across programmes.

Gap: No organization can tackle the increased risks posed by climate change alone or alleviate the exacerbated risks of vulnerable populations.

Opportunities for action: 1) KRCS is well-placed to empower those most at-risk through capacity building and capability enhancing activities that take an inclusive and gender-sensitive approach. The focus should be on empowering youth, volunteers, marginalized groups and women to understand their risks better and take up, or call for, dedicated evidence-informed climate action at the local and national levels. 2) KRCS should continue to foster and strengthen partnerships both within and outside the humanitarian and development sectors. There are opportunities to work closely with national agencies and donors to improve finance flows, strengthen infrastructure and facilitate access to technology-based solutions and innovations for climate adaptation and resilience as well as to support Forecast-based Financing mechanisms to scale-up anticipatory on the ground adaptation. More internal integration is needed with the disaster management, communication and policy teams and, in tandem, closer collaboration with external partners such as the national meteorological service, private sector, academia and CSOs is key in delivering holistic early warning systems and disseminating accessible information about disease outbreaks as well as the adverse health outcomes to at-risk communities. 3) KRCS is well-positioned to showcase the local action required to address the risks and needs of the most vulnerable and to broker collaborations to support policies and cross-sectoral planning processes, including the national ambitions for health within the Nationally Determined Contributions (NDCs) and the National Adaptation Plan (NAP).

RECOMMENDATION 9: Increasingly engage in policy dialogues on climate change adaptation

Gap: The local perspective is not consistently reflected in national policies, nor is local level data used to help inform policy decisions.

Opportunity for action: KRCS has ample experience on local climate and resilience programming that could enrich nationwide adaptation dialogues and efforts to address the climate and environmental crisis in Kenya. KRCS is well connected and positioned to engage in dialogue to increase the integration of the health needs of those most at-risk into climate change adaptation programmes at the national level and within the National Society's programmes. It can also engage in policy dialogue to ensure that a new health infrastructure is established, based on available climate information, while ensuring that the existing infrastructure is protected from extreme weather events.

REFERENCES

Abu, Thelma Zulfawu, and Susan J. Elliott. 2020. 'When It Is Not Measured, How Then Will It Be Planned for? WaSH a Critical Indicator for Universal Health Coverage in Kenya'. *International Journal of Environmental Research and Public Health* 17 (16): 5746. https://doi.org/10.3390/ijerph17165746.

Adekiya, Tayo Alex, Raphael Taiwo Aruleba, Babatunji Emmanuel Oyinloye, Kazeem Oare Okosun, and Abidemi Paul Kappo. 2019. 'The Effect of Climate Change and the Snail-Schistosome Cycle in Transmission and Bio-Control of Schistosomiasis in Sub-Saharan Africa'. *International Journal of Environmental Research and Public Health* 17 (1). https://doi.org/10.3390/ijerph17010181.

Adelana, Segun, and Alan MacDonald. 2008. *Applied Groundwater Studies in Africa: IAH Selected Papers on Hydrogeology*, Volume 13. CRC Press.

Andersson, Elina, and Sara Gabrielsson. 2012. '"Because of Poverty, We Had to Come Together": Collective Action for Improved Food Security in Rural Kenya and Uganda'. International Journal of Agricultural Sustainability 10 (3): 245–62. https://doi.org/10.1080/14735903.2012.666029.

Anyamba, Assaf, Jean-Paul Chretien, Jennifer Small, Compton J. Tucker, Pierre B. Formenty, Jason H. Richardson, Seth C. Britch, David C. Schnabel, Ralph L. Erickson, and Kenneth J. Linthicum. 2009. 'Prediction of a Rift Valley Fever Outbreak'. *Proceedings of the National Academy of Sciences* 106 (3): 955–59. https://doi.org/10.1073/pnas.0806490106.

Awuor, Cynthia Brenda, Victor Ayo Orindi, and Andrew Ochieng Adwera. 2008. 'Climate Change and Coastal Cities: The Case of Mombasa, Kenya'. *Environment and Urbanization* 20 (1): 231–42. https://doi.org/10.1177/0956247808089158.

Bakhtsiyarava, Maryia, Kathryn Grace, and Raphael J. Nawrotzki. 2018. 'Climate, Birth Weight, and Agricultural Livelihoods in Kenya and Mali'. *American Journal of Public Health* 108 (S2): S144–50. https://doi.org/10.2105/AJPH.2017.304128.

Castañeda Carney, Itza, Laura Sabater, Cate Owren, and A.E. Boyer. 2020. Gender-Based Violence and Environment Linkages: The Violence of Inequality. Edited by Jamie Wen. IUCN, *International Union for Conservation of Nature*. https://doi.org/10.2305/IUCN.CH.2020.03.en.

Egondi, Thaddaeus, Catherine Kyobutungi, Sari Kovats, Kanyiva Muindi, Remare Ettarh, and Joacim Rocklöv. 2012. 'Time-Series Analysis of Weather and Mortality Patterns in Nairobi's Informal Settlements'. *Global Health Action* 5 (s1): 19065. https://doi.org/10.3402/gha.v5i0.19065.

FAO, ed. 2018a. *Building Climate Resilience for Food Security and Nutrition.* The State of Food Security and Nutrition in the World 2018. Rome: FAO.

———. 2018b. 'Drought | Land & Water | Food and Agriculture Organization of the United Nations | Land & Water | Food and Agriculture Organization of the United Nations'. 2018. http://www.fao.org/land-water/water/drought/en/.

FEWS.net. 2013. 'Kenya - Seasonal Calendar: Tue, 2013-12-17'. Famine Early Warning Systems Network. December 2013. https://fews.net/print/east-africa/kenya/seasonal-calendar/december-2013.

Fiorella, Kathryn J., Carol S. Camlin, Charles R. Salmen, Ruth Omondi, Matthew D. Hickey, Dan O. Omollo, Erin M. Milner, Elizabeth A. Bukusi, Lia C. H. Fernald, and Justin S. Brashares. 2015. 'Transactional Fish-for-Sex Relationships Amid Declining Fish Access in Kenya'. *World Development* 74 (October): 323–32. https://doi.org/10.1016/j.worlddev.2015.05.015.

Foster, Stephen, Anne Bousquet, and Sean Furey. 2018. 'Urban Groundwater Use in Tropical Africa – a Key Factor in Enhancing Water Security?' Water Policy 20 (5): 982–94. https://doi.org/10.2166/wp.2018.056.

Gachathi, Francis N., and Siri Eriksen. 2011. 'Gums and Resins: The Potential for Supporting Sustainable Adaptation in Kenya's Drylands'. *Climate and Development* 3 (1): 59–70. https://doi.org/10.3763/cdev.2010.0066.

Gaythorpe, Katy AM, Arran Hamlet, Laurence Cibrelus, Tini Garske, and Neil M Ferguson. 2020. 'The Effect of Climate Change on Yellow Fever Disease Burden in Africa'. *ELife* 9. https://doi.org/10.7554/eLife.55619.

Gewa, Constance A., Monica Oguttu, and Nanette S. Yandell. 2012. 'Maternal Nutrition in Rural Kenya: Health and Socio-Demographic Determinants and Its Association with Child Nutrition'. *Maternal & Child Nutrition* 8 (3): 275–86. https://doi.org/10.1111 /j.1740-8709.2011.00322.x.

GHI. 2020. '2020 Global Hunger Index Results - Global, Regional, and National Trends'. Global Hunger Index (GHI) - Peer-Reviewed Annual Publication Designed to Comprehensively Measure and Track Hunger at the Global, Regional, and Country Levels. 2020. https://www.globalhungerindex.org/results.html.

GHSI. 2019. '2019 GHS Index Country Profile for Kenya'. GHS Index. 2019. https://www.ghsindex.org/country/kenya/.

Harika, Rajwinder, Mieke Faber, Folake Samuel, Judith Kimiywe, Afework Mulugeta, and Ans Eilander. 2017. 'Micronutrient Status and Dietary Intake of Iron, Vitamin A, Iodine, Folate and Zinc in Women of Reproductive Age and Pregnant Women in Ethiopia, Kenya, Nigeria and South Africa: A Systematic Review of Data from 2005 to 2015'. *Nutrients* 9 (10). https://doi.org/10.3390/nu9101096.

IDMC. 2018. '2018 Global Report on Internal Displacement'. IDMC. 2018. https://www.internal-displacement.org/publications/2018-global-report-on-internal-displacement.

IFRC. 2019. 'IFRC Go - Kenya Floods Situation Update'. 2019. https://go.ifrc.org/emergencies/3822#details.

ILO. 2019. 'Working on a Warmer Planet. The Impact of Heat Stress on Labour Productivity and Decent Work.' Geneva, Switzerland: International Labour Office. https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_711919.pdf.

IPCC. 2018. *Human Health: Impacts, Adaptation, and Co-Benefits.*

Jancloes, Michel, Vidya Anderson, Pierre Gosselin, Carol Mee, and Nicholas J. Chong. 2015. 'WWOSC 2014: Research Needs for Better Health Resilience to Weather Hazards'. *International Journal of Environmental Research and Public Health* 12 (3): 2895–2900. https://doi.org/10.3390/ijerph120302895.

KNBS. 2014. 'Demographic and Health Survey'. Kenyan National Bureau of Statistics. https://dhsprogram.com/pubs/pdf/FR308/FR308.pdf.

Marigi, Samwel N. 2017. 'Climate Change Vulnerability and Impacts Analysis in Kenya'. *American Journal of Climate Change* 06 (01): 52. https://doi.org/10.4236/ajcc.2017.61004.

Meason, B, and R Paterson. 2014. 'Chikungunya, Climate Change, and Human Rights'. *Health and Human Rights Journal* (blog). 2014. https://www.hhrjournal.org/2014/07/chikungunya-climate-change-and-human-rights-2/.

Ministry of Environment and Natural Resources. 2015. 'Kenya's Intended Nationally Determined Contribution (INDC)'. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Kenya%20First/Kenya_NDC_20150723.pdf.

———. 2016. 'Kenya National Adaptation Plan'. https://www4.unfccc.int/sites/NAPC/Documents%20NAP/Kenya_NAP_Final.pdf.

Moore, Sean M., Andrew S. Azman, Benjamin F. Zaitchik, Eric D. Mintz, Joan Brunkard, Dominique Legros, Alexandra Hill, *et al.* 2017. 'El Niño and the Shifting Geography of Cholera in Africa'. *Proceedings of the National Academy of Sciences* 114 (17): 4436–41. https://doi.org/10.1073/pnas.1617218114.

Mordecai, Erin A, Sadie J Ryan, Jamie M Caldwell, Melisa M Shah, and A Desiree LaBeaud. 2020. 'Climate Change Could Shift Disease Burden from Malaria to Arboviruses in Africa'. *The Lancet Planetary Health* 4 (9): e416–23. https://doi.org/10.1016/S2542-5196(20)30178-9.

Mwaniki, Fiona, and Humphrey M. Ngibuini. 2020. 'Understanding Kenyan Farmers' Perceptions of and Responses to Climatic Variability to Build Their Resilience'. In *Handbook of Climate Change Resilience*, edited by Walter Leal Filho, 1661–80. Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-93336-8_82.

NEMA. 2015. 'Second National Communication to UNFCCC'. National Environment Management Authority - Government of Kenya. https://unfccc.int/sites/default/files/resource/Kennc2.pdf.

Niang, Isabelle, Oliver C Ruppel, Mohamed A Abdrabo, Ama Essel, Christopher Lennard, Jonathan Padgham, Penny Urquhart, *et al.* 2018. 'Africa'. In *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, 67. IPCC. https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap22_FINAL.pdf.

Nyamogoba, H. D. N., A. A. Obala, and R. Kakai. 2002. 'Combating Cholera Epidemics by Targeting Reservoirs of Infection and Transmission Routes: A Review'. *East African Medical Journal* 79 (3): 150–55. https://doi.org/10.4314/eamj.v79i3.8896.

Okaka, Fredrick Okoth, and Beneah D. O. Odhiambo. 2018. 'Relationship between Flooding and Out Break of Infectious Diseasesin Kenya: A Review of the Literature'. Review Article. *Journal of Environmental and Public Health.* Hindawi. 17 October 2018. https://doi.org/10.1155/2018/5452938.

Opere, Alfred. 2013. 'Floods in Kenya'. In *Developments in Earth Surface Processes*, 16:315–30. Elsevier. https://doi.org/10.1016/B978-0-444-59559-1.00021-9.

Opiyo, Francis E. O. 2014. 'Climate Variability and Change on Vulnerability and Adaptation among Turkana Pastoralists in North-Western Kenya'. Thesis, University of Nairobi. http://erepository.uonbi.ac.ke/handle/11295/77661.

Parry, Jo-Ellen, Daniella Echeverria, Julie Dekens, and Joseph Maitima. 2012. 'Climate Risks, Vulnerability and Governance in Kenya: A Review'. UNDP. https://www.iisd.org/system/files/publications/climate_risks_kenya.pdf.

Relief Web. 2018. '2018 Global Report on Internal Displacement (GRID 2018) - World'. ReliefWeb. 2018. https://reliefweb.int/report/world/2018-global-report-internal-displacement-grid-2018.

Ryan, Sadie J., Catherine A. Lippi, and Fernanda Zermoglio. 2020. 'Shifting Transmission Risk for Malaria in Africa with Climate Change: A Framework for Planning and Intervention'. *Malaria Journal* 19 (1): 170. https://doi.org/10.1186/s12936-020-03224-6.

Scott, Anna A., Herbert Misiani, Jerrim Okoth, Asha Jordan, Julia Gohlke, Gilbert Ouma, Julie Arrighi, *et al.* 2017. 'Temperature and Heat in Informal Settlements in Nairobi'. *PLOS ONE* 12 (11): e0187300. https://doi.org/10.1371/journal.pone.0187300.

Stoltzfus, James D., Jane Y. Carter, Muge Akpinar-Elci, Martin Matu, Victoria Kimotho, Mark J. Giganti, Daniel Langat, and Omur Cinar Elci. 2014. 'Interaction between Climatic, Environmental, and Demographic Factors on Cholera Outbreaks in Kenya'. *Infectious Diseases of Poverty* 3 (1): 37. https://doi.org/10.1186/2049-9957-3-37.

Thorton, PK, PG Jones, T Owiyo, RL Kruska, M Herrero, P Kristjanson, and A Notenbaert. 2006. 'Mapping Climate Vulnerability and Poverty in Africa'. Department for International Development.

UN. 2011. 'UN Declares Famine in Two Regions of Southern Somalia'. UN News. 20 July 2011. https://news.un.org/en/story/2011/07/382072-un-declares-famine-two-regions-southern-somalia.

UNHCR. 2020. 'Analytical Study on the Promotion and Protection of the Rights of Persons with Disabilities in the Context of Climate Change'. 2020. https://undocs.org/A/HRC/44/30.

Wadekar, N. 2020. 'Climate Change Is Undermining Kenya's Efforts to End Child Marriage'. Time, 2020. https://time.com/5878719/climate-change-kenya-child-marriage/.

Wandiga, Shem O., Maggie Opondo, Daniel Olago, Andrew Githeko, Faith Githui, Michael Marshall, Tim Downs, *et al.* 2010. 'Vulnerability to Epidemic Malaria in the Highlands of Lake Victoria Basin: The Role of Climate Change/Variability, Hydrology and Socio-Economic Factors'. *Climatic Change* 99 (3): 473–97. https://doi.org/10.1007/s10584-009-9670-7.

Wang, Bin, Xiao Luo, Young-Min Yang, Weiyi Sun, Mark A. Cane, Wenju Cai, Sang-Wook Yeh, and Jian Liu. 2019. 'Historical Change of El Niño Properties Sheds Light on Future Changes of Extreme El Niño'. *Proceedings of the National Academy of Sciences* 116 (45): 22512–17. https://doi.org/10.1073/pnas.1911130116.

Watson, Elizabeth E., Hassan H. Kochore, and Bulle Hallo Dabasso. 2016. 'Camels and Climate Resilience: Adaptation in Northern Kenya'. *Human Ecology* 44 (6): 701–13. https://doi.org/10.1007/s10745-016-9858-1.

Welthungerhilfe. 2019. 'Hunger and Undernutrition in Kenya'. Welthungerhilfe.de - Für Eine Welt Ohne Hunger Und Armut. 10 April 2019. https://www.welthungerhilfe.org/news/latest-articles/2019/hunger-and-undernutrition-in-kenya/.

WFP. 2018. '2018 - The State of Food Security and Nutrition in the World (SOFI): Building Climate Resilience for Food Security and Nutrition | World Food Programme'. 2018. https://www.wfp.org/publications/2018-state-food-security-and-nutrition-world-sofi-report.

———. 2020. 'WFP Kenya Country Brief September 2020'. https://docs.wfp.org/api/documents/WFP-0000120674/download/.

WHO. 2015. 'Climate and Health Country Profile 2015: Kenya'. WHO/FWC/PHE/EPE/15.23. WHO. https://apps.who.int/iris/handle/10665/246133.

———. 2017. 'Diarrhoeal Disease'. 2017. https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.

———. 2018. 'Chikungunya – Mombasa, Kenya'. WHO. World Health Organization. 2018. http://www.who.int/csr/don/27-february-2018-chikungunya-kenya/en/.

———. 2018. 'Rift Valley Fever – Kenya'. WHO (blog). World Health Organization. 2018. http://www.who.int/csr/don/18-june-2018-rift-valley-fever-kenya/en/.

WHO, and UN. 2015. 'Climate and Health Country Profile 2015: Ethiopia'. WHO/FWC/PHE/EPE/15.07. United Nations. https://apps.who.int/iris/handle/10665/208861.

Women Deliver. 2021. 'The Link between Climate Change and Sexual and Reproductive Health and Rights'. https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report-1.pdf.

World Bank. 2013. 'Somalia | Data'. WorldBank Somalia: Data and Statistics. 2013. https://data.worldbank.org/country/somalia.

Yator, J. J. 2016. 'Impact of Climate Change on Food Security in Kenya'. *AGU Fall Meeting Abstracts* 41 (December). http://adsabs.harvard.edu/abs/2016AGUFMGC41B1100Y.

ANNEX A
EXISTING PROJECTS

INTERNATIONAL NONGOVERNMENTAL ORGANIZATION PROJECTS

UNICEF: A joint project, in collaboration with Kenya Red Cross Society, provides access to essential healthcare and services in vulnerable communities, including children's health interventions such as vaccines.
https://www.unicef.org/kenya/press-releases/unicef-and-kenya-red-cross-partner-provide-critical-healthcare-children

World Vision: WASH projects, in collaboration with local government, increase household's and individuals' access to clean water and sanitation and improve water governance within the Ministry of Water, Sanitation and Irrigation.
https://www.wvi.org/kenya/our-work/water-sanitation-and-hygiene-wash

World Bank: The Climate-Smart Agriculture Project aims to increase productivity and resilience to climate change among smallholder farming and pastoral communities. The project includes crisis and emergency response, support to upscale climate-smart agricultural practices, and decision support tools such as agro-weather and climate advisories.
https://projects.worldbank.org/en/projects-operations/project-detail/P154784

World Health Organization: This early warning intervention project used a prototype for predicting Malaria and other disease outbreaks such as Leishmaniasis. The data was shared in real-time by health facilities through a dedicated server within the Ministry of Health. Outlooks were made and issued 3–4 months in advance for diseases like Malaria. The project ended in 2016 due to a lack of support from governors and data availability issues.

NATIONAL GOVERNMENT PROJECTS

Ministry of Environment and Forestry: The Climate Change Directorate within the Ministry of Environment and Forestry conducts workshops and conferences with, for example, stakeholders from the Ministry of Health. These knowledge exchange forums aim to share best practice on climate change monitoring and evaluation towards coordinated decision-making and interventions.
http://www.environment.go.ke/?p=5826

Kenya Meteorological Department: Early warning systems have been set up for Malaria, based on a model developed in collaboration with the Kenya Medical Research Institute (KEMRI) supported by the International Development Research Centre (IDRC). The tool supports the forecasting of extreme weather events in western Kenya and issues advisories which include the preventative health measures that communities can take. This critical information is disseminated through county-specific websites, print and electronic media and social media. https://www.meteo.go.ke/

CIVIL SOCIETY AND NGO PROJECTS

Plan International: Farming communities are taught about short-cycle food crops and the use of greenhouse technology as well as irrigation and water conservation practices. Plan International also distributes tanks to schools (for water conservation) as well as to farms (for water storage and irrigation). Community-based projects involve other WASH interventions, such as drilling boreholes so that communities can access safe drinking water.
https://plan-international.org/kenya

CARE International: The Children's Safe Drinking Water Programme focuses on the promotion of point-of-use water treatment. Funded by Procter & Gamble, the project uses a technology known as the Purifier of Water (PUR). CARE International works with schools, communities and healthcare facilities to build their knowledge on how to ensure they have access to safe drinking water using PUR. The project also ensures the increased accessibility of PUR-treated water through linked healthcare facilities, community health volunteers, school health clubs and their patrons. The project's research arm looks into governance issues as well as the sustainability of these interventions.

The WISER project, conducted in the Lake Victoria region of Kenya, was aimed at "strengthening resilience to climate change" by tracking the potential impact of heat patterns in informal settlements including Siaya, Transnzioa and Migori. The project also developed a climate Vulnerability Capacity Assessment (VCA) that included an analysis of district-specific climate change issues.
https://www.care.or.ke/index.php/what-we-do/foodsecurity

IFRC

Climate Centre