Save the Children

Climate Resilient Health and Well-Being for Rural Communities in southern Malawi (CHWBRC)

Annex 2: Feasibility Study

Accredited Entity: Save the Children Australia

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LIST OF ACRONYMS

ACPC	Area Civil Protection Committee
ADC	Area Development Committee
AE	Accredited Entity
AEC	Area Executive Committee
CEFM	Child, Early and Forced Marriage
CHAGs	Community Health Action Groups
CHAM	Christian Health Association of Malawi
CHVs	Community Healthcare Volunteers
CHWBRC	Climate Resilient Health and Well-being for Rural Communities in southern Malawi
CN	Concept Note
CRECCOM	Creative Centre for Community Mobilisation
CSB	Corn Soy Blend
DCCMS	Department of Climate Change and Meteorological Services
DEC	District Executive Committee
DHAP	District Health Adaptation Plan
DNCC	District Nutrition Coordinating Committee
DODMA	Department of Disaster Management Affairs
DRIMS	Disaster Risk Information Management System
DRMP	Disaster Risk Management Plan
EAD	Environmental Affairs Department
EE	Executing Entity
EWARS	Early Warning and Response System
EWS	Early Warning System
FMCA	Financial Management Capacity Assessment
FP	Funding Proposal
GBV	Gender-based Violence
GCM	Global Climate Model
GDP	Gross Domestic Product

GEF	Global Environment Facility
GFCS	Global Framework for Climate Services
GoM	Government of Malawi
HCCCT	Health and Climate Change Core Team
HMIS	Health Management Information System
HNAP	Health National Adaptation Plan
HSAs	Health Surveillance Assistants
IDP	Internally Displaced Person
IPCC	Intergovernmental Panel on Climate Change
JNTCCCDRM	Joint National Technical Committee on Climate Change and Disaster Risk Management
LDC	Least Developed Country
LGA	Local Government Area
MEAL	Monitoring, Evaluation, Accountability and Learning
MHPSS	Mental Health and Psychosocial Support
MNCH	Maternal, Newborn And Child Health
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NCDs	Non-communicable Diseases
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organisation
NPF	National Planning Framework
PFP	Private For Profit
PHC	Primary healthcare
PIU	Project Implementation Unit
PMU	Project Management Unit
PNFP	Private Not For Profit
PSC	Project Steering Committee
PWD	People With Disabilities
RCP	Representative Concentration Pathway
RRMP	Residual Risk Management Plan
SCA	Save The Children Australia
SCI MW	Save The Children International Malawi
SCUK	Save The Children Fund (United Kingdom)
SDG	Sustainable Development Goals
SHSAs	Senior Health Surveillance Assistants
SRH	Sexual and Reproductive Health
TAG	Technical Advisory Group
TAs	Traditional Authorities
tCO2eq	Tons Of Carbon Dioxide Equivalent
ToC	Theory Of Change
TOR	Terms Of Reference
ToT	Training Of Trainers
UHC	Universal Health Coverage
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
VCPC	Village Civil Protection Committee
VHC	Village Health Committee
WASH	Water, Sanitation and Hygiene
WHO	World Health Organisation

1. INTRODUCTION

1.1 PURPOSE

This feasibility study provides background information to the Green Climate Fund funding proposal for the project "Climate resilient health and wellbeing for rural communities in southern Malawi", prepared by Save the Children Australia (SCA) in partnership with the Government of Malawi.

The purpose of this report is to provide the justification and further detail of the project design process and supporting information used to prepare the funding proposal. It also includes an assessment of the project design.

1.2 PROBLEM STATEMENT

Malawi is among the most climate-vulnerable countries in the world, ranking 161st out of 185 countries on the Notre Dame Global Adaptation Index in terms of its vulnerability to climate change and other global challenges in combination with its readiness to improve resilience[1]. The country is exposed to climatic changes, including increasing temperatures and changing rainfall patterns, and therefore to increasing extreme weather events such as floods, droughts and high/extreme heat events. The high exposure of Malawians to climate hazards is compounded by vulnerability resulting from high levels of poverty and food insecurity, gender inequality, persistent malnutrition, dependence on rain-fed agriculture, limited access to water and sanitation facilities, and high unemployment. Vulnerability is spatially and socially differentiated. Malawi ranks 173 out of 188 on the UN's Gender Inequality Index and has the 8th highest child marriage rate in the world. Climate change exacerbates existing inequalities, further restricting life chances for women, girls and other marginalised groups.

Climate risk poses threats to human health through several mechanisms. Chtraanging climate conditions have implications for the nature of the disease burden (including the distribution of disease risk throughout the year) (Section 3.3. for full details). Some examples are: many non-communicable diseases are related to heat/temperature rise, including cardiovascular disease, stroke, renal disease, diabetes, and respiratory disease; cholera increases under increasing temperatures, and outbreaks of cholera are frequent after intense/extreme rainfall events; changing temperature and rainfall patterns increase the seasonality, intensity and geographical prevalence of malaria; and mental health conditions such as depression and anxiety increase under climate change as climate change exacerbates many social, environmental and economic risk factors for problems in mental health and psychosocial wellbeing. People's vulnerability to disease is exacerbated by poor nutrition levels which leads to weakened immune systems, and this is particularly problematic from pregnancy to when a child is 2 years old (1,000 days) as this the critical window of opportunity where 70% of growth and development occurs and any negative impacts due to poor nutrition and care practices is likely going to lead to irreversible damage, thus affecticng the child's cognitive abilities and productivity throughout life. The risk of food insecurity and resulting 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, availability of food and clean water, and sanitary living conditions, all critical for optimal nutrition. Frequent floods and droughts, which occur throughout Malawi, but particularly affect the southern districts that are low-lying, are the leading causes of chronic food insecurity nationally[2]. The increased disease burden reduces health and wellbeing, increases poverty, and impedes healthy child development with future social and economic implications.

People have limited awareness of the risks that climate poses to their health, their potential capacity to mitigate the risk and so are unable to anticipate, prevent and respond to those risks.

The healthcare system is poorly resourced and poorly equipped to prepared and respond to climate change risks. On the one hand, healthcare service providers have limited awareness of how climate affects disease risk, and how they need to alter their public health messaging and response accordingly, and are not equipped with the information or skills to enable them to do this. On the other hand,

[1] Notre Dame Global Adaptation Index. Available at: https://gain.nd.edu/our-work/country-index/rankings/.
[2] IFRC (2021) Climate change impacts on health: Malawi assessment.

healthcare infrastructure is also vulnerable to climate exposure, both through direct impacts such as damage to facilities, and indirect impacts such as physical access being impeded in the wake of an extreme event such as a flood.

For instance, Tropical Cyclone Freddy in March 2023 affected 65 health facilities, increasing the burden on the few remaining functional facilities[3]. The disruption of the road network also affected access to health services, referral pathways and distribution of medical supplies. During times of crisis, there is a need for accessible and continued access to Sexual and Reproductive Health (SRH) to prevent unwanted pregnancy and for protection mechanisms for the increase in Gender-Based Violence (GBV) and Child, Early and Forced Marriage (CEFM). Climate-related events also exacerbate many social and environmental risk factors for mental health and psychosocial problems, exacerbating emotional distress, the development of new mental health conditions and a worsening situation for people already living with these conditions. In preparing for and responding to these recurring emergencies, there is an increasing need for the provision of Mental Health and Psychosocial Support (MHPSS). Climate change therefore threatens human health and wellbeing in Malawi.

1.3 THE PROPOSED PROJECT

The project takes a holistic health system approach, as advocated by the WHO, to develop a climate-resilient healthcare system that will reduce the adverse effects of climate change on health and wellbeing. The project will achieve climate-resilient health and wellbeing through a multi-pronged approach. Institutionally, the project will establish a climate-informed health surveillance system and health Early Warning And Response System (EWARS) that functions at national level and is able to track and provide appropriate early warning for the occurrence of climate-sensitive diseases and conditions. The healthcare system physical infrastructure will be adapted to withstand climate risk through the development and application of standards and guidelines for climate-resilient facilities and strengthened resilience of hospitals and health centres. The project will also respond to the gendered impact of climate change, providing support to the provision of SRH and protection systems against GBV and CEFM.

Healthcare staff will be trained to collect the data necessary to inform the early warning system to better manage the impacts of climate-induced health risk. Enabled by this information – from both the climate-informed health surveillance system and EWARS – as well as improved medical structures and technologies for responding to climate risk to health, staff will be well-equipped to cascade this awareness and capacity to anticipate and reduce risk to communities. Malawian citizens will therefore also be better equipped to manage the risk of climate to their own health, which will be supplemented by tangible nutrition interventions targeting the most physiologically vulnerable groups, i.e. pregnant women and mothers of children under two, to ensure that their health outcomes are not impacted by climate change. The project will specifically target six climate vulnerable districts in the south of Malawi, namely Balaka, Ntcheu, Machinga, Mangochi, Phalombe, and Zomba (see Section 6.3: Target Areas and Beneficiaries).

1.4 DESIGN APPROACH

The design of this project is based on a number of key principles:

Transformation and replication potential: Whilst the project expressly targets the most vulnerable people in some of the most vulnerable districts, the establishment of a climate-informed health surveillance system and health EWARS at national level provides significant system transformation potential. Considerable emphasis will be placed on monitoring, evaluation and learning to capture lessons from the implementation in six districts and inform efficient and effective replication and scaling out beyond the lifespan of the project, and budgeted activities with Ministry of Health at national level will enable sharing of these lessons with other districts.

[3] Office of the President and Cabinet Department of Disaster Management Affairs (2023), Tropical Cyclone Freddy emergency response plan. Government of Malawi, Lilongwe, Malawi. Available at: https://reliefweb.int/report/malawi/tropical-cyclone-freddy-emergency-response-plan-office-president-and-cabinet-department-disaster-management-affairs-march-2023.

Alignment with national priorities and commitments: The health sector is identified as one of six priority areas in Malawi's National Adaptation Plan framework[4], and the country already has an advanced draft of a Health National Adaptation Plan, the implementation of which will be supported by this project. The project also supports implementation of policy and strategy commitments spanning climate change (through the National Climate Change Management Policy 2016), disaster risk reduction (through the National Disaster Management Policy), and health (through the Health Sector Strategic Plan 2023-30).

Multi-stakeholder implementation: As mandated by the Health and Climate Change Core Team (HCCCT), the Ministry of Health will act as one of the Executing Entities, guided by a project steering committee that comprises other relevant government ministries, including the Ministry of Agriculture, Ministry of Water and Sanitation, Department of Disaster Management Affairs (DODMA), and Ministry of Forestry and Climate Change (which includes the Department for Climate Change and Meteorological Services and the Environmental Affairs Department, as the Nationally Designated Authority for the Green Climate Fund). In line with Malawi's Decentralisation Policy (2013) and with the ambitions of the global adaptation community of decentralising adaptation efforts and initiatives, implementation will take place at the local level through District Executive Committees, and Save the Children has selected a number of well-qualified implementing partners at local level.

Country ownership and local engagement: The design process has been inclusive, based on extensive stakeholder consultation with government and non-government partners at district and national level from the very beginning. The Health and Climate Change Core Team (HCCCT) of the Joint National Technical Committee on Climate Change and Disaster Risk Reduction (JNTCCCDRM) – Malawi's primary multi-stakeholder coordination body on climate change-related activities – has overseen the entire process of project design through the nominated task team members; and extensive consultation and needs assessment at both district and community level has informed the development of the Concept Note and the Funding Proposal.

An inclusive approach to targeting, with a particular focus on inclusion of women, children and people with disabilities: Entrenched gender inequality and social marginalisation means that vulnerability to climate change is gendered and socially differentiated. This is particularly the case with health, where, in addition, physiological vulnerabilities exist, particularly for pregnant women and mothers of children under two. As well as ensuring equal opportunities for inclusion in project activities and project benefits, this project is strongly committed to addressing the root causes of vulnerability and exclusion, which it will do through: (i) training and awareness-raising activities at various level (e.g., with government, with healthcare providers, and at community level); (ii) engaging communities in community-based adaptation, whereby community-led processes have the aim of achieving greater gender equality and social inclusion in health outcomes.

Focus on evaluation and learning: As Malawi is recognised to have high levels of vulnerability to climate change that cut across many sectors, there are already many projects and activities aiming to promote adaptation in different locations and at different scales. Under the auspices of the JNTCCCDRM, the project commits to coordinate with and learn from other initiatives, whilst actively communicating its own findings with the aim of promoting a paradigm shift and transformation to reduce climate risk.

1.5 STRUCTURE OF THE FEASIBILITY STUDY

The feasibility study is structured as follows. Section 2 introduces the Malawi context, giving an overview of national circumstances, the legal and regulatory framework, governance structures, institutional framework, policies, and how the project aligns with other climate finance initiatives. Section 3 presents the recent trends and future projections for Malawi's climate and the sectoral implications. Section 4 summarises the adaptation gaps that the project addresses by comparing and contrasting national circumstances and needs with the WHO climate-resilient health system framework. Section 5 presents

[4] Ministry of Natural Resources, Energy and Mining (2020) Malawi's National Adaptation Plan Framework. Environmental Affairs Department, Lilongwe, Malawi. Available at: https://napglobalnetwork.org/wp-content/uploads/2020/03/napgn-en-2020-malawis-national-adaptation-plan-framework.pdf.

technical assessments of selected project interventions. Section 6 presents how the project will reduce climate change vulnerability through the theory of change and provides an overview of outcomes, outputs and activities.

2. MALAWI CONTEXT

This section provides an overview of the Malawi context, outlining the geographical setting, governance structures, policy setting, and landscape of other related initiatives.

2.1 BRIEF COUNTRY OVERVIEW

Malawi is a land-locked country in south-eastern Africa, bordered by Tanzania to the north, Mozambique to the east, south and southwest, and Zambia to the west. It is also bordered by Lake Malawi to the east, which it shares with Tanzania and Malawi. The country comprises highlands and lowlands divided into four agro-ecological zones reflecting different soil, topographical and climate conditions: the Lower Shire valley, the lakeshore plains and Upper Shire valley, the mid-altitude plateau, and the highlands.

Malawi gained independence from Britain in 1966 and, since then, has transitioned from a one-party totalitarian state to a multi-party democracy. Over recent years population growth rates have been high, with the most recent census reporting a population of 19.1 million[5]. The population is largely rural, with smaller proportions living in the main cities of Lilongwe, Blantyre and Mzuzu. Urbanisation is proceeding slowly, with city-based labour markets struggling to absorb labour due to population growth. Low levels of education impede opportunities in productive economic activities. Although primary school completion rates are fairly high at 80%, this drops to around 20% completing secondary education[6] .

The economy is heavily reliant on agriculture, which contributes significantly to GDP, including through exports of tobacco. This sector is also the main livelihood activity for the majority of the population, although its contribution has declined over time such that, by 2019, just under a third of the population received their only income from agriculture[7]. This reflects greater diversification, including in ganyu (informal short-term labour, for example that which is particularly performed on an ad hoc piece work basis) and the informal labour market. However, food insecurity remains a major issue.

[5] National Statistical Office, 2019. 2018 Malawi Population and Housing Census. Main report. https://malawi.unfpa.org/sites/default/files/resource-pdf/2018%20Malawi%20Population%20and%20Housing%20Census%20Main%20Report%20%281%29.pdf

[66] Caruso, German Daniel; Cardona Sosa,Lina Marcela. Malawi Poverty Assessment: Poverty Persistence in Malawi - Climate Shocks, Low Agricultural Productivity, and Slow Structural Transformation (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/099920006302215250/P174948072f3880690afb70c2097fe214d

[7] Caruso, German Daniel; Cardona Sosa,Lina Marcela. Malawi Poverty Assessment : Poverty Persistence in Malawi - Climate Shocks, Low Agricultural Productivity, and Slow Structural Transformation (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/099920006302215250/P174948072f3880690afb70c2097fe214d

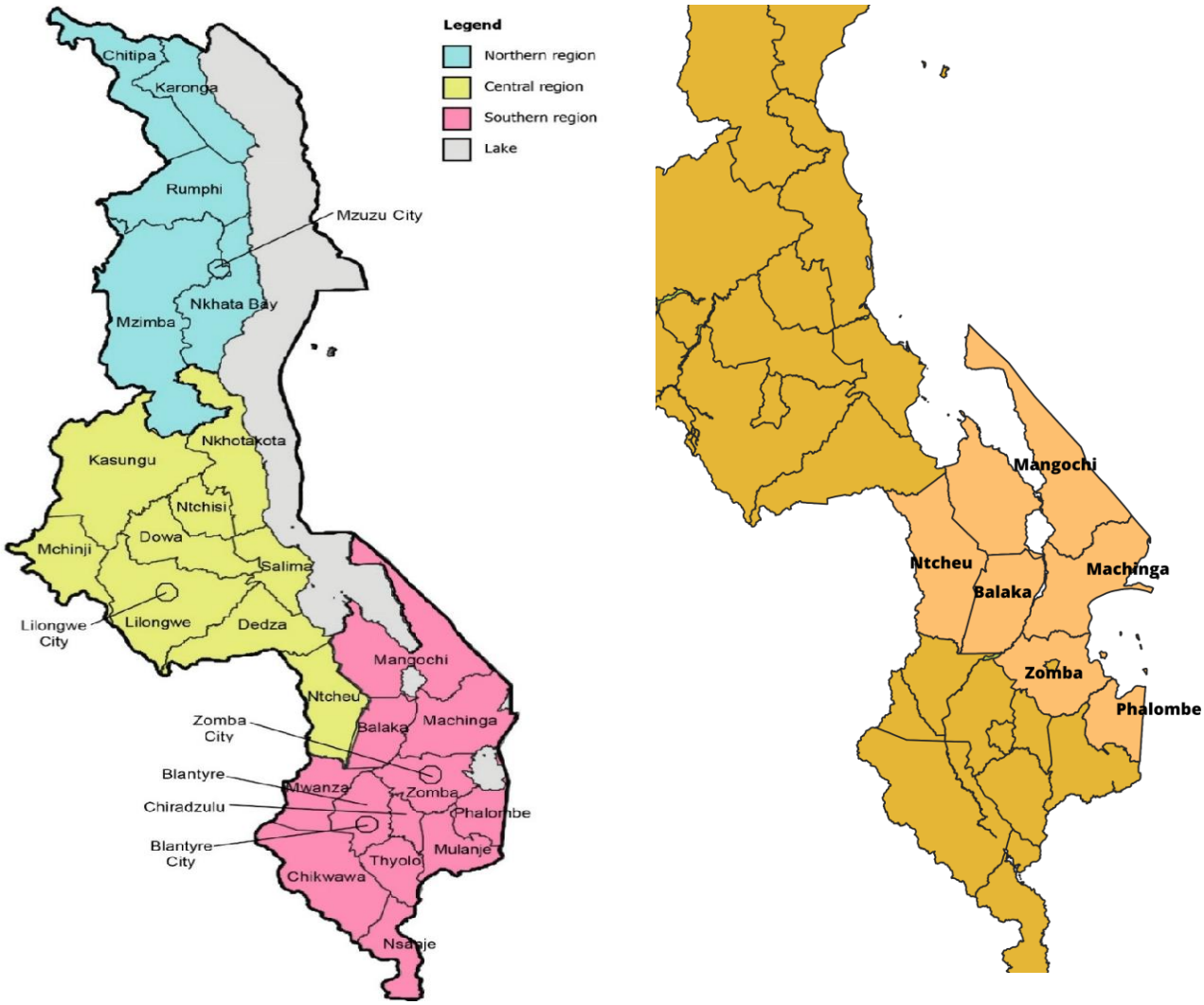

Figure 1: Map of Malawi and map of target project districts

2.1.1 Poverty and livelihoods

Malawi has high levels of poverty and scores low on human development indicators. There is strong reliance on natural resource-based livelihoods and maize production for internal consumption. The National Statistics Office (NSO) in Malawi defines the population that had a total consumption below K165,879 (USD126[8]) as poor in 2019/2020, as compared to K137,428 (USD105) in 2016/2017[9]. As regards ultra-poverty, the population that had a total consumption below K101,293 (USD77) in 2019/2020 was considered to be ultra-poor in the Fifth Integrated Household Survey (IHS5), while in 2016/2017 the threshold was at K85,260 (USD65).

Based on these thresholds and as shown in Figure 2, the proportion of population that was poor nationally reduced from 51.5% in 2016/2017 to 50.7% in 2019/2020[10]. This means that slightly over half of the population in Malawi is still in poverty. Analysis by place of residence shows that 56.6% of people from rural areas were poor compared to 19.2% in urban areas in 2019/2020 and since the six target project districts are predominantly rural, poverty levels within these districts are high[11].

[8] Based on an exchange rate on 17 June 2023 of MKW1314:$1.
[9] NSO (National Statistical Office) (2021). 2020 Malawi Poverty Report. Government of Malawi, Zomba.
[10] Ibid.
[11] Ibid.

At regional level, the Central region had the highest proportion of the population that was poor (55.8%) followed by the Southern region (51.0%) and then the Northern region (32.9%) in 2019/2020. Analysis by sex of household heads shows that 56.8 percent of people in female-headed households were poor in 2019/2020 compared to 48.5% in male-headed households.

Figure 2: Proportion of the population that is poor (Poverty Head Count Ratio) by Districts, Malawi 2020 (adapted from [12]).

Analysis of poverty data at district level (Figure 2) shows that the project's target districts rank very high in terms of levels of poverty, with Phalombe ranking highest (63.7% poverty headcount), followed by Mangochi (63.5%), Balaka (62.7%), Machinga (62.3%), Ntcheu (56.8%) and Zomba Rural (48.8%).

Part of the reason for the high levels of poverty is the high levels of reliance on natural resource-based livelihoods that are threatened by global environmental changes such as climate change. The country experiences chronic and recurrent food insecurity, with 5.4 million people facing moderate or severe food insecurity, and 4.4 million people facing mild food insecurity (in total over half of the total population)[13], which leads to significant proportions of Malawi's population relying on food aid to get through the "lean season" (the season when last year's staple harvests run out for many people) on an annual basis. This is particularly the case in the south of the country, which has the highest proportion of the population classified as being in the Integrated Phase Classification[14] level 4 (severe), including the whole of Balaka district. The numbers are often exacerbated when extreme events (droughts and floods) impede production.

[12] Ibid.

[13] Government of Malawi (2022) IPC analysis report on the chronic food insecurity situation. https://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/IPC_Malawi_ChronicFoodInsec_2022May_report.pdf. Government of Malawi, Lilongwe, Malawi.

[14] The Integrated Food Security Phase Classification (IPC) is an innovative multi-partner initiative for improving food security and nutrition analysis and decision-making. By using the IPC classification and analytical approach, Governments, UN Agencies, NGOs, civil society and other relevant actors, work together to determine the severity and magnitude of acute and chronic food insecurity, and acute malnutrition situations in a country, according to internationally-recognised scientific standards (https://www.ipcinfo.org/ipcinfo-website/ipc-overview-and-classification-system/en/).

Climate shocks will have severe impact on the nutritional status of vulnerable groups[15]. There has been some progress in recent years in reducing the number of babies born with low birth weight, in children with severe acute malnutrition and with stunting (a consequence of prolonged malnutrition), but the prevalence of stunting is still high at 35.5% of children under five[16]. Improvements in addressing malnutrition are under threat by climate shocks, disease outbreaks, and economic instability[17]. Moderate and severe acute malnutrition are typically exacerbated in drought period where food security is threatened. In 2016 there was a significant increase in new admissions of Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM) cases among children under five, adolescents, and adults[18].

2.1.2 Vulnerability to climate change

Against a backdrop of interannual climate variability, Malawi is experiencing increasing impacts from climate change as a result of high exposure and high vulnerability. Malawi is highly at risk from the impacts of extreme weather events given its location along the great African Rift Valley, rapid population growth, unsustainable urbanization, climate variability and change, and environmental degradation[19]. The most common historical weather-related shocks affecting Malawi (of interest to this project) include floods, drought and stormy rains . Historical data on high/extreme heat events is not available, although the clear signal in the projected trends in changes in temperature-based extremes support the notion that southern Malawi will be exposed also to heat-related hazards (see Section 3.2.3.1) which is why high/extreme heat events are also an area of project focus. In the 30-year period from 1979 to 2008 Malawi experienced more than 40 weather-related disasters. Climate-related national disasters were declared in 5 of the last 8 years, with costs to GDP ranging from 0.13-5.6% (Table 1). On average, Malawi loses approximately 1.7% of GDP every year due to the combined effects of droughts and floods – which is more than 5 times higher than the average for Least Developed Countries of 0.3%[20].

Table 1: Years that climate-related national disasters were declared and costs (sources listed at [21]).

Year	Nature of disaster	Cost of GDP
2015	Floods	0.5%
2016	Drought	5.6%
2019	Floods (relating to Cyclone Idai)	0.13%
2022	Floods (relating to Tropical Storm Ana)	(No post-disaster needs assessment conducted)
2023	Floods (relating to Cyclone Freddy)	0.5%

[15] Hopper, R. (2022) Breaking the cycle of poverty and food insecurity in Malawi. Discussion Paper. Available at: Breaking the Cycle Discussion Paper.pdf (kulima.com).
[16] Global Nutrition Report (2022) Malawi – the burden of malnutrition at a glance. Global Nutrition Report. Available at: https://globalnutritionreport.org/resources/nutrition-profiles/africa/eastern-africa/malawi/t.
[17] UNICEF (2023) Over half a million children at risk of malnutrition. UNICEF, Geneva, Switzerland. https://www.unicef.org.uk/press-releases/over-half-a-million-children-at-risk-of-malnutrition-in-malawi/#:~:text=In%202023%20alone%2C%20it%20is,%2452.4%20to%20US%2487.7%20million.
[18] Government of Malawi (2016) National Resilience Strategy. Government of Malawi, Lilongwe, Malawi. Available at https://www.usaid.gov/sites/default/ files/documents/1860/Malawi_National_Resilience_Strategy.pdf.
[19] Malawi Government (2019) Malawi 2019 Flood Post Disaster Needs Assessment Report. Government of Malawi, Lilongwe, Malawi. Available at: https://www.unicef.org/malawi/media/1756/file/Malawi%202019%20Floods%20Post%20Disaster%20Needs%20Assessment%20Report.pdf.
[20] Pauw, K. et al. (2011) The economic costs of extreme weather events: a hydro-meteorological analysis for Malawi. Environment and Development Economics 16: 177-98. doi:10.1017/S1355770X10000471.
[21] Malawi Government (2015) Malawi 2015: floods post disaster needs assessment report. Government of Malawi, Lilongwe, Malawi. Available at: http://reliefweb.int/sites/reliefweb.int/files/resources/Malawi-2015-Floods-Post-Disaster-NeedsAssessment-Report.pdf; Malawi Government (2016) Malawi 2016 Drought Post Disaster Needs Assessment Report. Government of Malawi, Lilongwe, Malawi. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/640011479881661626/malawi-drought-2015-2016-post-disaster-needs-assessment-pdna; Malawi Government (2019) Malawi 2019 Flood Post Disaster Needs Assessment Report. Government of Malawi, Lilongwe, Malawi. Available at: https://www.unicef.org/malawi/media/1756/file/Malawi%202019%20Floods%20Post%20Disaster%20Needs%20Assessment%20Report.pdf; Government of Malawi (2023) Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment. Government of Malawi, Lilongwe, Malawi. Available at: https://reliefweb.int/report/malawi/malawi-2023-tropical-cyclone-freddy-post-disaster-needs-assessment-april-2023.

The 2015 floods were as a result of, to date, the highest rainfall on record for Malawi, and constituted a 1 in 500-year event. There was significant flooding, particularly in the Southern Region, and in all the project target districts of Phalombe, Zomba, Balaka, Machinga, Mangochi and Ntcheu. Over 1.1 million people were affected, 230,000 were displaced and 106 people were killed. There was also substantial damage and losses in the productive, public infrastructure and social service sectors, including private and community assets. The floods washed away livestock, destroyed thousands of buildings, houses and assets, and damaged roads, bridges, irrigation infrastructure and school and health facilities[22].

The 2016 drought affected the country as a whole, but particularly the Central and Southern regions, and led to at least 6.5 million people (or 39 percent of the population) in 24 drought-affected districts not being able to meet their food requirements during the 2016/17 consumption period. The total cost of the drought was estimated at USD365.9million, with recovery needs estimated at USD500.2million[23]. The agriculture sector - including crops, livestock and fisheries - was the most affected, with damages and losses accounting for 70 percent of the total. There was a notable increase in food insecurity and decline in living conditions at household and community levels, and increased defaulting in health care programmes, including supplementary feeding for children under five.

In 2019, Tropical Cyclone Idai led to significant rains, floods and strong winds in southern and central Malawi, leading to the declaration of a state of disaster in the 13 districts and two cities in the Southern Region and two districts in the Central Region. It is estimated that approximately 975,600 people were affected by these floods, with 60 deaths and 672 injuries reported. The 15 affected districts, which include four of the six proposed project districts, were Balaka, Blantyre, Chikwawa, Chiradzulu, Machinga, Mangochi, Mulanje, Mwanza, Neno, Nsanje, Phalombe, Thyolo, Zomba districts in the Southern Region and Dedza and Ntcheu in the Central Region[24]. As a result of the disaster, around 90,000 internally displaced people (IDP) were sheltered in 174 IDP sites. While the disasters affected almost everyone, women were reported to have been affected more[25]. An interagency assessment finding showed that the internally displaced people included a disproportionate number of women, with 63 percent of those in internally displaced people shelters in Machinga, Mangochi, Balaka and Zomba being women, and 37 percent male.

In 2023, Cyclone Freddy brought heavy rains in March that led to multiple flood events in Blantyre, Mulanje and Thyolo, followed by landslides in Blantyre, Chiradzulu, Mulanje and Phalombe. Over 2.2 million people were affected, including over 650,000 people who were displaced (of which 335,252 were female and 323,026 were male), 679 who were killed, and over 530 people who were declared missing by mid-March. The flooding led to substantive damage and losses to social services (defined as a cluster of education, health and nutrition and housing – although within this sector health was the least affected, experiencing $8.3 million damage), followed by the productive and infrastructure sectors. The disaster impact was highest in the housing sector, with about 260,681 houses damaged or destroyed, as well as damage to roads, bridges, and power supply and irrigation infrastructure. The assessment has revealed a total disaster effect of $506.7 million, while the total cost of recovery and reconstruction is $680.4 million[26]. The impacts also last beyond the time of the floods themselves: in 2023, schools were closed for four weeks in the aftermath of cyclone Freddy, affecting 5% of the country's primary

[22] Malawi Government (2016) Malawi 2016 Drought Post Disaster Needs Assessment Report. Government of Malawi, Lilongwe, Malawi. Available at: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/640011479881661626/malawi-drought-2015-2016-post-disaster-needs-assessment-pdna.
[23] Ibid.
[24] Malawi Government (2019) Malawi 2019 Flood Post Disaster Needs Assessment Report. Government of Malawi, Lilongwe, Malawi. Available at: https://www.unicef.org/malawi/media/1756/file/Malawi%202019%20Floods%20Post%20Disaster%20Needs%20Assessment%20Report.pdf.
[25] Ibid.
[26] Government of Malawi (2023) Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment. Government of Malawi, Lilongwe, Malawi. Available at: https://reliefweb.int/report/malawi/malawi-2023-tropical-cyclone-freddy-post-disaster-needs-assessment-april-2023.

and secondary school children. Around 230 schools that withstood the floods were being used to shelter those who had lost their homes[27].

From a health perspective, health centres were included in the infrastructure that was damaged by the flood. It was noted that construction of such facilities, particularly at community level, does not follow minimum construction guidelines and site supervisions are not made by the MoH during construction. Some health centres have solar photovoltaic systems destroyed by strong winds, which impedes their capacity to deliver services, for example through cold storage of medicines. Damage to transport infrastructure impedes access to healthcare, with all six project districts registering losses to roads, the largest of which were in Phalombe. The implications of flooded land on crop harvests will likely lead to food insecurity in the coming season. Due to the gendered roles that accord responsibility for food provision to women, women are particularly vulnerable to adopting distress coping mechanisms such as sex work which, in turn, can increase their exposure to HIV and their need for SRH services.

The dominant role of agriculture plays a role in vulnerability to climate change. Changing climate and extreme events have impeded economic growth and progress against poverty indicators. For every three Malawians that moved out of poverty between 2010-19, four fell back into it due to the impact of weather shocks[28]. Extreme events are occurring with increasing frequency in Malawi. In 2022 the country was hit by Tropical Storms Ana and Gombe; in 2019 there was Cyclone Idai; in 2016 a severe drought linked with El Nino caused a food and humanitarian crisis; and in 2015 there was a 1-in-500-year flood in January. The Central and Southern regions are more exposed to these extreme weather events, and have higher levels of poverty.

The poorer a person is, the less likely they are able to have savings to rely on to absorb the losses and negative impacts of climate shock exposure, and fewer than 2% of Malawians reported receiving help from government or NGOs to soften the shock. The probability of a household being poor increases by 14 percentage points after experiencing a climate shock; household income from agriculture decreases 17 percentage points after a flood and 14 percentage points after a drought[29].

2.2 POLICY AND REGULATORY FRAMEWORK

Malawi has an extensive policy framework in place to address climate change and disaster risk reduction, and increasingly the risks of climate to health. The National Climate Change Management Policy was finalised in 2016 with the aim "*to promote climate change adaptation, mitigation, technology transfer and capacity building for sustainable livelihoods through Green Economy measures for Malawi*", and there is an accompanying learning strategy. A revised Nationally Determined Contribution to the UNFCCC was finalised in 2021 and the National Adaptation Plan is under development. Pending the conclusion of the National Adaptation Plan, a draft Health National Adaptation Plan is in existence.

The Disaster Risk Management Policy (2015) was finalised after the 2015 floods and aims to "s*ustainably reduce disaster losses in lives and in the social, economic and environmental assets of individuals, communities and the nation*" and is aligned with the Sendai Framework for Disaster Risk Reduction. Both policies encourage mainstreaming of climate and disaster risk across line ministries and from national to local level.

The chronic recurrence of food insecurity and concerns over intensification in the context of a changing climate prompted a focus on "breaking the cycle" from around 2015. There have been significant investments in social protection, including through the social cash transfer scheme, and into resilience building, as outlined in the National Resilience Strategy 2018-2030[30]. However, progress has been

[27] Reliefweb (2023) Nearly half a million children in Malawi unable to attend school due to Cyclone Freddy. Available at: https://reliefweb.int/report/malawi/nearly-half-million-children-malawi-unable-attend-school-due-cyclone-freddy.
[28] Caruso, G.D. & Cardona Sosa, L.M. (2022) Malawi poverty assessment: poverty persistence in Malawi - climate shocks, low agricultural productivity, and slow structural transformation. World Bank Group, Washington, D.C. Available at: http://documents.worldbank.org/curated/en/099920006302215250/P174948072f3880690afb70c2097fe214d.
[29] Caruso, G.D. & Cardona Sosa, L.M. (2022) Malawi poverty assessment: poverty persistence in Malawi - climate shocks, low agricultural productivity, and slow structural transformation. World Bank Group, Washington, D.C. Available at: http://documents.worldbank.org/curated/en/099920006302215250/P174948072f3880690afb70c2097fe214d.
[30] Government of Malawi. National Resilience Strategy. 2016. Available at https://www.usaid.gov/sites/default/files/documents/1860/Malawi_National_Resilience_Strategy.pdf

hampered by fragmentation of efforts – typically as a result of competing development partner perspectives and resource constraints – and failure to invest significantly in risk reduction efforts[31]. In general, policy implementation efforts are suboptimal, impeded by insufficient financing.

2.2.1 Development plans

Vision 2063

Vision 2063 is the long-term planning document in Malawi that has the vision of "An inclusively wealthy and self-reliant nation". Its three pillars are agricultural productivity and commercialisation, industrialisation and urbanisation. These are due to be achieved through 7 enablers. The proposed CHWBRC project contributes to enabler 1 "effective governance systems and institutions" (Outcome 1), which entails responsiveness and effectiveness and efficiency, as well as competency and capacity. It also contributes to enabler 5 "human capital development" (Outcome 3), which entails ensuring a robust education and skills development, good health and nutrition and improved access to clean water, sanitation, and hygiene. It also contributes to enabler 7 "environmental sustainability" (Outcome 2), which includes confronting disasters and climate change.

Malawi Growth and Development Strategy III

The third iteration of Malawi Growth Development Strategy 2017-22 (yet to be updated) is the medium-term development framework that has a long-term goal of a productive, competitive and resilient nation. Among its 6 key priority areas, the project contributes to priority 6 "health and population" and priority 2 "agriculture, water development and climate change management", as well as priority 3 "education and skills development". It also contributes to the other development areas, including "disaster risk management and social support", "gender, youth development, persons with disability and social welfare" and "nutrition".

2.2.2 Climate change policies

National Adaptation Programme of Action

Climate change policies in Malawi commenced with the National Adaptation Programme of Action in 2006 (Environmental Affairs Department, 2006). Developed as part of its commitment as a Least Developed Party to the UNFCCC, the NAPA included health and nutrition among 15 key climate adaptation needs. For health, the focus was on malaria and improving water availability for disaster preparedness and response. For nutrition the focus was on improvements through improved crop production and storage, diversification, and nutrition supplements for children.

National Climate Change Management Policy 2016

The National Climate Change Management Policy was adopted in 2016 as the national policy that aims to integrate climate change in development planning and implementation across sectors and at multiple levels (both national and district). The project interventions contribute to the first objective, "to effectively manage the impacts of climate change through interventions that build and sustain the social and ecological resilience of all Malawians" and to the second objectives to "integrate climate change into planning, development, coordination and monitoring of key relevant sectors in a gender sensitive manner". In particular, the proposed outcomes and activities contribute directly to three policy outcomes, namely "3: Increased awareness of climate change impacts, adaptation and mitigation measures (outcomes 1-4); "4: Research, technology development and transfer and systematic observations enhanced and strengthened;" (outcome 1 through the EWARS (Early Warning and Response System) and surveillance system) and 5: Enhanced capacity to implement climate change-related interventions (outcomes 1-4).

Updated Nationally Determined Contribution

The updated Nationally Determined Contribution was submitted in 2021 to the UNFCCC outlined Malawi's mitigation and adaptation commitments. "Healthy and protected people" is one of the six priority themes, and project components also contribute to other priority themes of "effective and

[31] Hopper, R. (2022) Breaking the cycle of poverty and food insecurity in Malawi. Discussion Paper. Available at: Breaking the Cycle Discussion Paper.pdf (kulima.com).

efficient Early Warning Systems" (Outcome 1) and "climate proofed infrastructure, buildings and energy systems" (Outcome 2). The project also contributes to several of the particular adaptation priorities in the updated NDC, including i) capacity building for diagnosis, prevention and control of climate-sensitive diseases and malnutrition (Outcomes 1, 2, 3 and 4) ; ii) capacity building for WASH interventions (Outcomes 2 and 4); iii) incorporating community-based adaptation measures in local climate change adaptation plans and budgets (Outcomes 1 and 4); and iv) awareness campaigns on hygiene, sanitation and water conservation (Outcome 4).

Malawi National Strategy on Climate Change and Learning 2021

The Malawi National Strategy on Climate Change and Learning 2021 aims to strengthen human resources, skills and develop institutional arrangements for the advancement of green, low emission, and climate-resilience development. The project contributes to pillars 1 and 2 of the strategy through the development of climate change awareness-raising programmes, training government officers at national and district levels, and targeting institutions prioritised in the strategy, including youth networks and associations, and associations targeting people with disability.

2.2.3 Health policies

National Health Policy 2018

The National Health Policy was adopted in 2018 with the theme "towards universal health coverage". The project aligns with three of the policy priority areas. These are policy priority area 5 "human resources for health" (Outcome 3), policy priority area 6 "medicines, medical supplies, medical equipment and infrastructure" (Outcomes 2 and 3), and policy priority area 8 "health information and research" (Outcome 1).

National Environmental Health Policy 2018

The National Environmental Health Policy was adopted in 2018 to provide direction on implementation of environmental health interventions, with the goal of achieving the highest possible level of health and well-being for every Malawian by reducing morbidity and mortality resulting from environmental health risks. The project directly supports priority area 5, "to reduce impacts of public health emergencies and effects of climate change on human health". It directly supports all of the outcomes under this priority area, which are "reduced health risks during emergencies and disasters" (Outcomes 1, 2, 3 and 4), "Enhanced capacity for health systems to prepare for and respond to climate change threats to human health" (Outcome 3) and "Scientific research promoted on climate change impacts and adaptation" (Outcome 1).

Malawi National Health Information System Policy 2015

The Malawi National Health Information System Policy was adopted in 2015 and aims to ensure an adequate provision of information support to all stakeholders in the health sector for evidence-based decision making in the planning and management of health services. The project contributes to the objective "to generate quality information (accurate, complete, timely, relevant, and reliable) and make them accessible to all intended users through standardized and harmonized tools across all programs that avoid duplication and reduce the workload on data capture by already stretched human resource at health facility level" through Outcomes 1 and 3.

National Community Health Strategy 2017-22

The National Community Health Strategy 2017-22 calls for building a sufficient, well-trained workforce, promoting and harmonizing community health system information with multi-directional flow, strengthening community engagement in and ownership of community health, improving coordination at the district level and providing sufficient health infrastructure at the community level. The project contributes to the thematic areas of health service delivery (outcome 3), human resources (outcome 3), information, communications and technology (outcome 1), supply chain and infrastructure (outcome 2), community engagement (outcome 3 and 4) and leadership and coordination (outcome 3).

Health Sector Strategic Plan 2023-30

The third edition of the Malawi Health Sector Strategic Plan 2023-30 guides the Ministry of Health in delivery of health care. The goal of the third Health Sector Strategic Plan is to move towards Universal

Health Coverage (UHC), in alignment with the National Health Policy. It does this by improving health status, financial risk protection and client satisfaction, which is achieved through a defined Health Benefits Package (HBP). The project supports five of the nine priority areas. These are priority 1, "service delivery: increase equitable access to and improve quality of health care services" (outcomes 2, 3 and 4); priority 2 "socio-economic determinants: to improve overall health, environmental health and prevent disease through addressing social determinants of health and burden of disease (outcomes 1 and 4); priority 3 "infrastructure and medical equipment: to improve the availability, accessibility and quality of health infrastructure and medical equipment at all levels of health care (outcome 2); priority 4 "human resources: improve the availability of competent and motivated human resources for health (HRH) for quality health service delivery that is effective, efficient, and equitable (outcome 3) and priority 5 "medical products and technology: to improve the availability, quality, and rational utilization of medicines and related medical supplies, balancing among the 3 P's: patients, products, and personnel (outcome 2).

Health National Adaptation Plan

The Health National Adaptation Plan (HNAP) is currently in draft format and represents the health sector contribution to the National Adaptation Plan, which is also still under development. The HNAP aims to ensure a climate-resilient health system and to protect health from climate change through adaptation planning. The project will directly contribute to the objectives (i) empower communities to take leading roles in adapting to climate change risks to health through planning, monitoring, surveillance, and reduction of risks (Outcomes 1 and 4); (ii) strengthen advocacy for climate change adaptation in health sector among non-state actors (Outcome 1); (iii) build capacity for monitoring, evaluation and research for effective preparedness and management of climate change health effects (Outcome 1); (iv) build climate-resilient health infrastructure, and health services able to respond to climate related illnesses (Outcomes 2 and 3); and (v) establish and strengthen local capacity and mechanisms for mobilizing additional domestic and international climate change and adaptation resources and improve the human resource capacity for response (Outcomes 2 and 3).

NATIONAL DIGITAL HEALTH STRATEGY 2020-2025

This strategy[32] identifies key challenges in terms of reliance on paper-based systems, inadequate quality of data collected/input into DHIS2 and other systems, the need for training healthcare facility staff, interoperability of different digital health applications and systems, sustainability of digital health solutions, and effective coordination of digital health efforts. The proposed project will contribute to achievement of the following objectives of this strategy: Objective 1 - Improved coordination of digital health investments to increase efficiency; Objective 2 - Establish a reliable ICT infrastructure that enables utilization of digital health systems; Objective 3 - Build the capacity of consumers, communities, human resources for health to participate in and benefit from digital health interventions; and Objective 7 - Strengthen the sharing and accessibility of data across systems to enable use.

NATIONAL TRADITIONAL AND COMPLEMENTARY MEDICINE POLICY 2020

This policy[33] states that "Malawi strives to provide quality health care services to all Malawians. As a consequence, adequate and high quality complimentary traditional health services shall be promoted in accordance with set laws and regulations of the country and in relation to the code of ethics for traditional health practitioners". The policy outlines priority areas of: i) Governance and Regulation of Traditional and Complementary Medicine; ii) Traditional and Complementary Medicine Standards; iii) Research and Development in Traditional and Complementary Medicine; iv) Partnership, Coordination and Collaboration; and v) Capacity Building and Awareness. The CHWBRC aligns with this policy in terms of the proposed Activity 4.1.3 which includes engagement of Traditional Healers to orientate them to the project, discuss information about the impact of climate and health, their perceptions of climate and health, and their role in helping community knowledge and adaptation.

[32] MoH, 2020. National Digital Health Strategy 2020-2025. Available here.
[33] Government of Malawi, 2020. National Traditional and Complementary Medicine Policy.

2.2.4 Disaster risk management policies

Disaster Risk Management Policy 2015

The Disaster Risk Management Policy was adopted in 2015 with the aim to sustainably reduce disaster losses in lives and in the social, economic and environmental assets of individuals, communities and the nation. The project directly contributes to objective 1 “mainstreaming disaster risk management into sustainable development, where among others it aims to ensure that ensure that DRM is mainstreamed in all sectors and at all levels” (outcome 1), objective 2 “establishment of a comprehensive system for disaster risk identification, assessment and monitoring” (outcome 1), objective 3 “development and strengthening of a people-centred early warning system, where it aims to ensure that newly established and existing early warning systems are comprehensive, effective, people-centred and integrated (outcome 1); objective 4 “promotion of a culture of safety, and adoption of resilience-enhancing interventions, where among other things it aims at ensuring that disaster risk management is integrated into primary, secondary and tertiary curricula (outcome 4) and objective 5 “reduction of underlying risks, where it aims at long-term community-based disaster risk reduction” (outcome 4). The policy is supported by the new Disaster Risk Management Bill no 9 of 2023 that was finalised in April 2023 and succeeds the previous one which dated to 1991. The new bill increases the powers of the commissioner in disaster response, including for mandating other institutions (e.g. Ministry of Health) to support response and provide suitable information.

National Resilience Strategy 2018-30

The National Resilience Strategy was developed in 2018 out of recognition of the need to shift Malawi to a different trajectory to avoid recurrent crises. The aim is to create a country free of chronic vulnerability and nutrition insecurity, where sustainable economic development creates opportunities for everyone, and where people are resilient to economic and environmental shocks that affect their lives and livelihoods. The project addresses the second pillar, “risk reduction, flood control early warning and response (outcome 1 1) and the third pillar “human capacity, livelihoods and social protection” which has particular focus on consumption support and nutrition (outcome 4).

2.2.5 Nutrition policies

National Multi-Sector Nutrition Policy 2018

The current National Multi-Sector Nutrition Policy was adopted in 2018 to provide a guiding framework for the successful implementation of the national nutrition response, including eliminating all forms of malnutrition. The project addresses five of the priority areas: priority 1-prevention of under-nutrition (outcome 4), priority 2-gender equality, equity, protection, participation and empowerment for improved nutrition (outcome 4); priority 5- nutrition education, social mobilisation, and positive behaviour change (outcome 4); priority 6-nutrition during emergency situations (outcome 4); and priority 8-nutrition monitoring, evaluation, research and surveillance (outcome 3).

2.2.6 Policies targeting vulnerable groups

National Gender Policy 2011

The National Gender Policy was adopted in 2011. It commits to strengthen gender mainstreaming and women’s empowerment at all levels in order to facilitate attainment of gender equality, and to enhance participation of women, men, girls and boys in socioeconomic development processes. The project is designed in alignment with this policy by integrating consideration of gender throughout all components through ensuring equitable benefits and proactive targeting of women and girls for inclusion in activities. It directly contributes to the priority areas on gender and health and agriculture, food security and nutrition (outcome 4). This is further outlined in **Annex 8: Gender Assessment and Gender Action Plan.**

National Disability Mainstreaming Strategy 2018-23

The Malawi National Disability Mainstreaming Strategy 2018-23 and Implementation Plan (NDMS&IP) aims to support implementation of the National Policy on Equalisation of Opportunities for Persons with Disabilities (NPEOPWD), adopted in 2006. The project supports priority area 1, “access to health services” and priority area 6 “cross-cutting issues: gender, accessibility, research, HIV and AIDS,

children and youth with disabilities, climate change and disaster management". This is further outlined in **annex 8: Gender Assessment and Gender Action Plan**.

National youth policy 2013

The National Youth Policy was adopted in 2013 and provides a framework that guides youth development and implementation of all youth programmes that contribute to the improvement in the welfare of the youth in Malawi. The project supports policy priority area 6 of youth health and nutrition (outcome 4), and policy priority area 4 of youth for education (outcome 4).

2.3 GOVERNANCE STRUCTURES

2.3.1 Local government

Malawi has two levels of governance: national and local. There are 35 Local Government Areas, divided into four categories: (i) Cities, with 4 in total; (ii) one Town, Mangochi; (iii) 28 Districts; and (iv) 2 Municipal Councils; Kasungu and Luchenza. Each of the project target districts is governed by a District Council, except for Mangochi district which has two Local Government Areas (LGAs)[34]. In Mangochi the project will operation with the Mangochi District Council covering Mangochi Rural (rather than Mangochi Boma urban area, represented by the independent Mangochi Town Council). There are 28 districts in the country, divided into three regions (Northern, Central and Southern), although these regions do not have decision-making capacity. Population size of the districts ranges from under 15,000 in the case of Likoma (the only non-contiguous district which comprises an island on Lake Malawi) to over 2.5 million in the case of Lilongwe district.

The Legal Framework for the Local Government System (LGS) in Malawi draws its legal mandate from Section 146 of the Constitution of the Republic of Malawi and the Local Government Act of 1998. Both the Constitution and the Act specifically mandate local governments to promote infrastructural and economic development within their area. Chapter XIV of the Constitution.22.2a Article 146(3) states that 'parliament shall, where possible, provide that issues of local policy and administration be decided on at the local level under the supervision of local government authorities'.

The Local Government Act provides a framework for decentralisation, establishing the councils and providing for their composition, powers, functions and financing. The objectives of local government are 'to further the constitutional order based on democratic principles, accountability, transparency and participation of the people in decision-making and development processes'. District level responsibility is now held for education, science and technology; health, population and water development; transport and public works; land surveying and physical planning; agriculture and irrigation; gender, youth and community affairs; natural resources and the environment; commerce and industry; and home affairs and internal security. The single tier structure means that all local authorities are independent of one another and no local authority has supervisory responsibility over another (Government of Malawi, 2013). This notwithstanding, the Local Government Act provides for collaboration between and among councils.

Each Council is arranged in a uniform manner, with six legally constituted service committees: the Finance Committee, the Development Committee, the Education Committee, the Works Committee, the Health and Environment Committee, and the Appointments and Disciplinary Committee. A Council Secretariat is headed by a District Commissioner, who is supported by the District Executive Committee (DEC) in acting as a technical arm and advisor to the Council. The DEC is composed of all heads of sectors and representatives of non-governmental organisations and the private sector at each Council level, totalling between 30 and 50 members. DECs meet monthly to discuss various development issues in the district. All projects that are implemented in a particular district require an approval from DEC.

[34] Sibale, B., & Jere, P. M. (2022). Organizational Capacity Assessments of the HIV Prevention, Programmatic and Operational Management Capabilities and Capacities within DHO, DHMT, City Health Office and other Relevant Blantyre District and City Council Offices/Committees. Blantyre: Blantyre Prevention Study.

Development planning at council level is coordinated by the DEC and informed by structures and processes operating at two sub-district levels: Area and Village.

Below the DEC and operating at Traditional Authority level is an Area Development Council (ADC). Each ADC has an Area Executive Committee (AEC) which comprises all extension workers from the public and NGO sector. At village level, the structures are replicated, with Village Development Committees (or Neighbourhood Committees for town, municipal and city councils). Both area and village levels have a range of supporting coordination structures for different sectors: for example, Area and Village Development Committees are responsible for development planning; Area and Village Civil Protection Committees are responsible for disaster management; Area and Village Health Committees for health. Particularly with regard to sub-district health governance structures, Village Health Committees promote primary health care activities through recruitment of Community Health Volunteers, overseeing work in the village according to their action plan, holding regular meetings with their community to disseminate information and give feedback, and working hand-in-hand with the Health Surveillance Assistants. At group village level, Community Health Action Groups that acts as a link between Village Health Committees (VHCs) and the ADC[35].

The development planning process is undertaken at multiple levels through these structures (3). Village Action Plans are developed under the auspices of the Village Development Committees. The AEC is responsible for supporting preparation, implementation and monitoring of VAPs and reporting to DEC. At district level, the Council Secretariat consolidates them into a local development plan (District Development Plans in district councils or Urban Development Plans in town, municipal or city councils). The local development plan, therefore, represents the priorities of the entire district, in alignment with Malawi 2063, the national long-term development plan.

The project aligns with these governance structures through supporting for the first time the development of District Health Adaptation Plans, and through ensuring that context-specific risks to health, including the most vulnerable populations and integrate these into the district development planning systems, through the health sector annual District implementing plans (DIPs) (outcomes 1 and 2). The District Health Adaptation Plans will be developed by the AEC and VDC and approved by the District Council. The plans will be accompanied by an action plan with timeframes, community-level health resilience indicators, costs and a definition of roles and responsibilities of the parties, which will support advocating for budget allocation and coordinating stakeholders' efforts at the district and community levels. Currently, there are no specific planning and monitoring tools for health-related interventions at local level, so provision is included in this project to support this monitoring on a quarterly basis.

[35] Malawi Government, 2017. National Community Health Strategy 2017-22. 104p.

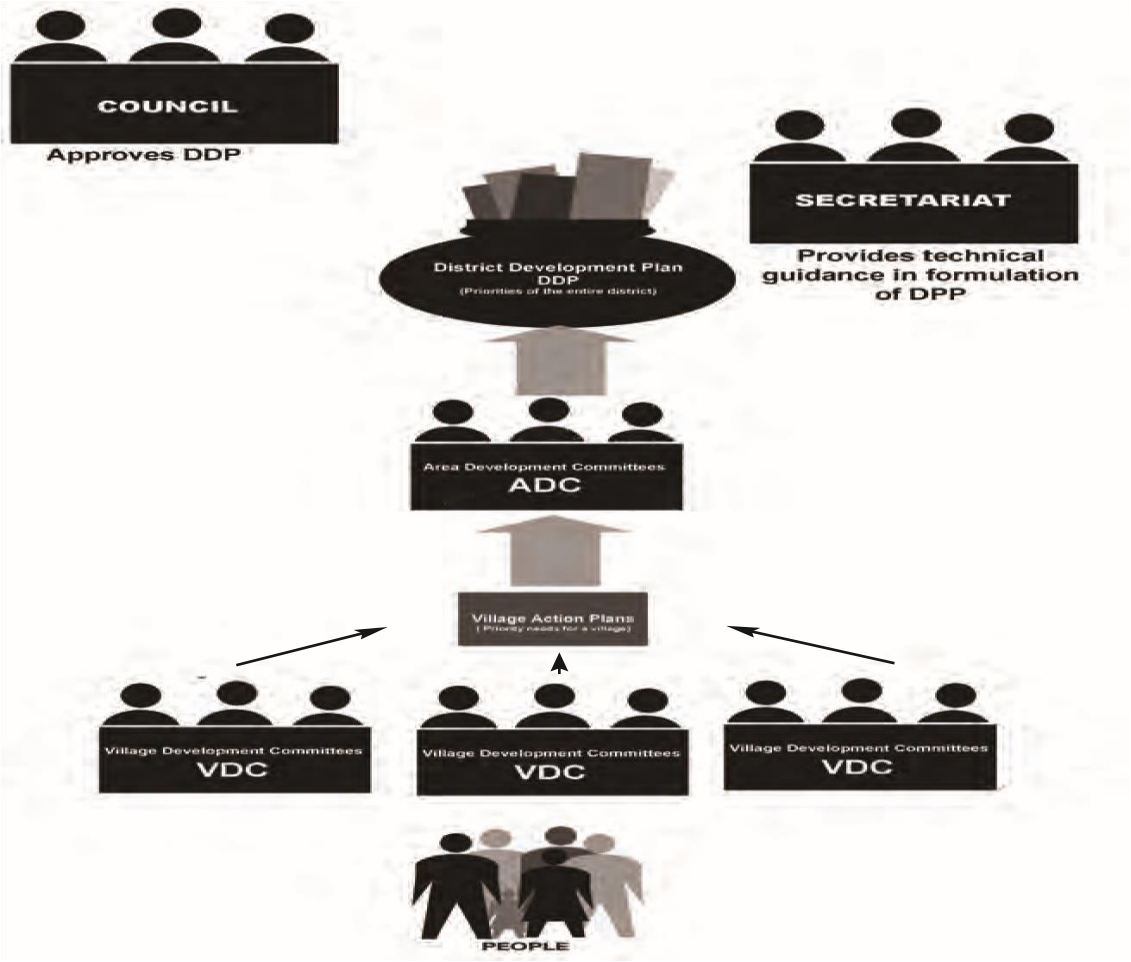

Figure 3: District and sub-district governance and development planning structure[36]

2.3.2 Traditional leadership

Traditionally and geographically, all districts are divided into traditional areas, which are headed by traditional leader/chiefs, who are called Traditional Authorities (TAs). Below the TA are group village headmen, below whom are village headmen. A group village typically comprises 10-12 villages.

The Traditional Authority (TA) positions are hereditary and the chieftaincy clan nominates the traditional leader. At the most senior level a Paramount Chief has responsibility for a number of TAs, with the senior chief having authority over all sub-chiefs in the district. TAs and group villages within each local government area serve, ex-officio, as non-voting members of the councils.

With regard to the legislation, chiefs are primarily governed by the Chiefs Act (1967). The Act empowers the chiefs to carry out the traditional functions of their office under customary law as long as such functions are not contrary to the constitution or any written law. Under customary law, which is the main source of the chiefs' authority, traditional leaders have many customary roles such as being gatekeepers and community mobilisers. Chiefs are prominent leaders because they maintain the country's cultural norms and values. Their roles are wide and include land allocation, conflict resolution, appointing other chiefs, mobilizing communities, and representing communities.

Community consultations in the six districts as part of proposal development showed that, just as it is in the rest of the country, communities tend to respect traditional leaders more than elected leaders because traditional leaders are supposedly the owners of land and tend to have absolute powers over their subjects. It is for this reason that the project has already consulted with chiefs and will continue to actively involve them, both directly in activities and indirectly through awareness of activities that are

[36] Malawi Government, 2013. Guidebook on The Local Government System in Malawi. 72p. Available here

implemented in their areas, throughout the project life span. For more detail see **Annex 7– stakeholder engagement plan**.

2.4 INSTITUTIONAL FRAMEWORKS

2.4.1 Health

In Malawi, health services are provided by a combination of public, private for-profit (PFP), and private not-for-profit (PNFP) sectors. The public sector includes all health facilities under the Ministry of Health, as well as those managed by district, town, and city councils, the Ministry of Defence, the Ministry of Internal Affairs and Public Security (such as police and prisons), and the Ministry of Natural Resources, Energy, and Mining[37].

In the public sector, health services are provided at no cost to users, which creates significant stress on public financing to the health sector and results in compromised quality of service delivery. The private for-profit (PFP) sector includes private hospitals, clinics, laboratories, and pharmacies, as well as traditional healers. The private not-for-profit (PNFP) sector is made up of religious institutions, non-governmental organizations, statutory corporations, and companies. The Christian Health Association of Malawi (CHAM) is a major religious provider, accounting for approximately 29% of all health services in the country. Many CHAM facilities also provide free public healthcare on behalf of the government via an MoU between the MoH and CHAM, as well as service level agreements (SLAs) between MoH and specific CHAM health facilities. Most private and PNFP providers charge fees for their services.

Table 2: Distribution of health facilities by type and ownership in Malawi - Source: MoH, (2023)

Facility type	Govt	Christian Health Association of Malawi (CHAM)	Mission / Faith-based (other than CHAM)	Other Non-Govt	Other	Para-statal	Private	Total
Central Hospital	4							**4**
District Hospital	24							**24**
Hospital	26	39	3	3	2	1	13	**87**
Health Centre	398	111	6	10	2		20	**547**
Clinic	44	13	14	27	15	4	189	**306**
Dispensary	59	4	4	6	2		86	**161**
Health Post	192	10					1	**203**
Other private							2	**2**
Unclassified	7		1					**8**
Total	**754**	**177**	**28**	**46**	**21**	**5**	**311**	**1,342**

Source: MoH, 2023.

The health care system in Malawi is divided into three levels, connected through a referral system: primary care (both community-based and facility-based - comprising health posts, clinics, dispensaries, health centres and community hospitals), secondary care (comprising district hospitals), and tertiary care (comprising central hospitals). The community, primary, and secondary levels fall under the jurisdiction of district councils. The District Health Officer (DHO) is responsible for overseeing the

[37] Ministry of Health, 2016. Vulnerability and adaptation assessment of the health sector in Malawi to the impacts of climate change. Government of Malawi. 45p.

district's healthcare system, and reports to the District Commissioner (DC), who oversees public institutions at the district level.

Primary care

Primary healthcare is delivered at community level as well as health centres and community hospitals. At the community level, healthcare services are provided by Health Surveillance Assistants (HSAs), health posts, dispensaries, and maternity clinics. Ministry of Health-funded HSAs are linked to the primary healthcare facilities, including facilities provided and run by CHAM. Each HSA is responsible for a catchment area of 1,000 people, and there are currently 7,932 HSAs supported by 1,282 Senior HSAs in place. The main responsibilities of the HSAs include providing promotive and preventive healthcare through door-to-door visits, village and outreach clinics, and mobile clinics. Because of this, the Health Surveillance Assistant (HSA) in the Area Civil Protection Committee (ACPC) acts as a bridge between the ACPC and the health centres in the area. In addition, the HSA relies on community meetings to disseminate information and sensitize communities on possible outbreaks (cholera, diarrhoea, and malaria). They also use these meetings to sensitize communities on preventive measures as well as WASH activities.

Representatives from VHC, community health action group also report cases of suspected disease outbreaks in the village to ACPC as well as the Health Centre in Charge. These cases are then followed. For cases like cholera and other communicable diseases, the Health Centre in Charge visits the patient to confirm the case and also provides treatment at home to prevent any spread at the health centre. The HSA and other health workers also have communication challenges with people in communities. This is due to lack of access to phones, electricity, and airtime and information sharing is sometimes delayed. In addition, the HSAs and other health workers do not have access to basic medicines and packages needed such as Thanzi Oral Rehydration Salts (for the treatment of diarrhea), and chlorine (for the treatment of water). Furthermore, spiritual beliefs (prophets and witch doctors) sometimes delay people from seeking help from health centres, although traditional healers continue to play an important and trusted role in the health care eco-system for many rural Malawians[38]. In some cases, health centres are the last resort and patients come when it is too late for treatment to work.

On average, a health centre provides outpatient and maternity services to a population of 10,000, while community hospitals are larger and offer both outpatient and inpatient services, including minor procedures, with a capacity of up to 250 beds.

Secondary care

The secondary level of care includes district hospitals and CHAM hospitals with similar capacity. There are 26 district hospitals in the country, many of which are located in rural areas and serve as referral centres for primary care facilities. They provide both outpatient and inpatient services, including surgical procedures such as caesarean sections, as well as emergency life-saving surgeries. These hospitals can have a capacity of up to 300 beds, and each one serves an area that has between 11 and 40 health centres. Some districts, such as Zomba, Mangochi and Phalombe also have (primary care) community hospitals with PFP and PFNP facilities that serve as intermediaries in the referral system. The population served by these hospitals ranges from 140,000 to 1,400,000.

Tertiary care

At the tertiary level, central hospitals are intended to offer specialized health services at the regional level and serve as referral centres for district hospitals within their region. However, due to the absence of a gatekeeping system, about 70% of the services provided by these hospitals are primary or secondary services[39].

[38] Lampiao, F., Chisaka, J., & Clements, C. (2019). Communication between traditional medical practitioners and western medical professionals. Frontiers in Sociology, 4, 37.; Simwaka, A., Peltzer, K., & Maluwa-Banda, D. (2007). Indigenous healing practices in Malawi. Journal of Psychology in Africa, 17(1-2), 155-161.; Drury, A. (2020). What Role Do Traditional Healers Play in the Pathway to Care of Psychiatric Patients in Malawi, and How Does this Compare to Other African Countries?. Journal of Psychiatry and Psychiatric Disorders, 4(4), 175-187.

[39] Ministry of Health, 2017a. Health Sector Strategic Plan III, 2017-2022. Lilongwe

Table 3 summarises the number of healthcare facilities in each of the six project districts Mangochi has

	Facility type								
District	Central Hospital	District Hospital	Hospital	Health Centre	Clinic	Dispensary	Health Post	Un-classified	**Total**
Balaka		1		12	11	1	2		**27**
Machinga		1		16		7	9		**33**
Mangochi		1	6	22	11	13	9		**62**
Ntcheu		1	2	25	4	3	3		**38**
Phalombe		1	1	11		3	2	1	**19**
Zomba	1		6	31	17	12	4		**71**
Total	**1**	**5**	**15**	**117**	**43**	**39**	**29**	**1**	**250**

the highest number of facilities, with 62; whilst Phalombe has only 19. Across all districts, the majority of healthcare facilities are health centres, with clinics, dispensaries, health posts, and hospitals of different grades also distributed.

Table 3: Number and type of health facilities in the six project districts

	Facility type								
District	Central Hospital	District Hospital	Hospital	Health Centre	Clinic	Dispensary	Health Post	Un-classified	**Total**
Balaka		1		12	11	1	2		**27**
Machinga		1		16		7	9		**33**
Mangochi		1	6	22	11	13	9		**62**
Ntcheu		1	2	25	4	3	3		**38**
Phalombe		1	1	11		3	2	1	**19**
Zomba	1		6	31	17	12	4		**71**
Total	**1**	**5**	**15**	**117**	**43**	**39**	**29**	**1**	**250**

Source: MoH, 2023.

In theory, Malawi has adequate primary healthcare structures, but in practice, the health system is plagued by lack of resources, uneven distribution of staff and funding between rural and urban areas and different levels of care, demotivated staff, and inadequate interdisciplinary models of work, which impede progress in implementation. An example of this uneven distribution of resources is the staff shortage in which 50% of the doctors and nurses are stationed in just four central hospitals, highlighting a lack of equity in deployment policies. Additionally, there are high vacancy rates (up to 80%) across all levels of care, particularly for senior medical officer positions, which further hinder the delivery of an otherwise effective primary healthcare model[40] Similarly, the primary healthcare infrastructure (health posts, dispensaries and health centres) are often understaffed and hampered by inadequate resources and supplies which compounds their ability to provide care.

The role of CHAM in Malawi's healthcare system

The Christian Health Association of Malawi (CHAM) is an integral part of the public health system in Malawi. It implements health programmes and provides healthcare services to 30 percent of the population through its 187 health facilities and also trains up to 80 percent of the healthcare workforce through its 11 training colleges in Malawi. CHAM works together closely with the government's Ministry

[40] Makwero, M. (2018). Delivery of primary health care in Malawi. African Journal of Primary Health Care & Family Medicine, 10(1), 3 pages. doi:**https://doi.org/10.4102/phcfm.v10i1.1799**

of Health. CHAM health facilities are managed by CHAM, with funding mainly from international religious organisations for equipment and buildings. Many CHAM facilities are effectively staffed by a combination of government-paid healthcare workers and CHAM paid healthcare workers. These CHAM facilities are providing healthcare services free of charge to the public, especially in the geographical areas where there is not adequate coverage from government-run health facilities, via agreements with the Ministry of Health.

A recent study[41] of the impact and cost-effectiveness of contracting out essential health package services in Malawi provides the following details on this arrangement between CHAM and the Ministry of Health: "For some primary and secondary health services, CHAM charges user fees, whereas those services would be free in the public sector. Since 2002, the government of Malawi (GOM) and CHAM have worked together to create service-level agreements (SLAs), to expand access to a defined set of free health services through CHAM facilities in geographic catchment areas where no government/public health facilities exist. SLAs aim to expand access by reimbursing CHAM for selected primary health. Under SLAs, the GOM pays health worker benefits (salaries, leave grants, pension contributions) to eligible CHAM facilities. In return, CHAM manages the facility-based staff, ensures adequate skills and submits expenditure reconciliation statements. Additionally, the GOM has agreed to pay service delivery costs based on SLAs that are negotiated at a district-council or city-council level to deliver essential health package (EHP). CHAM facilities with SLAs should not charge patients to deliver the EHP, which includes about 55 health services for both adults and children. These services consist of prevention and treatment of vaccine-preventable diseases; treatment of common illnesses among children such as respiratory infections, diarrhoea, malnutrition and malaria; maternal and child health (MCH) services and treatment of tuberculosis and HIV/AIDS. These services are regarded as highly cost-effective and critical in addressing the health needs of Malawians. The SLA-participating CHAM facilities must submit a monthly invoice detailing the scale and scope of services provided. The actual reimbursements through SLAs cover 70% of the estimated unit cost by interventions, and the remaining 30% is covered primarily by CHAM user charges for services not covered by EHP or funds raised by CHAM headquarters. Over the last decade, the GOM has invested substantial resources in contracting with CHAM through SLAs to provide free selected care for populations in remote areas. … The user fee exemption, through contracting Christian Health Association of Malawi, has improved the utilisation of antenatal and postnatal visits… Based on Malawi's per capita gross domestic product, user fee exemption proved cost-effective in Malawi from the government perspective, with the cost per quality-adjusted life year gained of $134.7." It has also been found that non-government healthcare providers typically perform better in terms of financial management than government healthcare facilities[42].

[41] Zeng W, Sun D, Mphwanthe H, et al. The impact and cost-effectiveness of user fee exemption by contracting out essential health package services in Malawi BMJ Glob Health 2019. Available here.
[42] World Bank. 2021. Spending for Health in Malawi : Current Trends and Strategies to Improve Efficiency and Equity in Health Financing. Health, Nutrition and Population Policy Brief. Available here.

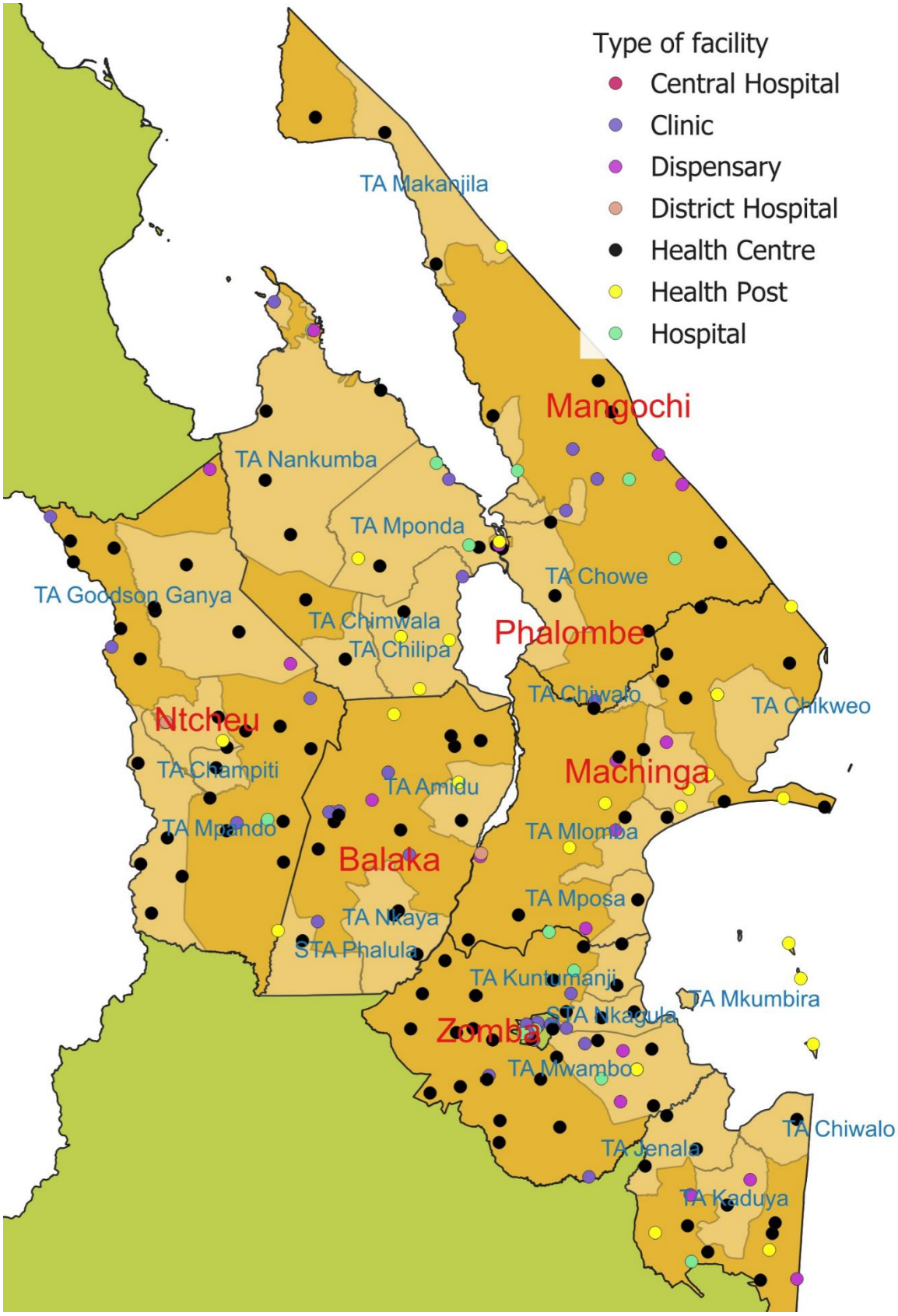

Figure 4 Map of all health facilities in target districts

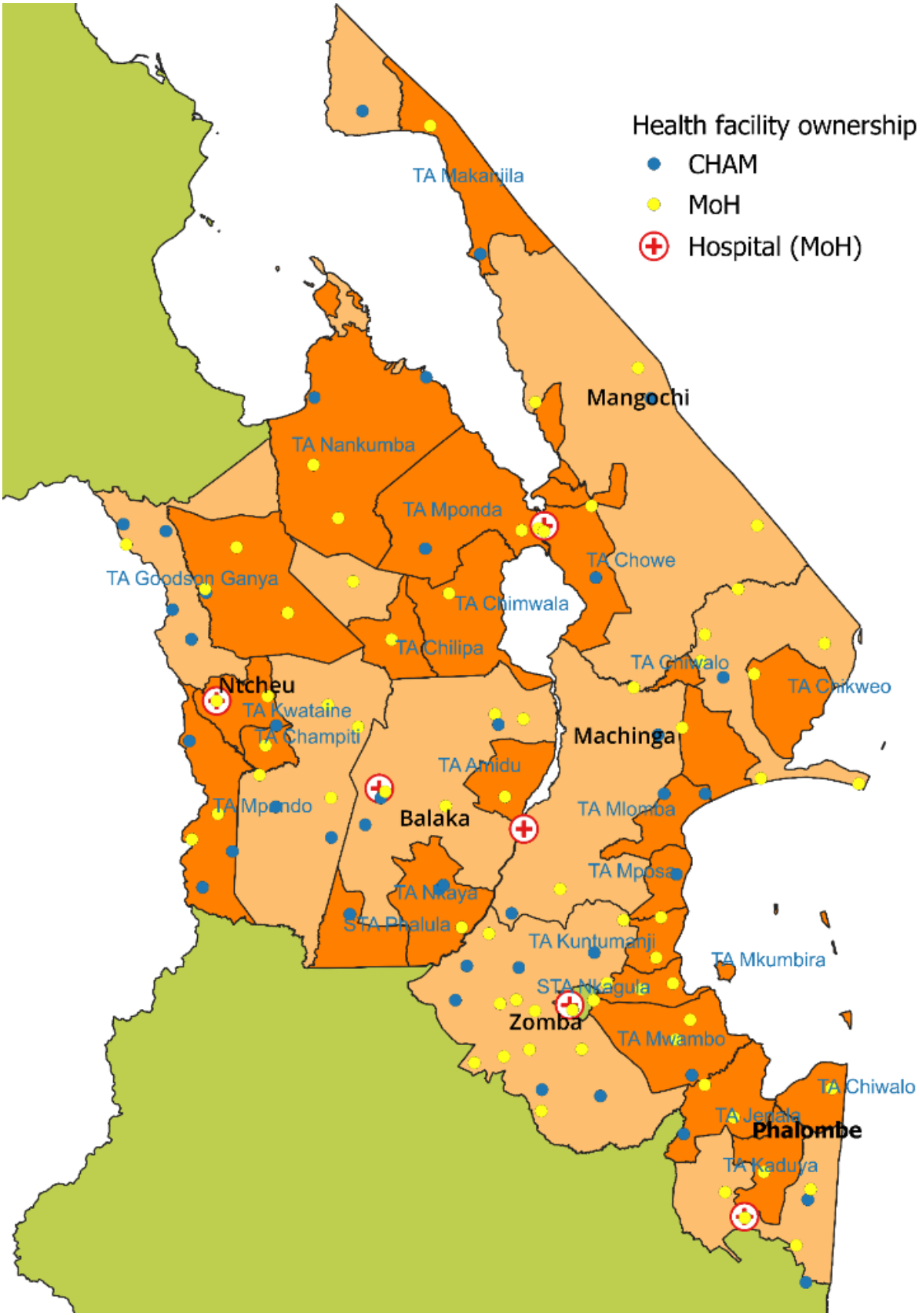

Figure 5 Map of Government and CHAM health centres, and district and central hospitals in target districts

2.4.2 Nutrition

Malawi prides itself in having a strong coordination architecture from the national (policy), district, to subdistrict level. Nutrition governance, leadership and coordination is led by the MoH's Department of Nutrition HIV and AIDS (DNHA) whose Director serves as the convenor for the country's Scaling up Nutrition (SUN) Movement, a global movement that the country subscribed to since 2011. The SUN Movement has been instrumental in advancing the country's stakeholder coordination for nutrition programming which has contributed to the significant reduction in stunting prevalence over the last decade (47% in 2010 compared to 36% in 2020). Nonetheless, current stunting levels remain high compared to the average in the southern African region (29%). At national level stakeholders are coordinated through the National Nutrition Coordination Committee that brings together all stakeholders in the Malawi nutrition response including government, INGOs, development partners, donors and civil society. During emergencies, nutrition humanitarian response is coordinated through the Nutrition Cluster where stakeholders coordinate in the development of national nutrition contingency and response plans as part of the overall interagency response plan coordinate by the Department of Disaster Management Affairs (DODMA). Whilst Malawi has strong coordination structures, resource and funding gaps remain a big challenge for effective coordination and implementation of humanitarian nutrition response activities. For example, in a recent year out of USD 8.2 Million overall nutrition cluster response resource needs, only USD 2.6 Million funding was secured leaving a funding gap of USD 5.6Million (representing 68% funding gap).

As regards routine nutrition development work, DNHA coordinates nutrition activities through the Principal Nutrition HIV and AIDS Officers who are strategically placed at the District Council to oversee nutrition coordination across the various sectors. There is a hierarchical structure in place for nutrition coordination, including the District Nutrition Coordinating Committee, the Area Nutrition Coordinating Committee (at the ADC level), and the Village Nutrition Coordinating Committee, Promoters, and Care Group Leaders (at the VDC level). The DNCC serves as a hub where agriculture, education, and health representatives work together. Discussions on food production and utilization involve the Food and Nutrition Officer from Agriculture, the School Health and Nutrition coordinator in schools, and the hospital nutritionist. Community groups, including care groups, are trained in Integrated Homestead Farming, which includes integrating plants, trees and small livestock around the home; soil health and water management; cooking demonstrations; and food preparation. Care groups are grassroots structures that represent all households in Malawi. Groups of 12 households are clustered and led by a cluster leader, and one care group comprises 12 cluster leaders. Each set of 3 care groups are represented by one promoter, meaning each promoter of care groups covers 432 households.

2.4.3 Disaster Risk Reduction

Disaster risk reduction is managed at both district and village level. Disaster Risk Management Officers and/or Assistant Disaster Risk Management Officers are present in the District Executive Committee. Most districts also have a District Disaster Technical Working Group and/or a District Civil Protection Committee. The Disaster Technical Working Group comprises various departments across all sectors of the council, including Logistics, Nutrition, Health, Police, Disaster, Journalists, Agriculture, and District Planning Director (DPD). The District Civil Protection Committee is a subcommittee of the District Executive Committee and comprises sector representatives from Health, Education, Public Works, Land/Housing, Water, Police (Search and Rescue), Gender, Social Welfare, and other non-government partners. Ntcheu and Phalombe districts, for example, have both a District Disaster Technical Working Group and a District Civil Protection Committee, whereas Zomba has only a District Civil Protection Committee.

At sub-district level, the District Disaster Management Office works at Traditional Authority level with the Area Civil Protection Committee (ACPC), which is a subcommittee of the Area Development Committee (ADC); and at village level with the Village Civil Protection Committee (VCPC), which is a subcommittee of the Village Development Committee (VDC). Coordination at all levels is encouraged. However, the extent to which the committees function at sub-district level is variable. For example, Balaka currently has 20 Traditional Authorities, with two that have recently been established. All ACPCs and VCPCs have been trained, except for the new ACPCs and VCPCs. These committees are also functional. New ACPCs have been trained but new VCPCs need to be established and trained. Representatives from the VCPC report to the ACPC, who then report to the DCPC.

The various committees oversee an annual process of contingency/disaster preparedness planning. The National Disaster Risk Management Policy indicates two complementary timeframes of disaster risk planning: five-year Disaster Risk Management Plans (DRMP) and annual Contingency Plans. DRMPs are typically informed though a bottom-up process of Participatory Vulnerability Capacity Assessments undertaken at village level, with the aim of assessing the vulnerability and capacities that exist to mediate hazard exposure and inform community-driven risk reduction solutions.

Contingency planning involves planning for response and recovery after exposure to hazards. The process of contingency planning is based on outlining the hazards, and assuming and preparing for impacts based on scenarios. This is typically done on a cluster approach, considering Health Cluster, Emergency Shelter and Camp Management Cluster, Protection Cluster, Coordination Cluster, Transport and Logistics Cluster, Nutrition Cluster, Water Sanitation and Hygiene (WASH) Cluster and Agriculture Cluster, with each cluster involving representatives from different departments. Once a disaster occurs, clusters are informed and lead on putting the contingency plan into operation, under the coordination of the Disaster Management Office. The coordination team checks the affected households for their well-being, such as their need for tents, food and bedding, and tracks population displacement. This information is collected and stored in the Disaster Risk Information System (DRIMS), which is sent directly to the DODMA office for response and rehabilitation efforts, including infrastructure repair, food distribution, and provision of kitchen utensils. The Disaster Office conducts assessments following a disaster, while the health team evaluates the health conditions and health facilities affected. The agriculture department assesses farm conditions and livestock to ensure food security for households, and the nutrition team checks if there is a need for food supplementation for under-five children. In practice, absence of robust information impedes the effectiveness of contingency planning, and even if the process takes place, implementation of the identified risk reduction activities is often impeded by lack of available budget.

Table 4: Status of Disaster Risk Management Plans and Contingency Plans in project districts

District	Disaster Risk Management Plan	Contingency Plan
Balaka	2021-25	Yes
Machinga	No	Yes
Mangochi	No	Yes
Ntcheu	No	Yes
Phalombe	No	Yes
Zomba	No	Yes

2.5 COMPLEMENTARY PROJECTS AND INITIATIVES

2.5.1 Building on initial climate and health work in Malawi under the Global Framework for Climate Services

This project marks the only health sector-focused adaptation project in Malawi at the current time. However, it builds on previous efforts in this arena conducted under the Global Framework for Climate Services (GFCS), which had an Adaptation for Africa project from 2014-19 that focused on several sectors in Malawi, including health. This project had a number of outputs that contributed to building the enabling environment upon this project will build, as outlined by Ministry of Health representatives during the proposal development phase (see **Annex 7: Stakeholder engagement**)

The project led to the creation of the Health and Climate Change Core Team (HCCCT), a multi-stakeholder body under the JNTCCCDRM and chaired by the Deputy Director of Preventive Health Services. Members comprise representatives of the Ministry of Health (Environmental Health, Epidemiology Unit, Public Health Institute of Malawi, Clinical Nutrition Unit, Research Unit, National Malaria Control Program, Central Monitoring and Evaluation Division and Preventive Health Service), WHO, Academia (Lilongwe University of Agriculture and Natural Resources-LUANAR, Chancellor College and College of Medicine), Department of Disaster Management Affairs, Ministry of Local

Government, Ministry of Agriculture Natural Resources and Water management, Environmental Affairs, Department of Climate Change and Meteorological Services.

Since its constitution in 2014, the HCCCT has overseen a number of key activities. These include:

- A preliminary vulnerability and adaptation assessment for the health sector[43]
- Revision of the district level Health Sector Contingency Plans to take into account flood and drought risk (after they previously focused on cholera outbreak response)
- Awareness raising of health workers on climate change in two districts (Chikwawa and Nsanje)
- Design of an additional health and climate change module to be offered to Health Surveillance Assistants (HSAs) – the first point of contact between communities and national health systems – as part of their three month long official training curriculum
- Development of health specific climate information in the form of historical malaria analysis (that shows suitability of malaria transmission based on historical climate records, and comparing current climate to past climate during outbreaks)
- Design of a climate and health bulletin (as a prerequisite to a targeted health climate information service)
- Training of personnel in the Ministry of Health and Department of Climate Change and Meteorological Services to undertake climate and health analysis (using statistical and programming software)
- Sensitisation on climate and health issues as relevant to district level development planning with DEC members in Zomba district
- Drafting of the Health National Adaptation Plan
- Drafting of a National Climate Change and Health Communication Strategy

The proposed GCF project directly builds on and leverages these experiences with the aim of enabling transformation to a climate-resilient health system. The HCCCT has directly overseen the evolution of the design of the project. This was enabled through a number of regular engagements, including multi-day workshops held in June 2022 and March 2023, complemented by regular interim engagements with a nominated task team and, in particular, the head of the HCCCT (Deputy Director of Preventive Health).

The project has been designed as one of the first projects to directly and explicitly address the aim of the Health National Adaptation Plan to create “a health sector that is resilient to climate change effects”. It addresses the goals of reduced risk of injury, disease and death for four conditions: heat waves, food and waterborne diseases such as a diarrhoeal diseases, vector-borne diseases such as malaria and under-nutrition resulting from climate change induced diminished food production (Outcomes 1, 2, 3 and 4). It also strengthens the leadership and governance capacity, human resource capacity, health infrastructure, delivery of climate change responsive health services, and monitoring and evaluation.

Specifically, the preliminary knowledge on climate and health risks that was undertaken as part of the venerability and adaptation assessment, and the development of health specific climate information through historical malaria analysis, will be strengthened in Outcome 1, where Activity 1.1.1 aims to strengthen Malawi-specific understanding of the links between climate parameters and key climate-sensitive diseases and conditions as an input to the EWARS.

The preliminary efforts made to develop the institutional framework and staff capacity around climate and health will also be built upon in this project. GFCS revised district health sector contingency plans to take into account flood and drought risk. The project will facilitate the preparation of district health adaptation plans (Output 1.2). It will also build substantively on the early efforts to raise awareness of health workers of climate change, through activities in Outcome 3, which includes strengthening capacity of health surveillance assistants, and through increasing consideration of health and climate

[43] Ministry of Health, 2016. Vulnerability and adaptation assessment of the health sector in Malawi to the impacts of climate change. Government of Malawi. 45p.

through national and district staff making decisions around healthcare infrastructure planning and management (Outcome 2) and general development planning (Outcome 1).

Critical reflections at the end of the GFCS Adaptation for Africa project have also informed aspects of the design that have been adopted here. At the time, the health sector had not had any prior exposure to considering climate change and activities were initially over ambitious in what they could achieve. The project was also externally designed, which did not allow sufficient inputs from within Malawi. Recognising the preliminary and foundational work undertaken by GCFS, the project leverages and extends those activities, paying particular focus to building sufficient institutional capacity for scaling up and transformation of approach. The institutional changes through the EWARS in Outcome 1, for example, are national in nature; and where guidelines and standards will be produced in Outcome 2, they will be publicised nationally and in non-project districts. The design of the project has been country-led from the start, and fully collaborative and participatory under the auspices of the HCCCT and with sustained stakeholder engagement (see A**nnex 7: Stakeholder engagement plan and summary of stakeholder consultations**).

Sequencing of activities in GFCS Adaptation for Africa was challenging as later activities were very dependent on early activities. This meant that when a delay was experienced in the completion of the vulnerability and adaptation assessment, progress in subsequent activities was hampered. The proposed GCF-funded project has been designed to avoid this risk by having all components start activities at the same time, with scope for iteration and development as new information becomes available. For example the establishment of thresholds for early warning alerts for climate-sensitive diseases in the EWARS in Outcome 1 will be dependent on the studies, but the institutional strengthening to enable the functioning of the EWARS through closer collaboration between the Ministry of Health (MoH) and Department of Climate Change and Meteorological Services (DCCMS) can proceed before alert levels; and training can take place for health staff on the modification of surveillance systems and data collection to feed data into the system in Outcome 3.

GFCS Adaptation for Africa also fell short of expectations in building local capacity to respond to climate risk in the health sector and supporting further advocacy on climate and health. Few training and communication materials were produced for training purposes – which will be addressed in the proposed project through activities in Outcome 3 which will expressly develop materials targeting health sector professionals on surveillance, the receipt and delivery of early warnings and mental health and psychosocial support; and in Outcome 4 which will expressly develop materials targeting community level on early warnings, climate-resilient WASH, and managing their own health and wellbeing in a changing climate. Outcome 1 has a specific activity to advocate for stronger integration of climate-resilient health within adaptation planning which includes coalition building and strengthening inclusion in governance processes.

Lessons from implementation structures in GFCS Adaptation for Africa have also been taken into account in project design. During GFCS Ministry of Health staff absorbed project management duties in addition to their existing full-time roles, which limited their capacity to implement. This has been addressed in the project through the secondment of MoH staff to the PMU so that their time is dedicated to project implementation. In addition, limited local capacity was built through the reliance on external expertise. To address this in the project, emphasis is on training of trainers that aims to build capacity of a national cadre of trainers, thereby ensuring expertise is built in country and that this is sustained post-project. Examples are the activity to equip healthcare workers with MHPSS capacity to address mental health impacts of changing climate (Outcome 3), and the capacity to deliver training on the EWARS and interpretation of alerts arising from this system (Outcomes 3 and 4).

2.5.2 Alignment with GCF Readiness activities in Malawi

Malawi has demonstrated commitment to address the impact of climate change through engagement and progress made on formulating national climate change policies and progress on the NAP and NDC. In addition, Malawi has accessed GCF readiness funds to provide early support activities to enhance country ownership and enable access to fund resources. As part of this funding, in-country mechanisms, including platforms for channelling GCF related information and processes, are being established. In

addition, Malawi is implementing two GCF Readiness-funded projects described below, to which the proposed project will align.

Advancing the NAP process: climate resilience for sustainable development in Malawi, implemented by UNEP from 2019-24, aims to develop capacity and tools for the coordination and execution of future NAP processes. The assessments, Malawi NAP Stocktaking Report (2016) and priorities identified under this readiness initiative informed the development of the proposed project and activities are fully aligned with priorities identified to date.

2.5.3 Alignment with funded GCF projects - Scaling up the use of modernised climate information and early warning systems in Malawi

The GCF-funded project, *Scaling Up the Use of Modernized Climate Information and Early Warning Systems in Malawi* (FP002, 2017-2023), implemented by UNDP, aims to save lives and minimize risks to livelihoods. This project has invested in enhancing hydro-meteorological capacity for early warning and forecasting, development and dissemination of tailored products for smallholder farmers and fishermen, and strengthening capacities of communities to respond to climate-related disasters (floods). To date, the project has installed 33 automated weather stations, Data Collection Platforms for housing automated hydrostations and gauging equipment, a lightning detection and thunder alert system, two lake-based weather buoys, 15 automated hydrological water level stations, and a weather data visualisation and integration system[44].

This geographical coverage has improved national and sub-national forecasts and reduced forecast errors. Downscaled seasonal forecasts are now produced for all 28 districts by DCCMS. The project has so far targeted 640,000 farmers across 14 districts with seasonal advisories through the Participatory Integrated Climate Services for Agriculture (PICSA) approach, and 25,000 fishermen in four districts with weather advisories.

It has also expanded the national level flood early warning system to cover two major flood prone rivers in the central region (Bua and Linthipe) and provided ancillary training to staff in the Department of Water Resources to manage the data and issue floor forecasts as per standard operating procedures. A community-based flood early warning system has been established covering 8 districts. The system includes a telemetric water level measuring device (the Data Acquisition Unit -DA), Data Upload unit (DU) and an Alarm unit. The system is calibrated to trigger an alarm when thresholds for floods at a particular location is exceeded. The alarm is manually or automatically triggered to alert on an impending flood in 1 to 3 hours' time. Similarly, mobile phone text (SMS) alerts customized to individual rivers are distributed to the relevant people and agencies warning of the same flood.

The proposed project aims to build on the achievements of FP002 in several ways. First, the greater capacity for generating weather and climate information enabled by FP002 will act as an input to the development of the EWARS in Outcome 1. Second, the institutional architecture that was strengthened between DCCMS and Department of Water Resources in order to provide flood warnings will be mirrored in the project through the strengthening of the linkages between DCCMS and MoH in order to provide health early warnings. Third, the experiences of FP002 in building community level awareness of flood early warnings will be built upon in Outcome 4, where communities will be sensitised to receive, understand an act upon health early warnings from the health EWARS.

As part of stakeholder consultation, meetings were held with UNDP in May 2021 during the concept note development phase. It was identified that the project will integrate the existing health early warning with the improved climate information capacities built under FP002. It will refer to lessons learned and best practices pertaining to communicating climate risks to community members and, where possible, use mechanisms and structures created through the UNDP-implemented project (CBEWS, SMS platform designed under GCF-funded project). Coordination with the legacy of this UNDP-implemented project and maximising synergies and lessons learned, will take place through the executing entities for

[44] UNDP Annual Performance Report FP002, 2020

both projects (DODMA and MoH, respectively) being represented on the Joint National Technical Committee on Climate Change and Disaster Risk Management (JNTCCCDRM)[45].

2.5.4 Alignment with GCF proposals under development

Solar for Health Programme: Enabling the provision of sustainable low-carbon energy services to public health facilities in Sub-Saharan Africa

Solar for Health is a GCF funding proposal led by UNDP for a project covering Malawi, Zambia, Zimbabwe, Namibia, and Liberia. The total value of the project is $219 Million of which $73 Million is for Malawi. It is envisioned to be a 10-year project with MoH as the Executing Entity, in partnership with WHO and Renewable Energy Association. This project is anticipated to start in 2024. The main focus of the project is to increase security of energy supply to health facilities that have no or unreliable access through the use of cost-effective, rapidly deployable and reliable solar energy solutions. The project has three components: 1) Low carbon infrastructure focusing on solarisation of health facilities targeting 450 health facilities; 2) Climate informed health services to finalise the national level Early Warning and Response Systems (EWARS) with four sentinel sites (Chitipa, Salima, Zomba, and Chikwawa) to improve collection and integration of climate and health data; and 3) Creating an Enabling Policy Environment and Community of Practice.

The first component of the Solar for Health project has complementarities with the CHWBRC project's Outcome 2, which includes strengthening resilience of healthcare facilities in six project districts in terms of resilient energy and WASH facilities. Complete solarisation (with the aim of reducing greenhouse gas emissions) is not the aim of the CHWBRC project; however, ensuring secure energy supply for cold storage of vaccines/medication at health facilities and for operation of health surveillance and early warning systems and other essential functions, will require installation of small-scale solar. To do this, the project will assess the specific needs of each facility and build upon the performance standards applied by Solar for Health and ensure that there is no overlap in facilities covered. The Ministry of Health have confirmed that they will play a coordinating role to ensure the target districts have minimal overlap, and if there is some district overlap, that different facilities will be targeted by the two projects.

In terms of tte second component of the Solar for Health project in Malawi, the expectation is that the Solar for Health project will: i) further develop the national-level health EWARS dashboard which MoH and WHO have piloted in Malawi in order to automate processes; ii) set up/strengthen four sentinel sites in Chitipa, Salima, Zomba, and Chikwawa; iii) engage with DODMA, EAD, DCCMS as well as MoH on integration of different data sources; iv) build capacity of selected relevant staff at national level; v) support the development of an enabling environment by finalising the Health National Adaptation Plan and incorporating EWARS into national health and climate change policies as needed. The MoH-Save the Children CHWBRC project will complement this so that synergistically the comprehensive work needed to realise an effective climate-informed health EWARS in Malawi is achieved. The CHWBRC project will do this in the following main ways: i) strengthen institutional architecture at national and district level (Activity 1.1.2); ii) develop alert triggers for climate-sensitive diseases and conditions (Activity 1.1.1) – improving threshold for malaria which is used in the existing pilot EWARS and developing alert triggers for conditions not yet covered, i.e. cholera, drought-linked malnutrition and diseases linked to high/extreme heat exposure; iii) establish new sentinel sites in the districts of Balaka, Machinga, Mangochi, Ntcheu and Phalombe (Activity 1.1.3); iv) build capacity of health facility staff, management staff, information technology staff and community healthcare workers to implement a climate-informed health EWARS at district and health facility level (Activities 3.1.1. and 3.1.2); v) empower communities to understand and act on climate-health early warnings (Activity 4.1.2).

As part of stakeholder consultation, multiple discussions were held with UNDP and WHO during the proposal development phase to assure project complementarity. The proposed MoH-Save the Children GCF project will continue to align with this MoH-UNDP proposal as both move towards approval by the GCF to ensure synergies and complementarity. During implementation, there will be close collaboration between the two projects via the MoH as Executing Entity for both projects, via the HCCCT and with

[45] The JNTCCCDRM is a multi-stakeholder technical committee, chaired by government, that coordinates climate change and disaster risk management activities and reports to the National Steering Committee on Climate Change

UNDP (on solarisation) and WHO (on health surveillance and early warning systems). On a technical level this will also be ensured by WHO being represented on the Technical Advisory Group of the CHWBRC (Implementation Arrangements are described in the CHWBRC Funding Proposal).

Building Climate Change Resilience of the Most Vulnerable Rural Communities and Watersheds in Malawi

This Concept Note for USD 40 million was submitted by FAO and Malawi's Ministry of Agriculture to the GCF in July 2021[46]. The proposed interventions on climate-resilient and gender-responsive agriculture, based on soil and water conservation, crop diversification and agro-forestry will complement the CHWBRC's interventions focused on improved nutrition for mothers and children via integrated homestead farming and improved nutrition practices (Activity 4.1.4). This synergy would also be realised in terms of geographical coverage, with five of the CHBRC target districts also proposed for this Ministry of Agriculture-FAO project, namely Balaka, Phalombe, Zomba, Mangochi and Ncheu.

2.5.5 Alignment with Adaptation Fund projects

The project *Adapting to Climate Change Through Integrated Risk Management Strategies and Enhanced Market Opportunities for Resilient Food Security and Livelihoods*[47] (approved by the Adaptation Fund 10 November 2019), implemented by the World Food Programme (WFP) until 2024, is seeking to promote access to integrated climate risk management strategies and structured market opportunities as a means of enhancing climate adaptation and food security, with a focus on the most vulnerable, especially women and other marginalised groups, The project is targeting 85,000 households (382,500 beneficiaries) in Balaka, Zomba, and Machinga districts in 22 Traditional Authorities (TAs), with a total of 23,600 farmers from the three districts with surplus production benefiting from access to market access opportunities including through farmer associations and cooperatives throughout the duration of the project. Given geographical complementarity in districts covered, the proposed project will utilize capacity developed through existing projects financed by the Adaptation Fund and focus on disseminating relevant information to inform decision-making and risk reduction in the health sector, targeting community health committees, school children, community health facilities, and district health departments.

There are complementarities between *Adapting to Climate Change Through Integrated Risk Management Strategies and Enhanced Market Opportunities for Resilient Food Security and Livelihoods* and the proposed project in terms of geographical location of operation and thematic content. Under outcome 4 the proposed project will focus on improving climate-resilient food and nutrition security with a particular focus on households with pregnant women and parents of children under 2, including through post-harvest food storage, that will complement activities implemented through the project financed by the Adaptation Fund and where possible scale-up and link beneficiaries with services offered under the AF project (e.g., financial services). Coordination with the Adaptation Fund-financed project, and maximising synergies and lessons learned, will take place through each implementing entity being represented on the JNTCCCDRM.

2.5.6 Alignment with LDCF-funded projects

Transformational Adaptation for Climate Resilience in Lake Chilwa Basin of Malawi (TRANSFORM)

The Transformational Adaptation for Climate Resilience in Lake Chilwa Basin of Malawi (TRANSFORM) project was approved in 2021 to run for five years under the Ministry of Forestry and Natural Resources. Its aim is to reduce the vulnerability of communities surrounding Lake Chilwa to the adverse effects of climate change by strengthening the resilience of livelihoods through Ecosystem-based Adaptation (EbA) and financing of climate-resilient enterprises in Lake Chilwa and scaled up to other regions of Malawi. It will achieve this through strengthening capacity of village level institutions for natural resource management and watershed (and lake) management and strengthening capacity of local- and district-level institutions for watershed planning and management, and lake protection. Particular activities

[46] Building Climate Change Resilience of the Most Vulnerable Rural Communities and Watersheds in Malawi. Available here.
[47] https://www.adaptation-fund.org/project/adapting-to-climate-change-through-integrated-risk-management-strategies-and-enhanced-market-opportunities-for-resilient-food-security-and-livelihoods/

include strengthening community level watershed management committees and rehabilitation of aquatic ecosystems and supporting strengthened market linkages for climate-resilient livelihoods.

There is little in the way of thematic complementarity between TRANSFORM and the proposed project. However, there is an overlap of project districts, as TRANSFORM will be implemented in Zomba, Phalombe and Machinga. Coordination with TRANSFORM, and maximising synergies and lessons learned, will take place through each implementing entity being represented on the JNTCCCDRM, and because the Ministry of Natural Resources and Forestry will be on the project steering committee for the project.

Malawi-climate resilient and sustainable capture fisheries, aquaculture development and watershed management project

Malawi-climate resilient and sustainable capture fisheries, aquaculture development and watershed management project was approved in 2022 under the auspices of the African Development Bank. The baseline project's sector goal is to contribute to Government's poverty reduction efforts by improving management and utilization of fisheries resources along Lakes Malawi and Chilwa as well as Shire River System and developing aquaculture in a changing environment. The goal of the project itself is, to improve resilience of the fishing and fish farming communities, provision of infrastructure for increased fisheries productivity, strengthened nutritional security through value chains and build climate resilience.

The thematic content of *Malawi-climate resilient and sustainable capture fisheries, aquaculture development and watershed management* project is very different to the proposed project. However, part of its geographical focus on Lake Malawi and Lake Chilwa complements lakeside communities in districts in the project, namely Mangochi, Balaka, Machinga and Zomba. Coordination with the *Malawi-climate resilient and sustainable capture fisheries, aquaculture development and watershed management project* and maximising synergies and lessons learned, will take place through each implementing entity being represented on the JNTCCCDRM.

Building Climate Change Resilience in the Fisheries Sector in Malawi

The Building Climate Change Resilience in the Fisheries Sector in Malawi project began in 2016 under the auspices of FAO and will run (including a 2 year no cost extension) to 2023. The project will improve the resilience of fishing communities around Lake Malombe to the effects of climate change. Components involve mainstreaming climate change into fisheries policies; building the adaptive capacity of fishermen at local level; and building an early warning system on the shore of Lake Malombe.

The thematic content of Building Climate Change Resilience in the Fisheries Sector in Malawi is very different to the proposed project. However, its geographical focus is on three common districts of interest, i.e. Mangochi, Balaka, Machinga. Coordination with Building Climate Change Resilience in the Fisheries Sector in Malawi and maximising synergies and lessons learned, will take place through each implementing entity being represented on the JNTCCCDRM.

Climate Adaptation for Sustainable Water Supply

Climate Adaptation for Sustainable Water Supply was approved in 2019 under the auspices of the African Development Bank (ADB). The project will ensure sustainability of water sources through catchment management activities and installation of hydrological monitoring, adaptation activities. The objective is to sustain the availability of water supply in the river courses and climate proof the water resources outputs of the baseline investment in five districts, namely, Mangochi, Ntcheu, Nkhotakota, Phalombe, and Rumphi by either scaling up or enforcing activities planned under the baseline project.

The thematic content of Climate Adaptation for Sustainable Water Supply is very different to the proposed project. However, its geographical focus has three districts in common: Mangochi, Ntcheu, and Phalombe. Coordination with Climate Adaptation for Sustainable Water Supply and maximising synergies and lessons learned, will take place through each implementing entity being represented on the JNTCCCDRM.

2.5.7 Alignment with other initiatives

Energizing Development

Energizing Development (EnDev) is a global initiative, which has focused on a variety of electrification and energy projects worldwide since 2005, when the Dutch and German governments joined together with an aim 'to provide access to sanitation and clean drinking water for 50 million people, and to modern energy services to 10 million poor people in developing countries by 2015'. This has been achieved primarily by providing electricity, and access to clean energy through cookstoves and other products, with EnDev claiming to have 'supported 28.7 million people to gain access to electricity or improved cooking technologies by 2022'.[48]

In Malawi, EnDev commenced work in Malawi with a cookstoves program in 2015, and are currently implementing several different electrification and energy programs, the most relevant of which to the CHWBRC project is 'energizing health'. The Energizing health project (funded by BMZ) aims to provide electrification to health facilities through solarization and provide cold storage through solar direct drive freezers and fridges.[49] The energizing health project will work in 12 districts across Malawi, of which four have overlap with the CHWBRC project (Balaka, Mangochi, Ntcheu and Phalombe). The project is worth 2.25m Euros overall, targeting around 200 health facilities in total, and health facilities will be provided with a combination of a small solar home system and a solar direct drive fridge or freezer. The option for solar home systems provided by the Energizing Health project is just 2KW, which for a larger health facility is very small compared to need. The project design team consulted with GIZ in July 2023 (see **Annex 7: stakeholder engagement and summary of stakeholder consultations)**, and GIZ confirmed commitment to collaboration with Save the Children and coordination through the ministry of health.

The GIZ team in Malawi have already successfully procured solar direct drive freezers (2022) and will install solar home systems starting in late 2023.[50] The CHWBRC project will work closely with the GIZ project team throughout implementation to ensure results are not duplicated across health facilities. GIZ also intends to lead a stakeholder working group of organizations working on electrification of health facilities, of which Save the Children will be a part. This will also link to the work in Malawi conducted by the Global Energy Alliance for People and Planet (GEAPP – see below **2.5.7.2**)

Integrated Energy Planning Tool

In 2022, the Global Alliance for People and Planet (GEAPP), and Sustainable Energy for All (SE4all) launched it's 'integrated energy plan (IEP)' with a bold aim to achieve 100% access to electricity for all by 2030.[51]

The project uses a data-driven approach to electrification and has built the first-of-its-kind 'integrated energy planning tool', which combines data from various sources to estimate electricity needs across the country. This includes data on healthcare facilities, with a geospatial analysis of health facilities in Malawi, accompanied by analysis on the most suitable forms of electricity needs for each facility (grid or solar electricity).[52]

Save the Children has been provided access to the underlying data for the tool, and will work closely with the planning team to ensure that the work in health facilities under the CHWBRC project is aligned to the national planning and is providing suitable forms of electricity. GEAPP is also working on coordination across sectors, including with government agencies, donors and NGOs, and Save the Children aims to contribute to the coordination work.

Efficient solar energy in Malawi's health sector supported by CHAI

From mid-2023 onward, the Clinton Health Access Initiative (CHAI) is supporting the Government of Malawi to better coordinate solar power installations in the health sector, and to develop a model so

[48] EnDev website, available here.
[49] GIZ: 'Accelerating access to sustainable energy in Malawi', available here
[50] Energizing Development: 'EnDev progress report 2022', pp65, available here
[51] GEAPP: 'Global Energy Alliance for People and Planet launches energy program in Malawi to achieve universal energy access by 2030', accessed 12/10/2023, available here.
[52] GEAPP. Integrated Energy Planning Tool', accessed 12/10/2023, available here.

that solar systems will work for longer than has historically been the case. CHAI is supporting the Ministries of Health, Energy and Finance to develop a costed National Health Facility Solar Electrification plan that would guide new financing for solar towards the sites that need power the most. This plan will include a prioritization criterion (a priority list of facilities), and aims to standardize the specifications for solar systems so that a coherent national Operations and Maintenance (O&M) system can be built and sustained. The standardized specifications will require procurements of solar equipment and O&M to be aligned around the national plan. CHAI will also work with the Government to find ways of reducing O&M costs and to also bring in sources of sustainable co-financing for O&M, so that donor-supported solar investments can work to their full potential life cycle. The Government is asking CHAI to work with donors and partners to arrive at working solutions that will enable all to participate in this vision, from aligning procurement to standardizing O&M processes. Save the Children met with CHAI representatives and the MoH in October 2023 and in Q1 of 2024 and will continue to coordinate with CHAI and the MoH in this regard to ensure synergies during implementation of the proposed GCF project.

Disaster Risk Management for Resilience Programme (DRMRP)

The DRMRP, co-managed by GoM and UNDP, aims to: a) Strengthen national and local-level disaster risk governance; b) Improve risk reduction and early recovery in disaster prone urban and rural areas; and c) Improve planning, monitoring and evaluation of the disaster risk management sector. The programme targets seven disaster-prone districts and two urban councils over a period of 5 years (2019-2023). The project has a budget of 10.2 million USD, including financing from the British FCDO, and is implemented by the Department of Disaster Management Affairs (DoDMA). Prior to this project, Malawi did not have a model district with a fully functional DRM system. In order to strengthen national and local-level disaster risk governance, DRMRP prioritised the establishment of fully functional model district DRM systems in six districts namely, Nsanje, Chikwawa, Phalombe, Mangochi, Zomba, Mulanje. The programme also provided parallel support for DRR interventions in Mangochi, Chikwawa, Phalombe and Balaka districts. DRMRP aims to address the root causes of vulnerability while strengthening national and local government institutional capacity in disaster risk knowledge, risk governance, risk reduction, preparedness, response and recovery. CHWBRC will be able to draw on learnings from the DRMRP and build on its results, especially within the shared districts of Balaka, Mangochi, Phalombe and Zomba.

3. MALAWI'S CLIMATE: RECENT TRENDS AND FUTURE PROJECTIONS

3.1 STATE OF MALAWIAN CLIMATE: OBSERVED AVERAGE CONDITIONS AND HISTORICAL CHANGES

Malawi has two distinct cold and warm seasons, which coincide respectively with the dry and wet season. Southern Malawi has become both hotter and drier in recent decades, and trends in climate-related extremes all exhibit an increase: risk of flooding has increased as a result of a combination of climatic factors (as indicated by increases in observed streamflow) and land-use change factors; the impact of tropical cyclones has increased in recent years due to a combination of the frequency and intensity of such events as well as high vulnerability of communities to such events; and drought events have also increased, consistent with observed changes in temperature.

3.1.1 Temperature

Malawi has two distinct cold and warm seasons. Figure 6a shows the observed monthly temperature for southern Malawi. Observed temperature (and precipitation for subsequent sections) is computed from temperature datasets from the Climate Research Unit (CRU)[53]. The CRU TS v4.404 dataset is one of the most widely used datasets in climate analyses. It is derived from interpolating monthly climate anomalies from extensive networks of weather station observations and is available from 1901 to 2019, covering all global land domains at a 0.5^{o} x 0.5^{o} resolution. The cold, and typically dry, season extends

[53] Harris, I. et al. (2014) Updated high-resolution grids of monthly climatic observations - the CRU TS3.10 Dataset. International Journal of Climatology 34: 623-642. doi:10.1002/joc.3711.

from April to August with daily temperatures typically at their lowest during June and July. Average temperatures during the cold season range from 17 to 27 degrees Celsius with minimum observed temperatures ranging from 4 to 10 degrees Celsius. Warmer temperatures in September spell the end of the cold season, with peak summer temperatures observed in October and November. Average daily summer temperatures range from 27 to 37 degrees Celsius, with some low-lying areas experiencing temperatures of up to 40 degrees Celsius.

Observed mean annual temperature anomalies, relative to the 1961 – 1990 average (taken as the standard historical period for historical trend analysis in the majority of IPCC assessments), exhibit an upward trend in observed temperature (Figure 6b). The increase in temperature is more apparent from the late 1980s, with mean annual temperatures not falling below the historical mean since 1990. Patterns in observed temperature changes are consistent with regional patterns and observed global patterns attributable to anthropogenic emissions of greenhouse gases (GHGs).

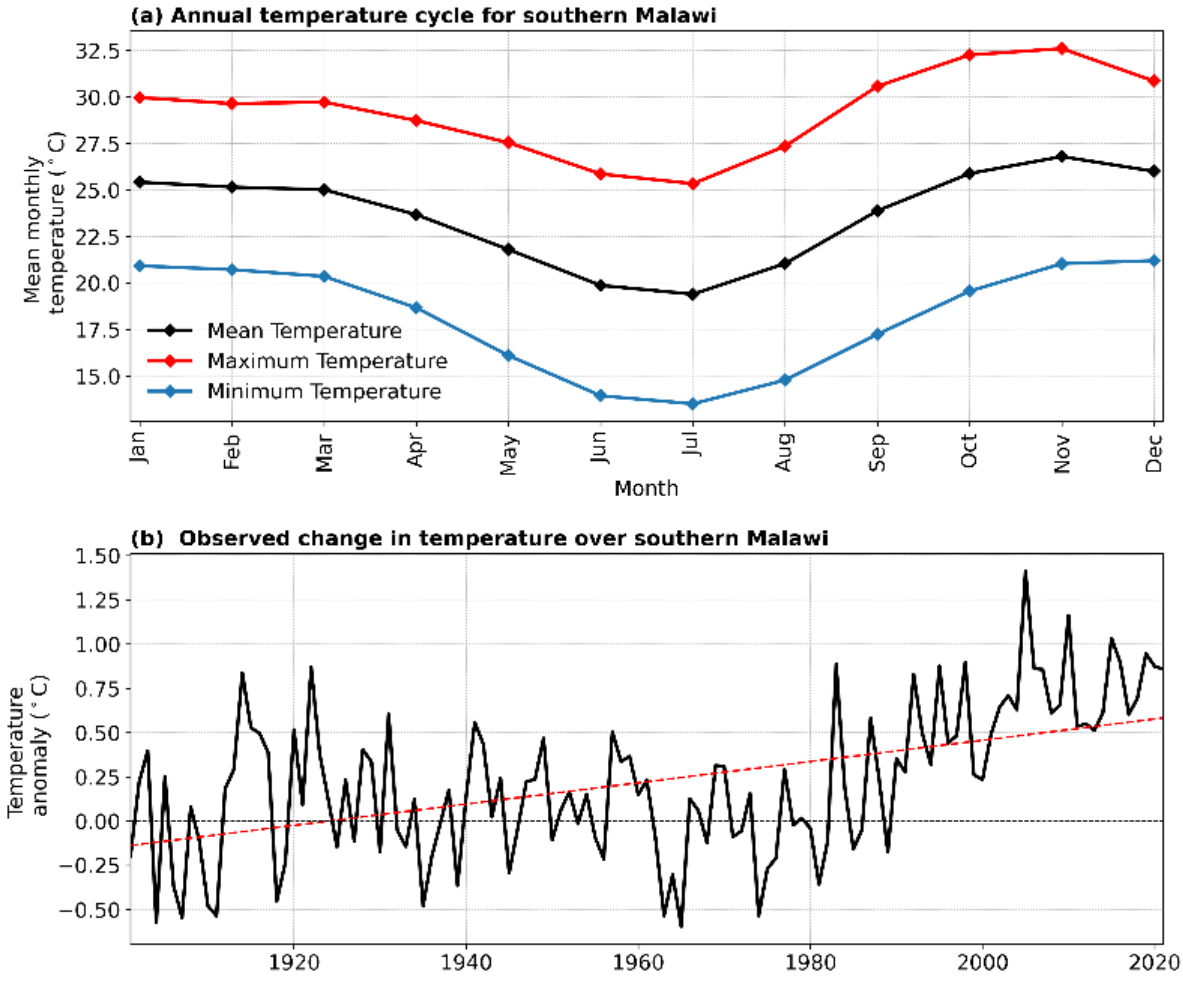

Figure 6: (a) Observed monthly temperatures for southern Malawi. (b) Long-term changes in observed mean annual temperature for southern Malawi relative to the 1961 – 1990 climatological mean; the dashed red trendline in (b) highlights the direction of observed changes in mean annual temperature over southern Malawi.

3.1.2 Precipitation

Malawi has a unimodal (austral summer) rainfall pattern generally consistent across most parts of the country and all of the southern region. Mean annual rainfall ranges from 725 mm to 2500 mm depending on location. Figure 7a shows the mean monthly rainfall for southern Malawi. The warm-wet season stretches from November to April, during which period 95% of the annual rainfall is received. The period between December and January is the wettest and coincides with the period when most of the agricultural activities take place, especially for single-round crops which dominate the agriculture sector

in Malawi[54]. Over Malawi, precipitation and its variability are driven by the convergence of three air masses; two easterly air masses originating from the Indian Ocean and effectively making up the Intertropical Convergence Zone (ITCZ); and a northwesterly air mass originating from the Congo basin which converges with the two easterly air masses at the Congo Air Boundary. Together, the three air masses form a convergence zone over Malawi, whose north-south shifts may create precipitation dipoles between the north and south of Malawi[55]. This process is key to drought processes and interannual variability which is driven by a range of processes including the El Niño Southern Oscillation, a prominent driver of precipitation variability and extremes in the tropics.

Annual precipitation anomalies (relative to the 1961 to 1990 average) over southern Malawi (Figure 7b) exhibit a downward trend in mean annual precipitation. Mann-Kendall tests indicate statistical significance at 95% confidence level, consistent with studies conducted for parts of southern Malawi[56] for the 1971 – 2000 period.

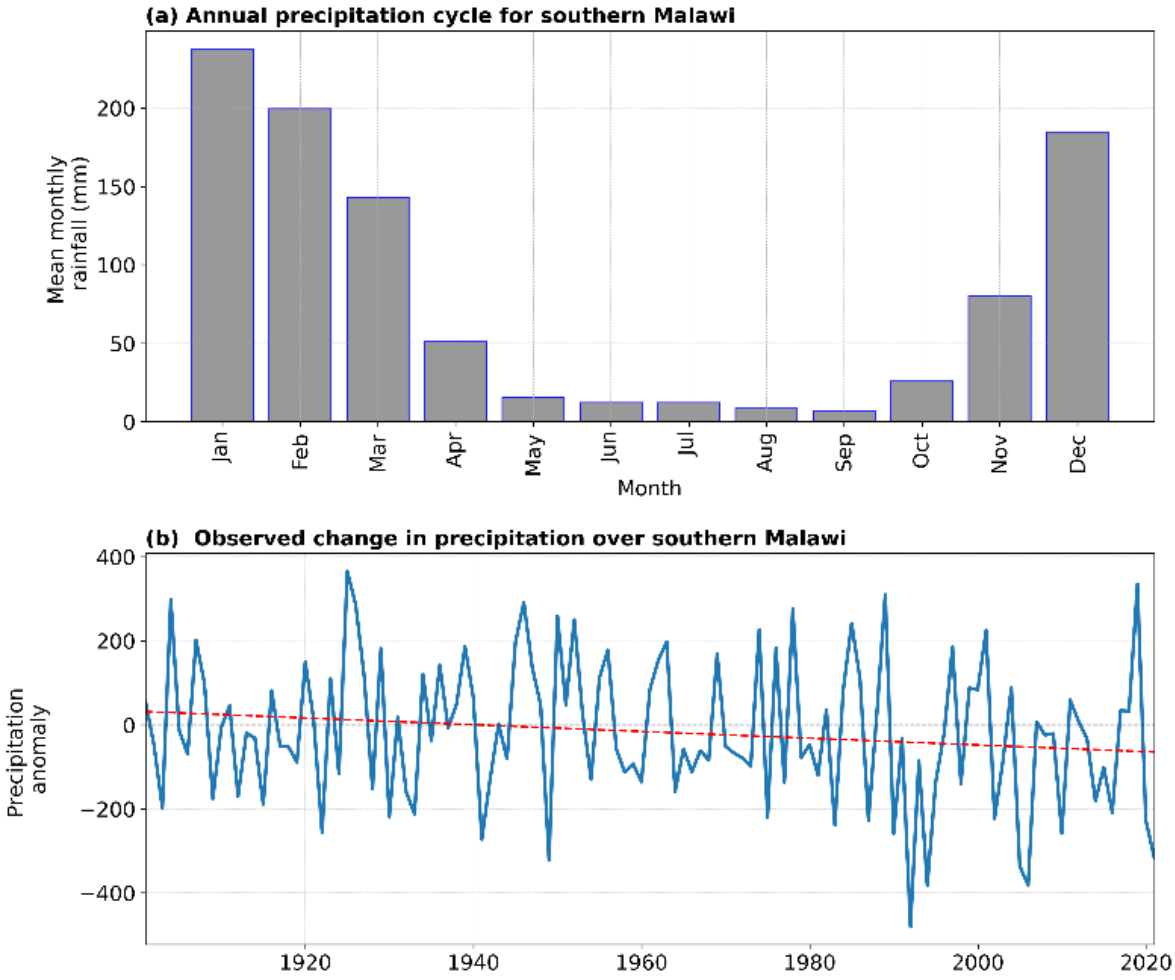

Figure 7: (a) Observed annual precipitation cycle. (b) Observed changes in mean annual precipitation; red trendline in (b) highlights the trend in observed mean annual precipitation changes over southern Malawi.

[54] Njoloma, H.M. et al. (2011) Effect of climate change on rainfed maize production: assessment of maize production vs. a changing rainfall pattern in Malawi. Journal of Rainwater Catchment Systems, 16: 25-37. doi:10.7132/jrcsa.kj00007225456.
[55] Likoya, E. et al. (2023) Austral summer droughts and their driving mechanisms in observations and present-day climate simulations over Malawi. International Journal of Climatology 43: 5154-5176. doi:10.1002/joc.8137.
[56] Ngongondo, C. et al. (2015) Observed and simulated changes in the water balance components over Malawi, during 1971-2000, Quaternary International 369: 7-16. doi:10.1016/j.quaint.2014.06.028.

3.1.3 Extremes

Extreme weather events are a common feature of the southern and eastern African climates[57]. Malawi is no exception to such extremes, the impacts of which have had disastrous consequences affecting a wide range of sectors and have perpetually rendered a significant portion of the population destitute. Floods and droughts are the most common extreme weather events in Malawi with isolated cases of hailstorms[58] and heat waves[59] also posing a considerable threat to human and natural systems. Tropical cyclones originating from the Indian Ocean have also led to considerable – if not the most prominent – damage in recent years, especially over southern Malawi. While records for extreme temperatures and heatwaves were either not available, reliable or of sufficient duration to support an objective and robust historical analysis of high/extreme heat events, a set of temperature-based extreme indices were examined in the climate projections (refer to section 3.2.3.1).

Floods

There is a considerably high risk of floods across most parts of southern Malawi. The occurrence of floods is a combination of multiple related factors including the prevalence of heavy or persistent precipitation, poor drainage systems, and landscapes with a high risk of flooding. Flood examination is typically at river basin scales such that these can range in size to reflect either the main river basin or its tributaries. The relevance of such scales to the scale of examination in relation to the target districts and traditional authorities may thus vary considerably. For the purposes of this examination, the Shire River Basin is taken as the standard scale of reference given that all target districts fall within this basin even though the Shire River does not flow through all of these districts.

Figure 8 shows the average monthly observed streamflow for the period 1981 – 2010, acquired from HyData – a database of observations from hydrometric stations managed by the Malawi Department of Water Resources. Streamflow seasonality is closely associated with intra-seasonal variability in precipitation. Thus, changes in streamflow are highly sensitive to changes in precipitation. A unique feature of the Shire River basin is its interconnectedness with Lake Malawi to form what hydrology scholars have simply referred to as the Lake Malawi Shire River Basin[60]. It is due to this interconnected system that low flows in October and November are still as high as ~400 cumecs. March has the highest mean monthly streamflow, indicating a two-month lag in the precipitation and streamflow peaks.

Observed streamflow at the most downstream station of the Shire River is characterized by a high degree of interannual variability, reminiscent of patterns observed for mean annual precipitation. The control of flows at the Liwonde Barrage near the outlet of the Shire River from Lake Malawi means that flows are not totally natural and discerning natural variability from human controls may not be straightforward. Nonetheless, there is an indication of an increase in peak flows at the downstream observation station of the Shire River basin. Figure 8b shows the timeseries of monthly peak flow anomalies for the period 1960 – 2009 relative to the 1961 – 1990 climatological mean. Though not the most prominent indicator, seeing as floods are short-lived events (therefore daily peaks would be more robust), there is an indication that monthly peak flows are increasing relative to the 1961-1990 period. Mann-Kendall tests performed on the timeseries of the peak flows indicate a significant upward trend at the 95% confidence level.

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[57] Shongwe, M.E. et al. (2009) Projected changes in mean and extreme precipitation in Africa under global warming. Part I: southern Africa. Journal of Climate 22: pp. 3819-3837. doi:10.1175/2009JCLI2317.1.; Engelbrecht, C.J. et al. (2013) High-resolution model-projected changes in mid-tropospheric closed-lows and extreme rainfall events over southern Africa. International Journal of Climatology 33: 173-187. doi:10.1002/joc.3420.

[58] Department of Disaster Management Affairs (2015) Malawi Hazards & Vulnerability Atlas. Department of Disaster Management Affairs, Lilongwe, Malawi.

[59] Mittal, N. et al. (2019) Malawi heatwaves threaten tea yields and livelihoods. Future Climate for Africa, Cape Town, South Africa. Available at: https://futureclimateafrica.org/news/malawi-heatwaves-threaten-tea-yields-and-livelihoods/.

[60] Bhave, A.G. et al. (2020) Lake Malawi's threshold behaviour: a stakeholder-informed model to simulate sensitivity to climate change. Journal of Hydrology 584: 124671. doi:10.1016/j.jhydrol.2020.124671; Bhave, A.G. et al. (2022) Stress-testing development pathways under a changing climate: water-energy-food security in the lake Malawi-Shire river system. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 380(2221). doi:10.1098/rsta.2021.0134.

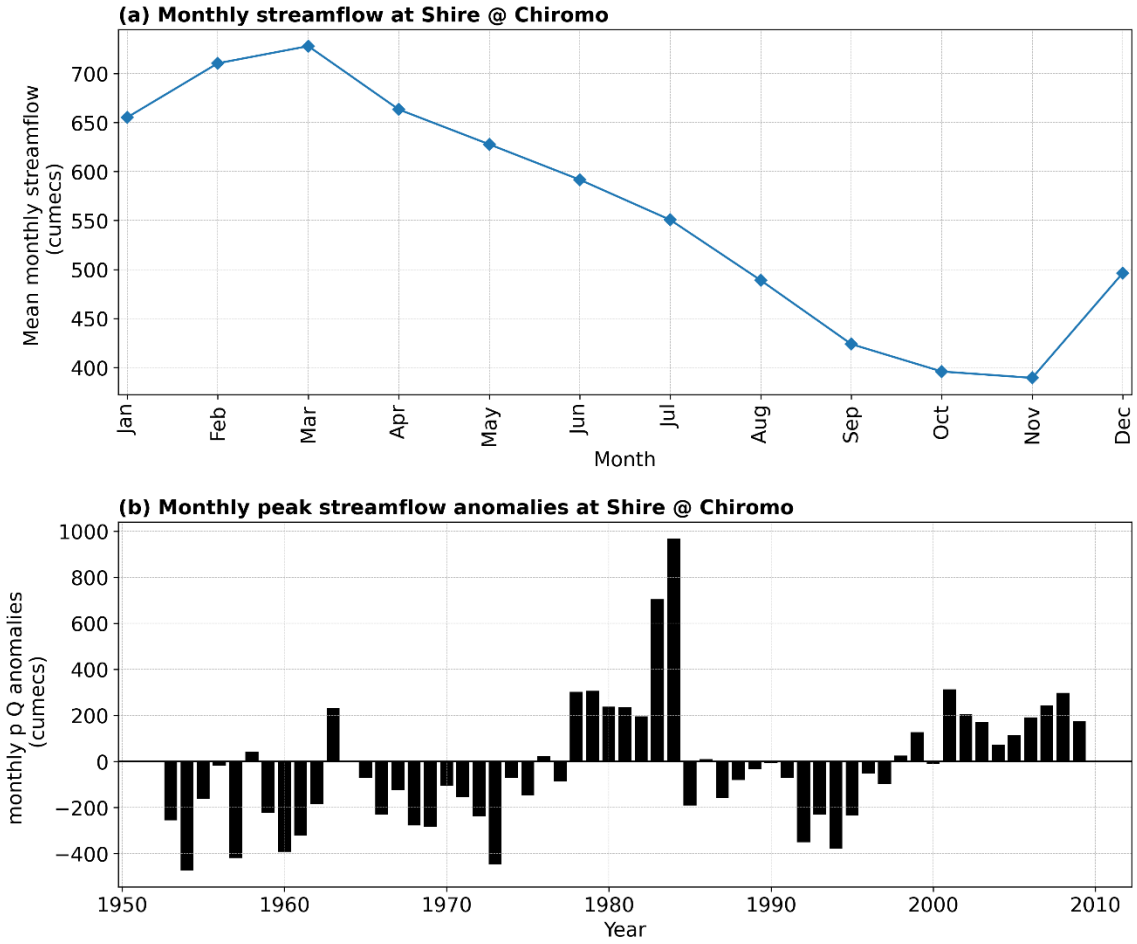
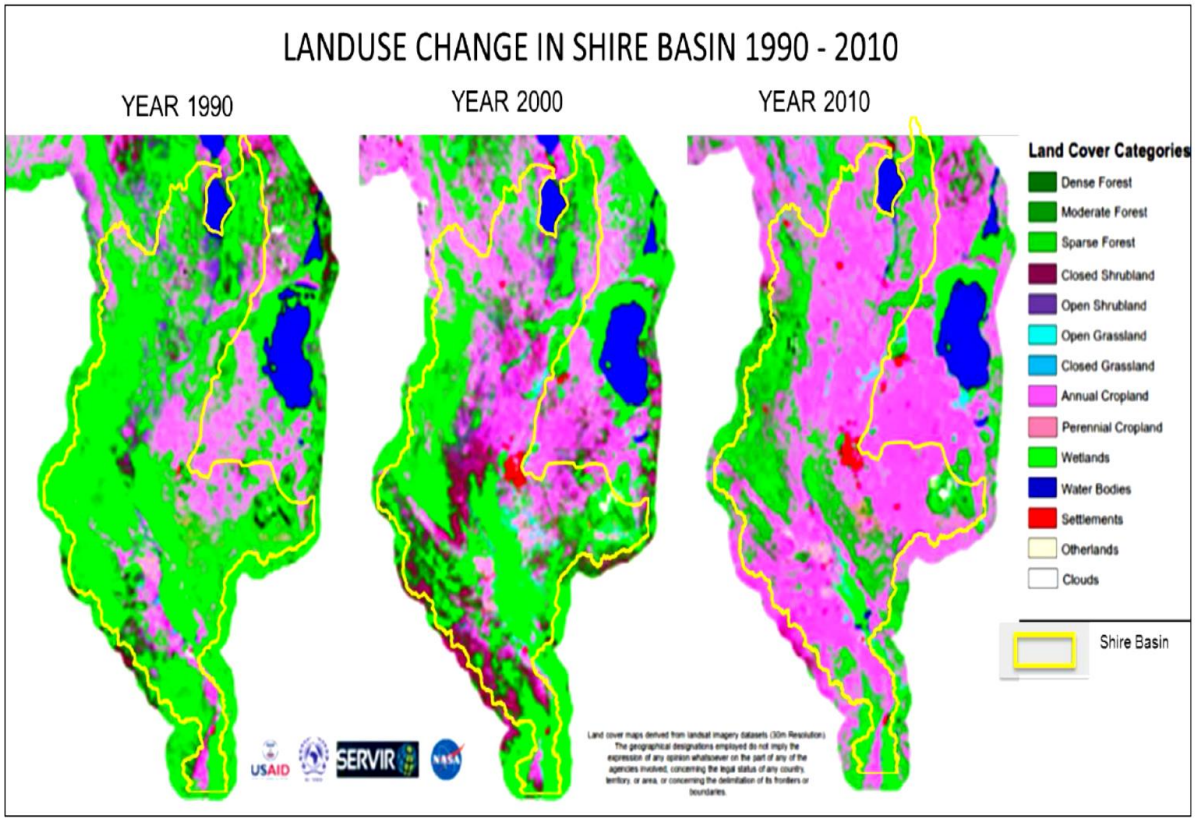


Figure 8*: (a) Average monthly observed streamflow for Shire River at Shire Chiromo station averaged for the period 1981 – 2010. (b) Anomalies of peak monthly flows (i.e., year to year maxima of average monthly flows) for the period 1960 – 2010, relative to the 1961 – 1990 reference period.*

Other than climatic factors, changes in land use and land cover have led to a considerable increase in flood risk across the Shire River basin: rampant forest degradation and deforestation to create new fields, settlements and for biomass fuel has left large areas of land bare and prone to floods due to increased runoff[61;62]. Figure 9 shows the extent of land cover change between 1990 and 2010, showing significant decrease in forest cover and increase in cropland. Consequently, this land cover change has increased the flood-causing potential of precipitation events that would otherwise not cause any floods. The interaction of multiple risk factors is key to understanding and addressing flood risk factors in the wider context of environmental change, considering factors and drivers beyond climate change.

[61] Likoya, E. (2019) Attribution of the risk of extreme flood events to climate change in the context of changing land use and cover: case study of the Shire River Basin flood of 2015. Master's Thesis, University of Cape Town, Cape Town, South Africa. Available at: https://open.uct.ac.za/handle/11427/31607.
[62] Nkhoma, L. et al. (2021) Evaluation of integrated impacts of climate and land use change on the river flow regime in Wamkurumadzi river, Shire Basin in Malawi. Journal of Water and Climate Change 12: 1674–1693. doi:10.2166/wcc.2020.138.



Source : Shire Basin extraction from http://rcmrd.org/wp-content/uploads/2014/06/malawi.png

Figure 9: Changes in land use in the Shire River Basin over three different periods: 1990, 2000, and 2010. Land-use changes highlight the potential influence of other factors interacting with climatic factors to drive flood risk.

Tropical Cyclones

Tropical cyclones play a role in weather systems over subtropical southern Africa and eastern Africa[63]. In terms of influencing the regional precipitation climatology, they are associated with reduced rainfall over the continent as tropical cyclones create conditions for pronounced offshore winds which draw moisture away from the continent. When they make landfall, however, tropical cyclones can cause heavy precipitation that is associated with strong winds, flooding, landslides and mudslides. Tropical cyclones form from pre-existing depressions or low-pressure systems over the ocean, catalyzed by abnormally higher sea surface temperatures and vertical windshear.

Historically, over 28 tropical cyclones have occurred in Southern Malawi since the 1980s, with four cyclones occurring in 2022 alone[64]. The impacts of tropical cyclones have been increasing in recent years, with the region affected in 2015 by the highest records of precipitation (Tropical Storm Chedza and Tropical Cyclone Bansi); in 2017 by Tropical Cyclone Dineo; in 2019 by Tropical Cyclones Idai and Kenneth; and in 2022, by tropical storms Ana and Dumako and tropical cyclones Gombe and Halima. Together with the increasing intensity of such events there is pronounced vulnerability of communities to the same: household vulnerabilities to tropical cyclone-related floods have been increasing since the

[63] Mason, S.J. & Jury, M.R. (1997) Climatic variability and change over southern Africa: a reflection on underlying processes. Progress in Physical Geography: Earth and Environment 21: 23-50. doi:10.1177/030913339702100103; Finney, D.L. et al. (2020) The effect of westerlies on East African rainfall and the associated role of tropical cyclones and the Madden–Julian Oscillation. Quarterly Journal of the Royal Meteorological Society 146: 647–664. doi:10.1002/qj.3698.

[64] Pangapanga-Phiri, I. et al. (2022) Understanding the impact of sustainable landscape management practices on farm productivity under intensifying tropical cyclones: evidence from Southern Malawi. Tropical Cyclone Research and Review 11: 265-276. https://doi.org/10.1016/j.tcrr.2023.02.002.

1970s[65]. Most recently, Malawi experienced one of the worst tropical cyclones on record (Tropical Cyclone Freddy, in March 2023)[66].

Droughts

Droughts are a common feature of the Malawian climate. The temporal scales at which droughts occur over Malawi and neighboring countries is highly variable but there is the indication that, like most parts of subtropical southern Africa, droughts in Malawi typically occur at interannual timescales[67]. Naturally, therefore, droughts over subtropical southern Africa are typically associated with drivers of interannual rainfall variability, key to which is the El Nino Southern Oscillation (ENSO). Malawi's geographical position fundamentally determines the regions where droughts occur during different ENSO phases[68]. The positive (El Nino) phase is associated with drier conditions across southern Malawi, consistent with patterns observed across subtropical southern Africa. While La Nina conditions are associated with drier conditions over the north, such years are typically associated with wetter conditions in the south. The association between droughts and ENSO is not totally linear given that droughts can occur during non-El Nino years while not all El Nino years are associated with drought conditions. This association is particularly complex for Malawi as it lies in the ENSO transition zone, where the north and south are split with regards to responses to ENSO signals. Thus, other drivers, and regional influences, are also essential for drought processes. Such drivers and regional influences include the Indian Ocean Dipole, the Subtropical Indian Ocean Dipole, sea surface temperatures in adjacent ocean basins, local topography, as well as tropical cyclones, among other relevant processes.

Like all other extreme weather events, droughts are driven by both dynamic and thermodynamic factors, the interplay of which is key to understanding the changing drought risk and drought patterns in the context of climate change[69]. Dynamical factors are related to circulation patterns. They are key to the timing of drought events as a result of anomalously low precipitation. On the other hand, thermodynamic influences are associated with changes in temperature and atmospheric evaporative demand. The frequency of observed droughts in Malawi has increased, following patterns in increasing temperatures[70]. Hence, there is a lot more confidence in attributing changes in drought attributes to thermodynamic influences rather than changes in dynamic influences. Figure 10 shows the timeseries of a drought index – the Standardized Precipitation and Evapotranspiration Index (SPEI)[71] – for southern Malawi. The SPEI is one of the many drought indices (primes that are used to evaluate drought from a relevant weather variable or an integration of relevant weather variables) that has been used to examine drought processes and evaluate the risk of droughts in the context of climate change. Its objectivity and integration of both precipitation and temperature makes it an ideal index for drought monitoring in the context of climate change, more so in agrarian settings[72]. Accounting for changes in observed temperature, it is apparent that the risk of drought – or at least their frequency and

[65] Pangapanga-Phiri, I. et al. (2022) Understanding the impact of sustainable land-scape management practices on farm productivity under intensifying tropical cyclones: evidence from Southern Malawi. Tropical Cyclone Research and Review 11: 265-276. https://doi.org/10.1016/j.tcrr.2023.02.002.

[66] Government of Malawi (2023) Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment. Government of Malawi, Lilongwe. Available at: https://reliefweb.int/report/malawi/malawi-2023-tropical-cyclone-freddy-post-disaster-needs-assessment-april-2023

[67] Masih, I. et al. (2014) A review of droughts on the African continent: a geospatial and long-term perspective. Hydrology and Earth System Sciences 18: 3635-3649. doi:10.5194/hess-18-3635-2014.

[68] Likoya, E. et al. (2023) Austral summer droughts and their driving mechanisms in observations and present-day climate simulations over Malawi. International Journal of Climatology 43: 5154-5176. doi:10.1002/joc.8137.

[69] Sillmann, J. et al. (2017) Understanding, modeling and predicting weather and climate extremes: Challenges and opportunities. Weather and Climate Extremes 18: 65-74. doi:10.1016/j.wace.2017.10.003; Seneviratne, S.I. et al. (2021) Weather and climate extreme events in a changing climate. In: Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1513-1766. doi:10.1017/9781009157896.013.1514.

[70] Ngongondo, C. et al. (2015) Observed and simulated changes in the water balance components over Malawi, during 1971-2000. Quaternary International 369: 7-16. doi:10.1016/j.quaint.2014.06.028; Mtilatila, L. et al. (2020) Meteorological and hydrological drought assessment in Lake Malawi and Shire River basins (1970–2013). Hydrological Sciences Journal 65: 2750-2764. doi:10.1080/02626667.2020.1837384; Likoya, E. et al. (2023) Austral summer droughts and their driving mechanisms in observations and present-day climate simulations over Malawi. International Journal of Climatology. doi:10.1002/joc.8137.

[71] Vicente-Serrano, S.M. et al. (2010) A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. Journal of Climate 23: 1696-1718. doi:10.1175/2009JCLI2909.1.

[72] ibid, as well as Comparison of SPI and SPEI applicability for drought impact assessment on crop production in the Danubian Lowland and the East Slovakian Lowland. Theoretical and Applied Climatology 128: 491-506. doi:10.1007/s00704-016-1870-2.

pronouncement of attributes such as duration and severity – has increased since the early 80s, consistent with observed changes in temperature.

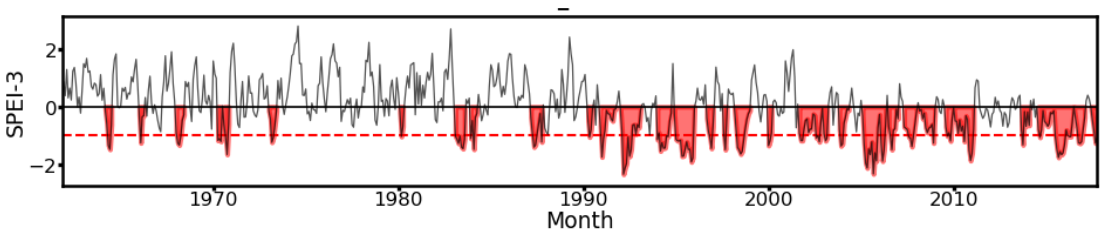


Figure 10: Standardised Precipitation and Evapotranspiration Index timeseries for southern Malawi for the period from 1961 to 2020. The timeseries measures monthly departures from the climatological water balance (the difference between precipitation and potential evapotranspiration). Negative values indicate dry anomalies while positive values indicate wet anomalies. Shaded areas indicate periods when it was dry enough to qualify as a drought.

3.2 PROJECTIONS OF FUTURE CLIMATE CHANGE

Novel climate projections for southern Malawi were computed for this Feasibility Study from bias-corrected outputs of Global Climate Models (GCMs) participating in the fifth phase of the Coupled Model Intercomparison Project (CMIP5)[73]. A bias-corrected archive of CMIP5 models has been made available through the AMMA2050 project[74] creating useful outputs of global climate projections for locally relevant development applications and impact modelling. The AMMA2050 archive provides a wide suite of global climate projections that have been bias-corrected for the African region at 0.5 degrees x 0.5 degrees horizontal resolutions for near surface variables including temperature, precipitation, specific humidity, as well as horizontal wind vectors. The AMMA2050 bias-corrected datasets provide a relatively high-resolution set of climate projections useful for development application and impact modelling.

For this assessment, 16 CMIP5 GCMs were examined. They were selected based on each model's outputs being available for historical runs and two future emission scenarios – RCP8.5 and RCP4.5. Table 5 summarises the list of models that were used for the analysis. Models were analysed for projected changes in mean climatic values for temperature and precipitation and a selection of relevant extremes associated with the two variables. Model projections are characterized by considerable uncertainties emanating from a wide range of sources including natural internal variability, model structure, scenarios, forcing, and response to such forcings. This analysis does not dwell much on the uncertainties or their quantification, but a summary of their description is given for each variable or index that has been examined to highlight the range of plausible outcomes with regards to future climate projections. Basing the analyses on an ensemble of 16 models provides valuable information in this regard.

[73] Taylor, K.E. et al. (2012) An Overview of CMIP5 and experimental design. Bulletin of the American Meteorological Society 93: 485-498. https://doi.org/10.1175/BAMS-D-11-00094.1.
[74] Famien, A.M. et al. (2018) A bias-corrected CMIP5 dataset for Africa using the CDF-t method – a contribution to agricultural impact studies. Earth System Dynamics 9: 313–338. doi:10.5194/esd-9-313-2018.

Table 5: List of CMIP5 global climate models used for the analysis, showing the institution and the parent horizontal resolution.

Modelling Centre/Group	**Model**	**Resolution (Lat x Lon x Lev)**
Commonwealth Scientific and Industrial Research Organisation (CSIRO), and Bureau of Meteorology (BOM), Australia	ACCESS1-0	1.25º ×1.875º ×38
	ACCESS1-3	
Beijing Climate Centre, China Meteorological Administration	BCC-CSM-1	1.875º ×1.875º ×16
	BCC-CSM-1-1-M	
College of Global Change and Earth System Science, Beijing Normal University	BNU-ESM	2.81º ×2.81º ×26
Centro-Euro Miditerraneo per I Cambiamenti Climatic	CMCC-CESM	3.443º ×3.75º ×39
Centre Nationale de Recherches Meteorologiques/ Centre Européen de Recherche et Formation Avancée en Calcul Scientifique	CNRM-CM5	1.4º ×1.4º ×31
NOAA Global Fluid Dynamics Lab	GFDL-CM3	2º ×2.5º ×48
	GFDL-ESM2G	2º ×2.5º ×24
	GFDL-ESM2M	2º ×2.5º ×24
Met Office Hadley Centre	HadGEM2-CC	1.25º ×1.875º ×38
	HadGEM2-ES	1.25º ×1.875º ×38
Institute for Numerical Mathematics	INMCM4	1.5º ×2º ×21
Institut Pierre-Simon Laplace	IPSL-CM5A-MR	1.25º ×2.5º ×39
	IPSL-CM5B-LR	1.9º ×3.75º ×39
Max-Planck-Institut fur Meteorologie (Max-Planck Institute for Meteorology)	MPI-ESM-LR	1.8653º ×1.875º ×47
	MPI-ESM-MR	1.8653º ×1.875º ×95
Norwegian Climate Centre	NorESM1-M	1.9º ×2.5º ×26

In terms of temperature, projections clearly show further significant increases for Southern Malawi. By the mid-century, the GCMs project an increase in temperature of between 1 and 2°C under both the RCP4.5 and RCP8.5 scenarios, compared to the historical reference period. By the end of the century, temperatures are expected to rise by 2°C under RCP4.5 and by more than 4°C under RCP8.5. In terms of precipitation, the GCMs project a decrease across southern Malawi over the course of the twenty-first century, with the decrease becoming more apparent from the middle to the end of the century, and with the degree of projected change being greater in RCP8.5 than RCP4.5.

With respect to temperature-related extremes, maximum temperature (TXx) and minimum temperature (TNn) are likely to rise steadily over the course of the twenty-first century across southern Malawi for both RCP4.5 and RCP8.5 emission scenarios, relative to the historical reference period. It is likely that cold days and cold nights will decrease, while warm days and warm nights will increase, during the course of the century. For warm days (TX90p) and warm nights (TN90p), the exceedance rate steadily increases over the course of the century with the increase being more pronounced for warm nights than for warm days, and under RCP8.5 than RCP4.5. In contrast, both cold nights and cold days are likely to decrease over the course of the 21st century. The rate of decrease is more pronounced for cold nights than for cold days, and the rate of decrease for both indices is more pronounced in RCP8.5 than RCP4.5 with much of the separation becoming more apparent from the 2050s. Warm spell duration is likely to increase over the course of the century while cold spell duration is likely to decrease. The projected increase in warm spell duration is weaker in RCP4.5 than RCP8.5. In contrast, there is a general decrease in the cold spell duration across both the mid-century and end-of-century time slices for both emission scenarios, with the extent of the decrease being more prominent in RCP8.5.

With respect to precipitation-based extremes, both 1-day (RX1day) and 5-day (RX5day) maximum precipitation are likely to increase over the course of the 21st century. Changes in both RX1day and RX5day are more pronounced in RCP8.5 but the interquartile model spreads in the two RCPs hardly diverge and remain overlapping until the end of the century. There is also considerable likelihood that total precipitation on very wet and extremely wet days will increase over the course of the 21st century. The rate of change is more pronounced for extremely wet days where the total precipitation on extremely wet days increases by up to and more than 50% across most parts of southern Malawi by end of 21st century for both RCP4.5 and RCP8.5 emission scenarios. Finally, with respect to drought risk, consecutive dry day (CDD) duration is likely to increase over the 21st century, and by the end of the century, the maximum number of CDD in a year increases by up to 30 days across parts of southern Malawi for the RCP8.5 emissions scenario, relative to the historical reference period. The projected change in CDD is less pronounced in the RCP4.5 emissions scenario.

3.2.1 Temperature

There is a strong likelihood that near surface temperatures will continue to rise across southern Malawi throughout the course of the twenty-first century if greenhouse gas emissions remain unabated. Bias-corrected CMIP5 GCMs consistently project a steady increase in mean annual temperature across southern Malawi for the RCP4.5 and RCP8.5 emission scenarios (Figure 11). This increase is generally consistent with projected trends for subtropical southern and eastern Africa, as well as most land regions of the world. Projected changes in temperature for the RCP4.5 emission scenario are consistent with RCP8.5 emission scenario projection up to the mid twenty-first century when separation between the two emission scenarios starts to emerge. Beyond that, projected changes are more pronounced in the RCP8.5 emission scenario with a multi-model ensemble median change of more than 4 degrees Celsius by the end of the twenty-first century, compared to a projected change of 2 degrees Celsius by end of century for the RCP4.5 scenario.

The IPCC's sixth assessment report indicates that an upward trend in greenhouse gas emissions is very likely such that chances of being locked in a high emissions scenario remain considerably high with direct implications for changes in temperature[75]. Ambitions to keep global temperature increase well below two degrees Celsius may have different implications for different regions as some areas may experience temperature changes that significantly exceed the global average. This is highly apparent for southern Malawi. Projected changes in temperature for southern Malawi highlight the need for urgent climate action – emphasising both mitigation and adaptation – to limit negative consequences on historically vulnerable communities.

[75] IPCC (2023) Summary for policymakers. In: Climate change 2023: synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001.

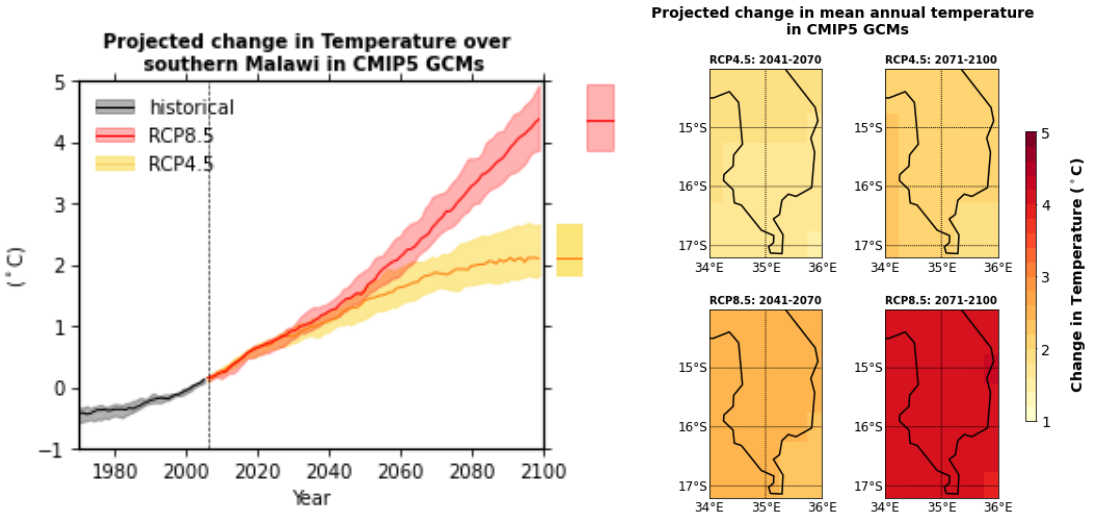


Figure 11: Projected changes in temperature presented as a year-on-year anomaly in the absolute value (10-year running mean) relative to the mean over the historical period (graph), and average changes in temperature for the mid twenty-first century and end-of century time slices (maps), presented as multi-model ensemble mean of the absolute change in temperature across bias corrected CMIP5 GCMs. The solid line on graph is the multi-model ensemble median and shaded area represents interquartile spread (25th and 75th percentile) between individual projections.

3.2.2 Precipitation

Precipitation is likely to decrease across southern Malawi over the course of the twenty-first century, more so towards the end of the century. Figure 12 shows projected changes in precipitation through the twenty-first century, including the projected average change by mid and end century for southern Malawi. Elsewhere in Malawi, there are considerable uncertainties with regards to the direction and magnitude of projected changes in precipitation. On the contrary, models are relatively more consistent in projecting a drying trend over the south of the country. The degree of the multi-model average projected change is generally more pronounced in RCP 8.5 than in RCP 4.5. Changes in precipitation may vary with seasons, which is a potentially key aspect for adaptation planning given the pre-existing seasonal variations in precipitation and the extent to which they govern agricultural practices, among other activities.

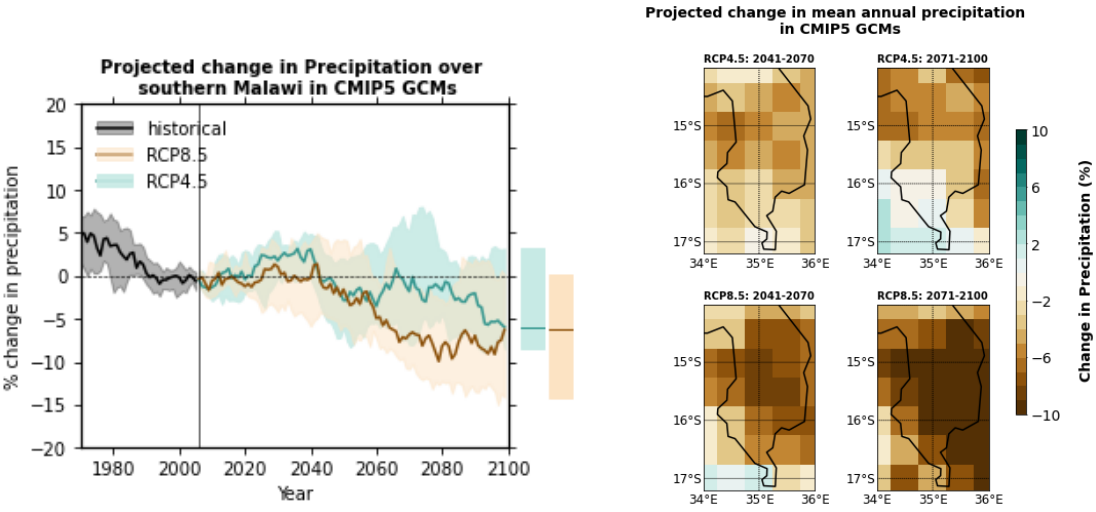


Figure 12: Projected changes in mean annual precipitation presented as year-on-year percent change in mean annual precipitation (10-year running mean) relative to the mean over the historical mean (graph) and projected change in

mean annul precipitation as an average over two different time slices (maps), presented as multi-model ensemble mean of bias corrected CMIP5 GCMs. Solid lines on the graph represent the multi-model ensemble median and shaded area represents the interquartile range (25th and 75th percentile) between individual models.

Changes in precipitation are more apparent in the long-term (towards end of century) rather than near-term (up to the 2040s) projections. Global and regional studies have shown that, over smaller regions, and in the near-term, the magnitude of the projected change in precipitation is small compared to the magnitude of the internal natural variability hence internal variability is an important source of uncertainty in that regard[76]. Uncertainties emanating from natural internal variability are compounded by response uncertainties, i.e., the proportion or the dimension of model uncertainty that is directly related to the response of the model to external forcings. Changes in precipitation can be due to both thermodynamic and dynamic reasons, the accuracy of whose simulation varies comparably across different climate models and regions of the world[77]. Some changes in precipitation can be reflected in the spatial and temporal distribution of the precipitation rather than changes in the mean annual precipitation. This is reflected in, among other aspects, changes in extreme precipitation.

3.2.3 Extremes

Climate and weather extremes have profound societal impacts such that their occurrence often provokes conversations on climate change in the public domain, and prompts questions regarding whether climate change may have resulted in the occurrence of certain events, or whether such events will increase in frequency and intensity in a warmer climate[78]. Planning around climate and weather extremes has become increasingly important in Malawi over the past decade, with some key policies adopted in the aftermath of disastrous extreme events[79]. A selection of extreme events, both temperature and precipitation related, are examined for this analysis. The examination of the latter provides a basis for examining the potential for changes in risk of other climatic events including floods without having to explicitly model river basin processes through, for instance, hydrological simulations. While the modelling of tropical cyclones is outside the bounds of this analysis (given that tropical cyclones are remote events, originating and mostly dissipating in the Indian Ocean with a few making occasional landfalls), it is important to highlight that extreme rainfall may be caused by tropical cyclones. While there is a projected decrease in the number of tropical cyclones making landfall in the region at 1°C, 2°C and 3°C of global warming, they are projected to become more intense, so when they do make landfall, the impacts are expected to be high[80].

For this analysis, changes in extremes are computed based on indices developed by the Expert Team on Climate Detection and Indices (ETCDI) and extensively discussed by Sillmann *et al.* (2013)[81]. The ETCDI is mandated to address the need for objective measurement and characterization of climate variability and change. It provides international coordination and collaboration on climate change detection and indices relevant to climate change detection while encouraging the need for comparison of modelled data and observations. Among other things, the ETCDI has facilitated the analysis of climate and weather extremes by defining a set of climate indices that provide a comprehensive overview of temperature and precipitation

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[76] Kirtman, B. et al. (2013) Near-term climate change: projections and predictability. In: Climate change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. Available online at: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter11_FINAL.pdf.

[77] Ibid.

[78] Zeng, X. (2015) Is climate change to blame for extreme weather events? Attribution science says yes, for some – here's how it works. The Conversation, 25 August. Available at: https://theconversation.com/is-climate-change-to-blame-for-extreme-weather-events-attribution-science-says-yes-for-some-heres-how-it-works-164941.

[79] Such as the Disaster Risk Management Bill, passed by Parliament on 12th April 2023 (see https://malawi.savethechildren.net/news/malawi-parliament-passes-disaster-risk-manage-bill-country-recounts-impacts-cyclone-freddy).

[80] Niang, I., et al. (2014) 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 [Barros, V.R., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1199-1265. Available at: https://www.ipcc.ch/report/ar5/wg2/africa/.

[81] Sillmann, J. et al. (2013) Climate extremes indices in the CMIP5 multi model ensemble: Part 2. Future climate projections. Journal of Geophysical Research Atmospheres: 118: 2473–2493. doi:10.1002/jgrd.50188.

statistics focusing particularly on extreme aspects. The development of global datasets on indices, namely the HADEX and HADEX2, takes after advances in the development of extreme indices through the ETCDI. HADEX and HADEX2 are developed at coarse resolutions, however, given challenges with observed climate data, more so for Malawi and many parts of Africa where observations are sparse. Attempts to evaluate models on the basis of how well they simulate these indices are not made for this analysis, but reference is made to the work of Sillmann et al. (2013)[82], who highlight that CMIP5 models demonstrate reasonable performance with regards to simulating such extremes. Finally, indices developed by the ETCDI have demonstrated reasonable robustness and find multiple applications in climate research and related fields[83]. Results are presented separately for temperature and precipitation extremes. Specific definitions and descriptions of the respective extremes are given in the corresponding section.

The descriptions of the indices used for this examination are given under each corresponding section for temperature- and precipitation-related extremes respectively.

3.2.3.1 Temperature-related extremes

In relation to temperature, six extreme indices are examined namely minimum temperature, maximum temperature, warm nights, cold nights, warm spells, and cold spells. **Error! Reference source not found.** provides the definition, and a summary of the numerical computation that governs the derivation of the associated index following Sillmann *et al.* (2013)[84].

Table 6: List of temperature-related extreme indices and their corresponding Expert Team on Climate Detection and Indices definitions/descriptions and units.

Index label	Index name	Definition/Description	Units
TXx	Maximum temperature	The maximum of maximum daily temperatures. Let TX_x be the daily maximum temperatures in month *k*, period *j*. The maximum daily maximum temperature each month is then: TX_{xkj} = max (TX_{xkj})	^oC
TNn	Minimum temperature	The minimum of minimum daily temperatures over a given period of time. Let TN_n be the daily maximum temperatures in month *k*, period *j*. The maximum daily maximum temperature each month is then: TN_{nkj} = max (TN_{nkj})	^oC
TX90p	Warm days	Annual exceedance rate of the 90th percentile of *maximum* daily temperature. Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}90$ be the calendar day 90th percentile centered on a 5-day window. The percentage of days is determined where TX_{ij} > $TX_{in}90$	%
TN90p	Warm nights	Annual exceedance rate of the 90th percentile of *minimum* daily temperature. Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}90$ be the calendar day 90th percentile centered on a 5-day window. The percentage of days is determined where TN_{ij} > TNin90	%
TX10p	Cold days	Annual exceedance rate of the 10th percentile of *maximum* daily temperature. Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}10$ be the calendar day 10th percentile centered	%

[82] Ibid.
[83] E.g., Chervenkov, H. & Slavov, K. (2020) ETCCDI Climate Indices for Assessment of the Recent Climate over Southeast Europe. In: Dimov, I. & Fidanova, S. (eds) Advances in High Performance Computing. HPC 2019. Studies in Computational Intelligence, vol 902. Springer, Cham. Available at: https://doi.org/10.1007/978-3-030-55347-0_34.
[84] Sillmann, J. et al. (2013) Climate extremes indices in the CMIP5 multi model ensemble: Part 2. Future climate projections. Journal of Geophysical Research Atmospheres 118: 2473-2493. doi:10.1002/jgrd.50188.

		on a 5-day window. The percentage of days is determined where $TX_{ij} < TX_{in}10$	
TN10p	Cold nights	Annual exceedance rate of the 10th percentile of *minimum* daily temperature. Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}10$ be the calendar day 10th percentile centered on a 5-day window. The percentage of days in a year is determined where $TN_{ij} < TN_{in}10$	%
CSDI	Cold spell duration	The maximum duration for spells of at least 6 days when the minimum daily temperature is below the 10th percentile of the minimum temperature. Let TN_{ij} be the daily minimum temperature on day *i* in period *j* and let $TN_{in}10$ be the calendar day 10th percentile centered on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days: $TN_{ij} < TN_{in}10$	Days
WSDI	Warm spell duration	The maximum duration for spells of at least 6 days when the maximum daily temperature is above the 90th percentile of the maximum temperature. Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let $TX_{in}90$ be the calendar day 90th percentile centered on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days: $TX_{ij} > TX_{in}90$	Days

Minimum and maximum temperature

Both maximum temperature (TXx) and minimum temperature (TNn) are likely to rise steadily over the course of the twenty-first century across southern Malawi for both RCP4.5 and RCP8.5 emission scenarios, relative to the 1976 – 2005 reference period. The projected increase is consistent with the projected increase in mean annual temperatures due to increasing greenhouse gas emissions and concentrations in the atmosphere. Rising mean temperatures are associated with the thermodynamically driven increase in warm extremes (associated with pronounced maximum temperatures) and decrease in cold extremes (associated with minimum temperatures). Figure 13 shows projected changes in minimum and maximum temperatures for southern Malawi. The multi-model median increase in TNn and TXx respectively over southern Malawi by end of 21st century is 2.7° C and 2.8° C in RCP4.5, and 6 °C and 5.8 °C in RCP8.5. These values are within the ranges of projected changes in the same indices over global land areas by end of 21st century for the corresponding emission scenarios[85][86].

[85] Sillmann, J. et al. (2013) Climate extremes indices in the CMIP5 multimodel ensemble: Part 1. Model evaluation in the present climate. Journal of Geophysical Research Atmospheres 118: 1716-1733. Doi:10.1002/jgrd.50203.

[86] Trisos, C.H. et al. (2022) Africa. In: Climate change 2022: impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1285–1455. doi:10.1017/9781009325844.011.

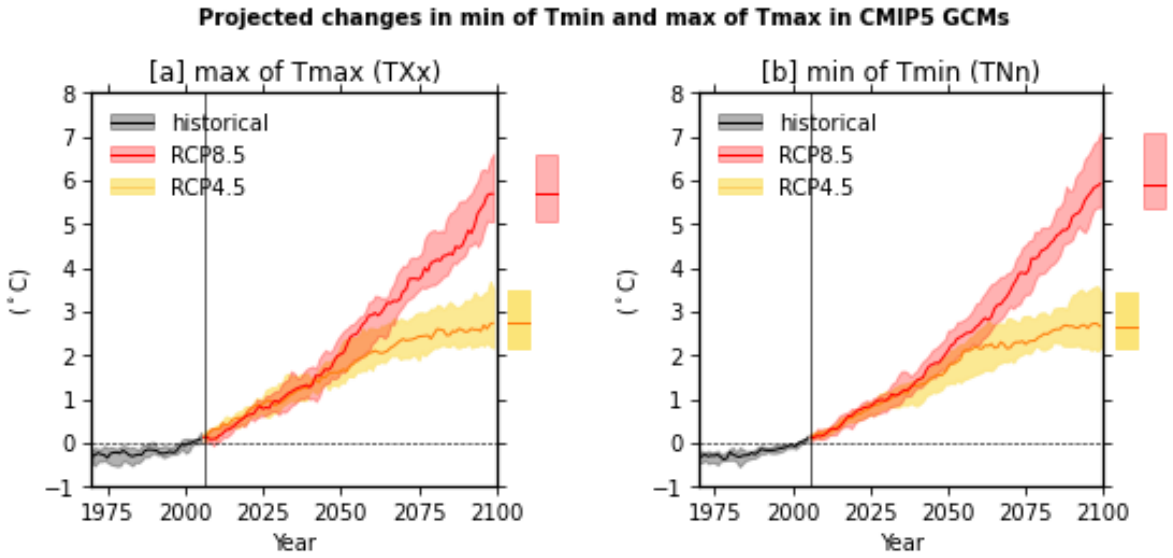

Figure 13: Projected changes in maximum of maximum temperature (TXx) and minimum of minimum temperature (TNn) over the course of the twenty-first century over southern Malawi in bias-corrected CMIP5 models for two emission scenarios. Projected changes are relative to the average over the 1976 – 2005 historical reference period and are presented as ensemble median (solid line). Shaded area is the interquartile range (25th and 75th percentile) between individual models.

Daytime and nocturnal temperature extremes

It is likely that cold days and cold nights will decrease while warm days and warm nights will increase. These trends are generally consistent with the anticipation that warm extremes will increase in a warmer climate, while cold extremes will decrease. Figure 14 shows projected changes in cold nights, cold days, warm days, and warm nights, over the course of the twenty-first century across southern Malawi, in both RCP4.5 and RCP8.5 emission scenarios. Projected changes are shown in absolute terms and not as differences relative to the historical reference period. This is because, by construction, the indices (which are in percentile terms) represent exceedance rates relation to a historical calibration period (1971 – 2000) which subsequently serves as the basis for historical comparisons. The average exceedance rate for all four extremes is approximately 10% during the historical calibration period. The exceedance rate represents the exceedance probabilities for threshold (10th and 90th percentile) maximum or minimum daily temperatures that represent a cold/warm day/night. For instance, a 10% exceedance rate for warm days/nights, means that there is a 10% chance that the 90th percentile of the daily maximum/minimum temperatures will be exceed in a year. The threshold temperatures are derived from daily minimum/maximum temperatures over the calibration period.

For warm days (TX90p) and warm nights (TN90p), the exceedance rate steadily increases over the course of the century with the increase being more pronounced for warm nights than for warm days. The increase in warm nights and warm days in RCP8.5 is from approximately 10% during the calibration period (1971 – 2000) to 60% and 50% respectively by the end of the 21st century. The rate of increase in both warm days and warm nights is more pronounced in RCP8.5. In contrast, both cold nights and cold days are likely to decrease over the course of the 21st century. The rate of decrease is more pronounced for cold nights than for cold days. For RCP8.5 cold days (TX10p) and cold nights (TN10p) decrease from approximately 10% over the calibration to 2% and almost negligible (~ 0%) respectively by the end of the 21st century. The rate of decrease for both indices is more pronounced in RCP8.5 than RCP4.5 with much of the separation becoming more apparent from the 2050s.

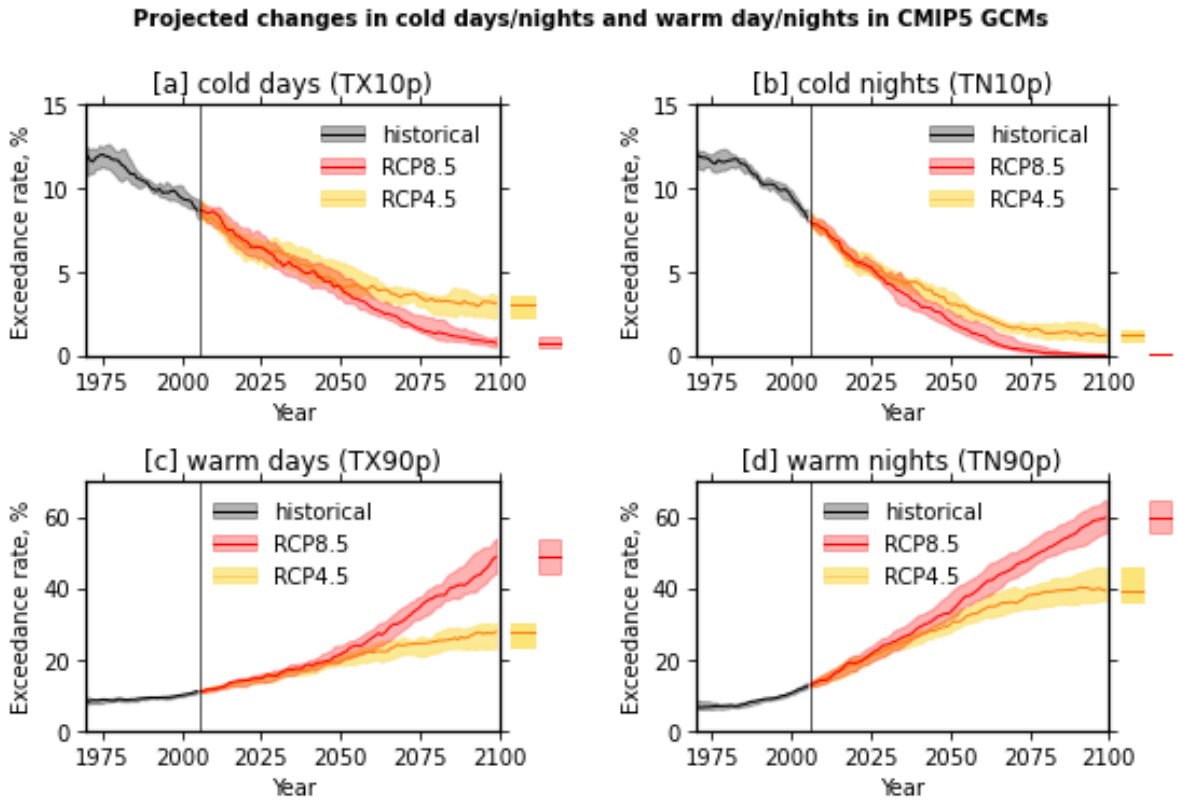

Figure 14: projected changes in (a) cold days, (b) cold nights, (c) warm days and (d) warm nights for the twenty-first century over southern Malawi, relative to the average over the historical reference period in bias-corrected CMIP5 GCMs. Solid lines represent the multi-model ensemble median while shaded area is the interquartile range (25th and 75th percentile) between the individual models.

Cold spells and warm spells

Warm spell duration is likely to increase over the course of the century while cold spell duration is likely to decrease. These trends also are consistent with the anticipation of changes in cold and warm extremes in a warmer climate. Based on the ETCDI framework, a warm spell is defined as an any streak of six or more days when the maximum temperature is above the 90th percentile temperature (defined from a calibration period which, for this examination, was done for the period from 1971 to 2000). The warm spell duration index is given as the total sum of individual warm spell durations. The same applies for a cold spell duration where a cold spell is defined as the any streak of six or more days when the minimum temperature is below the 10th percentile temperature.

Figure 15 shows the multi-model ensemble median of the projected changes in cold spell and warm spell duration over southern Malawi across two different time slices for the two emission scenarios: RCP4.5 and RCP8.5. Projected changes are reflective of the mechanisms associated with changes in temperature extremes where cold extremes decrease, and vice versa for warm extremes. By end of the 21st century, the total number of days under a warm spell in a year increase by up to 140 days across parts of southern Malawi under RCP8.5 relative to the 1976 – 2005 reference period. The projected increase in warm spell duration is relatively weaker in RCP4.5, with a corresponding increase of between 20 and 40 days across different parts of southern Malawi by end 21st century. In contrast, there is a general decrease in the warm spell duration across both the mid-century and end-of-century time slices for both emission scenarios. The extent of the decrease is more prominent in RCP8.5 where, by end of 21st century, the warm spell duration decreases by 15 – 20 days across different parts of southern Malawi. A 10 – 15-day decrease is projected for the same period for RCP4.5, relative to the 1976-2005 reference period.

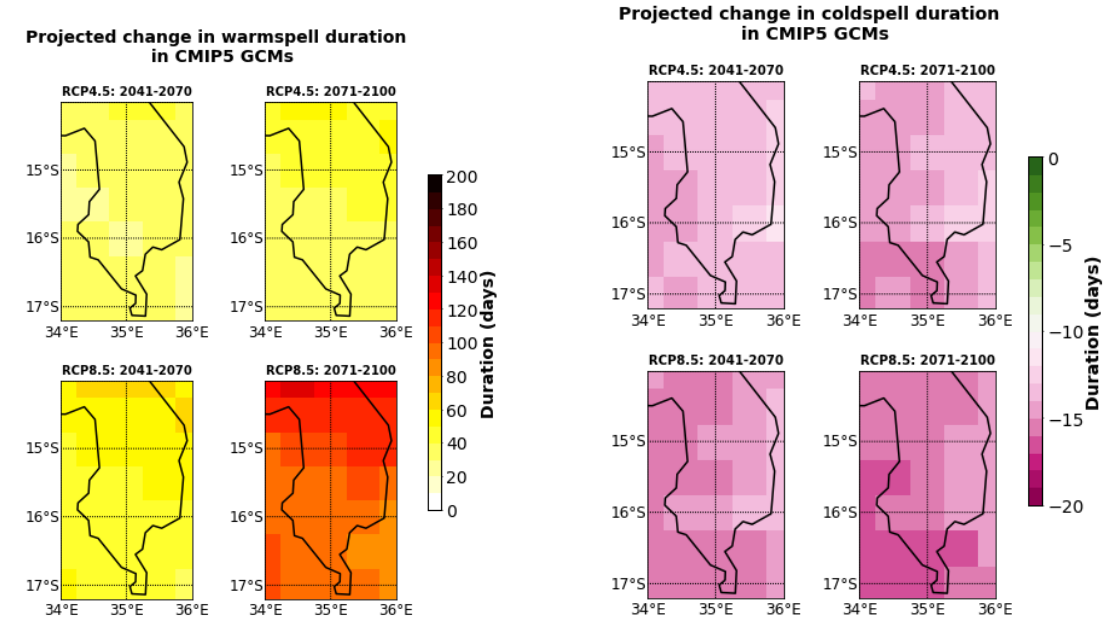

Figure 15: Projected changes in the warm spell and cold spell duration in bias-corrected CMIM-5 GCMs for the mid-century and end of century time slices over Southern Malawi for two different emission scenarios relative to the historical reference period. Projected changes are presented as multi-model ensemble means.

3.2.3.2 Precipitation-related extremes

Four precipitation-related extreme indices were examined for this analysis. These are 1-day and 5-day maximum precipitation, as well as total very-wet day and total extremely wet day precipitation. The index labels and their corresponding definitions/descriptions are given in Table 7. Projected changes are examined relative to the 1976 – 2005 historical reference period.

Table 7: List of precipitation-related extreme indices and their corresponding definitions/descriptions.

Index label	Index name	Description	Units
RX1day	1-day maximum precipitation	Maximum daily precipitation for a given period. Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. The maximum 1-day value for period *j* are: $RX1day_j = max(PR_{ij})$.	mm
RX5day	5-day maximum precipitation	Maximum five-day precipitation for a given period. Let PR_{kj} be the precipitation amount for the 5-day interval ending *k*, period *j*. Then maximum 5-day values for period *j* are: $RX5day_j = max(PR_{kj})$.	mm
R95p	Very wet days	Daily precipitation on very wet days. Let PR_{wj} be the daily precipitation amount on a wet day w (PR >= 1mm) in period *i* and let PR_{wn95} be the 95th percentile of precipitation on wet days in the 1971–2000 period. If *W*	mm

		represents the number of wet days in the period, then: $R95p_j = \sum_{w=1}^{W} PR_{wj}$, where $PR_{wj} > PR_{wn}95$.	
R99p	Extremely wet days	Daily precipitation on extremely wet days. Let PR_{wj} be the daily precipitation amount on a wet day w (PR >= 1mm) in period *i* and let PRwn99 be the 99th percentile of precipitation on wet days in the 1961–1990 period. If *W* represents the number of wet days in the period, then: $R99p_{i=} \sum_{w=1}^{W} PR_{wj}$, where $PR_{wj} > PR_{wn}99$.	mm
CDD	Consecutive dry days	Let PR_{ij} be the daily precipitation amount on day *i* in period *j*. Count the largest number of consecutive days where $PR_{ij} < 1mm$	days

1-day and 5-day maximum precipitation

Both 1-day and 5-day maximum precipitation are likely to increase over the course of the 21st century. The increase in both RX5day and RX1day highlight a more extreme aspect of the precipitation distribution. The projected median changes of up 20% are apparent for both RX1day and RX5day. Figure 16 shows the projected changes in 1-day maximum precipitation and 5-day maximum precipitation for southern Malawi over the course of the 21st century. Changes in both RX1day and RX5day are more pronounced in RCP8.5 but the interquartile model spreads in the two RCPs hardly diverge and remain overlapping until the end of the century. Global evaluation studies[87] showed that, though demonstrating an improvement on previous generations of models, CMIP5 models underestimate RX5day partly due to mismatches in the gridded modelled data and point observations that are the basis index databases i.e., HADEX and HADEX2, on which the evaluations are based. Projected increases in the 1-day and 5-day maximum precipitation are indicative of potential increase in short-term precipitation intensity (potentially due to the increase in the water-holding capacity of a warmer atmosphere) and risk of flooding for southern Malawi. Parts of the region are already susceptible to the risk of flooding and have been the subject of some of the most disastrous floods in recent years[88] such that projected upwards trends in flood-causing events demand the need for urgent action to build the resilience of communities and ecosystems.

[87] E.g., Sillmann, J. et al. (2013) Climate extremes indices in the CMIP5 multi model ensemble: Part 2. Future climate projections. Journal of Geophysical Research Atmospheres 118: 2473–2493. doi:10.1002/jgrd.50188.

[88] Department of Disaster Management Affairs (2015) Malawi hazards & vulnerability atlas. Department of Disaster Management Affairs, Lilongwe, Malawi. Available at: https://www.researchgate.net/publication/282856847_Malawi_Hazards_and_Vulnerability_Atlas; Likoya, E. (2019) Attribution of the risk of extreme flood events to climate change in the context of changing land use and cover: case study of the shire river basin flood of 2015. Master's Thesis, University of Cape Town, Cape Town, South Africa. Available at: https://open.uct.ac.za/handle/11427/31607.

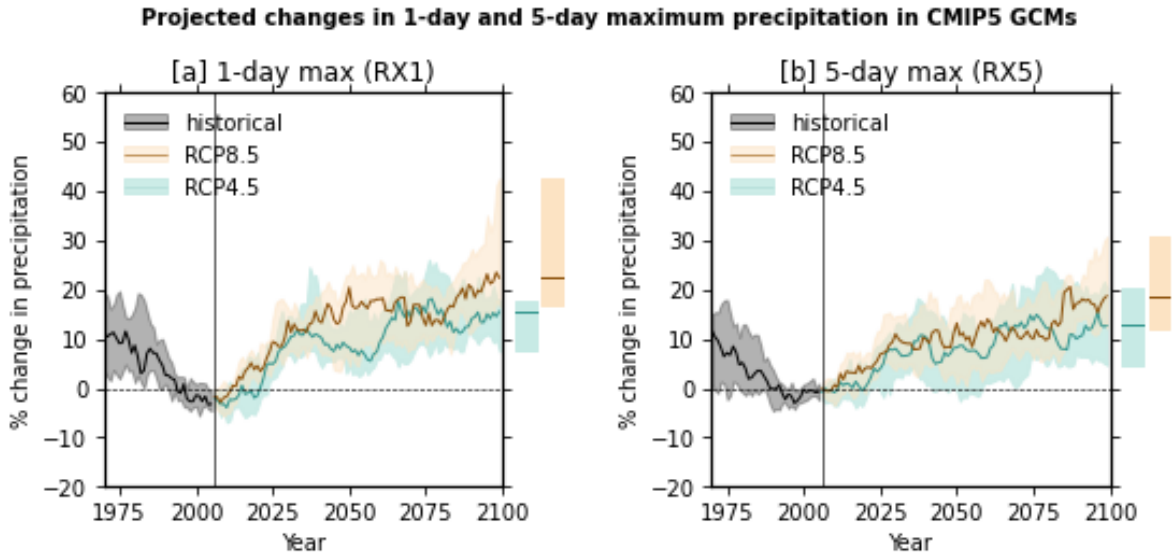

Figure 16 : Projected changes in (a) 1-day and (b) 5-day maximum precipitation over southern Malawi, relative to the average over the historical reference period in bias-corrected CMIP5 GCMs. Solid lines are multi-model ensemble medias and shaded areas are the interquartile range (25th and 75th percentiles) between the individual models.

Very wet days and extremely wet days

There is considerable likelihood that total precipitation on very wet and extremely wet days will increase over the course of the 21st century. On the basis of the ETCDI, very wet (extremely wet) days are those where cumulative daily precipitation reaches or exceeds the 95th (99th) percentile of the daily precipitation recorded over a calibration period, 1971 – 2000 in this case (Table 7). Figure 17 shows the projected (multi-model ensemble mean) in the percent change in precipitation on very wet and extremely wet days for two future time slices for two emission scenarios, relative to the historical reference period. The rate of change is more pronounced for extremely wet days where the total precipitation on extremely wet days increases by up to and more than 50% across most parts of southern Malawi by end of 21st century for both RCP4.5 and RCP8.5 emission scenarios. Consistently projected increases in total precipitation on very wet and extremely wet days reinforces the indication of an increase in short-term precipitation intensity and the increasing risk of flooding from heavy rainfall.

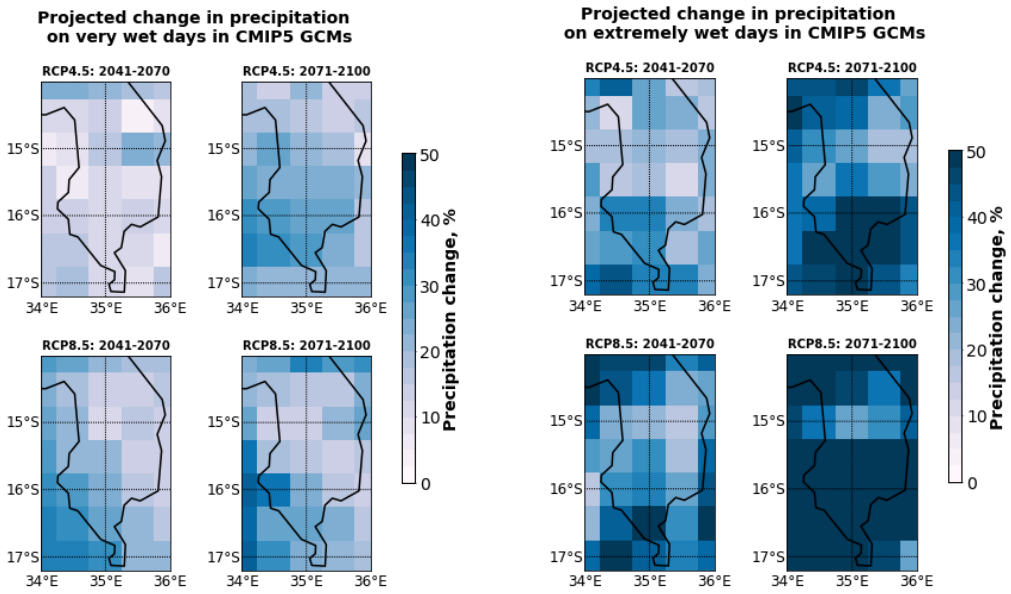

Figure 17: Projected changes in very wet days (R95p) and extremely wet days (R99p) for the mid-century and end-of-century time slices over Southern Malawi for two different emission scenarios in bias-corrected CMIP5 GMCs.

3.2.3.3 Risk of drought

Consecutive dry day (CDD) duration is likely to increase under conditions of global warming. The CDD measures the longest streak of consecutive days with precipitation below 1 mm in a year. The maximum number of consecutive dry days has profound impacts on several systems including vegetation, ecosystems, and water resources. It is a potential indicator of droughts and an increase (decrease) in the CDD would potentially indicate a change towards a drier (wetter) climate due to less (more) frequent daily rainfall[89]. Figure 18 shows the projected change in consecutive dry duration (number of days). By the end of the 21st century, the maximum number of consecutive dry days in a year increases by up to 30 days across parts of southern Malawi for the RCP8.5 emissions scenario, relative to the historical reference period. The projected change in CDD is less pronounced in the RCP4.5 emissions scenario. The projected increase in CDD is consistent with the projected dryness over southern Malawi and may be attributed to the likely decrease in the number of wet days, indicating the potential for an increase in droughts.

[89] Frich, P. et al. (2002) Observed coherent changes in climatic extremes during the second half of the twentieth century. Climate Research 19: 193-212. doi:10.3354/cr019193.

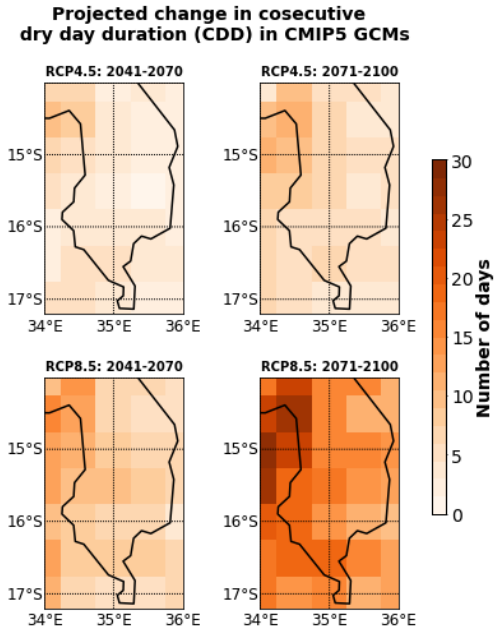

Figure 18: Projected changes in maximum consecutive dry day duration for the mid-century and end-of-century time slices over Southern Malawi for two different emission scenarios in bias-corrected CMIP5 GMCs, relative to the historical reference period.

The risk of drought is further examined by an evaluation of projected changes in various drought attributes. The event-based evaluation looks at of range of drought attributes namely frequency, duration and severity, intensity and areal extent of austral summer drought events identified from SPEI timeseries derived for each of the models for the historical period and two future time slices for the RCP4.5 and RCP8.5 emission scenarios following approaches by Likoya et al, (2023)[90]. The different drought attributes are defined as follows:

1. Frequency (count): the number of drought events identified in a given period.
2. Duration (months): the period during which the SPEI is continuously below zero (i.e., the time between initiation and termination). It is necessary to highlight that the emphasis on the December to February (DJF) period does not imply that the maximum duration of an austral summer drought would be limited to three months (i.e., an event lasting from December to February). It is possible to have a duration of more than three months.
3. Severity: the cumulative sum of the negative SPEI over the entire duration of the drought event.
4. Intensity: the average negative SPEI, computed as drought severity divided by duration. It is an indicator of the extent of dryness at any point during the drought.
5. Area extent: the proportion of the area under drought conditions relative to the whole area of interest.

It is likely that droughts will become more frequent over the course of the century, with the number of events identified from the multi-model ensemble more than doubling midway through, and towards the end of the century, relative to number of droughts identified from the ensemble over the historical reference period. Figure 19 highlights the projected change in frequency and other drought attributes for two future time slices for the two emission scenarios: RCP4.5 and RCP8.5. The projected change in drought frequency is more pronounced in RCP8.5. The average drought duration decreases. However, the decrease is not due to droughts becoming shorter in general, but rather because of additional high-frequency short-lived events.

[90] Likoya, E. et al. (2023) Austral summer droughts and their driving mechanisms in observations and present-day climate simulations over Malawi. International Journal of Climatology 43: 5154-5176. doi:10.1002/joc.8137.

In fact, the number of events with duration equal to or greater than the average duration during the historical reference period increases in both future time slices. The severity of droughts is projected to increase. Given the projected decrease in mean drought duration, it is likely that the increase in severity is due to an increase in the extent of dryness (and more pronounced negative SPEI values). Indeed, this view is reinforced by the projected increase in drought intensity, indicating that the extent of dryness at any point during a drought in future climates will be higher than the extent of dryness during a drought in the historical reference period. There is no clear signal in terms of the projected change in the areal extent of regional droughts over southern Malawi for either emission scenario.

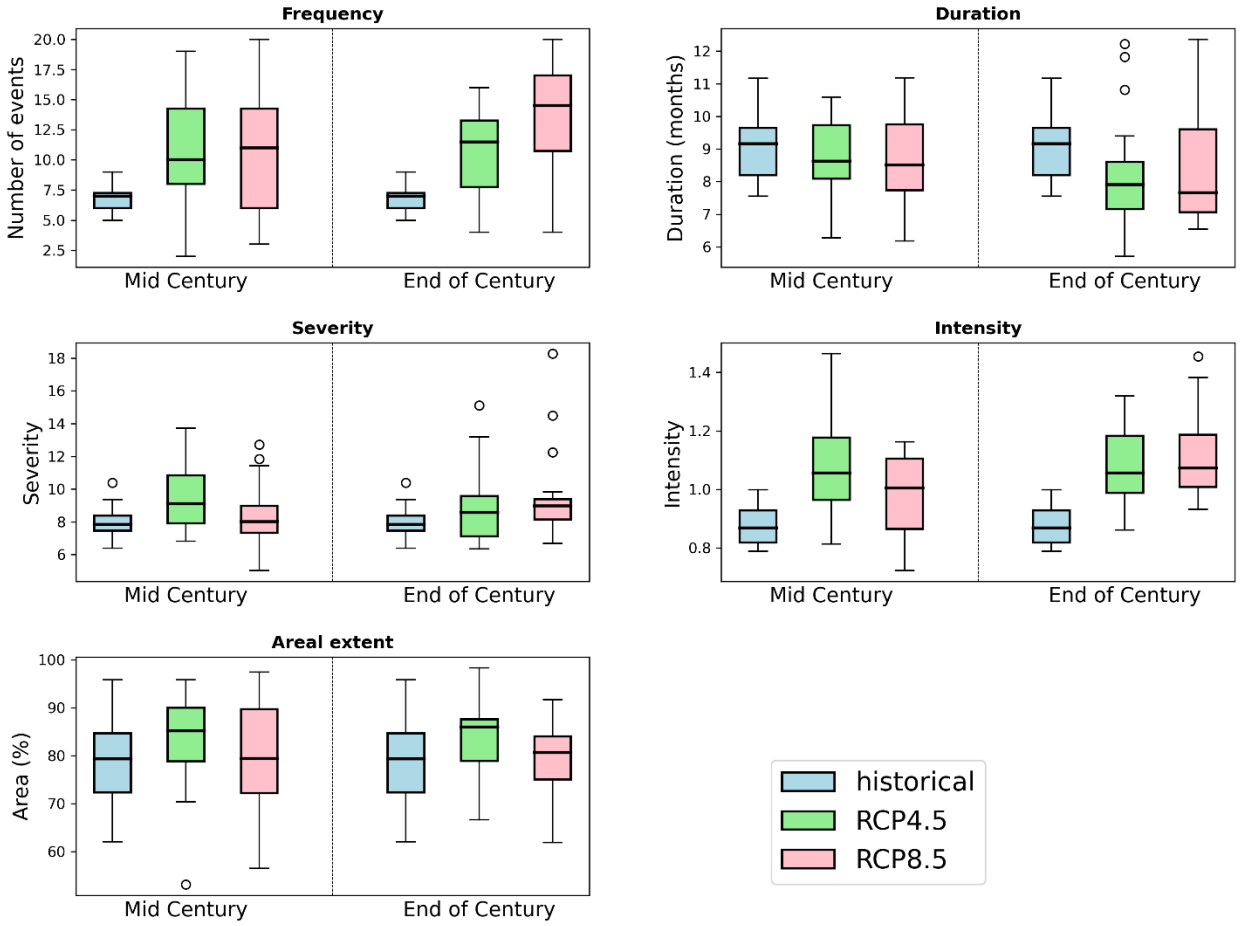

Figure 19: distribution of austral summer drought attributes in the historical reference period and two future time slices for southern Malawi in bias-corrected CMIP5 models under RCP4.5 and RCP8.5 emission scenarios. Drought attributes are derived from

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3.3 IMPACTS OF PROJECTED CHANGES

The projected changes in temperature, rainfall and extremes have numerous implications for health and wellbeing, and the availability, accessibility and quality of healthcare[91]. These implications come about as a result of several pathways – some of which are direct, and some of which are indirect. Changing temperatures and rainfall patterns and extreme events (in particular floods) affect the provision of water, sanitation, and hygiene infrastructure; and the productivity of agriculture, with implications for food and nutrition security. A changing climate also has implications for a wide spectrum of diseases and other conditions that undermine health, wellbeing, daily functioning and productivity. Higher temperatures increase the risk of heat exhaustion and heat stress, as well as many non-communicable diseases (e.g., cardiovascular disease); whilst changing temperature and rainfall patterns have implications for vector- and water-borne diseases such as malaria, cholera, and diarrhoea. Varying aspects of climate exposure create challenges for health and wellbeing, and for sexual and reproductive health and rights. Damage caused to health care facilities impedes the availability of health care, which, together with disruptions to transport, affect the accessibility of healthcare. All of these pathways of health impacts of climate exposure exhibit social and gendered differences. The following sections outlines the main expected impacts of climatic changes on health and wellbeing outcomes and on availability and access of healthcare in Malawi, with a focus on the Southern Region.

3.3.1 Water and sanitation

Water resources are under pressure in Malawi due to a rapidly growing population and increasing demand for domestic, agricultural and industrial purposes[92]. Water is also the major source of electricity in the country through hydropower generated from Lake Malawi. Water and sanitation services in Malawi are already under pressure. In the 2007 water point survey, 72% of groundwater points were operational and only 49% of surface water points[93]. In the early 20th century rainfall variability led to low levels in Lake Malawi and no outflows to the Shire River[94]. Outflows into Lake Shire are essential for hydropower (through the Kamuzu barrage), for environmental flows through elephant marsh, and to support mega-irrigation schemes that are under development for southern Malawi, for example the 42,000-hectare Shire Valley Irrigation Programme. Low water levels lead to rationing of hydropower generation and contribute to regular loadshedding. Future projections of water outflows from Lake Malawi into the Shire vary across the suite of models in CMIP5 under RCP8.5 – approximately one third of the 29 models show that outflow levels will reduce to below the threshold at which outflows occur, with significant implications for downstream flows in the Shire River[95].

The overall decline in the water table – resulting both from less rainfall overall and increasing demands placed on water resources – has cost implications for the provision of safe WASH. During district consultations, there were reports of increased demand for deep 100-meter wells fitted with stronger pumps and other reticulated pumps using solar or mechanized power, which increases costs of WASH service delivery.

Against the backdrop of reduced water availability overall, extreme rainfall events and floods will exacerbate the damage to WASH infrastructure that has already been observed in recent extreme events. The recent census shows that 75% of the toilet facilities in the Southern Region are pit latrines (with or without earth

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[91] USAID (2022) Climate change impacts on human health and the health sector. USAID. Available at: https://www.usaid.gov/sites/default/files/2022-05/Climate_Change_Impacts_on_Human_Health_and_the_Health_Sector_508_Tagged_Mar_2022.pdf.

[92] Hettinger et al. (2020) Malawi economic monitor. doing more with less: improving service delivery in energy. Washington, D.C.: World Bank Group. Available at: http://documents.worldbank.org/curated/en/697811607978316710/Malawi-Economic-Monitor-Doing-More-with-Less-Improving-Service-Delivery-in-Energy.

[93] Kanyerere, T.O.B. et al. (2009) Rural water supply and sanitation in Malawi: Groundwater context. In: Y. Xy & E. Braune (Eds.), Sustainable groundwater resources in Africa, pp. 221-233. CRC Press, London. https://doi.org/10.1201/9780203859452.

[94] Bhave, A.G. et al. (2019) Projecting future water availability in Lake Malawi and the Shire River basin. Future Climate for Africa country brief. Available at: https://kulima.com/wp-content/uploads/2019/07/3124-UMFULA-WEAP-brief.pdf.

[95] Bhave, A.G. et al. (2019) Projecting future water availability in Lake Malawi and the Shire River basin. Future Climate for Africa country brief. Available at: https://kulima.com/wp-content/uploads/2019/07/3124-UMFULA-WEAP-brief.pdf.

slabs); and 65% of people are dependent on boreholes for their main source of drinking water[96]. Cyclone Idai in 2019 led to the contamination of 332 boreholes and the collapse of 258,000 latrines[97]. Tropical storm Ana in 2022 resulted in the destruction of 337 boreholes, 207 water taps, 8 gravity-fed water schemes and over 53,962 latrines[98]. Consultations in project districts highlighted that many pit latrines have been constructed without appropriate standards, which increases their risk of failure and contamination. When floods come, these latrines are the first to collapse or are washed away. This infrastructure destruction brings previously eradicated open defecation practices back to communities which, in turn, increases the likelihood of transmission of water-borne diseases such as cholera (refer to section 3.3.3).

During proposal development, preliminary assessments in the project districts founds that, in health care facilities, most WASH facilities - particularly toilets - are inadequate and the available ones are also in bad condition. For example, at Mlomba Health Centre in Machinga, some of the WASH facilities are not functioning. The facility has two water harvesting tanks, but the pump that transfers water into them is not functioning, so they now depend on a borehole for water use. The flush toilets are not operational and they have only one pit latrine, which is shared by both staff and patients and is in poor condition.

The District Environmental Health Officer for Machinga further stated that regarding WASH, the maintenance of guardian shelters and toilets (for non-patients but accompanying family and friends) is often neglected, as they are managed by communities. If the responsibility of managing the guardian shelters is transferred to the healthcare facility, they could be properly maintained with appropriate infection prevention measures in place. For instance, during a cholera outbreak, the district saw five cases originating from the guardian shelter of one health centre due to a blocked water system that impacted the flow of water in the toilets and at the guardian shelter. The consequences of inadequate WASH will be exacerbated by both drier and wetter conditions, and through extreme events such as droughts and floods.

3.3.2 Agriculture and food security

Since much agriculture in Malawi is rainfed[99], production levels are highly contingent upon the nature of the rainy season. This link is particularly the case in southern Malawi where the growing season is already short, lasting between 62 and 115 days[100] and soil quality is poor, with low organic carbon level[101]; staple crops are maize, rice, cassava and sorghum. Maize is predominant across the country[102], despite even current climate conditions not being preferable for it in many places[103]. Changes to the suitability ranges of crops are further anticipated under climate change, particularly in the southern region. Maize yields decrease with higher temperatures, with sensitivity to heat intensified in drought conditions. By the 2050s, in parts of southern Malawi, one in every two or three years will have a failed agricultural season[104]. Increasing temperature and lower rainfall during early maize growing season will impact mycotoxin occurrence in terms of their type, geographic distribution and concentration – with particular risks to the

[96] NSO (2018) Malawi population and housing census. Government of Malawi, Zomba.
[97] Government of Malawi (2019) Malawi 2019 Floods Post Disaster Needs Assessment (PDNA) Report. Available at: file:///C:/Users/LPasquini/OneDrive%20-%20Save%20the%20Children%20UK/downloads/Malawi%202019%20Floods%20Post%20Disaster%20Needs%20Assessment%20Report.pdf.
[98] Department of Disaster Management Affairs (2022) Emergency Response Plan: Tropical Cyclone Ana.
[99] Narain et al. (2022) Malawi - Country Climate and Development Report. World Bank Group, Washington DC. Available at: http://documents.worldbank.org/curated/en/099545010272237260/P1772201ced75ce9182e7142761bde013662bca4fe42.
[100] Ngongondo, C. et al. (2014) Growing season length and rainfall extremes analysis in Malawi. IAHS-AISH Proc. Reports 363, 361–366. Available at: https://iahs.info/uploads/dms/16616.65-361-366-363-65-Paper-53-Ngongondoetal.pdf.
[101] Li, G. et al. (2017) Mapping land suitability for agriculture in Malawi. Land Degradation and Development 28: 2001–2016. doi:10.1002/ldr.2723.
[102] Narain et al. (2022) Malawi - Country Climate and Development Report. World Bank Group, Washington DC. Available at: http://documents.worldbank.org/curated/en/099545010272237260/P1772201ced75ce9182e7142761bde013662bca4fe42.
[103] Benson, T. et al. (2016) Detailed crop suitability maps and an agricultural zonation scheme for Malawi. Spatial information for agricultural planning purposes. Feed the Future Innovation Lab for Food Security Policy Research Papers 259052, Department of Agricultural, Food, and Resource Economics, Michigan State University, Michigan, USA.
[104] Verhage, F. et al. (2018) Climate risk assessment and agricultural value chain prioritisation for Malawi and Zambia. CCAFS Working Paper no. 228. Wageningen, the Netherlands: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Available at: https://cgspace.cgiar.org/bitstream/handle/10568/96184/WP%20228.pdf?sequence=1&isAllowed=y.

central and south of the country[105]. This means that even if yields can be sustained, the quality of the resulting crop will be affected.

During a focus group discussion with women in Zomba, TA Mwambo area, it was reported that in past years, on average a household would harvest 10 to 20 bags of maize; however, due to climate change-induced increases in drought, a household now only manages one to two bags (and a maximum of five bags) per growing season, which has led to a lot of malnutrition in the area. Almost all participants in the focus group discussion were experiencing famine due to very poor harvest every year. In M'phika village and Sanza village in TA Bwanje (Ntcheu), women noted that floods destroy agricultural capacity by washing away farmlands and depositing sand, which reduces the productive capacity in the following seasons.

For lakeside communities, which include populations in Mangochi (Lake Malawi), Phalombe, Zomba, and Machinga (Lake Chilwa), nutrition is also related to the availability of fish. This availability is changing due to changes in temperature, rainfall and runoff into the lake (which has a high fertilizer and sediment load due to poor soil management from deforestation, poor agricultural practices, and land cover changes). Lake Chilwa has also dried up completely on several occasions in the 19th and 20th century, which corresponded with a reduction in fish catches[106].

Poor agricultural production levels and limited dietary diversity lead to food and nutrition insecurity, and cases of malnutrition. Malnutrition affects individual and population health (particularly maternal and child health) through reduced child survival, decreased immune function, increased maternal mortality, increased susceptibility to infectious diseases, and stunted growth[107]. For instance, around 45% of deaths among children under 5 years of age are linked to undernutrition, and these mostly occur in low- and middle-income countries[108].

Lower production, lower nutrient content, and reduced dietary diversity in will have a severe impact on malnutrition in southern Malawi, exacerbating an already challenging situation where in rural areas, 37% of children under five are stunted (too short for their age), 3% are wasted (low weight-for-height), and 12% are underweight (low weight-for-age)[109]. For example, in Balaka it was reported by the nutrition officer that about 32.6% of the population experiences stunted growth due to poor nutritional status as the district faces a lot of climate-related disasters including floods and dry spells that affect their agricultural produce. Pregnant and breastfeeding women and children are particularly affected in the eight TAs and 12 sub-TAs.

3.3.3 Climate-sensitive diseases and conditions

Climate-sensitive diseases and conditions are highly likely to increase in the future. Though there are strong variations in heat vulnerability given that the risk determinants for heat-related morbidity and mortality include a complex mix of variables (physiological, psychological, socio-economic, physical, ecological and environmental), adults older than 65 years, very young children, and people with cardiopulmonary and other chronic diseases are often particularly vulnerable to the effects of heat[110]. For instance, heatwaves in Malawi are projected to increase heat-related deaths in older people (65+ years) to 73 per 100,000 year by

[105] Warnatzsch, E.A. et al. (2020) Climate change impact on Aflatoxin contamination risk in Malawi's maize crops. Frontiers in Sustainable Food Systems 4. doi:10.3389/fsufs.2020.591792.
[106] Wilson, J. (2014) The History of the Level of Lake Chilwa. The Society of Malawi Journal, 67: 41-45. Available at: https://www.jstor.org/stable/24332681.
[107] E.g., Black, R.E. et al. (2008) Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 371:243-60. doi: 10.1016/S0140-6736(07)61690-0; Victora, C.G. et al. (2008) Maternal and child undernutrition: consequences for adult health and human capital. The Lancet 371: 340-357. https://doi.org/10.1016/S0140-6736(07)61692-4.
[108] WHO (2021) Malnutrition. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/news-room/fact-sheets/detail/malnutrition.
[109] Doctor, H & Nkhana-Salimu, S. (2017) Trends and determinants of child growth indicators in Malawi and implications for the Sustainable Development Goals. AIMS Public Health 4: 590-614. Doi: 10.3934/publichealth.2017.6.590.
[110] McGeehin,M. & Mirabelli, M. (2001) The potential impacts of climate variability and change on temperature-related morbidity and mortality in the United States. Environmental Health Perspectives 109 (Suppl. 2): 185-189. Available at: https://pubmed.ncbi.nlm.nih.gov/11359685/.

2080, up from 3 per 100,000 between 1961-1990[111]. Estimates of the impact of climate change on annual heat-related child deaths in sub-Saharan Africa for the 1995–2020 and 2020–2050 time periods have shown that by 2009, heat-related child mortality was double what it would have been without climate change, while under a high emissions scenario (SSP585), heat-related child mortality is projected to double by 2049 compared to 2005–2014[112]. In the Southern Region, fully a quarter of the population is made up of under-ten-year-old children[113], further highlighting the vulnerability of the region to the impacts of climate change on health.

Extreme heat and heatwaves have direct impacts on heat strain. Heat "strain" or "stress" (including heat exhaustion and heat stroke) refer to a range of heat-related illnesses, that happen when the body cannot cool down enough to maintain its core temperature[114]. Dehydration (which is naturally aggravated when water availability is limited, as is expected in the target regions, section 3.3.1) places people at greater risk.

Extreme heat and heatwaves impact many diseases and conditions, beyond the well-known effects of heat exhaustion and heat stroke. Non-communicable diseases (NCDs) are globally responsible for 74% of all deaths; of all NCD deaths, 77% are in low- and middle-income countries[115]. According to the National Action Plan for the Prevention and Management of Non-Communicable Diseases in Malawi 2017-2022, NCDs make up 25% of the total burden of disease in Malawi and 29% of the mortality[116]. Many NCDs are related to heat/temperature rise, including cardiovascular disease, stroke, renal disease, diabetes, and respiratory disease. Although heat-related morbidities and mortalities are poorly registered worldwide, studies show a marked increase in the risk of death and hospitalization from NCDs when patients are exposed to excessive heat[117]. As noted above, people with cardiopulmonary and other chronic diseases are particularly vulnerable to the effects of heat. In Malawi, lower respiratory tract infections, stroke and ischemic heart disease are all leading causes of death[118].

Changing temperature and rainfall patterns will influence the seasonality, and intensity and geographical prevalence of climate-sensitive infectious and vector-borne diseases. Rising temperatures could increase a variety of infectious diseases in different (and often complex) ways. However, there is a strong relationship between increased temperatures and diarrhoeal diseases like cholera, because cholera bacteria do well in warmer temperatures and warmer water[119]. Diarrhoea is the 5th biggest cause of mortality in Malawi, and the country experiences regular cholera outbreaks. Outbreaks have occurred as recently as 2023, when over 45,000 people were infected and 1,400 people died. Outbreaks of cholera are frequent in east and southern Africa following tropical cyclones[120]. For children younger than five in low- and middle-income countries, diarrhoea is also responsible for exacerbating malnutrition which as reviewed above, will already be heavily impacted by climate-induced changes in agriculture and food security. These findings highlight the numerous intersecting ways in which climate change will adversely impact health outcomes. Extreme

[111] WHO (2016) Climate and health country profile Malawi – 2015. World Health Organization, Geneva, Switzerland. Available at: https://climhealthafrica.org/wp-content/uploads/2017/06/Malawi-WHO-UNFCCC-Country-Profile.pdf.
[112] Chapman et al. (2022) Past and projected climate change impacts on heat-related child mortality in Africa. Environmental Research Letters 17: 074028. Available at: https://iopscience.iop.org/article/10.1088/1748-9326/ac7ac5/meta.
[113] Malawi Data Portal (2018) Population of Malawi by Region, Age, 2018. Malawi National Statistical Office, Zomba, Malawi. Available at: https://malawi.opendataforafrica.org/azfucgf/population-of-malawi-by-region-age-2018.
[114] Gauer ,R. & Meyers BK (2019) Heat-related illnesses. American Family Physician 99: 482-489.
[115] WHO (World Health Organization) (2022) Noncommunicable diseases. World Health Organization, Geneva, Switzerland. Available at https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases.
[116] Ministry of Health (2017) National Action Plan for the Prevention and Management of Non-Communicable Diseases in Malawi. Available at: https://www.iccp-portal.org/system/files/plans/MWI_B3_s21_Malawi%20NCD%20Strategy_2018.pdf.
[117] Global Heat Health Information Network (2023) Heat and Health. Available at https://ghhin.org/heat-and-health/.
[118] Institute for Health Metrics and Evaluation (IHME) (2023) Malawi. Institute for Health Metrics and Evaluation, Seattle, USA. Available at: https://www.healthdata.org/malawi.
[119] Reyburn, R., Kim, D.R., Emch, M., Khatib, A., Von Seidlein, L. and Ali, M., 2011. Climate variability and the outbreaks of cholera in Zanzibar, East Africa: a time series analysis. The American Journal of Tropical Medicine and Hygiene 84: 862-869. DOI: 10.4269/ajtmh.2011.10-0277.
[120] Trisos, C.H. et al. (2022) Africa. In: Climate change 2022: impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner et al. (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1285–1455. doi:10.1017/9781009325844.011.

events such as floods have also typically increased exposure to water-borne diseases, such as cholera, diarrhoea and typhoid, as a result of contamination. From limited existing modelling, diarrhoea incidence is due expected to rise progressively to 2030 and 2050 in the districts of Chikwawa, Lilongwe and Zomba but decrease in Salima[121].

With regard to vector-borne diseases, temperature, along with rainfall and humidity, is a key driver of the rate of malaria transmission[122]. Although rates are dropping, Malawi is a high-burden malaria country with 214 cases annually per 1,000 people. Malaria is the 6th biggest cause of death in Malawi[123]. The spread and proliferation of malaria-carrying mosquitoes at higher altitude areas is already reported in previously malaria-free zones; at lower altitudes, warmer temperatures and changing rain patterns are expected to alter the growth cycle of the parasite, enabling it to develop faster, increasing transmission and burden of disease and changing seasonal malaria patterns, giving rise to exposure over 7-9 months instead of the historical 3-4 months (January-April)[124]. Catchment overflow as a result of floods is likely to spread vector-borne diseases to new locations through the creation of breeding grounds for mosquitoes[125].

Based on stakeholder engagement undertaken as part of proposal development (see Annex 7: Summary of consultations and stakeholder engagement plan), knowledge at district and community level on the specific nature of changing disease risk was found to be variable, which impedes the capacity to anticipate and adapt. For example, health officials in Mangochi made links between the changing climate and malaria and cholera risk, but noted that no specific studies have taken place. Further complicating the situation is the fact that in many cases little knowledge still exists regarding the varied links between a changing climate and its effects on a range of diseases and conditions. For instance, a relatively recent study for Tanzania demonstrated that respondents from the health sector had little knowledge of how heat might affect health outcomes[126].

3.3.4 Health and wellbeing

Increased temperatures, more hot days and nights, and increased heatwaves in Malawi will also affect people's health and well-being more generally. For instance, hot weather and heat extremes are associated with increased mental health issues, multiple adverse pregnancy and birth outcomes[127] (such as maternal hypertensive disorders, dehydration and placental abruption, and increased levels of pre-term birth and foetal distress), occupational health issues, and increased health-care costs[128].

In terms of climate change adverse effects on pregnancy and birth outcomes, dehydration during pregnancy can be especially devastating to both mother and child, causing low birthweight, preterm birth, increased anaemia and eclampsia and maternal and infant death[129]. Similarly, malnutrition caused by food insecurity

[121] Government of Malawi (2021) Draft Health National Adaptation Plan March 2021.
[122] E.g., Blanford, J. et al. (2013) Implications of temperature variation for malaria parasite development across Africa. Scientific Reports 3: 1300. https://doi.org/10.1038/srep01300.
[123] Institute for Health Metrics and Evaluation (IHME) (2023) Malawi. Institute for Health Metrics and Evaluation, Seattle, USA. Available at: https://www.healthdata.org/malawi.
[124] Alcayna, T. et al. (2021) Climate change impacts on health: Malawi assessment. Red Cross Red Crescent Climate Centre, The Hague, Netherlands. Available at: https://www.climatecentre.org/wp-content/uploads/RCRC_IFRC-Country-assessments-MALAWI-3.pdf.
[125] Republic of Malawi (2021) The Third National Communication of the Republic of Malawi to the Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC). Ministry of Forestry and Natural Resources, Lilongwe, Malawi. Available at: https://newsroom.unfccc.int/sites/default/files/resource/TNC%20report%20submitted%20to%20UNFCCC.pdf.
[126] Pasquini, L. et al. (2020) Emerging climate change-related public health challenges in Africa: a case study of the heat-health vulnerability of informal settlement residents in Dar es Salaam, Tanzania. Science of The Total Environment 747: 141355. doi: 10.1016/j.scitotenv.2020.141355.
[127] Chersich M.F. et al. (2023) Increasing global temperatures threaten gains in maternal and newborn health in Africa: A review of impacts and an adaptation framework. International Journal of Gynecology & Obstetrics 160: 421-429. doi: 10.1002/ijgo.14381.
[128] Wondmagegn, BY, et al. (2019). What do we know about the healthcare costs of extreme heat exposure? A comprehensive literature review. Science of the Total Environment657: 608-618. doi: 10.1016/j.scitotenv.2018.11.479.
[129] Roos, N. et al. (2021) Maternal and newborn health risks of climate change: a call for awareness and global action. Acta Obstetricia et Gynecologica Scandinavica 100: 566-570. https://doi.org/10.1111/aogs.14124.

and undernutrition among pregnant women can affect pregnancy, nursing, and newborn outcomes and lead to low-weight births, miscarriages, and perinatal mortality[130].

To consider the case of mental health, the prevalence of mental ill-health is on the rise in both the developed and developing world with mental and behavioural disorders contributing significantly to the global burden of disease[131], and multiple studies also demonstrate the relationship between maternal depression and subsequent malnutrition in their infants[132]. Climate change exacerbates many social, environmental and economic risk factors for problems in mental health and psychosocial wellbeing[133]. A few recent findings regarding the effects of climate change on mental health are: GBV is exacerbated by extreme weather and climate events[134] (see more below); survivors of extreme weather events are at increased risk of post-traumatic stress disorder, suicide, depression and anxiety[135] (see more below); and higher temperatures lead to more aggressive behaviours[136] (see more below). Yet, despite this impact, large gaps also exist in many countries between mental health needs and the availability and accessibility of the mental health systems and services to address them. Mental health impacts of climate change in Malawi are still poorly quantified. However, a recent and as yet unpublished study conducted in 2022 found that 86% of women reported that their mental health has been affected by climate change[137].

Climate-related events (droughts and floods) impact food availability, which causes stress and anxiety, particularly for women as gendered roles dictate their responsibility for household food security (see section 3.3.8). This was the biggest concern cited by the women in the study mentioned above, who recognised that the inability to provide sufficient food for their children leads to hunger and malnutrition, and has a detrimental effect on their children's health, education and general development. However, there is also research evidence from Malawi that increased anxiety and mental health problems experienced by caregivers at the same time impedes their capacity for adaptation and to take the behaviour changes needed to mitigate the challenges they face and to provide optimal care for themselves and their children[138].

There are other ways that climate change impacts mental health and wellbeing. For instance, a growing body of research suggests that rising temperature increases aggressive behaviour and criminal activity,

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[130] Victora, C. et al. (2021) Revisiting maternal and child undernutrition in low-income and middle-income countries: variable progress towards an unfinished agenda. The Lancet 397: 1388-99. https://doi.org/10.1016/ S0140-6736(21)00394-9.

[131] WHO (World Health Organization) (2022) Mental disorders. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/news-room/fact-sheets/detail/mental-disorders

[132] E.g., Smith Fawzi et al. (2019) Lifetime economic impact of the burden of childhood stunting attributable to maternal psychosocial risk factors in 137 low/middle-income countries. BMJ Global Health 4:e001144. doi:10.1136/ bmjgh-2018-001144.

[133] WHO (2022) Mental health and climate change: policy brief. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/publications/i/item/9789240045125;

[134] Van Daalen, K.R. et al. (2022) Extreme events and gender-based violence: a mixed-methods systematic review. Lancet Planet Health 6: e504–23. Doi:https://doi.org/10.1016/S2542-5196(22)00088-2.

[135] Schwartz, R.M. et al. (2015) The impact of Hurricane Sandy on the mental health of New York area residents. American Journal of Disaster Medicine 10: 339-46. Doi:10.5055/ajdm.2015.0216; Carleton, T.A. (2017) Crop-damaging temperatures increase suicide rates in India. PNAS 114: 8746-8751. https://doi.org/10.1073/pnas.170135411; Burke, M., et al. (2018) Higher temperatures increase suicide rates in the United States and Mexico. Nature Climate Change 8: 723-729. https://doi.org/10.1038/s41558-018-0222-x; Silveira, S. et al. (2021) Chronic mental health sequelae of climate change extremes: a case study of the deadliest Californian wildfire. International Journal of Environmental Research and Public Health 18: 1487. https://doi.org/10.3390/ijerph18041487; Wanying, M. et al. (2022) One Year after the flood: prevalence and correlates of post-traumatic stress disorder among residents in Fort McMurray. Behavioral Sciences 12: 69. https://doi.org/10.3390/bs12030069;

[136] Heilmann, K. (2021) The urban crime and heat gradient in high and low poverty areas. Journal of Public Economics 197: 104408. https://doi.org/10.1016/j.jpubeco.2021.104408.

[137] GCU (Glasgow Caledonian University) (2022) Climate change makes violence against women in Malawi worse, study finds. Glasgow Caledonian University, Glasgow, Scotland. Available at: https://www.gcu.ac.uk/aboutgcu/universitynews/climate-change-makes-violence-against-women-in-malawi-worse,-study-finds#:~:text=More%20than%2086%25%20of%20the,to%20their%20marriage%20(10%25); Jafry, T. et al. (2022) The inter-relationship between climate change, mental health and gender-based violence in Malawi. Glasgow Caledonian University. Available at: https://researchonline.gcu.ac.uk/ws/portalfiles/portal/89990915/89990812.pdf.

[138] Slekiene J. et al. (2022) Does poor mental health impair the effectiveness of complementary food hygiene behavior change intervention in rural Malawi? International Journal of Environmental Research and Public Health 19:10589. doi: 10.3390/ijerph191710589.

including sex offences[139], which heightens the effects of climate change on sexual and reproductive health and rights (see section 3.3.5), as well as on GBV. Significant evidence points to how climate change, and particularly climate-related disasters, can be linked to increased vulnerability to GBV, including sexual violence, transactional sex, and sex trafficking, which in turn are linked to increased risk of STIs and unintended pregnancies[140]. Increases in GBV and intimate partner violence caused by climate stresses also causes a lack of access to sexual and reproductive health services: where women and girls are living with GBV, unwanted sex and reduced ability to make decisions about their reproductive rights places them at risk of unwanted pregnancy[141], heightening the effects of climate change on sexual and reproductive health and rights (section 3.3.5). These effects occur against a backdrop of GBV being already a significant challenge in Malawi with 34% of women aged 15-49 reporting they have experienced some form of physical violence in the year prior to the 2015-16 population and demographic health census[142]. Despite varied laws, such as the Gender Equality Act and Marriage, Divorce and Family Relations Law, there appears to be high tolerance for GBV in Malawi, with 16% of men and 13% of women believing that a husband is justified in beating his wife for at least one of five specified circumstances, including burning the food, arguing, going out without telling him, neglecting the children and refusing sexual intercourse[143].

Finally, elevated temperature has as direct impact on the health, safety and productivity of working populations[144]; health risks during high temperatures are greater in people who are physically active, particularly poorer labourers working under difficult environmental conditions, such as those working outside with high physical loads. The agricultural workforce has been recognized as a vulnerable occupational group with an increased risk of adverse health outcomes from rising global temperatures[145].

3.3.5 Sexual and reproductive health and rights

Provision of support for Sexual Health and Reproductive Rights (SHRR) is highly dependent on accessibility and availability of the healthcare system, which are disrupted by climate-related disasters (see section 3.3.6). Accessibility and availability are particularly impeded after floods, where the washing away of roads and bridges, and damage to health care infrastructure directly, reduces the availability and accessibility of sexual and reproductive health care services. When health facilities and supply chains are compromised, there is a direct and immediate negative impact on access to and quality of SRH services, such as post-exposure prophylaxis for HIV, HIV treatment, emergency contraception, and safe abortion services[146]. Lack of access to sexual and reproductive health services has a devastating impact on women and girls[147]. Unwanted pregnancy, especially during times of other stress can cause poverty, disability and death. For already married women with children, it can place additional stress on the family's budget. For unmarried adolescent girls, unwanted pregnancy can disrupt education and life chances.

Child marriages are known to increase following shocks and disasters, because it can reduce the number of mouths to feed and raise income through the payment of dowries. After Covid-19 a helpline reporting

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[139] Mahendran, R. et al. (2021) Interpersonal violence associated with hot weather. The Lancet Planetary Health 5: E571-E572. doi: 10.1016/S2542-5196(21)00210-2.

[140] Women Deliver (2021) The link between climate change and sexual and reproductive health and rights: an evidence review. New York, USA. Available at: https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report.pdf.

[141] Desai, B.H. & Mandal, M. (2021) Role of climate change in exacerbating sexual and gender-based violence against women: a new challenge for international law. Environmental Policy and Law 51: 137-157. Doi: 10.3233/EPL-210055.

[142] NSO (National Statistical Office) (2017) Malawi Demographic and Health Survey. National Statistical Office, Lilongwe, Malawi.

[143] Ibid.

[144] Kjellstrom, T. et al. (2009) Workplace heat stress, health and productivity–an increasing challenge for low and middle-income countries during climate change. Global Health Action 2: 2047-2052. doi: 10.3402/gha.v2i0.2047.

[145] El Khayat et al. (2022) Impacts of climate change and heat stress on farmworkers' health: a scoping review. Frontiers in Public Health 10:782811. doi: 10.3389/fpubh.2022.782811.

[146] Women Deliver (2021) The link between climate change and sexual and reproductive health and rights: an evidence review. New York, USA. Available at: https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report.pdf.

[147] E.g., Maharaj, N.R. (2022) Adolescent pregnancy in sub-Saharan Africa - a cause for concern. Frontiers in Reproductive Health 4: 984303. doi: 10.3389/frph.2022.984303; United Nations (2023) Lack of access to sexual, reproductive health education and rights results in harmful practices, impedes sustainable development, speakers tell population commission. Available online at: https://press.un.org/en/2023/pop1106.doc.htm.

child marriage saw an 83% increase in calls, whilst teen pregnancy also increased[148]. A study conducted in 2022 in both Nkhata Bay and project district, Mangochi, found that roads and bridges washed away by floods prevented access to SRH services by adolescent young men and women, leading to early and unwanted pregnancies and marriages, which disrupted education attainment for both boys and girls, with girls' individual health and wellbeing the most affected[149]. In particular, the drying of Lake Chilwa is associated with an increased number of early marriages in daughters[150]. These effects occur against a backdrop of already high child and adolescent marriage and pregnancy rates, particularly in rural areas, with nearly a third of women aged 15-19 beginning childbearing in 2015-16[151]. In Malawi, it is estimated that 1.5 million girls are at risk of becoming child brides due to the impacts of extreme weather events caused by climate change, which make it harder for families to afford to feed and house their own children[152].

Pregnant women encounter additional challenges during childbirth as heavy rains can wash away roads and bridges leading to healthcare facilities. Some women may have to give birth at home or undertake long journeys just to receive proper medical attention at a hospital. Women in a focus group in TA Mlomba, Machinga district, explained that reaching inappropriate healthcare facility to give birth is particularly challenging during flooding, and leads to the incurring of greater transport costs and many women giving birth in unsafe conditions en route. This was corroborated by a group in TA Mponda in Mangochi, who highlighted that the consequences of such unsafe births, due to not being able to access health care facilities, included infection.

3.3.6 Availability of healthcare

Repeated extreme event exposure, particularly to floods, causes physical damage to health care infrastructure which impedes the availability of health care. Infrastructure includes buildings, WASH facilities, equipment and medical supplies. An annual average of 100 education and health care facilities are already affected by 1-in-10 year floods, and 145 facilities in 1-in-50 year floods, with over 40% of the average annual loss accruing to the Southern Region[153].

In early 2022, Tropical Storm Ana resulted in the destruction of 47 Community Health Facilities in the Southern Region in the form of infrastructural damage, power cuts, loss of medicines, damage to medical equipment, vaccines and other supplies[154]. In 2023, the floods associated with tropical cyclone Freddy led to damage to health centres and their facilities, including solar PV-managed cold chains[155].

Infrastructure damage of health facility buildings was reported across all project districts. Roofs were blown off facilities in Zimba (Mayaka Health Centre, 2021; Chisi and Namadidi Health Centre, 2022) due to heavy winds. Rains and flooding damaged facilities in Ntcheu (Magangani Health Centre in Lower Ganya and Bwanje Health Centre), including causing cracks in buildings. Mwima Health Post in Balaka has been damaged by both strong winds and heavy rainfall, which is particularly problematic as the centre was

[148] Rigby, J. (2020) Child marriages skyrocket in Malawi as Covid-19 closes schools, figures show. The Telegraph, 14 August. Available at: https://www.telegraph.co.uk/global-health/women-and-girls/child-marriages-skyrocket-malawi-covid-19-closes-schools-figures/.

[149] Sibale, B. et al. (2022) Formative assessment to inform design of a gender transformative positive youth development (PYD) approach to improve family planning/reproductive health (FP/RH). Pact Malawi, Lilongwe, Malawi.

[150] Alcayna, T. et al. (2021) Climate change impacts on health: Malawi assessment. Red Cross Red Crescent Climate Centre, The Hague, Netherlands. Available at: https://www.climatecentre.org/wp-content/uploads/RCRC_IFRC-Country-assessments-MALAWI-3.pdf.

[151] NSO (National Statistical Office) (2017) Malawi Demographic and Health Survey. National Statistical Office, Lilongwe, Malawi.

[152] Chamberlain, G. (2017) Why climate change is creating a new generation of child brides. The Guardian, 26 Nov. Available at: https://www.theguardian.com/society/2017/nov/26/climate-change-creating-generation-of-child-brides-in-africa#:~:text=%E2%80%9CGiven%20that%20there%20are%20about,That%20is%20a%20huge%20number.%E2%80%9D.

[153] These numbers will be even higher for extreme events like those of 2015 and 2022. World Bank GFDRR, 2019. Disaster risk profile: Malawi. Available at: https://www.gfdrr.org/en/publication/disaster-risk-profile-malawi-2019.

[154] Department of Disaster Management Affairs (2022) Emergency Response Plan: Tropical Cyclone Ana.

[155] Government of Malawi (2023) Malawi 2023 Tropical Cyclone Freddy Post-Disaster Needs Assessment. Government of Malawi, Lilongwe, Malawi.

designed to be accessible to the elderly, pregnant women and people with disabilities; hence when it is unavailable, the access of these groups to health care is impeded.

The situation is exacerbated by the fact that most buildings are constructed without adhering to appropriate standards, which means that they are rarely robust to withstand climate impacts. This is particularly problematic at the very times when needs for healthcare increase. For instance, following Tropical Storm Ana it was estimated that 126,000 people would be affected by cholera and other disease outbreaks, including typhoid and malaria, placing additional and unexpected burdens on healthcare provision[156]. Typical referral mechanisms are also disrupted. During and after Cyclone Idai, some primary health facilities remained cut off from secondary and tertiary facilities for almost two weeks, meaning that their catchment populations were cut off from healthcare. During stakeholder consultations as part of proposal development, many women cited the risks this posed for childbirth, with many women having to give birth in unsafe conditions at home or en route to seeking an appropriate facility (see Annex 8: Gender assessment). The lack of appropriate standards for buildings also impacts the ability of health facilities to provide "cool spaces", given that heat-resistant buildings can reduce vulnerability to heat[157].

This situation occurs against a backdrop of changing temperature and water availability conditions that create increased demands for electricity for air conditioning, and water to supply WASH facilities. The consequence of repeated damage to unprepared infrastructure is that it increases costs for repairs and rehabilitation. The District Health Officer is typically forced to use extra-budgetary resources to implement response and recovery activities.

3.3.7 Access to healthcare

The consequence of damage to health care infrastructure is that it is difficult to access health care facilities. This is exacerbated by damage to transport infrastructure. In Phalombe, it was reported that often bridges are washed away by floods, limiting accessibility to the health facility. This leads to people failing to seek health care even when it is required.

Inability to access healthcare is not only a problem for patients, but also for staff. Mobility of healthcare workers is similarly impeded, which means that healthcare facilities may not be adequately staffed. The feasibility study team was told in Balaka district at Mwima health facility by the health facility in charge that *"During the rainy season, flooding occurs in the Mwima community, caused by water from the mountains. This affects both households and the health centre, making it difficult for healthcare staff to access the facility and provide services. In addition, the staff's own homes are also affected, causing delays in service provision as they prioritize their safety and the safety of their belongings".*

3.3.8 Gender and social vulnerability

The above climate impacts, as has been highlighted numerous times already, are gendered and socially differentiated, affecting men, women, children, youth and vulnerable populations differently. Risk is worsened by differing aspects of vulnerability which are physiological, socio-economic, physical, ecological and environmental. For example, vulnerability to climate-sensitive diseases is often higher among pregnant and breastfeeding women, children, the elderly, people with disabilities, and the poor[158]. There are several gender specific impacts of climate change, such as an increased incidence of GBV and child marriage and loss of access to SRH, which impact on the health and life chances of women and girls. Therefore, different adaptation responses to the impacts of climate change on health are required based on available assets, resources, and roles.

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[156] Department of Disaster Management Affairs (2022) Emergency Response Plan: Tropical Cyclone Ana.

[157] Quinn, A. et al. (2014) Predicting indoor heat exposure risk during extreme heat events. Science of the Total Environment 490: 686–693. https://doi.org/10.1016/j.scitotenv.2014.05.039.

[158] World Health Organization (2013) Protecting health from climate change: vulnerability and adaptation assessment. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/publications/i/item/protecting-health-from-climate-change-vulnerability-and-adaptation-assessment.

For instance, focus groups with school children highlighted that disruption caused to WASH facilities (at schools) caused more problems to girls than to boys (see Annex 8: Gender assessment). The poor conditions of WASH shelters at health care facilities also disadvantage women and people with disabilities. Water and sanitation scarcity makes it more difficult for women and girls to manage menstrual hygiene which in turn limits their participation in school, workplace, and community[159].

Gendered roles also mean that women typically have responsibility for fetching water, so if water availability declines under future climate, it will have implications for women and girls in terms of time taken to collect water, as well as potentially exposing them to gender-based violence, because of the increased risk of sexual and physical violence for women who walked long distances to access water[160]. In addition, collecting water in times of scarcity places a heavy burden on women and girls who miss opportunities for study, work, and self-care as a result[161].

Vulnerability to the health impacts of climate change differs across different population groups and reflects both physiological and socio-culturally constructed gender norms. For instance, gendered roles accord responsibility for food provision to women. If agricultural production decreases as a result of a variable climate, this can lead to food and nutrition insecurity. As noted in 3.3.4, the stress created by such circumstances has impacts on the mental health of women. Increases in food and nutrition insecurity can lead to coping strategies that further reinforce gender inequality, for example pulling girl children from school and encouraging early marriage.

After tropical cyclone Ana, flooding highlighted the vulnerability to waterborne diseases and food and nutrition insecurity (because of agriculture failure and loss of assets), of children under five and pregnant and breastfeeding women, with 131,144 children under five and 39,000 pregnant and breastfeeding women affected, placing further strain on household coping mechanisms[162]. Increase in vector-borne diseases can increase the risk of spontaneous abortion, premature delivery, stillbirth, low-weight births, eclampsia, and caesarean delivery for pregnant women[163]. Pregnant women are disproportionately susceptible to mosquito-borne diseases, as they are performing domestic tasks, such as cooking and those related to water, sanitation, and hygiene[164]. Vulnerability to GBV, including sexual violence, is higher for the most marginalised girls and women, such as those living in socially or geographically isolated places or those living in poverty[165].

Gendered (and socially differentiated) impacts combine and intersect in multiple ways. For instance, increases in GBV as a result of climate shocks means there is increased demand for GBV services at a time when they are likely to be less accessible. Increased incidence of GBV together with loss of access to sexual reproductive health services lead to unwanted pregnancy and increased incidence of CEFM, which in turn lead to higher school dropout rates and poor health outcomes for girls and babies.

[159] Tegegne, T.K. & Sisay, M.M. (2014) Menstrual hygiene management and school absenteeism among female adolescent students in Northeast Ethiopia. BMC Public Health 14: 1118. https://doi.org/10.1186/1471-2458-14-1118.
[160] Tallman, P.S. et al. (2023) Water insecurity and gender-based violence: a global review of the evidence. WIREs Water 10: e1619. https://doi.org/10.1002/wat2.1619.
[161] UNICEF (2016) UNICEF: Collecting water is often a colossal waste of time for women and girls. UNICEF, New York, USA. Available at: https://www.unicef.org/press-releases/unicef-collecting-water-often-colossal-waste-time-women-and-girls; Tomberge, V.M.J. et al. (2021) The physical burden of water carrying and women's psychosocial well-being: evidence from rural Nepal. International Journal of Environmental Research and Public Health 18:7908. Doi: 10.3390/ijerph18157908.
[162] Department of Disaster Management Affairs (2022) Emergency Response Plan: Tropical Cyclone Ana.
[163] Women Deliver (2021) The link between climate change and sexual and reproductive health and rights: an evidence review. New York, USA. Available at: https://womendeliver.org/wp-content/uploads/2021/02/Climate-Change-Report.pdf.
[164] Ibid.
[165] Ibid.

4. ADAPTATION GAPS

Comparing and contrasting policy commitments with knowledge on the ground – particularly at district and community level – highlights a number of challenges that exist around building a more climate-resilient health care system in Malawi that is able to withstand and flourish within the context of a changing climate. The current assessment presented thus far shows that the state of the health care system in Malawi is already inadequate, and that exposure to current climate change and extremes is already undermining achievements and the effectiveness of the health care system in delivering intended services to the population. To date there have been limited financed projects addressing health and climate change, with a notable exception being the GFCS Adaptation for Africa project. Whilst this project made some preliminary and foundational progress, there is a need for substantial further adaptation efforts targeting the various pillars of a robust climate-resilient health care system, in order to contribute towards transformational change and health system adaptation in Malawi. This section highlights the extent of need across the various pillars of a climate-resilient health care system, and how the project will address these adaptation gaps (**Error! Reference source not found.**).

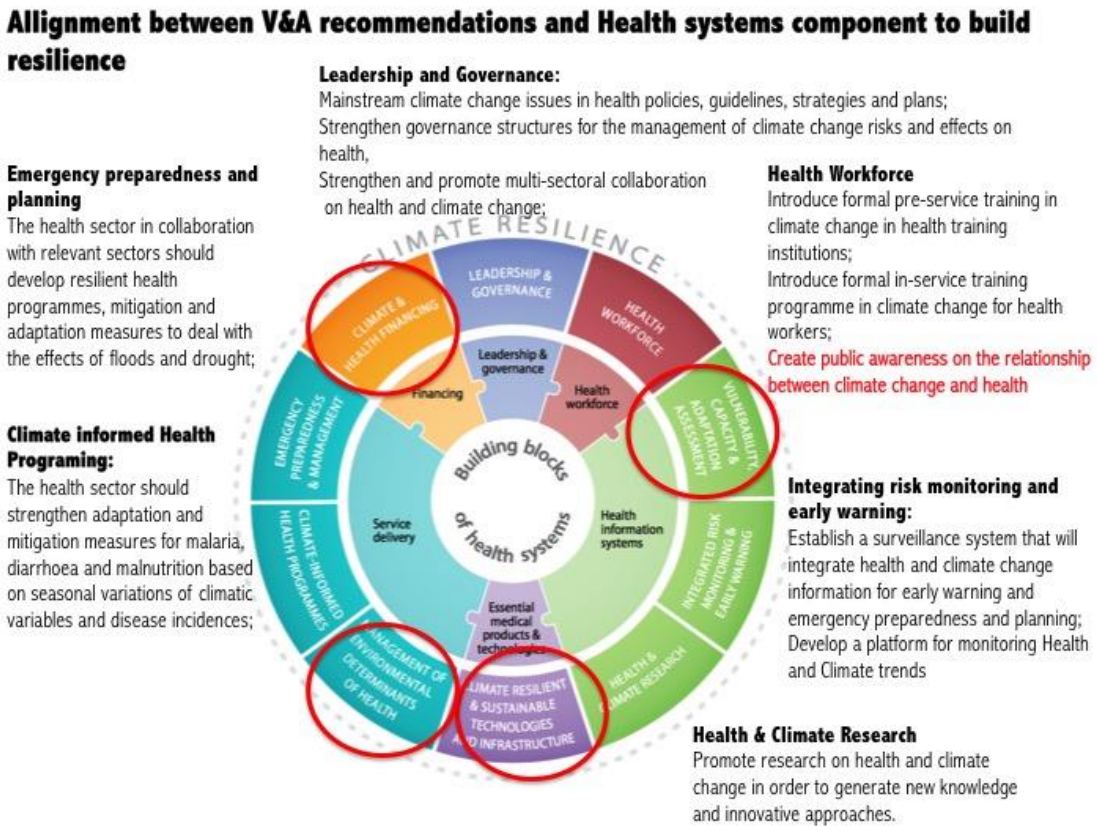

Figure 20 Building blocks of a climate-resilient health system (based on a WHO framework), with priorities for Malawi as outlined in the vulnerability and adaptation assessment[166].

[166] WHO (World Health Organization) (2015) Operational framework for building climate resilient health systems. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/publications/i/item/9789241565073.

4.1.1 Health Information Systems

The health information systems pillar comprises three components: i) vulnerability and adaptation assessment; ii) integrated risk monitoring and early warning; and iii) health and climate research. A preliminary vulnerability and adaptation assessment was conducted under GFCS Adaptation for Africa[167]. This assessment recognised the need for additional climate and health research. As has been shown in this feasibility study, the extent of Malawi-specific knowledge on the links between climate parameters and climate-sensitive diseases and conditions is underdeveloped, and largely linked with low resolution studies that cover the region. The results of the vulnerability and adaptation assessment conducted under GFCS Adaptation for Africa showed that malaria, diarrhoeal diseases, and malnutrition are among the main causes of death in Malawi and that the situation which will be exacerbated by climate change[168]. Heat exposure in Africa is associated with high mortality and morbidity, especially amongst vulnerable populations (people in low socio-economic brackets, people with cardiovascular disease, pregnant women, the elderly, infants, people with disabilities, and outdoor workers)[169], but the African continent has large weaknesses in monitoring and early warning systems and response systems for heat[170], as does Malawi. To contribute towards addressing these gaps, the project will develop targeted knowledge on climate parameters for malaria risk, cholera/diarrhea risk, malnutrition risk and the risk of select diseases/conditions linked to heat exposure. This targeted knowledge will be used to inform a climate-informed health surveillance system and EWARS (Activity 1.1.1), in line with the integrated risk monitoring and early warning. The project will establish sentinel sites at selected healthcare facilities to provide improved climate and health data for the health surveillance system and EWARS (Activity 1.1.3); and will build data entry capacity for this climate-informed health surveillance system and EWARS, by training staff involved in the health management information system at district level to be able to enter relevant data to enable ongoing surveillance (Activity 3.1.1).

4.1.2 Leadership and governance

The leadership and governance pillar refers to the required institutional and technical capacity that is necessary to manage and sustain a climate-resilient health system. This project will contribute to building this institutional and technical capacity by addressing some of the gaps identified in the climate change/health vulnerability and adaptation assessment[171]. This includes mainstreaming climate change issues in health policies, guidelines, strategies and plans, which will be enabled through several entry points. To complement the draft Health National Adaptation Plan at national level, the project will support the development of district Health Adaptation Plans in the target districts (Activity 1.2.1), in line with Malawi's commitment to decentralisation. Also, in line with the recommendations of the climate change/health vulnerability and adaptation assessment[172], the project will strengthen governance structures for the management of climate change risks and effects on health, and strengthen and promote multi-sectoral collaboration on health and climate change. This will be achieved through advocacy for stronger integration of climate-resilient health within adaptation planning at district and sub-district level (Activity 1.2.2), and the

[167] Ministry of Health (2016) Vulnerability and adaptation assessment of the health sector in Malawi to the impacts of climate change. Government of Malawi, Lilongwe, Malawi. Available at: https://health.bmz.de/wp-content/uploads/page/06-12-2015_Health_Sector_December_Final_.pdf.
[168] Ibid.
[169] Manyuchi, A.E. et al. (2022) Extreme heat events, high ambient temperatures and human morbidity and mortality in Africa: a systematic review. South African Journal of Science 118. doi: 10.17159/sajs.2022/12047; Green H et al. (2019) Impact of heat on mortality and morbidity in low and middle income countries: a review of the epidemiological evidence and considerations for future research. Environ Research 171: 80-91. doi: 10.1016/j.envres.2019.01.010.
[170] E.g. Harrington, L. & Otto, F. (2020) Extreme heat is a threat to lives in Africa, but it's not being monitored. The Conversation Africa, 26 November. Available at: https://theconversation.com/extreme-heat-is-a-threat-to-lives-in-africa-but-its-not-being-monitored-149921. Zali, M. (2023) Extreme heat events, high ambient temperatures, human morbidity and mortality in Africa: Review. Phys.org, 29 May. Available at: https://phys.org/news/2023-05-extreme-events-high-ambient-temperatures.html.
[171] Ministry of Health (2016) Vulnerability and adaptation assessment of the health sector in Malawi to the impacts of climate change. Government of Malawi, Lilongwe, Malawi. Available at: https://health.bmz.de/wp-content/uploads/page/06-12-2015_Health_Sector_December_Final_.pdf.
[172] Ibid.

active involvement of national and district level health staff across all activities to build their capacity and leadership potential for further use in multi-stakeholder fora.

4.1.3 Service delivery

The service delivery pillar comprises emergency preparedness and management, climate-informed health programmes, and management of the environmental determinants of health. The related specific recommendations of the vulnerability and adaptation assessment[173] are for the health sector to strengthen adaptation measures for malaria, diarrhoea and malnutrition based on seasonal variation of climatic variables and disease incidences. Informed by the climate-informed health surveillance system and improved Malawi-specific understanding of climate parameters for malaria risk, cholera/disease risk and malnutrition risk, along with health risks from heat exposure, the project will strengthen the institutional architecture for managing the ongoing operation of the climate-informed EWARS (Activity 1.2.2) and ensure that capacity is built at national and district level, and among government staff and health care workers, to be able to understand and effectively communicate early warning alerts to community level (Activity 3.1.2), as well as building the capacity of communities, including children, to understand early warnings and alert protocols (Activity 4.1.2). In addition, the project will equip healthcare workers to offer the expanded range of healthcare services that will be necessitated by a changing climate, building the capacity of district and community health care workers to understand and thus better manage the impacts of climate change on a range of health risks (Activity 3.1.2). This capacity-building focuses in particular on under-prioritised diseases/conditions for which the current lack of data prevents their inclusion in the EWARS, but where the disease burden is expected to increase under climate change. As such, the project will equip healthcare staff with MHPSS capacity to address the mental health impacts of a changing climate (Activity 3.1.4); and with capacity to address the gendered impacts of a changing climate (Activity 3.1.5), which affect GBV, Sexual Health and Reproductive Rights, and CEFM.

4.1.4 Climate-resilient and sustainable technologies and infrastructure

The climate-resilient and sustainable technologies and infrastructure pillar refers to essential medical products and technologies. Recognising the importance of ensuring that healthcare infrastructure is able to continue to provide services in the context of a changing climate, the project will develop a national standard for climate-resilient healthcare facilities (Activity 2.1.1), enabling localisation of the WHO green hospital approach, and then apply that to select health care facilities in the project districts (Activity 2.1.2) to address the current challenges that health care facilities are not withstanding climate exposure; and build capacity more broadly for the use of the national standard elsewhere in the country (Activity 2.1.3). It will also develop a guideline on climate-resilient WASH for use in public facilities (e.g., schools, health facilities and public buildings) and in communities and homes (Activity 2.1.4); provide improved WASH facilities at schools, recognising their critical position as community centres serving a majority of children within their communities, as well as teachers, parents and other community members (Activity 2.1.5); and equip community structures to provide knowledge and skills for climate-resilient WASH facilities to community members (Activity 4.1.1). In addition, and recognising the ways in which climate change will increase the burden of existing climate-sensitive diseases, the project will provide medical supplies and technologies for climate health risk reduction and response (Activity 3.1.3), with a particular focus on malaria, cholera and malnutrition, in accordance with the prioritisation of these diseases in the climate change/health vulnerability and adaptation assessment[174]. Given the importance for children's health and wellbeing of a sound nutritional basis, and the increasing difficulties of this being secured in the context of a changing climate, the project will also support families with pregnant women, breastfeeding mothers and children under 2 to provide appropriate infant feeding and grow climate-resilient complementary nutritious food (Activity 4.1.4).

[173] Ibid.
[174] Ibid.

4.1.5 Health workforce

Having a well-trained health workforce that is equipped to understand, anticipate and respond to the risks that climate change poses is a key pillar of a climate-resilient health system. This project dedicates an entire component of activities to this task, variously targeting national and district level health technical staff in government, health care facilities staff, and healthcare practitioners in the primary, secondary and tertiary facilities. In particular, those involved in healthcare planning will be trained in the application of the climate-resilient healthcare facility standard (Activity 2.1.3). Those involved in data collection and functioning of the health management information system will be trained in data entry capacity for climate-related disease surveillance (as inputs to the climate-informed EWARS) (Activity 3.1.1). Public-facing healthcare staff will be targeted for capacity-building in understanding how climate risk will alter public health risks and in disseminating early warnings to communities (Activity 3.1.2); and in better understanding and treating the mental health impacts (Activity 3.1.4) and the gendered impacts (Activity 3.1.5) of a changing climate. These activities will occur alongside the empowerment of communities at grassroots level to be able to ensure their own health and wellbeing in the context of a changing climate (Activities 4.1.3 and 4.1.5).

4.1.6 Climate health and financing

Sustainable financing underpins the success of a climate-resilient health system. The GCF grant and associated co-financing will catalyse the process of system transformation, and the monitoring and evaluation and knowledge management component will provide the evidence to motivate for further domestic and other financing where required – for example for the increased provision of medical supplies and technologies.

5. TECHNICAL ASSESSMENT OF PROPOSED ACTIVITIES

This section provides a technical assessment of a range of activities under the project, finding that the selected activities and implementation modalities are fit for the context and follow international best practice. All project activities also have strong government buy-in, critical for sustainability and the paradigm shift.

5.1 CLIMATE-INFORMED HEALTH SURVEILLANCE AND HEALTH EARLY WARNING AND RESPONSE SYSTEM

Health surveillance and health information systems

DHIS2 is an open source, web-based platform most commonly used as a health management information system (HMIS). It is the world's largest HMIS platform, in use by 80 low and middle-income countries. DHIS2 can be used to aggregate statistical data collection, and for validation, analysis, management, and presentation. It is completely web-based and includes visualization features and the ability to create analysis from live data. In addition, DHIS2 can be used to monitor patient health, improve disease surveillance, map disease outbreaks, and speed up health data access for health facilities and government organizations[175]. In Malawi, the DHIS2 software platform has been used by the Ministry of Health since 2012 (when it replaced the original District Health Information System [DHIS]) as the country's Health Management Information System (HMIS), the main data collection and aggregation tool and national repository for health data. Malawi's HMIS includes data from more than 60 health programs. For example, large national-level programs such as those for malaria, tuberculosis, immunization, and HIV have moved from project-specific monitoring and evaluation systems to a national-level DHIS2 platform[176]. In 2020, the electronic Logistics Management Information System (eLMIS) for collecting and managing data on medical stocks down to the facility level was integrated with the HMIS[177].

[175] District Health Information System 2 (DHIS2). Available here
[176] Health Policy Plus Policy Brief, 2021. A Strategic Approach to Strengthening Data Quality and Use: Lessons from Malawi. Available here.
[177] DHIS2, 2023. Integrating HMIS and eLMIS systems for better decision making in Malawi. Available here.

The MoH has worked with the Health Policy Plus (HP+) project, funded by USAID and in conjunction with Malawi's President's Malaria Initiative (PMI), to strengthen its capacity to manage health information and use data for decision making[178]. This was done within the framework of the *Monitoring, Evaluation and Health Information Systems Strategy (MEHIS) 2017–2022*[179]. This work included: i) implementation of DHIS2 at central hospitals and at selected other health facilities across 15 districts; ii) advocacy for adequate data management staff at health facilities; iii) training of HMIS officers (data management focal persons) and district environment and health officers in charge of district planning (data users), iv) decentralising data entry from the district HMIS office to the facility to enable district-level data management staff to focus on data quality; and v) standard operating procedures for data quality.

Like most African countries, Malawi has adopted the Integrated Disease Surveillance and Response (IDSR) strategy developed by the World Health Organization's Regional Office for Africa[180] as its national surveillance system. The implementation of the IDSR strategy in Malawi is supervised by the Public Health Institute of Malawi (PHIM), which forms part of the Ministry of Health[181]. A study by PHIM and the Norwegian Institute of Public Health in 2023[182] found that:

"In terms of governance, while the MoH oversees the Health Management Information System (HMIS), PHIM plays a central role in Malawi's surveillance activities. Malawi uses the third edition of the Technical Guidelines for Integrated Disease Surveillance and Response (IDSR) in the African Region[183]. Aside from HMIS and IDSR, data is also collected by several vertical disease programs (e.g., HIV/AIDS, tuberculosis, malaria, and schistosomiasis) that are run by donor organizations (i.e., PEPFAR, Global Fund, World Bank). In addition, there is a One Health Surveillance Platform (OHSP), an integrated community HIS (ICHIS), and an eIDSR, underscoring the complexity of Malawi's data surveillance landscape." The study identified the following areas for improvement:

- Reporting: Improve the IDSR guidelines so that the case definitions for the conditions monitored are understandable and accessible; revise list of diseases reported from the districts to include only those that can be diagnosed at that level
- Training: provide training for those who complete reports, including data clerks
- Connectivity: improve internet connectivity or access to the internet to enable reporting
- Data integration: integrate information from different vertical disease programs with the IDSR to improve data quality and reduce work
- Task force: establish a national task force to integrate information from different programs and IDSR
- Laboratory reporting: strengthen the laboratory system given that it is the backbone of disease surveillance
- Feedback: provide feedback to those reporting the data so they can use it for decision making and planning
- Data validation: validate data in the reporting chain with quality checks at the district level
- Technical challenges: address unreliable internet connectivity and insufficient server capacity.

Based on these findings, the study made the following recommendations, with a plan to address these aspects being developed with the MoH:

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[178] Health Policy Plus Policy Brief, 2021. A Strategic Approach to Strengthening Data Quality and Use: Lessons from Malawi. Available here.
[179] Republic of Malawi, Ministry of Health, 2018. Monitoring, Evaluation and Health Information Systems Strategy (MEHIS) 2017–2022.
[180] WHO, 2019. Regonal Strategy for Integrated Disease Surveillance and Respnse: 2020–2030. Available here.
[181] https://phim.health.gov.mw/phim_dev/
[182] Myhre, Arnesen, Mtisunge and Iversen, 2023. Insights from Malawi's Deep Dive of the Integrated Disease Surveillance System. Available here.
[183] WHO. Technical Guidelines for Integrated Disease Surveillance and Response in the African Region: Third edition Available here.

- Improve data quality at the facility level by making case definitions available as posters and pocketbooks, writing out abbreviations and acronyms, and orienting data clerks on correct disease codes
- Establish a formal collaboration between vertical programs to promote integration and understanding. This collaboration should ensure agreement on common case definitions, reporting frequencies, a single data input from a reporting facility, and improved interoperability of laboratory data with DHIS2/OHSP
- Align the list of reportable diseases with the reporting forms including how often reporting is conducted (i.e., immediate, weekly, monthly, and quarterly)
- Improve data quality by assigning focal persons at district and national levels to validate data reports.

Field visits undertaken for this feasibility study found that the integrated disease surveillance response (IDSR) system is in place in the six target districts of the proposed project. For disasters like floods, the health sector relies on the agriculture sector and meteorological services to provide information on climate and weather (**Annex 7: Stakeholder engagement**).

Meteorological services

Weather and climate monitoring and prediction in Malawi is the responsibility of the Department of Climate Change and Meteorological Services (DCCMS) within the Ministry of Natural Resources and Climate Change. The DCCMS operates a network of 22 full meteorological stations, complemented by a larger network of automatic weather stations (**Error! Reference source not found.**)[184]. The DCCMS is mandated by the National Meteorological Policy[185] to provide climate information to different sectors, including to the health sector for prediction of disease outbreaks and planning, as well as for research purposes. In recent years, the hydro-meteorological capacity for early warning and forecasting in Malawi have been strengthened thanks to GCF investment via the project *Scaling Up the Use of Modernized Climate Information and Early Warning Systems in Malawi*[186]. As a result, national and subnational forecasts and early warnings have improved - DCCMS now produces downscaled seasonal forecasts for all 28 districts, and there is better dissemination of climate information to farming and fishing communities. Further information on how the proposed project will build on these successes is provided in Section 2.5.3 above.

[184] https://www.metmalawi.gov.mw/dccms_station.php
[185] Government of Malawi, 2019. National Meteorological Policy. Available here.
[186] FP002 - Scaling Up the Use of Modernized Climate Information and Early Warning Systems in Malawi. Available here.

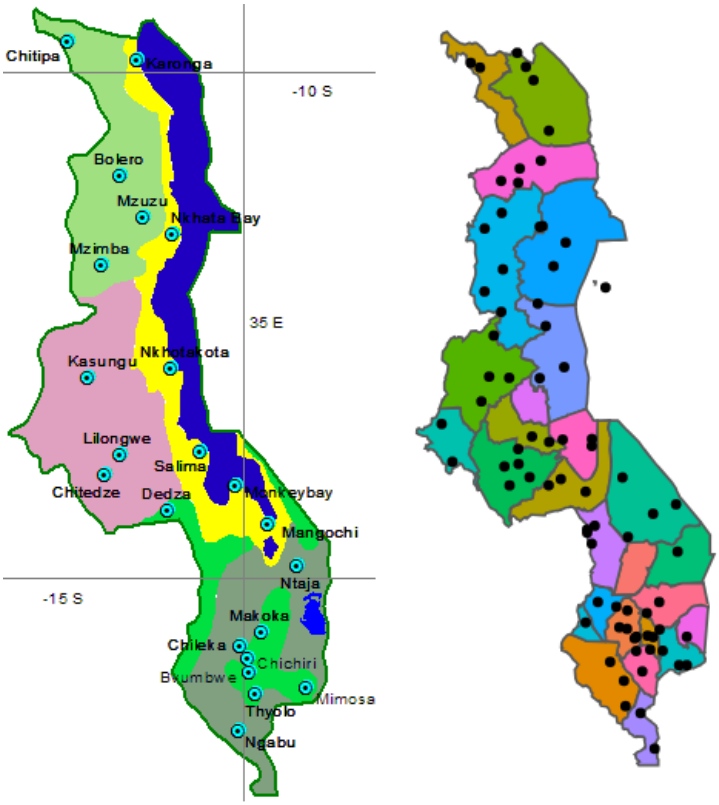

Figure 21 Location of full meteorological stations (left) and automatic weather stations (right) in Malawi. Source: https://www.metmalawi.gov.mw/dccms_station.php

An Early Warning and Response System (EWARS) is a tool to predict outbreaks/surges of climate sensitive diseases and conditions based on a set of relevant alarm indicators. Such a system aims to statistically predict disease events given climate anomalies, to strengthen district-level decision-making, to improve coordination from local to central level and to provide warning signals that can easily be translated into organised responses. The WHO have developed a set of quality criteria for evaluation of climate-informed early warning systems for infectious diseases[187], which will be followed by the proposed project. A 2021 review of early warning systems for infectious diseases found that: i) EWS should ideally be integrated with national surveillance programmes; ii) EWS should conceptually be perceived as an information system designed to support the decision-making of national- and local-level institutions but also enable vulnerable groups in the society to take actions to mitigate the impacts of an impending risk; iii) early warning and response systems that are capable of demonstrating evidence of prospective predictive ability and allows technical and practical adaptations of local public health responses while augmenting communications channels between users at central and district levels are more likely to be implemented into national surveillance programs; iv) meteorological indicators are key predictors and timely and improved access to meteorological information from local meteorological stations is important[188]. The proposed project design incorporates these recommendations.

[187] WHO, 2021. Quality criteria for the evaluation of climate-informed early warning systems for infectious diseases. https://www.who.int/publications/i/item/9789240036147

[188] Hussain-Alkhateeb, Laith, et al. "Early warning systems (EWSs) for chikungunya, dengue, malaria, yellow fever, and Zika outbreaks: What is the evidence? A scoping review." PLoS neglected tropical diseases 15.9 (2021): e0009686.

5.2 CLIMATE-RESILIENT INFRASTRUCTURE AND WASH AT SCHOOLS

There is increasing global attention on the impacts of climate change on health and the urgent need for adaptation[189], as well as on the need for the healthcare sector to better manage its own environmental impacts and carbon emissions[190]. As the proposed CHWBRC project focuses on enhancing the climate resilience of the healthcare system in Malawi, this section focuses on the resilience of healthcare facilities. The WHO has released international guidance for climate resilient and environmentally sustainable health care facilities[191], which provides suggested interventions in terms of: i) the health workforce; ii) water, sanitation, hygiene and health care waste management; iii) sustainable energy services; and iv) infrastructure, technologies and products. This is complemented by WHO checklists for assessing vulnerabilities of health care facilities to different climate hazards such as floods, storms, droughts and heatwaves, in order to establish baselines at facilities and to identify interventions to improve resilience[192]. This guidance builds on earlier work by the WHO and others, such as a European technical strategy document on environmentally sustainable health systems[193] and a discussion paper on addressing climate change in healthcare settings[194].

5.2.1 Solar energy for healthcare facilities

Climate change impacts negatively on electricity supply at healthcare facilities in Malawi, with floods and storms affecting grid supply (damage to transmission) and reduced output from hydropower during droughts, and lack of access to diesel for generators due to flood events. Unreliable electricity supply at healthcare facilities in Malawi have various negative impacts on healthcare provision, including irregular water supply and poor medical equipment sterilization; safety of healthcare workers, and poor lighting and working conditions[195]. Erratic power supply and water supply at hospitals in the south of Malawi is one of the main barriers to quality care for newborns[196].

Technical assessments of the energy needs of Malawi's health sector[197,198] by the Government of Malawi, UNDP and UNICEF have made various recommendations for increasing the resilience of health facilities in terms of energy, including on typical needs of different types of health facilities in Malawi, appropriate technical solutions, operations and maintenance, and sustainability. The proposed project design builds on these recommendations, is further informed by consultation and coordination with MoH and its partners such as UNDP, GIZ and GEAPP who are involved in energy upgrades in the health sector, and the CHWBRC's interventions at its target health facilities will further be informed by detailed assessments of each individual facility as part of Activity 2.1.2.

The installation of solar energy solutions at healthcare facilities will enhance climate resilience by providing additional resilient and reliable energy supply that support improved health outcomes - given the increasing burden of climate-sensitive diseases - and in the context of the climate change impacts of floods, droughts and strong winds on grid electricity supply and transport networks for fuel distribution to diesel generators at health facilities.

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[189] Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., ... & Costello, A. (2022). The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. The Lancet, 400(10363), 1619-1654.
[190] Lenzen, Manfred, et al. "The environmental footprint of health care: a global assessment." The Lancet Planetary Health 4.7 (2020): e271-e279.
[191] WHO, 2020. WHO guidance for climate resilient and environmentally sustainable health care facilities. Available here.
[192] World Health Organization, 2021. Checklists to assess vulnerabilities in health care facilities in the context of climate change. Available here.
[193] World Health Organization (2017) Environmentally sustainable health systems: a strategic document. Available here
[194] WHO, n.d. Healthy hospital, healthy planet, healthy people. Addressing climate change in health care settings. Available here
[195] Reuland, Frances, et al. "Energy access in Malawian healthcare facilities: consequences for health service delivery and environmental health conditions." Health Policy and Planning 35.2 (2020): 142-152. Available here.
[196] Gondwe, Mtisunge Joshua, et al. "Resource availability and barriers to delivering quality care for newborns in hospitals in the southern region of Malawi: A multisite observational study." PLOS Global Public Health 2.12 (2022): e0001333.
[197] Government of Malawi and UNICEF, 2018. Energy needs assessment of Malawi's health sector. Available here.
[198] UNDP 2019. "Power for Health" Masterplan for Malawi - Energy Load Assessment, Efficiency Options and Sustainable Energy Solutions for Health Facilities in Malawi. Available here

The CHWBRC will include the following options:

- Photovoltaic systems – on-grid and off-grid, rooftop and ground installation
- Solar direct drive refrigerators, especially for vaccine storage at appropriate and constant temperature
- Solar lanterns
- Repair of existing photovoltaic systems as required based on technical assessment

Systems and equipment will be designed and installed to be resilient to climate impacts, e.g. photovoltaic panels will be fixed such that they can withstand strong winds associated with tropical storms.

5.2.2 Climate-resilient WASH

The importance of addressing climate change impacts on WASH is recognised by the WHO in its Water, Sanitation and Hygiene strategy 2018–2025[199]. A key way to enhance climate resilience of WASH is to develop national standards for WASH in healthcare facilities. Such standards are necessary for implementing, monitoring and regulating health services. Standards are a set of requirements that dictate the infrastructure and resources necessary to provide sustainable WASH services within health care facilities. These requirements will vary based on the type of care provided and size of facility. The WHO recommends that "Standards should be relevant to the local context, comprehensive and specific enough to provide actionable technical guidance. They must also reflect the needs of vulnerable populations including those with limited mobility. WASH in health care facilities standards may include aspects of climate resilience and water/energy conservation or be part of a 'minimum package' for health care facilities: they do not need to be a standalone document. Developing a set of standards is not sufficient to ensure implementation. Roll out, sensitization, engagement of partners and accountability mechanisms (to help ensure that standards are implemented, met and upheld) are all important. Examples include regulation, accreditation, licensing, community scorecards and feedback mechanisms".[200]

International practical guidance has also been developed by the WHO for improving quality of care through water, sanitation and hygiene in health care facilities[201].

Climate change is adversely impacting the Water Sanitation and Hygiene (WASH) sector in Malawi. Prolonged dry spells, seasonal droughts, changes in rainfall patterns and floods are posing serious health risks. The interruption or deterioration of WASH services in communities affects health, nutritional status and the safety and dignity of children and women. Access to WASH is affected especially severely in emergencies caused by floods and droughts. Poor sanitation and hygiene are major contributors to the burden of disease and child deaths, costing Malawi US$57 million each year, or 1.1 per cent of national GDP, due to health costs and productivity losses[202]. At healthcare facilities specifically there are also gaps in WASH provision: 7% of facilities have no water service and 16% have limited water service[203].

To address these challenges, the Government of Malawi has been working hand in hand with development partners to map pathways aimed at building climate resilient WASH infrastructure in communities and minimize disruptions from climate disasters. The Ministry of Water and Sanitation has developed the Malawi

[199] Addressing climate change: Supplement to the WHO Water, Sanitation and Hygiene strategy 2018-2025. Geneva: World Health Organization; 2023. Available here
[200] WHO and UNICEF, 2020. Global progress report on water, sanitation and hygiene in health care facilities: fundamentals first. Available here
[201] WHO & UNICEF, 2022. Water and sanitation for health facility improvement tool (WASH FIT): a practical guide for improving quality of care through water, sanitation and hygiene in health care facilities, 2nd ed. https://apps.who.int/iris/handle/10665/353411.
[202] UNICEF Malawi. Water, sanitation and hygiene. Available here
[203] No service = Water is taken from unprotected dug wells or springs, or surface water sources; or an improved source that is more than 500 metres from the premises; or there is no water source; Limited service = An improved water source is within 500 metres of the premises, but not all requirements for basic service are met. UNICEF & WHO, 2022. Progress on WASH in health care facilities 2000–2021: special focus on WASH and infection prevention and control. Available here

Climate Resilient Water, Sanitation and Hygiene (WASH) sector Financing Strategy[204] aligned with Vision 2063 and the First 10 Year Implementation Plan (MIP-1). The strategy is also aligned with the country's Nationally Determined Contribution (NDC), which features adaptation measures specific to the WASH sector. This strategy sets out a path to close the finance gap in the WASH sector in Malawi and to ensure the financial sustainability of the WASH sector, considering future climate scenarios and the socio-economic context of the country. The Government of Malawi also has a Water Sanitation and Hygiene in Health Care Facilities Roadmap (2022) in place[205]. In addition to the Ministry of Water and Sanitation, the Ministry of Education has the responsibility to deliver school-based WASH services, while District Council mandates include providing services such as water supply and sanitation systems, and health and education.

In 2023, Tropical Cyclone Freddy caused total damages of $42.64 million in the water and sanitation and water resources sectors, of which 34.85 million was in the water and sanitation subsector. WASH facilities for 1.3 million people were damaged. A total of 1,847 boreholes and over 100 protected shallow wells were damaged including several piped water schemes. The floods and landslides also contaminated water sources with debris, sewage and other pollutants, increasing the risk of waterborne diseases[206].

Since Malawi currently does not have national standards for climate-resilient WASH at public facilities such as health facilities and schools, such standards will be developed by the CHWBRC project, in line with international best practices and tailored specifically for the Malawian context. These standards will include recommendations such as the use of eco-san toilets and protection walls for latrines to reduce the likelihood of contamination during floods, rainwater harvesting and water re-use systems (i.e., greywater).

Rainwater harvesting

Community water supply in Malawi is provided through several sources; currently the major sources are boreholes, springs, rivers and lakes[207]. Rainwater harvesting (RWH) technologies are also implemented in some places for collecting and storing rainwater for different uses, mostly agricultural and domestic uses. With the average rainfall received in most areas in Malawi being relatively high, RWH is considered technically feasible in both urban and rural areas, although there is limited documentation for Malawi[208],[209]. The seasonality of rainfall in Malawi is also favourable for rainwater harvesting and rainfall amounts and patterns under climate change are expected to remain suitable for rainwater harvesting in Malawi to be an important additional water supply solution, especially considering the dry season (Section 3).

Rainwater Harvesting is used mainly to supplement (rather than replace) water supply from the above-mentioned sources. Under the impacts of climate change, conventional water sources are greatly affected, therefore it is critical to investigate alternative water sources.

In 2005, the Rainwater harvesting association of Malawi (RHAM) was created as a development partner to deliver on the Government of Malawi's 'integrated water resources management initiative',[210] and it has been active since then in advocating for RWH where appropriate. RHAM aims to promote water harvesting in both the Agriculture and WASH sectors to improve food security and improved water supply through climate resilient WASH infrastructure. The creation of the RHAM was an initial step in moving towards RHW

[204] Malawi Climate Resilient Water, Sanitation and Hygiene (WASH) sector Financing Strategy 2022-2032. Available here
[205] Ministry of Health, 2022. Water Sanitation and Hygiene in Health Care Facilities Roadmap. Available here
[206] Tropical Cyclone Freddy Post Disaster Needs Assessment
[207] See, for example, Getts, 2019. 'Lack of Access to Water in Rural Malawi'. Ballard brief. Available here
[208] Nthara, 2020. Rainwater harvesting for improved food security and environmental conservation - Experiences from Malawi. In Espíndola, J. A. G., Flores, C. A. C., Pacheco-Vega, R., & Montes, M. R. P. (Eds.). (2020). International Rainwater Catchment Systems Experiences: Towards Water Security. IWA Publishing. Available here
[209] Mloza-Banda, H. R., Chikuni, A., & Singa, D. D. (2006). Small Scale Rainwater Harvesting for Combating Water Deprivation at Orphan Care Centres in Peri-Urban Areas of Lilongwe, Malawi. Available here
[210] Nthara, 2020. Rainwater harvesting for improved food security and environmental conservation - Experiences from Malawi. In Espíndola, J. A. G., Flores, C. A. C., Pacheco-Vega, R., & Montes, M. R. P. (Eds.). (2020). International Rainwater Catchment Systems Experiences: Towards Water Security. IWA Publishing. Available here

as a preferred method, but there have been several other successful projects in Malawi since then, in both health and education settings similar to those proposed under the CHWBRC project.

Examples of rainwater harvesting and water treatment in healthcare facilities in Malawi

The SURG-water project with funding from Science Foundation Ireland has developed a sustainable, low energy solution to address water standards in rural healthcare facilities in Malawi, specifically focusing on needs of mothers, new-born babies and clinicians providing maternal healthcare services. Solar water disinfection (SODIS) technology is used to treat harvested rainwater, with the aim to provide a backup supply to address interruptions in existing water supplies. The use of water may vary from each health facilities (principally used for drinking, cleaning or washing). This study which runs from February 2023 to July 2024 will evaluate the feasibility, effectiveness and adoption of solar water disinfection technology in clinical settings to inform national scale-up. SURG-Water will support the national discussion about the need for evidence-based planning and applying solutions tested in rural areas.[211]

Additionally, as part of a response to Covid-19, the UNDP and Japanese International Cooperation Agency (JICA) funded an intervention to deliver 100 solar-powered bleach makers to 43 health facilities in Malawi. The solar technology was used to treat water for drinking, including rainwater, and it uses only water, salt and a 12-volt DC power source. The water was used mainly for sanitizing surfaces and creating a disinfectant to disinfect water to prevent the spread of water-borne diseases such as cholera.[212]

Rainwater harvesting in schools

The water situation in most schools and communities across Malawi is variable, as each school faces a distinct but often similar set of challenges. In some cases, presence of a borehole (hand pump) at a school or community may signal sufficient water supply, but these can often breakdown and have low yield, which worsens during the dry season. Inadequate WASH in schools can lead to poor health, malnutrition, and absenteeism, negatively affecting children's education,[213] with investment in WASH at schools providing substantial socio-economic benefits. For instance, the 2012 Malawi Water Sector Investment Plan (WSIP) indicated that among interventions, the highest net cost-benefit is achieved by providing sanitation and ensuring every school has hygiene facilities, which led to a return of more than MK 11,410 (USD 14) per each Malawian Kwacha (or dollar) invested[214].

There have been a number of projects in schools and communities which aim at providing water in schools all year round through Rainwater Harvesting. For example, Canadian Physicians for Aid and Relief (CPAR) in collaboration with Kasungu Water office and the Irrigation department installed a 30,000-litre rainwater harvesting tank at Chamatete Primary School in Kasungu, along with face boards and gutters to direct rainwater from the roof into the tank. The project aimed at enhancing quality education for pupils at Chiputu primary school in Kasungu district through improved health status.[215]

The Rainwater Harvesting Association of Malawi (RHAM) in alliance with a number of organizations[216] have delivered a program to raise awareness of rainwater harvesting among primary school learners, by

[211] Surg-water: working to provide safer water for rural healthcare facilities in Malawi. Available here
[212] Baseflow, 2022. 'Bleach Reach: expanding the impact of the Bleach Maker'. Available here
[213] See, for example, FHI360, 'WASH and education'. Available here.
[214] As cited in Malawi Climate Resilient Water, Sanitation and Hygiene (WASH) sector Financing Strategy 2022-2032. Available here

[215] Canadian Physicians for aid and relief, Primary school rainwater harvesting. Accessed 10/10/2023. Available here

[216] Namely, School Colleges Permaculture Education – SCOPE-Malawi, Village Health Clean Water and CCAP Smart Centre - https://www.smartcentremalawi.com/index.php/about/

constructing thirteen 10,000 litre Calabash cisterns in selected schools across the country. The Ministry of education conceded that water supply is a critical challenge impacting sanitation in schools, therefore adopting rainwater harvesting is a viable technology to overcome water supply challenges. Government officials were impressed by the use of low-cost calabash tanks as an innovative source of water supply, compared to other more costly measures. [217]

The project intervention

The proposed project will construct mostly 5,000 and 10,000 L calabash cisterns, as masons in Malawi have typically been trained to build these sizes, which also correspond to standard international practice for these cisterns. The overall shape is a vertical cylinder with a round-shaped bottom and a slightly conical roof. The material that will be used is ferrocement, which consists of a cement-rich mortar applied on both sides of a thin layer of wire mesh and closely spaced thin steel rods. This material and method is proposed because it can be built by local artisans in the project districts[218]. Furthermore, cement is a highly suitable material for water storage, as it is cheaper than stainless steel and more resistant to sunlight and extreme heat than plastic. It can be constructed on the spot using hand tools. These tanks are resistant to the sun and extreme weather like flooding. A leaking wall is reparable hence the tanks have a longer lifespan than plastic tanks. The rainwater will be harvested through the roof catchment into gutters and directed into the tanks through pipes with a pre-filtration system, such as a first-flush diverter and leaf guards, to prevent debris and contaminants from entering the rainwater storage tank (see Error! Reference source not found. below).

Tanks will also be sealed to keep the water clean and prevent breeding of mosquitos inside the tanks. The tap on the tank will be secured and locked to ensure proper management by the responsible persons, namely the school Health and Nutrition patrons (teachers) and the Head Teacher. Treatment of the water will therefore be provided at point of use (Filtration, Chlorination, Boiling or SODIS). The Guidelines for drinking Water Quality published by the World Health Organization in 2017, recognize that a well-designed rainwater harvesting system with clean catchments, covered storage cisterns and point of use treatment, as appropriate can offer drinking water with very low health risks[219].

A Committee of about 10 people from the community and a representation from the school will be trained on the operation and maintenance of the tanks and water quality. The Water Monitoring Assistants and the Health Surveillance Assistant from the catchment of the school will be part of these trainings to ensure proper and timely maintenance of tanks, e.g. repairing leaks or cracks which is done from the inside and cleaning of tank (done every 3 to 4 years). When rainwater is collected from a clean surface it will further improve in storage. Bacteria die-off in the cistern can be substantial while biofilms developing at the cistern-water interface are also considered to have a positive effect on water quality. Thus, to benefit from the biofilm effect it is better to clean the cistern only every 3 to 4 years.

Overall, rainwater harvesting will be delivered in **400 schools** across the six target districts, after an initial assessment of schools within the project areas. The average number of school pupils per school in these districts is 967, meaning an **estimated 386,800 children** will directly benefit from these improved water source. One or two tanks – mainly 10,000 litres but possibly some 5,000 litre tanks too depending on suitability of school buildings – will be built at each school, depending on need and assessment of existing infrastructure.

Similarly, rainwater harvesting will be delivered in **79 health facilities** across the six target districts, based on need and suitability of infrastructure. It is envisioned that two tanks per facility will be built, with the option

[217] Zodiak Malawi, 'Rainwater harvesting association ropes in school learners', accessed 10/10/2023. Available here
[218] Calabash rainwater harvesting manual, 2023. Available here
[219] http://www.who.int/water_sanitation_health/publications/gdwq4-with-add1-chapters/en/.

for more tanks for larger facilities. The implementation steps will include technical and prioritisation assessment of current climate resilient electricity sources and WASH in health facilities and schools which is also linked to the development of national standards relating to Outcome 2; selection of contractors; selection and training of local masons; and the formation and training of Maintenance Committees at all participating health facilities and schools (approximately 10 members including key health facility and school leaders, community representatives, and Health Surveillance Assistants).

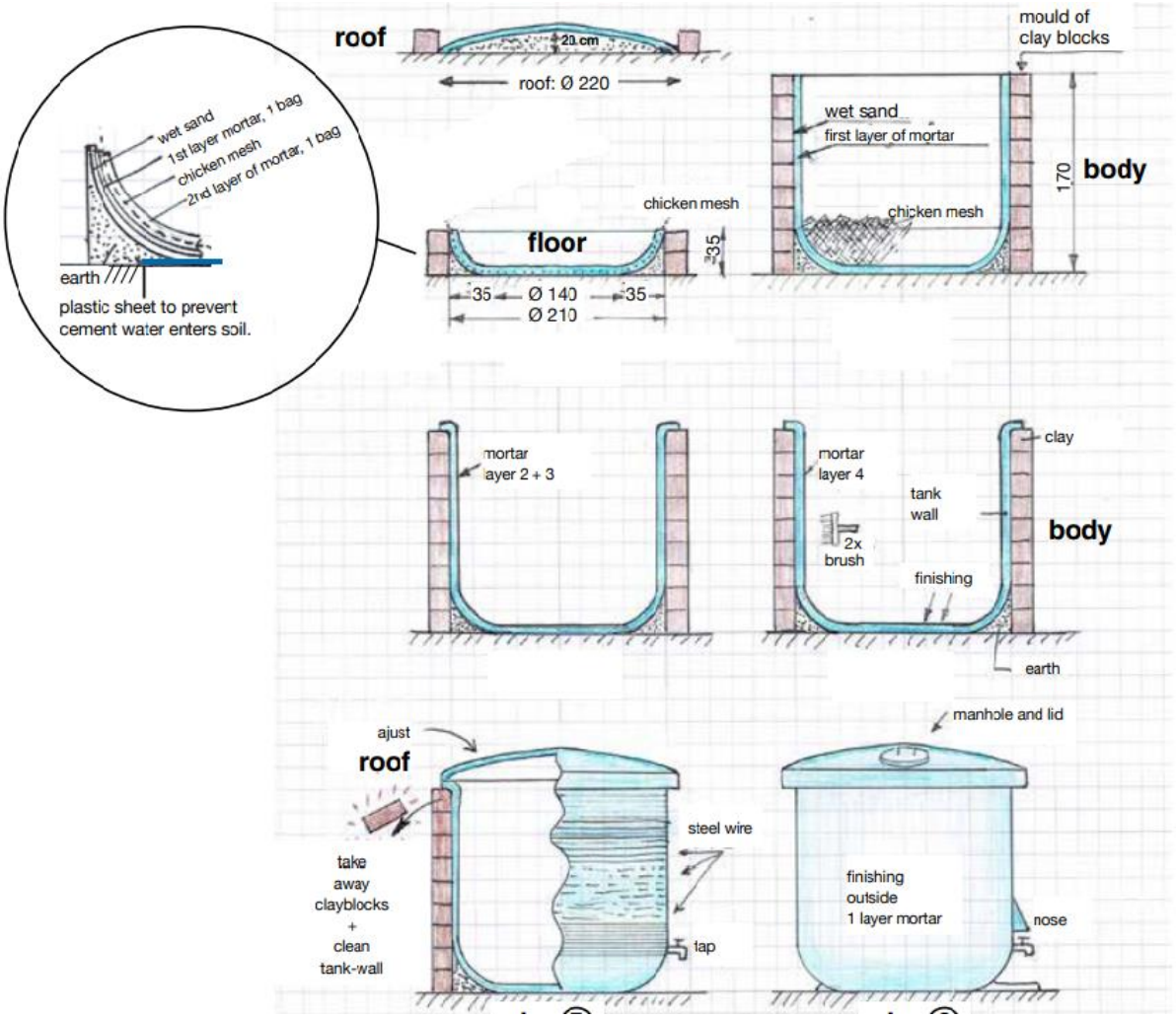

Figure 22 Calabash cistern construction method.

Source: http://degevuldewaterkruik.nl/assets/uploads/pdf/2023/calabash-manual-2023-en.pdf

Figure 23 An example of a 10,000 litre calabash rainwater harvesting tank installed at Tsokamkanasi Primary School in Lilongwe, Malawi.

Image source: https://scopemalawi.com/strenghtening-resilient-school-communities/

5.3 MEDICAL SUPPLIES AND TECHNOLOGIES FOR CLIMATE HEALTH RISK REDUCTION AND RESPONSE

Malawi launched the successor Health Sector Strategic Plan 111 (2023-2030) that suggests key health interventions prioritized within the Essential Health Package including treatment and management of the key diseases that are of focus in this project (Malaria, Diarrhoea, treatment of acute malnutrition and immunization). The project will support government of Malawi's ambition in achieving universal health coverage through provision of additional supplies and medicines to ensure uninterrupted access to services at primary health service delivery points even in the face of heightened climate impact. Implementation of health services will leverage on existing capacities at both health facility and community level whilst building the capacity of service providers in quantification and prepositioning of essential drugs and medicines as part of anticipatory action informed by the data from the EWARS. Management of medical supplies in Malawi is managed through the government of MALAWI Health Commodities Logistics Management System, however, results from the Financial Management Capacity Assessment (FMCA) showed inefficiencies and delays with the government's procurement system. During emergencies, most partners lead the procurement processes and facilitate logistics and distribution of the medical supplies through the government's logistics and supplies management. For example, Save the Children has supported the government in procurement of drugs during multiple health in emergency humanitarian response efforts of COVID19, Cholera and Tropical Cyclone Freddy where Save the Children facilitated procurement of essential medicines and supplies either through the organization's Emergency Health Unit or through the capacity at regional level.

As regards programmatic processes across the different disease of focus, there is diversity in operationalization platforms and processes since each programme is managed by different departments within the Ministry of Health (MoH). The MoH facilitates health in emergency response efforts through the health cluster and the districts Public Health in Emergency Management Committees (PHMEC) though there are subcommittees within the health cluster managing specific health emergency response for

particular diseases. For example, Cholera response is led by the Cholera Case Management Committee guided by the Cholera Case management and treatment protocols with routine diarrhea diseases managed through the existing Integrated Management of Childhood Illnesses (IMCI) or the Integrated Community Case Management (iCCM) which has treatment protocols and algorithms for all childhood illnesses of diarrhea, Malaria and Acute Malnutrition. As regards nutrition the national level Nutrition response is led by the nutrition Cluster response with operationalization guided by the Community Based Management of Acute Malnutrition for treatment and management of acute malnutrition for children and Pregnant and Breastfeeding Women (PLWs) and Nutrition Care Support and Treatment (NCST) for treatment of acute malnutrition in adolescents and adults. However response efforts for other diseases like Malaria follow through routine processes of the Malawi National Malaria Response led by the Malawi National Malaria Control Programme (NMCP) whose work is guided by the National Malaria Strategic Plan 2023-2030 (NMSP) with immunization programming led by the Expanded Programme for Immunization (EPI) programme of Ministry Health.

The approach to nutrition programming in Malawi endeavours towards facilitating a comprehensive set of interventions that focuses on both treatment or recuperative and preventive activities and ensures a complete cycle with the immediate focus on treatment of acute malnutrition for children and PLW with Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM) and ensuring transition to nutrition and food security resilience among the nutritionally vulnerable groups. The government of Malawi established the Community Based Management of Acute Malnutrition (CMAM) to facilitate nutrition screening, treatment and management of Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM). Over the years, support towards the programme has significantly dwindled following the downward trend in acute malnutrition in the developmental context, however, there remain great gaps during emergencies where there is always heightened numbers of both SAM and MAM. The SAM component of CMAM continues to receive support from UNICEF with funding from USAID. Though UNICEF supports SAM, the needs during emergencies increase with nutrition cluster usually requesting for additional support from partners to address the increased needs for screening, treatment and management of acute SAM. As regards MAM, there is no existing funding for the MAM component following the phasing off of support from WFP in August 2019. The permanent gap in MAM puts children and PLWs at a risk of acute malnutrition deterioration thus increasing the risk to morbidity and mortality due to acute malnutrition. For example, the Cost of Hunger report of 2015 established that 23% of under-five deaths are due to acute malnutrition. This demonstrates that in Malawi malnutrition significantly exacerbates the rates of death among children thus slowing down the country's ambition to achieve the Sustainable Development Goal 3.4 of ending preventable deaths of newborns and children under five.

The non availability of funding for Specialised Nutritious Foods (NSF) for treatment of acute malnutrition has caused front line workers to slack off on active case finding or nutrition screening despite huge investments in capacity building from government and partners. The gap for active case finding has been hugely observed during the recent experience of Tropical Cyclone Freddy districts leading to likely at risk children, pregnant and breastfeeding women being missed for immediate nutrition treatment and support following the devastating impacts of the cyclone. As part of the tertiary level of prevention as per the climate health adaptation framework, the GCF project will have to incorporate targeted acute malnutrition treatment support to resuscitate and contribute towards reinstating active acute malnutrition and treatment in the health facilities targeted for the GCF project. The project will endeavour towards closing the gap of 25% SAM and MAM cases through procurement of SAM and MAM treatment supplies which will be managed through the existing MoH supply chain management for specialised nutritious food commodities.

In relation to Malaria, the programme will support additional prevention needs that will exist as a result of a changing climate. This includes malaria prophylaxis via Long Lasting Insecticide Nets (LLINs) and Seasonal Malaria Chemoprevention (SMC) to be administered through health care facilities. Seasonal Malaria Chemoprevention (SMC) is recommended by the World Health Organisation and involves the monthly administration of two antimalarial medicines to children from 3 to 59 months of age, during the season of high malarial transmission. Multiple trials in low-and-middle-income countries in Africa have demonstrated

the effectiveness and cost-effectiveness of the intervention and even more so when provided in combination with the malaria vaccine[220] (ref). SMC is not yet adopted or mainstreamed in Malawi, but the National Malaria Strategic Plan (2023-2030) recognises the potential role of SMC and 'embraces' efforts to explore and build the case for its integration[221]. This programme will target children in the TAs of two districts (approximately 90,000) for implementation of SMC, benefiting the recipient children and strengthening the in-country evidence base to support policy discourse.

LLINs have been a long-term feature of malaria control strategies globally and in Malawi, despite variances in usable life, quality and use that are also recognised in the national strategy. Discussions with district and national Ministry officials highlight that although nets are present and used in many households, gaps in availability remain. The programme will take a supplementary approach to the availability of LLINs from other sources, using programme resource in a targeted way. LLINs will be procured and allocated to each of the 25 programme TAs (proportionate to population) during years 2, 3 and 4. These will be targeted to pregnant and recently delivered mothers and their infants, at the local discretion and assessment of PHC health workers and community-based HSAs, and in conjunction with information and social and behavioural change approaches to improve appropriate use.

In relation to cholera and diarrhoeal outbreaks, as well as gender-based impacts of climatic events, the programme will also provide additional supplies of Oral Rehydration Solution, Zinc treatments and GBV, CEFM and SRH treatment supplies (such as post-exposure prophylaxis for HIV, HIV treatment, emergency contraception) through the health care facilities in all 25 target TAs. These supplies are essential for supportive treatment during cholera and diarrhoea outbreaks, as well as for treating the gender-based impacts of climate-related events; however, available supplies are inadequate and cannot meet the increased need that will result from climate-related events. These efforts will be augmented by the health promotion and health protection activities and messaging undertaken by the programme via health service and community-based HSAs, community groups and mobile programme outreach.

5.4 CLIMATE-RESILIENT NUTRITION APPROACHES

Climate induced impacts present both immediate or acute causes (illness and diseases) whose impact manifests as wasting and underlying causes of malnutrition which consequently manifests on a longer term as stunting. Climate resilient approaches for this project endeavours towards employing both recuperative or curative nutrition specific interventions that aim at treating severe or moderate acute malnutrition through specialized nutritious food products following confirmed acute malnutrition status through nutrition screening at community level or nutrition assessment at the health facility. Interventions will include facilitating active nutrition screening at the community level through the HSAs using Mid-Upper Arm Circumference (MUAC) tapes[222]; provision of Ready to Use Therapeutic Food to treat Severe Acute Malnutrition and provision of Corn Soy Blend (CSB) and vegetable oil or CSB++ for treatment of Moderate Acute Malnutrition). In Malawi management of acute malnutrition treatment is done through the Community Based Management of Acute Malnutrition Programme (CMAM) or at the community level through the integrated iCCM and CMAM programme in districts of Malawi. Though these are mainstreamed programmes within the MoH programming, recent experience with the Tropical Cyclone Freddy confirmed an increased risk to acute malnutrition following a climate impact. For example, the nutrition cluster update of April-May 2023, revealed that SAM and MAM admissions skyrocketed following the aftermath of TCF as per below figure:

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[220] Conteh L, Shuford K et al, Costs and Cost-Effectiveness of Malaria Control Interventions: A Systematic Literature Review, Value in Health. 2021; 24(8):1213–1222, doi: https://doi.org/10.1016/j.jval.2021.01.013;
Chandramohan D, Zongo I, et al, Seasonal Malaria Vaccination with or without Seasonal Malaria Chemoprevention, N Engl J Med 2021; 385:1005-1017 DOI: 10.1056/NEJMoa2026330

[221] Government of Malawi Ministry of Health (2023) National Malaria Strategic Plan (2023-2030) National Malaria Control Programme, Lilongwe

[222] MUAC tapes are predominately used to measure the upper arm circumference of children but also of pregnant women, helping identify malnutrition.

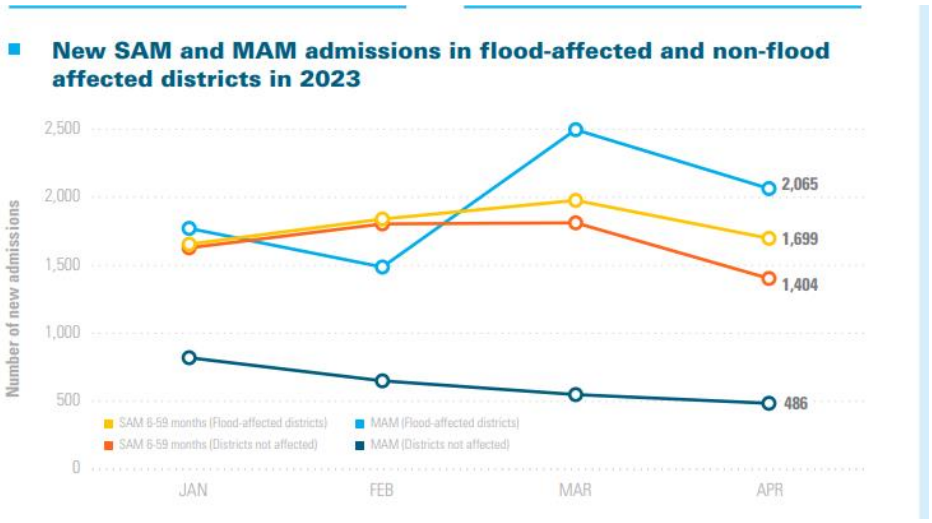


Figure 24 SAM and MAM admissions extracted from the UNICEF nutrition update bulletin for April-May 2023

The report further reveals that Malawi experienced a funding gap of US$ 5,652,953 which was required to achieve adequate coverage of nutrition interventions prioritizing the promotion of maternal, infant, young child and adolescent nutrition (MIYCAN) practices and the early identification and treatment of moderate and severe acute malnutrition. As of May 2023, Malawi had a low coverage of 35.7% of children 6-59 months targeted to be screened. The report observed the need for mobilizing more funding to scale up the early identification and referral activities and to procure treatment supplies during the aftermath of the Tropical Cyclone where more cases were expected. By the time of the report, only 45.9% of primary caregivers of children had been reached with education and counselling on infant and young child feeding and 46.2% of adolescent girls had benefitted from IFA supplements to help reduce anaemia susceptibility. The GCF project will fill in the heightened need on acute malnutrition during climate induced emergencies to increase coverage in identification and treatment of acute malnutrition which will contribute towards reducing the risk to mortality and morbidity due to acute malnutrition. Food insecurity serves as one of the underlying causes of malnutrition which is annually worse off during the lean months and is further exacerbated following a metrological climatic impact. The Nutrition cluster update report observed that the Cyclone hit Malawi as the country was experiencing one of the worst cholera outbreaks in Malawi's recent history. Within this, the trend in cholera cases amongst those affected by tropical Cyclone Freddy took a longer time to take a downward trend compared to other districts. Additionally, the impact of Tropical Cyclone Freddy increased concern about acute malnutrition due to an early onset of lean season as the Cyclone hit the districts close to the harvest season causing huge damage to already matured crops and livelihoods. The Integrated Food Security Phase Classification of August 2023, indicated that 3 million people representing 15 percent of the total population were experiencing high acute food insecurity IPC Phase 3, Crisis, in 28 districts and four cities. The situation was expected to prevail from June to September 2023 for the affected population. As such, the IPC called for immediate measures to be taken to protect livelihoods and reduce food consumption gaps. Additionally, an additional 5.9 million individuals were classified under IPC Phase 2, ie Stressed and necessitating the need for immediate intervention to mitigate disaster risks and protect their livelihoods. The IPC classified eleven districts classified to be in IPC Phase 3, Crisis, these include all the 5 GCF focussed districts in the Southern region: Balaka, Blantyre, Chikhwawa, Chiradzulu, Machinga, Mangochi, Mulanje, Nsanje, Phalombe, Thyolo and Zomba. The IPC MVAC report observed that key factors driving the situation included the various climatic shocks experienced throughout the district, mainly dry spells, cyclones and floods, leading to below average crop production; economic decline, including the effects of the war in Ukraine on fuel and commodity prices, the 25 percent devaluation of the Malawi Kwacha, high input prices, leading to high costs of production and the continued high food inflation leading to high food prices and low purchasing power.

The Malawi agricultural season, experiences a seasonal lean season almost every year and as such, the food insecurity situation is expected to worsen during the period from October 2023 to March 2024. In this projected period, 4.4 million people, representing 22 percent of total Malawians in the country will be in IPC Phase 3 or above (Crisis or worse).

To safeguard future food insecurities and reduce the risk to acute malnutrition following climate impact, the project will employ proven health centre, household, and group-led approaches to support integrated household farming (through own and provided agricultural inputs, health centre demonstrations, training, and peer-to-peer mentoring) of climate-resilient nutritious foods (plants, trees, and animals) , cooking demonstrations, and training on food preservation, processing, and storage to address seasonal food shortages. Supportive interventions at health service and community level (such as groups) have been shown to have a positive and protective effect on mental health and resilience, coping mechanisms and adaptive capacity, strengthened social networks and reduced isolation – factors that play a particularly important role for mothers and their infants in early life.

All districts have started integrated homestead farming (IHF) in varying qualities. Ideally some funding is used to identify additional role models during the review of the IHF to have a national team of trainers support the initial trainings with districts, including visits to the role models. Key trainers and role models in this approach are part of the Permaculture Network in Malawi and/or past IHF support projects. Examples of this approach in Malawi are listed below.

Area 25 Health Centre[223] has the largest and most comprehensive Permaculture programme which focuses on establishing a safe, nurturing environment for all patients receiving care at the facility, particularly pregnant women staying at the maternity waiting home. Waiting home clinicians and staff members hold daily classes on healthcare and skills development topics. Women are encouraged to take the knowledge and skills they learn back to their village, including family planning, maternal and infant care, nutrition, sustainable agriculture, home gardening, healthy cooking, and knitting and sewing. Permaculture design is a method of designing human-centred landscapes in an integrated manner that is harmonious with local ecological, cultural, and social backgrounds. It focuses first on formulating big picture plans in which we identify the major features of what will become the human landscape.

Permaculture Paradise Institute[224] quest is to eradicate hunger and poverty and improve self-reliance across the county. They offer hands on training and demonstration on organic agriculture and nutrition.

Ecolodgy[225] is a social enterprise that has built a community of passionate people with one thing in common, creating a better future for the planet. We believe we can change the world though smarter living, better farming, and expanded learning.

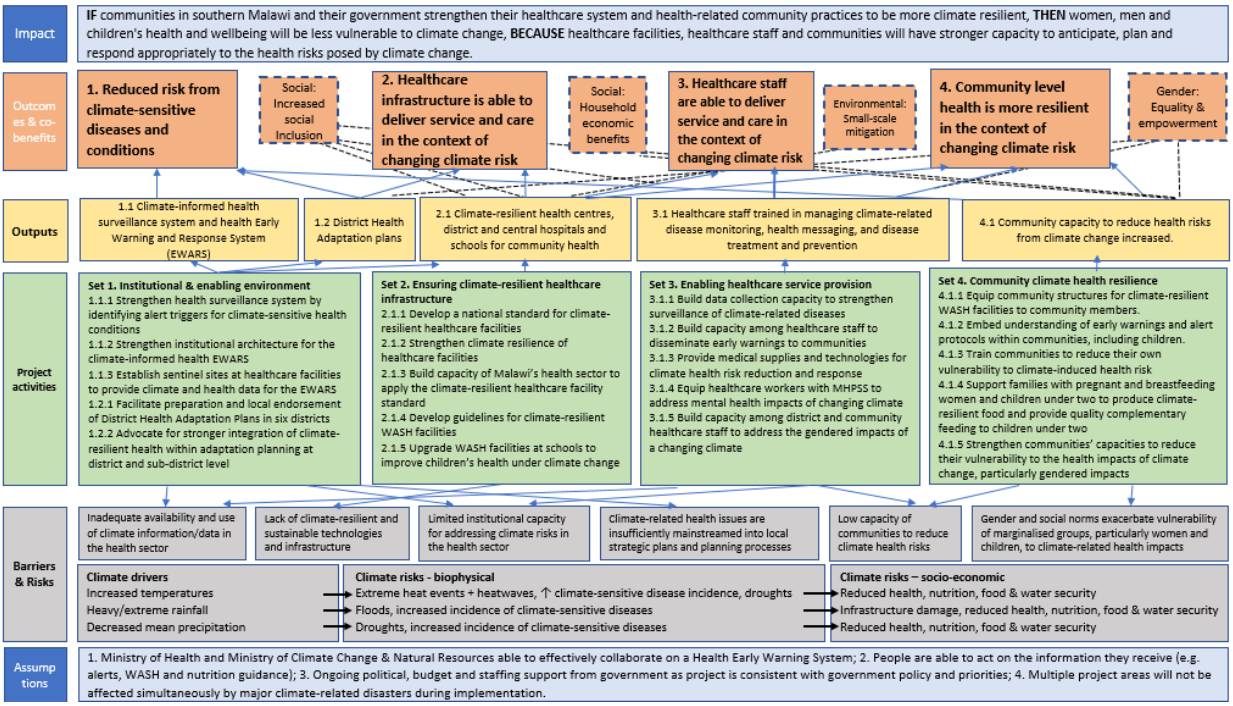
Mitongwe Training Center[226] in Malawi aims to create community-based environments of care and opportunities to achieve lives free from poverty. Their goals are all centred around the desire to offer ways to raise the health, food security, and future hope of those in poverty. They promote education through hands-on training, achievable improvements that will circle back into the villages and communities, for the benefit of all.

223 https://web.facebook.com/pages/Area-25-Health-Centre/405876476151678

224 https://www.facebook.com/permaculturetraining
225 https://ecolodgy.org
226 https://standasoneministry.com/mitongwe-woodland-reserve/

6. How will the Climate Resilient Health and Well-Being for Rural Communities in Southern Malawi project reduce climate change vulnerability?

6.1 *Theory of change*



6.1.1 The problem context

The theory of change starts from the problem that climate risk poses threats to human health. Increased temperatures and heat waves, extreme and variable rainfall, and extreme events frequency and magnitude are projected to change in the future (see Section 3.2). This has implications for health through a variety of mechanisms, including through effects on water and sanitation, food and nutrition security, the range and intensity of climate-sensitive diseases, health care availability and health care accessibility (see Section 3.3). These effects are exacerbated by vulnerability. For example, climate risk will increase disease burden (e.g., extreme temperatures cause heat stress and aggravate heat-sensitive diseases and conditions, changing seasonality affects malaria distribution through the year, heavy rainfall and floods increase diarrhoea and cholera) and a range of factors exacerbate vulnerability: poverty is high, and nutritional levels and dietary diversity are already generally poor, giving rise to weakened immune systems. An increased disease burden will reduce wellbeing, will likely increase poverty, and impede child development – with not everybody affected equally. At the same time, climate risks will compromise the ability of the system to provide healthcare, both through damage to facilities and limited accessibility, exacerbating the current deficits in the system; these deficits relate both to the state and upkeep of facilities, and to the presence and capacity of staff to be able to provide sufficient services.

6.1.2 Barriers

There are a number of current barriers that impede improvements to this situation.

Barrier: *inadequate availability and use of climate information/data in the health sector*: integrated surveillance (disease surveillance and weather surveillance) systems are key for enhancing the capacity of health systems to prepare and adapt to climate-sensitive diseases and conditions. Climate-informed surveillance can enhance the preparedness of health systems via early warning systems, which anticipate risks and trigger early warning responses to avoid or reduce impact and prepare for effective response. In the context of a rapidly changing environment and risk landscape, early warning systems are a valuable tool for building the adaptive capacity and climate-resilience of health systems. However, the extent of Malawi-specific knowledge on the links between climate parameters and climate-sensitive diseases and conditions is underdeveloped, and largely linked with low-resolution studies that cover the region. The absence of country-specific information contributes to gaps in integrated risk monitoring, early warning and response; thus, there is a lack of an integrated surveillance and climate-informed health early warning system in Malawi.

Barrier: *lack of climate-resilient and sustainable technologies and infrastructure*: the lack of specific attention to climate change impacts on the health sector also means that healthcare infrastructure is poorly prepared to deal with the impacts of climate exposure. The recent occurrence of multiple extreme events in the south of the country has further exposed the extent of impacts that arise from direct damage to buildings and supplies. This damage impedes the capacity of the sector to deliver healthcare both immediately after the event and in the recovery period and acts as a barrier to the achievement of a healthy population in Malawi. For example, in early 2022, Tropical Storm Ana resulted in the destruction of 47 Community Health Facilities in the Southern Region in the form of infrastructural damage, power cuts, loss of medicines, damage to medical equipment, vaccines and other supplies[227].

Barrier: *limited institutional capacity for addressing climate risks in the health sector:* There is limited institutional capacity to anticipate, prepare for and respond to the health risks of climate change and this is a further barrier to adaptation. At a broader level, there is insufficient institutional coordination between the Ministry of Health and Department of Climate Change and Meteorological Services to enable the functioning of an integrated surveillance and climate-informed health early warning system in Malawi. Within the healthcare system, healthcare staff do not have sufficient capacity to use climate-informed health surveillance and early warning and response systems; and are not aware of how climate change will affect health outcomes and how they need to alter their service delivery and messaging accordingly. They also lack sufficient resources (medical supplies and technologies) for climate health risk reduction and response. This means that health risks of climatic changes are overlooked and under-addressed, leading to poorer health outcomes, and an inability to sustain the healthcare improvements that have been attained over recent years.

Barrier: *climate-related health issues are insufficiently mainstreamed into local strategic plans and planning processes*: Whilst preliminary investigations of the links between health and climate have been undertaken, and a Health National Adaptation Plan (HNAP) drafted, these national-level efforts are not supported by strong institutional awareness or capacity at local level, and multi-sectoral collaboration on health and climate change is lacking at district and sub-district levels.

Barrier: *low capacity of communities to reduce climate health risks*: the lack of information and awareness around climate risks to health means that communities are not aware of the nature of a range of climate-related health risks. Without such knowledge, they are unable to take measures to reduce risk, which means that health burden from climate change will increase and undermine general health and well-being.

Barrier: *marginalised groups, particularly women and children, are more vulnerable to climate-related health impacts*: people have differential vulnerability to climate change and extremes. Marginalised groups are more likely to have lower adaptive capacity and higher sensitivity to the health impacts of climate change. Vulnerability to climate-sensitive diseases is often higher among women, children, the elderly, people with

[227] Department of Disaster Management Affairs (2022) Emergency Response Plan: Tropical Cyclone Ana.

disabilities, and the poor[228]. This differential vulnerability often arises from socially-constructed gender and social norms that give rise to differential resource allocation, decision-making and political participation. For instance, gendered roles accord responsibility for food provision to women. If agricultural production decreases as a result of a variable climate, this can lead to food and nutrition insecurity (Section 3.3.2, Annex 2). The stress created by such circumstances has impacts particularly on the mental health of women (Section 3.3.4, Annex 2). Increases in food and nutrition insecurity can lead to coping strategies that further reinforce gender inequality, for example pulling girl children from school and encouraging early marriage (Section 3.3.8, Annex 2). Food and nutrition insecurity affect particularly children under five, and young children are also particularly vulnerable to a number of climate-sensitive diseases and conditions.

6.1.3 Responses – the theory of change

Addressing this problem requires several dimensions. Reducing the risk from climate-sensitive diseases and conditions requires better surveillance, linked to early warning systems and modified public health messaging that is based on a sound understanding of the target communities and of their barriers and enablers to taking action on their health, and that is effectively communicated (including messaging around disease burden and reducing personal risk through WASH and nutrition). Reducing risk also requires a strengthened institutional environment. Ensuring that the healthcare system physical infrastructure is able to withstand climate risk requires that health centres are equipped to manage climate risk and exposure so that they are able to continue to deliver healthcare. Ensuring that healthcare staff are better prepared to manage the impacts of climate risk requires that they have the capacity to anticipate, respond to and track climate risk and modify their public health messaging, and that they have access to appropriate medical technologies for climate-health risk reduction. Ensuring that communities are better prepared to manage the impacts of climate change on health requires that citizens, as the target audience for healthcare systems, become healthier because they can access healthcare at all times, and they understand climate risks to their health and can manage them accordingly. Ensuring that harmful gender and social norms do not place health risks and poor life outcomes on the most impacted - women, girls and people with disabilities (PWD) – requires that communities and the health system address these harmful norms.

The **goal statement** of the project is that:

IF the health system in southern Malawi is strengthened in terms of governance, health and climate information systems, service delivery and community engagement,

THEN the negative impacts of climate change on the health of women, children and men will be reduced,

BECAUSE healthcare staff, facilities and communities will have stronger capacity to anticipate, plan and respond to climate-health risks.

The project aims to achieve impact through four interlinked outcomes:

• Outcome 1: Reduced risk from climate-sensitive diseases and conditions

This outcome will be realised by strengthening the health surveillance system and the health Early Warning and Response System to incorporate climate information (Output 1.1) as well as by enhancing adaptation planning for health in districts (Output 1.2).

• Outcome 2: Healthcare infrastructure is able to deliver service and care in the context of changing climate risk

This outcome will be achieved by climate resilience upgrades to health facilities under Output 2.1, which will also include improving school water supply for children's health (Activity 2.1.5), development and

[228] World Health Organization (2013) Protecting health from climate change: vulnerability and adaptation assessment. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/publications/i/item/protecting-health-from-climate-change-vulnerability-and-adaptation-assessment.

implementation of national standards for climate resilient health facilities (Activities 2.1.1. and 2.1.3), as well as creating guidelines for climate resilient WASH facilities at public buildings (Activity 2.1.4).

• Outcome 3: Healthcare staff are able to deliver service and care in the context of changing climate riskThis outcome will be achieved by delivering healthcare staff trained in managing climate-related disease monitoring, health messaging, and disease treatment and prevention (Output 3.1). This will require enhancing data collection for health surveillance (Activity 3.1.1.), boosting the capacity of healthcare staff to disseminate early warnings to communities (Activity 3.1.2), providing strategic medical supplies and technologies (Activity 3.1.3), and addressing climate impacts on health in terms of gender (Activity 3.1.5) and mental health dimensions (Activity 3.1.5).

• Outcome 4: Community level health is more resilient in the context of changing climate risk

This outcome will be achieved by strengthening community capacity for collective action and empowering communities to reduce the risks of climate change to their health (Output 4.1.) in terms of the project's key areas of early warning response (Activity 4.1.2), awareness and behaviour change (Activity 4.1.3), nutrition (Activity 4.1.4), gender (Activity 4.1.5) and WASH (Activity 4.1.1).

The potential for transformation comes from taking a multi-pronged approach that targets several pillars identified as the foundations of climate-resilient health systems – covering the institutional and enabling environment (Outcome 1), healthcare infrastructure (Outcome 2), enabling healthcare service provision, including through staff capacity (Outcome 3), and building community climate-health resilience (Outcome 4).

The project combines national, district, and local level interventions to create strong conditions for scalability, and strategic integration to catalyse the transition to a climate-resilient health system. By addressing the institutional and enabling environment at both national and district level, there is scope to establish critical mass among health staff in government and healthcare facilities so that districts not targeted directly by the project could take on board interventions, such as climate-resilient healthcare facility standards; whilst the health EWARS will be developed so that it can be used nationally and rolled out in target districts and health facilities. At district level, ownership by relevant staff at District Executive Council level will create sufficient momentum to increase the profile of climate in health planning. The comprehensive capacity strengthening of government health sector technical staff at national and district level, and healthcare staff and practitioners, recognises that a whole-of-system approach is necessary to gain the critical mass necessary to truly embed new practices. At community level, efforts will be tailored to the varied needs of different population groups, and Outcome 4 includes targeted support to the groups who are most physiologically vulnerable to food and nutrition insecurity from which so many other health problems typically stem.

Co-benefits

The project is expected to achieve social, environmental and gender co-benefits, namely:

Co-benefit 1 – Social: Improved social inclusion for marginalized community members, through increased access to public health information, cooperative management of community assets, and increased involvement.

Co-benefit 2 – Social: Improved social outcomes for household economies based on using improved integrated homestead farming and nutrition practices due to reduced need to purchase diversified food for nutritionally vulnerable household members

Co-benefit 3 – Environmental: Very small-scale mitigation co-benefits through solar installations at health facilities reducing reliance on diesel generators at facilities and on the national electrical grid.

Co-benefit 4 – Gender: Increased gender equality and empowerment, through improved knowledge of climate change impacts on gender issues, community-level training and engagement on gender roles and

dynamics, women-focused training on nutrition, and increased women's participation and influence in decision-making.

6.1.4 Assumptions

For the project's theory of change to be realised, a number of assumptions need to hold.

The Ministry of Health (as the custodian of the health EWARS) and the Ministry of Climate Change & Natural Resources (as the producer and custodian of weather and climate information) need to be able to effectively collaborate on a climate-informed health EWARS. The roles and responsibilities around provision of early warning information can vary, for example the Department of Climate Change and Meteorological Services (DCCMS) issues warnings of extreme weather but, if that were foreseen to lead to risks to human health (through extreme heat or potential disease outbreaks), then it is likely that Ministry of Health should issue that warning. Activities under Outcome 1 aim to strengthen the institutional relationship between the two bodies to enable this. Precedents exist for such institutional arrangements between different ministries, as river-related flood risk warnings are currently issued by the Ministry of Water and Sanitation, informed by weather information from DCCMS. However, achieving Output 1.1 (Climate-informed health surveillance system & Early Warning and Response System) assumes that these linkages will be able to be strengthened.

The success of Output 4.1 (Community capacity to reduce health risks from climate change increased) is contingent upon the assumption that people are able to act on the information they receive (e.g. alerts, WASH, and nutrition guidance) in order to reduce their risk. Outcome 4 focuses strongly on providing information to communities (enabled by Outcomes 1, 2 and 3 which ensure that the institutional, infrastructure and staff capacity are in place to generate and provide this information). Comprehensive efforts are made to build capacity and provide people with the tools to make climate resilient health decisions, and the assumption is that people will be able to act on this. However, as outlined above, Malawi is an extremely poor country with low levels of development which means that, in general, people have low access to assets. This means, for example, that comprehensive efforts to increase understanding of the importance of nutrition and dietary diversity may be effective in raising awareness but if putting that knowledge into practice requires resources (land, access to inputs, time) and those resources are not available, then the envisaged outcomes may not be achieved. The project focuses on approaches that use limited land, inputs that are renewable locally, and are easy to implement and sustain. The social differentiation of these capacities has been recognized within the Gender Action Plan (Annex 8) and the broader targeting, together with supporting interventions where required (for example provision of inputs to support stronger nutrition among pregnant and breastfeeding women and mothers of children under two under Outcome 4).

The overall success and sustainability of the project is based on the assumption that there will be ongoing political, budget, and staffing support from government. Aligning the project with existing policy frameworks and ensuring that the outputs contribute to commitments in those policies, does what is within the sphere of control of the project, however, for the longer-term impact to be achieved, ongoing government support is required. Extraneous circumstances such as high-level political change can alter national development priorities and goals, and hence the assumption here is that current commitments remain.

The final assumption is that multiple project areas will not be affected simultaneously by major climate-related disasters during implementation. Although the long-term aim is to build resilience of the health system, this resilience-building will be a scaffolded process over time and the occurrence of severe or repeated extreme events would run the risk of impeding progress, not least because the attention of the health sector, facilities, and staff would be diverted into emergency response.

6.1.5 OUTCOME 1: Reduced risk from climate-sensitive diseases and conditions

The activities under this outcome will: i) enable better surveillance of diseases and conditions related to climate change; ii) enhance the use of climate information in the health sector for effective health early

warning; and iii) build institutional and human capacity to increase community health adaptive capacity in line with the draft GCF Sectoral Guide on Health & Well-being. These activities will address the barrier of inadequate availability and use of climate information/data in the health sector, the barrier of limited institutional capacity for addressing climate risks in the health sector and the barrier that climate-related health issues are insufficiently mainstreamed into local strategic plans and planning processes. The project will produce greater understanding of the associations between climate data and the incidence of the target diseases/conditions, as well as develop Malawi-specific thresholds and alert trigger levels through studies and validation for the target diseases/conditions.

Output 1.1 Climate-informed health surveillance system and health Early Warning and Response System (EWARS)

Activity 1.1.1 Strengthen the health surveillance system by identifying alert triggers for key climate-sensitive health conditions

Malawi's health sector has a Health Management Information System (HMIS) in place that includes surveillance of disease outbreaks, but currently these are not analysed in concert with weather conditions. This means there is a limited local evidence base to inform the design of a climate-health EWARS. Additional evidence is needed to add resolution to the understanding of disease patterns in relation to weather variables in Malawi. At the same time, and using this information and existing knowledge on the linkages between climate and different diseases and conditions, alert triggers need to be set that distinguish different potential levels of threat for different diseases and conditions. These include diseases linked to high/extreme heat exposure, malaria, cholera and diarrhoea, and drought-linked malnutrition. The alert triggers will, in turn, inform the transmission of early warning information should the thresholds be reached through surveillance or anticipation. Triggers will be calculated based on a combination of threshold levels for climate-related indicators, with incidence of disease for our target diseases. There is current ongoing work by the Ministry of Health, the Department of Climate Change and meteorological services, and several academics and technical consultants to develop a functioning health EWARS at national level, in four pilot districts for malaria, with some nascent work on understanding associations between climate data and cholera incidence. The work under the proposed project would build on existing research conducted by these institutions, and scale-up the rollout of the EWARS to five additional districts through the establishment of sentinel sites. The final datasets to be utilised will be narrowed down as part of the project activity. The work of strengthening the health surveillance system by identifying alert triggers for key climate-sensitive health conditions will be a collaborative effort between: Save the Children; the Ministry of Health; the Met office through the Department of Climate Change and Meteorological services (DCCMS); the Environmental Affairs Department (EAD); the Department of Disaster Management Affairs (DODMA); academics; and technical consultants – either individuals or a firm / specialist agency. The collaboration will be facilitated by establishing a committee at the start of the project, who will then meet regularly to oversee the work of the consultants, and the consultants will provide regular updates and present the ongoing work. With regards to the health surveillance system, there is an integrated disease surveillance and response strategy in country, where 43 diseases/conditions are reported upon on one tool (which is an improvement from the past where each disease had its own surveillance system). For many diseases/conditions, such reporting is monthly or quarterly, but for epidemic-prone diseases – which includes malaria and cholera, two of the focus diseases for this project – reporting occurs on a weekly basis. With regard to acute malnutrition and diseases/conditions linked to high/extreme heat, there are no platforms for surveillance of either in place. For these diseases/conditions, the project currently aims to contribute towards a climate-informed EWARS that is not linked to disease surveillance (though during the implementation of the project activities, the potential to leverage current health services activities to conduct acute malnutrition surveillance will be explored).

This activity will: i) improve the existing health surveillance system to incorporate climate information; and ii) set alert triggers for specific diseases and conditions. Targeted studies and expert validation will be undertaken for each of the diseases/conditions, followed by validation by the HCCCT and relevant national

and district-level stakeholders. Malawi-specific thresholds for the climate-sensitive diseases and conditions will be determined via collaboration with relevant ongoing and planned efforts, in order to ensure integration of expertise and findings from MoH, DCCMS, international organisations such as the World Health Organisation, and national and international research initiatives by universities and the private sector. This applies in particular to malaria and cholera where significant international work and some efforts in Malawi on prediction models and thresholds are ongoing or planned.

This activity incorporates the following sub-activities:

1.1.1.1 Establish and support a task team under the HCCCT to convene the process of determining Malawi-specific thresholds and setting alert trigger levels.
1.1.1.2 Determine Malawi-specific thresholds and warning levels for diseases linked to high/extreme heat exposure.
1.1.1.3 Determine Malawi-specific thresholds and warning levels for malaria.
1.1.1.4 Determine Malawi-specific thresholds and warning levels for diarrhoeal disease/cholera.
1.1.1.5 Determine Malawi-specific thresholds and warning levels for malnutrition linked to drought.
1.1.1.6 Arrange 2 multi-stakeholder validation activities with national and district level representatives with HCCCT (each combining 2 of the 4 studies).

Activity 1.1.2 Strengthen the institutional architecture for managing the ongoing operation of the climate-informed health Early Warning and Response System (EWARS)

Significant national efforts in Malawi have been made to improve the availability of weather and climate information (including through the GCF-funded project FP002) and to disseminate this to different sectors who take responsibility for issuing sector-specific alerts. However, to date this climate information has not been utilised adequately in the health sector. This project activity will build from the GFCS Adaptation for Africa project's pilot and align with World Health Organisation-supported efforts to support the MoH in Malawi to strengthen health surveillance and early warnings.

The proposed project will improve the institutional architecture for effective communication of weather and climate information from the DCCMS to the MoH. At this stage, there are no well-established forums which meet regularly with a fully-functioning committee, terms of reference or similar administrative processes. The project will include strengthening the forum between the two ministries that enables communication of weather and climate information, and interpretation of what this information means for particular diseases and conditions, in order to develop the health EWARS so as to integrate climate information. The intention of the proposed project is to establish a more concrete forum governed by a committee, which will meet at least on a quarterly basis for governing purposes, with clearly-defined processes for sharing data between the two organizations, including information about precisely which kind of data will be shared and the regularity. Outside of the quarterly governance meetings, there will be more regular communications (at least weekly) between technical and data colleagues regarding weather alerts and automated sharing of data, which links to the technical system already in development by WHO MOH and DCCMS. In the case of longer-term weather and climate information (for example seasonal forecasts and climate projections), this forum should enable interpretation in order to inform annual planning; whilst in the case of short-term information (for example sub-seasonal weather through to extreme event alerts) this forum should facilitate rapid communication across scales from national to district level and through to members of the public. There is currently no structured, formal platform that combines met and health surveillance data, as such the objective is to ensure the linkage between the two: either ensuring that met data also includes epidemiological data (linking to the data generated from the health surveillance system in the sentinel sites), or having epidemiological data generated as part of the met data sets.

The resulting climate-informed health EWARS will be integrated with existing Common Alert Protocols and potentially integrated with other Early Warning Systems and surveillance that focus on physical safety and livelihoods protection. The institutional architecture will enable communication beyond national level to district and local level through the MoH (from national to district level, and through media targeting the

public) in alignment with the current communication channels, thereby adding a climate dimension. Training manuals and guides will be developed with and for all levels, building on the current modules and curricula used by Malawi College of Health Sciences and in training of HSAs. The knowledge and skills of health staff (at national level and at district level beyond the six target districts) in terms of the existence and functioning of the climate-informed health EWARS will be enhanced. The project will also specifically build the capacity of relevant national-level technical staff for the long-term operation and sustainability of the system beyond donor-funded projects.

At community level, to ensure that the information reaches the most marginalised and vulnerable people, the project will assess the accessibility needs of target communities, and develop inclusive communications to respond to their access to technology, literacy-levels, work patterns (paid and unpaid), and other potential barriers. This effort will ensure gender-responsiveness and social inclusion. Based on examples in other sectors, this approach may involve participatory scenario planning processes with intermediary actors, or more passive dissemination through (community) radio and existing formal and informal governance structures.

This activity incorporates the following sub-activities:

Strengthen linkages between relevant parties (including DCCMS, MoH) at national level by convening an appropriate coordination committee and defining TORs.

Strengthen appropriate mechanisms for cascading information from the climate-informed health EWARS from national to local level through MoH, and ensure that these mechanisms are functional for the 6 target districts.

Support the convening of quarterly meetings of the national committee (1.1.2.1) for oversight and management (including monitoring and evaluation of alert dissemination and use).

Build skills and knowledge of the climate-informed health EWARS among health staff at national level and in non-project districts (project target district staff covered in Activities 3.1.1 and 3.1.2).

Provide updates and in-service training on the health EWARS for disaster management staff at national and district level, including awareness raising in national disaster risk management coordination fora and annual multi-hazard contingency planning.

Activity 1.1.3. Establish sentinel sites at selected healthcare facilities to provide improved climate and health data for the health Early Warning and Response System (EWARS)

Designating selected healthcare facilities as sentinel sites will provide better data for the surveillance and prediction of climate-sensitive diseases, specifically malaria and cholera, from strategic geographical locations. The locations of the sentinel sites will be selected based on the needs of the health system, such as geographical gaps in health surveillance, and the location of existing nearby automatic weather stations run by the Department of Climate Change and Meteorological Services (DCCMS). The sentinel sites will send health surveillance data to the District Health Information System and the national Health Management Information Service. This health surveillance data will then be combined with the meteorological data to improve modelling, predictions and responses in the health EWARS. This activity will expand the approach already used jointly by the MoH and the WHO for the existing sentinel site for malaria at the Zomba central hospital. Additional sentinel sites will be established in the other five project target districts besides Zomba. Healthcare staff and information technology staff at the sentinel sites will receive dedicated training under Activity 3.1.1 to collect good quality data at the necessary time interval (e.g. weekly rather than monthly) to enable the use of the WHO-supported prediction models for malaria and cholera in the national health EWARS. This will be done in line with the recommendations of Malawi's National Digital Health Strategy 2020-2025 and building on the Monitoring, Evaluation and Health Information Systems Strategy (MEHIS) 2017–2022. In cases where the new sentinel healthcare facilities

lack essential information technology equipment (such as computers, tablets or reliable internet connections), the project will also invest in providing such equipment to the healthcare facilities where the MoH can guarantee funds for the long-term operation and maintenance of the equipment. The sentinel site health facilities – which are typically hospitals – will also benefit from increased and better quality data from health centres in their surrounding areas. Therefore, in addition to the focus on the sentinel sites, the project will also invest in providing essential data collection equipment to these surrounding health centres, to complement the training provided to staff at healthcare facilities on data collection under Activity 3.1.1.

This activity incorporates the following sub-activities:

1.1.3.1 Select locations of sentinel site healthcare facilities.

1.1.3.2 Put in place arrangements and essential equipment for the selected healthcare facilities to function as sentinel sites.

1.1.3.3 Provide essential technological equipment for health data collection at health centres.

Output 1.2: District Health Adaptation plans

Activity 1.2.1 Facilitate preparation and local endorsement of District Health Adaptation Plans in six districts

District Health Adaptation Plans (DHAPs) will be developed in alignment with but localising the priority actions of the Health National Adaptation Plan. This development will include analysis of the nature of district-specific climate risks to health, including vulnerability based on the age, gender, and disability profile of the district population, together with gender-responsive and socially-inclusive actions that reflect multisectoral risk management approaches to health risks; risk communication and prevention strategies; mechanisms to direct resources in case of new disease outbreaks/surge capacity (linked to the health EWARS); protocols and policies informed by current and likely future climatic conditions; and emergency management coordination measures to anticipate and respond to climate events affecting public health (linked to the health EWARS).

The process of DHAP generation will mirror the typical consultative nature of other district planning documentation. Stakeholder inputs will be solicited through consultations with district staff in other sectors, non-government stakeholders, and community consultations in selected locations to provide inputs to a plan, produced in alignment with and informed by other relevant district planning documents (for example the District Development Plan, the District Socio-Economic Profile). The draft plan will be presented and validated in a multi-stakeholder forum prior to district-level endorsement. To ensure effective implementation of the plan, awareness of climate change risk to health and the actions in the DHAP will be raised among district council members, and community health action groups, through a one-day training in the 25 target TAs across the six districts who will ultimately be responsible for implementation. Community health action groups will be provided with a visual aid summarising the DHAP contents, and supported logistically to ensure they are able to cascade this inclusively to community level, ensuring comprehensive awareness of the DHAP across priority TAs. Budget is also allocated for quarterly meetings at district level to monitor implementation and provide opportunity for course correction. In order to ensure that this process of DHAP production and implementation can be replicated to other TAs within the target districts, and to other districts in Malawi, a toolkit will also be developed that outlined the process of developing and implementing a DHAP, including the actions that need to be taken at district, community health action group and community level. Building capacity at district and subdistrict levels in the operationalization of the DHAPs (District Health Adaptation Plans) will facilitate generation of lessons learnt and best practices that will inform improvement of the NHAP (National Health Adaptation Plan) at the higher level. Human health and climate coordinators (from the MoH) at the district level will generate data (at the district and sub-district levels) and share it with the national-level human health and climate coordinators. The project will facilitate a robust monitoring and feedback system between the two levels of human health and climate coordinators, via existing platforms, for instance, the Human Health and Climate Change Coordination Team, that is

chaired by the MoH through the national climate change and health manager. Conversely, the HNAP serves as an overarching document for health and climate work and therefore serves to provide strategic and implementation guidance to the DHAPs.

The DHAPs will be endorsed by appropriate local authorities and accompanied by an action plan with timeframes, costs and a definition of roles and responsibilities of the parties, which will support advocating for budget allocation and coordinating stakeholders' efforts at the district and community levels. A tool for district and traditional authority health climate risk assessment and adaptation planning will be developed in collaboration with the MOH and other relevant ministries, that will support planning efforts in districts not targeted through the proposed GCF project.

This activity will incorporate the following sub-activities:

1.2.1.1 Assess the state of knowledge of climate change risks to health among district-level government staff (across sectors) in 6 project districts.
1.2.1.2 Based on the results of 1.2.1.1, build capacity to understand the dimensions of climate change risk to health at district level of government staff (across sectors) in 6 project districts.
1.2.1.3 Enable production of DHAPs in each of the 6 project districts (facilitating district inputs through consultation, drafting, validating and presenting for adoption).
1.2.1.4 Build capacity to implement the DHAPs across sectors at district level (district council).
1.2.1.5 Build skills and knowledge on climate change risk to health and for implementation of the DHAPs to community health action groups in the 25 target TAs across 6 districts.
1.2.1.6 Support cascading of knowledge on climate change risk to health and implementation of the DHAPs by community health action groups to village members.
1.2.1.7 Develop a toolkit for use in other (non-target) districts on how to develop and implement a DHAP at district, community health action group and community level.

Activity 1.2.2. Advocate for stronger integration of climate-resilient health within adaptation planning at district and sub-district level

In addition to DHAPs, this activity recognises that holistically addressing climate and health risk requires mainstreaming of climate and health into broader development planning activities, through the structures and processes that are activated to develop district and national development plans. This approach requires active engagement with other parties that are involved in planning processes: the District Planning Director's office; the DEC offices that are responsible for disaster risk reduction, climate adaptation and other sectoral planning; and the area and village committees whose development plans feed into the district one. Active engagement will further be achieved through enabling more inclusive governance, and the integration of usually-excluded voices and perspectives – such as women and girls' organisations, as well as children and young people's voices – into these village, area and district level planning processes, and through supporting coalition-building at district and national level. Thus, the advocacy activities will take place at different levels, from national level coalition-building, to district-level engagements and development of action plans, to engagement of key population groups at community level (facilitated by the project working in collaboration with other civil society groups to build the advocacy agenda and conduct specific engagements with key decision makers).

At the district level, the project will use the existing governance structures, for instance, the District Executive Committees, that are responsible for overall development work at the district level. Working with key members of the District Executive Committees, such as the Director of Planning and Development, the project will facilitate high visibility and prioritisation of health and climate in the District Development Plans and District Profiles. Civil society actors that exist within the districts (which varies by district, for instance these could consist of international NGOs and/or local NGOs), youth groups, and key actors from across relevant sectors (e.g. health, education, climate change and natural resources) will be engaged.

Coalition-building meetings will be organised nationally, as well as in the six target districts, with other organisations/networks that work on climate adaptation, disaster risk reduction, and sectoral planning; and joint advocacy strategies and action plans will be developed collaboratively with non-government groups. At national level, there are a number of platforms that can be used to facilitate the advocacy and coalition-building work, to build the climate change/health agenda and prioritise it. For example, there is a Civil Society Network on Climate Change (that has its own youth network as a separate entity); there are the Cabinet, Principal Secretary and Parliamentary Committees on Social Services; there is the Malawi Health Network and Coalition on Universal Health Coverage. There will also be a Project Steering Committee established under the project that can be used to facilitate advocacy and coalition-building given the set of actors that will be involved (see Section 1.4, as well as Section B.4 of the Full Proposal).

The representation and inclusion of marginalised voices (e.g., women and girls' organisations, children and young people) will be strengthened during the processes described above. In line with the UNCRC General Comment 26 on Environment with a special focus on climate change, which calls on governments to protect children from the adverse impacts of climate change, the project will facilitate children and young people's engagement in community, district and national level advocacy on issues of climate impact on health and work with them on holding duty bearers accountable on addressing most urgent needs.

This activity will incorporate the following sub-activities:

1.2.2.1 Organize coalition-building meetings nationally and in the 6 target districts with other organizations/networks that work on climate adaptation, disaster risk reduction, and sectoral planning, in order to ensure integration of climate-resilient health planning, integration of health in adaptation and disaster risk reduction, and to leverage resources and increase impact.
1.2.2.2 Collaborate with other (non-government) groups to develop joint advocacy strategies and action plans.
1.2.2.3 Strengthen representation and inclusion of marginalised groups within coalitions (1.2.2.1) and policy consultations (1.2.2.2) to ensure evidence-informed policy.
1.2.2.4 Review plans in the 6 target districts (District Social Economic Profile, District Development Plans and District Budgets on health, climate change and disaster) in order to establish their status and strategic entry points for influencing.
1.2.2.5 Advocate for stronger inclusion and integration of climate-resilient health in district planning processes.

6.1.6 OUTCOME 2: Healthcare infrastructure is able to deliver service and care in the context of changing climate risk

This outcome focuses on ensuring that healthcare system physical infrastructure (for example health centres, district and central hospitals) is able to continue providing healthcare services in light of climate risk, for example increasing temperatures, variable rainfall and flood risk. There is dual emphasis on highlighting what such modifications look like, which can be used beyond the six districts of focus and by the non-government health care providers, as well as tangible climate resilience-building in health facilities that deliver free health services to the public. This effort addresses the barrier of a lack of climate-resilient and sustainable technologies and infrastructure. In addition to improving the overall climate-resilience of health facilities, schools will be targeted for improved water facilities, given their critical position as community centres serving a majority of children within their communities, as well as parents and carers. The stakeholder consultations conducted as part of the project design found that existing water sources in schools were almost universally below adequate standard. Given the clear links between climate change, water-borne diseases, water security and overall health (described in Annex 2: Section 3), improving WASH at schools will have a large positive impact on health and the ability to adapt to climate impacts across the project districts by increasing the number of people with improved water quantity and quality.

Output 2.1 Climate-resilient health centres, district and central hospitals and schools for community health

Activity 2.1.1: Develop a national standard for climate-resilient healthcare facilities

The WHO has provided extensive guidance on how to best strengthen the climate resilience of physical infrastructure, and the green hospital concept[229], but this guidance has not been tailored to the Malawi context. In Malawi there are different grades of healthcare facility: outpost, dispensary, clinic, health centre, district hospital and central hospital, each with different catchment areas and capacities. This activity will translate the WHO guidance to the Malawi context, highlighting the various options for strengthening the climate resilience of these different types of facilities, taking into account aspects such as construction standards and design, sustainable energy supply (including for vaccine cold chains, lighting, water pumping), sustainable WASH (including water-use efficiency), ventilation/cooling and supply of technology to enable effective surveillance of climate-sensitive health conditions. It will also include and build upon Save the Children's existing knowledge on how to ensure gender-responsiveness and social inclusion, including of people with disabilities and children, when designing infrastructure and public facilities. This standard will be produced through a consultative process. This standard can subsequently be used by the MoH when commissioning/upgrading infrastructure throughout the country, expanding the reach beyond the six target districts of the project.

This activity will incorporate the following sub-activities:

2.1.1.1 Undertake a multi-level consultative process to develop and validate a national standard for climate-resilient healthcare facilities, incorporating gender-responsiveness and social inclusion in the standard.

2.1.1.2 Develop and deliver training on the national standard to health infrastructure planners in the public and private sector at national level.

Activity 2.1.2 Strengthen climate resilience of healthcare facilities

Building on the guidance developed under Activity 2.1.1, this activity will apply the standards to build the climate resilience of a range of health facilities in the 6 project districts, to increase the likelihood that they are able to continue to provide health care services, through reliability of lighting, cold chain for medical supplies, and WASH. Physical interventions will be in line with Save the Children Australia's ESS Accreditation of Category C. Informed by district and community health adaptation plans, and the concept of green hospitals[230], these interventions will include: i) solar energy systems to improve energy supply in order to enhance climate resilience, i.e. solar energy for vaccine cold chains, lighting, water pumping and cooling fans and ii) improved WASH facilities, i.e. rainwater harvesting systems, water filters, hand-washing facilities.

As part of the installation of equipment, suitable staff working at the health facilities will be trained in basic operations and maintenance for both solar equipment and WASH equipment, and local artisans will be identified within short distances to the facilities, who can conduct larger-scale repairs. In addition to local artisans, health facilities will be linked to service providers and suppliers who can provide replacement parts for equipment and complete more technically-demanding maintenance tasks as needed. Infrastructure maintenance staff within the district offices of the MoH will also receive training to oversee the operations and maintenance of solar and WASH equipment at health facilities. The regular government budgets for health facility infrastructure at the district level should include provision for the long-term operation and maintenance of solar and WASH equipment installed through the project.

In order to maximise the learning potential from this activity and so that the process can easily be replicated elsewhere, a standalone tool will also be produced, building on the guidance produced under Activity 2.1.1. This tool can be used by healthcare facilities to screen their current facilities against climate risk, taking into

[229] WHO (n.d.) Healthy hospital, healthy planet, healthy people. Addressing climate change in health care settings. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/docs/default-source/climate-change/healthy-hospitals-healthy-planet-healthy-people.pdf?sfvrsn=8b337cee_1.

account aspects such as construction standards and design, climate-resilient and sustainable energy supply (including for vaccine cold chains, lighting, water pumping and ventilation), sustainable WASH, supply of technology to enable effective surveillance of climate-sensitive health conditions, and gender-responsive and socially-inclusive facilities.

This activity will incorporate the following sub-activities:

2.1.2.1 Assess the extent of alignment of 79 health care facilities in the 6 project districts with the national standard developed under 2.1.1.1; and finalise the prioritisation of planned climate resilience strengthening activities.

2.1.2.2 Scope, undertake tender process and oversee service providers applying modifications to strengthen resilience of healthcare facilities.

2.1.2.3 Develop a standalone tool (building on 2.1.2.1) for use in determining climate resilience strengthening needs of healthcare facilities for use nationally and in other districts.

2.1.2.4 Establish maintenance committees at facility level with responsibility for protecting and maintaining equipment

2.1.2.5 Deliver training on equipment upkeep and establish links to nearby service providers and suppliers

Activity 2.1.3 Build capacity of Malawi's health sector to apply the climate-resilient healthcare facility standard

Recognising the transformative potential of this project beyond the six target districts, training will be provided in the application of the climate-resilient healthcare facility standard developed in Activity 2.1.1. Training will take place through the MoH at national level and will include national MoH staff, staff from the six target project districts, and their counterparts from Malawi's other 22 districts. This approach will increase the likelihood that the standard is applied nationally going forward, and thus contribute to transformation of the health system at scale. This capacity building will also target the non-government healthcare sector (i.e. private not-for-profit institutions like CHAM health facilities, of which many are subsidised by the government to deliver essential healthcare services free of charge to the public and other not-for-profit institutions) which serve up to a quarter of Malawians in certain areas[231], as well as the small number of private for-profit institutions in Malawi in order to promote broad uptake across the country's health system.

This activity will incorporate the following sub-activities:

2.1.3.1 Design and deliver training on the climate-resilient healthcare facility standard (2.1.1) and the associated screening tool (2.1.2.3) to health infrastructure planners at national level and in non-project districts.

2.1.3.2 Organise study visits for health infrastructure planners from national level and non-project districts to resilient healthcare facilities upgraded by the project.

Activity 2.1.4 Develop guidelines for climate-resilient WASH facilities

Beyond healthcare facilities, there are other public buildings where lack of climate-resilient WASH often leads to their use being impeded, particularly in periods of drought and flood. This includes public buildings, such as government offices, and schools. To address this gap, guidelines will be created for developing climate-resilient WASH facilities and retrofitting existing facilities, with a particular focus on public buildings,

[231] WHO – Regional Office for Africa (n.d.) WHO Malawi Country Cooperation Strategic Agenda (2017–2022). World Health Organization – Regional Office for Africa, Brazzaville, Republic of Congo. Available at: https://www.afro.who.int/sites/default/files/2019-08/World%20Health%20Organization%20Malawi%20Country%20Cooperation%20Startegy%202017%20to%202022.pdf.

such as government buildings and schools. These guidelines will complement the Malawi Climate Resilient WASH Financing Strategy[232] to reduce the rehabilitation costs of WASH infrastructure. The process of developing the guidelines will be consultative and include representation at national level and from at least one district (recognising that the challenges faced are similar across all districts, even if the exact nature of climate risk differs). To ensure that necessary gender and social inclusion considerations are included in the guidelines, marginalised groups (women, girls, disabled people, the elderly, etc.) will also be consulted. The guidelines will consider the most environmentally appropriate and economically efficient methods according to geographical location and climate conditions. For instance, for sanitation facilities the guidelines might include the use of eco-san toilets and protection walls for latrines to reduce the likelihood of contamination during floods. For water facilities, the guidelines may include rainwater harvesting, water filters and water re-use systems. The guidelines will also consider important gender and social inclusion considerations, such that WASH facilities are designed and constructed to include safety, accessibility and convenience in terms of location, lighting, menstrual hygiene management, accessibility for disabled people, etc.

This activity will incorporate the following sub-activities:

2.1.4.1 Undertake multi-level consultative process to develop and validate guidelines for climate-resilient WASH facilities.

2.1.4.2 Build skills and knowledge (based on guidelines developed in 2.1.4.1) of health and education sector staff at national level and in 6 project districts to design and manage climate-resilient WASH facilities.

2.1.4.3 Advocate for guidelines on climate-resilient WASH facilities to be applied in the health, education and other sectors.

Activity 2.1.5. Upgrade WASH facilities at schools to improve children's health under climate change

Building on the guidelines developed under Activity 2.1.4, this activity will implement climate-resilient WASH solutions at public schools across the 25 target TAs, in selected villages from the 500 villages targeted under Outcomes 2 and 4. To provide additional safe water supply for enhanced resilience to droughts, floods and heat, rainwater harvesting systems will be installed at schools. These systems will consist of 5,000 and 10,000 litre ferrocement tanks, which withstand floods better and last longer than plastic tanks, and can be built and repaired by local artisans. Rainwater harvesting systems will include the necessary filtration devices to provide water safe for drinking. In addition, small-scale water treatment solutions for existing water points at schools and hand washing facilities will also be installed where appropriate. The provision of clean water is not only crucial to reduce the transmission of diseases such as cholera but is also a key component of adapting to high temperatures and extreme heat events, by allowing people to hydrate sufficiently. The improved WASH facilities at schools will benefit not only school children, but also teachers, parents and other people in the community near schools. School facilities are also more numerous and used by more people more frequently than healthcare facilities. This intervention aligns with existing policies and strategies in Malawi such as the Malawi Climate Resilient WASH Financing Strategy[233]. A maintenance committee consisting of school staff and community authorities and members (including representatives from among the youth, women/girls and disabled people) will be established and/or strengthened at each school to take responsibility for the upkeep of the WASH facilities. There will

[232] Government of Malawi & UNICEF (n.d.) Malawi Climate Resilient WASH Financing Strategy 2022 – 2032. UNICEF Malawi, Lilongwe, Malawi. Available at: https://www.unicef.org/malawi/media/7831/file/Malawi%20Climate%20Resilient%20WASH%20Financing%20Strategy%202022-2032.pdf.

[233] Government of Malawi & UNICEF (n.d.) Malawi Climate Resilient WASH Financing Strategy 2022 – 2032. UNICEF Malawi, Lilongwe, Malawi. Available at: https://www.unicef.org/malawi/media/7831/file/Malawi%20Climate%20Resilient%20WASH%20Financing%20Strategy%202022-2032.pdf.

also be coordination at district level with the Ministry of Education, which is responsible for WASH at schools.

This activity will incorporate the following sub-activities:

2.1.5.1 Select schools in target communities, based on needs assessment of schools.

2.1.5.2 Scope, undertake tender process and oversee service providers to implement rainwater harvesting and other small-scale WASH solutions at schools.

2.1.5.3 Establish and train maintenance committees on WASH technologies, including school authorities and community authorities and members.

6.1.7 OUTCOME 3: Healthcare staff are able to deliver service and care in the context of changing climate risk.

This outcome will address the need to build the capacity of healthcare staff to know how climate risk will alter public health risks, how they can inform surveillance of conditions, how they can effectively interpret and disseminate the messaging from the climate-informed EWARS, and how they can better anticipate and support presenting physical and mental health needs in their communities. It addresses the barrier of inadequate availability and use of climate information/data in the health sector, and the barrier of limited institutional capacity for addressing climate risks in the health sector. This outcome will also take the opportunity to integrate gender awareness and training, so that healthcare workers are empowered to target their services and ensure gender-responsiveness and social inclusion.

Output 3.1 ,Healthcare staff trained in managing climate-related disease monitoring, health messaging, and disease treatment and prevention

Activity 3.1.1. Build data collection capacity to strengthen surveillance of climate-related diseases

Given that climate change will alter the nature of disease burden, data analysts, and technicians working in healthcare facilities within the districts, and HSAs who work in communities, need to be empowered to understand what type of surveillance inputs are required to augment the existing District Health Information System and inform the EWARS. This activity comprises a needs assessment of staff in these positions across the six project districts to inform the pitching and subsequent decision of a training course which will be delivered at national level to all relevant district data analysts and technicians. This will also include especially staff from the sentinel healthcare facilities established under Activity 1.1.3. Subsequent district-level trainings will be undertaken in each district to cascade the training to the relevant HSAs. The trainings will include collecting data at the necessary time intervals and geographic scale, data collection protocols, and data quality.

This activity will incorporate the following sub-activities:

3.1.1.1 Assess state of knowledge of climate change impacts on health among healthcare staff in 73 facilities in 6 districts.

3.1.1.2 Design and deliver trainings on surveillance operation for healthcare staff, data technicians and data analysts.

Activity 3.1.2 Build knowledge and capacity among district and community healthcare staff on climate and health and how to use the EWARS alerts

Alongside establishing the climate-informed EWARS (under Output 1.1) and training healthcare staff and data technicians to input appropriate surveillance data under Activity 3.1.1, it will be essential to train healthcare staff at district and community level on how to understand and interpret the alert system developed for the target diseases and conditions (diseases linked to high/extreme heat exposure, malaria, cholera and diarrhoea, and drought-linked malnutrition). Concomitantly, it will be essential to train

healthcare staff on how climate risk will alter public health risks more broadly (i.e., beyond the EWARS-linked target diseases and conditions), and how they can better anticipate and support the range of climate-related physical and mental health impacts in their communities.

Whilst such information will cascade through the MoH, it will be district staff and primary health care workers, including the HSAs, who will have the primary responsibility for further disseminating this information to community members. Since there are regularly new entrants to the primary health care provision system, and all will similarly need to be trained, it will be necessary to run such training regularly and, for sustainability of local capacity-building, the most appropriate model will be to establish a cadre of national trainers who can be deployed as per their availability. This cadre of trainers is likely to be drawn from both government and non-government representatives currently active in the health and/or climate spaces, and should be gender representative. Trainings will then be run from healthcare facilities, covering resident staff and the HSAs that work under each facility.

There are already significant lessons that can be learned around the communication of climate information to other user groups, including from MCLIMES (FP002). Existing insights into the communication of climate information show that there are strong gender differences, which often partly reflect gender roles and responsibilities: for example men may be happy to receive information remotely through mobile phone push notifications, for example through SMS; whilst women have typically shown a preference for personal contact when receiving information, for example through people personally delivering messages in spaces that women frequent given gender roles such as around water points, churches or health centres[234]. Healthcare staff will also be trained on ensuring inclusive access to such information for people with disabilities who may be unable to read or hear. This activity will entail training on these communication methods and how to ensure inclusive communication of messages to enable equitable risk reduction and adaptation.

This activity will incorporate the following sub-activities:

3.1.2.1 Design and obtain MoH endorsement of a training course on climate and health and the utilisation of early warning alerts from the climate-informed EWARS.

3.1.2.2 Establish and build capacity of a national cadre of trainers on climate and health and the utilisation of early warning alerts from the climate-informed EWARS.

3.1.2.3 Build the knowledge and skills of district staff and health facility staff in 73 facilities on climate and health awareness and how to use the surveillance system and warning alerts (using national cadre of trainers).

3.1.2.4 Assess state of knowledge of climate change impacts on health among community healthcare staff (HSAs and Senior HSAs [SHSAs]) in 25 TAs in six project districts.

3.1.2.5 Build the knowledge and skills of community healthcare staff (HSAs and SHSAs) in 25 TAs in six project districts on climate and health awareness and how to use the alerts from the climate-informed EWARS (using national cadre of trainers and district staff).

3.1.2.6 Training of community healthcare volunteers (part of village health committees) by senior HSAs and HSAs trained in 3.1.2.5 on climate and health knowledge and the dissemination of warning alerts.

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[234] Coulibaly, Y.J. et al. (2015) Which climate services do farmers and pastoralists need in Malawi? Baseline Study for the GFCS Adaptation Program in Africa. CCAFS Working Paper no. 112. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark. Available at: https://gfcs.wmo.int/sites/default/files/projects/Global%20Framework%20for%20Climate%20Services%20Adaptation%20Programme%20in%20Africa%20%28GFCS%20APA%29%2C%20Phase%20I%2C%20-%20Building%20Resilience%20in%20Disaster%20Risk%20Management%2C%20Food%20Security%20and%20Health/WP%20112_Baseline%20Malawi.pdf.

Activity 3.1.3 Provide medical supplies and technologies for climate health risk reduction and response

Whilst increased knowledge and understanding can reduce risk, the changing nature of climate risk for health creates additional needs for medical supplies and technologies for reducing the incidence of climate-sensitive diseases and conditions, which will be provided as part of this activity. This will involve ensuring that climate risk and the forecasted climate conditions over the coming season are used to inform the current district planning processes, which will be enabled by the capacity built among district executive committee members on climate and health risk under Outcome 1.

The activity will also support the additional prevention and treatment needs that will exist as a result of a changing climate. This includes malaria prophylaxis via Long Lasting Insecticide Nets (LLINs) and Seasonal Malaria Chemoprevention (SMC) to be administered through health care facilities. Seasonal Malaria Chemoprevention (SMC) is recommended by the World Health Organisation and involves the monthly administration of two antimalarial medicines to children from 3 to 59 months of age, during the season of high malarial transmission. Multiple trials in low-and-middle-income countries in Africa have demonstrated the effectiveness and cost-effectiveness of the intervention and even more so when provided in combination with the malaria vaccine[235]. SMC is not yet adopted or mainstreamed in Malawi, but the National Malaria Strategic Plan (2023-2030) recognises the potential role of SMC and "embraces" efforts to explore and build the case for its integration[236]. This programme will target children in the TAs of two districts for implementation of SMC, benefiting the recipient children and strengthening the in-country evidence base to support policy discourse.

LLINs have been a long-term feature of malaria control strategies globally and in Malawi, despite variances in usable life, quality and use that are also recognised in the national strategy. Discussions with district and national Ministry officials highlight that although nets are present and used in many households, gaps in availability remain. The programme will take a supplementary approach to the availability of LLINs from other sources, using programme resource in a targeted way. LLINs will be procured and allocated to each of the 25 programme TAs (proportionate to population) during years 2, 3 and 4. These will be targeted to pregnant and recently delivered mothers and their infants, at the local discretion and assessment of PHC health workers and community-based HSAs.

The importance and role of approaches that are integrated with up-stream vector control and larval source management are well acknowledged by the Government of Malawi and this is reflected in the national strategy, with activities previously funded by the Global Fund and President Malaria Initiative. Historically, they supported the implementation of Indoor Residual Spraying in four high-burden districts until 2022, including the programme-focus district of Mangochi.

However, currently the government has de-prioritised Indoor Residual Spraying and larval source management for the application of current funding mechanisms (including Global Fund and PMI) due to the overall and relative costs of these interventions, verses LLINs, which have been prioritised. Protective household behaviours in relation to effective use of LLINs are also focused on within programme community/group resilience activities (Outcome 4 – 4.1.3).

The programme will also provide additional supplies of Oral Rehydration Solution and Zinc treatments through the health care facilities in all 25 target TAs, essential for supportive treatment during cholera and diarrhoea outbreaks, but where available supplies are sometime inadequate. This will be augmented by the

[235] Chandramohan, D. et al. (2021) Seasonal malaria vaccination with or without seasonal malaria chemoprevention. New England Journal of Medicine 385:1005-1017. Doi: 10.1056/NEJMoa2026330; Conteh, L. et al. (2021) Costs and cost-effectiveness of malaria control interventions: a systematic literature review. Value in Health 24:1213-1222. doi: https://doi.org/10.1016/j.jval.2021.01.013.
[236] Ministry of Health, Government of Malawi (2023) National Malaria Strategic Plan (2023-2030). National Malaria Control Programme, Ministry of Health, Lilongwe, Malawi.

health promotion and health protection activities and messaging undertaken by the programme via health service and community-based HSAs, community groups and mobile programme outreach.

The impacts of increasing droughts under climate change on subsistence agriculture lead to increased malnutrition, especially among children who are the most vulnerable. Malnutrition during childhood has long-term and life-long negative impacts on people's health and thus reducing childhood malnutrition is key to enhancing people's overall resilience to climate change[237]. Therefore, this project activity will include delivering proven, cost-effective methods for treating the additional burden of childhood malnutrition linked to climate change, i.e. therapeutic feeding for treatment of acute malnutrition (Ready to Use Therapeutic Food for Severe Acute Malnutrition, and Corn Soy Blend (CSB) and vegetable oil or CSB++ for Moderate Acute Malnutrition), which will be provided on the basis of screening and identification by HSAs using assessments based on MUAC tapes. The provisions will be procured with the additional climate risk-related needs for the six project districts funded through the project. Reflecting the gendered nature of health vulnerability, this activity will proactively target the most vulnerable groups (women, people with disabilities, children) and thus contribute to equitable risk reduction and adaptation.

The project will use the existing platforms and coordination mechanisms for quantification, procurement, distribution, and delivery of supplies - the Health Technical Support Services (HTSS) - that USAID plays a significant role in, to maximise efficiency. All supplies, including LIINs, Oral Rehydration Solution and Zinc, and therapeutic feeding (when active), use this centralised mechanism. Districts Health Offices arrange distribution and collection of combined district-specific supplies directly from the Central Medical Stores.

This activity will incorporate the following sub-activities:

3.1.3.1 Review the process of identifying annual needs for malaria prevention (LLINs and Seasonal Malaria Chemoprevention) and the supply of medication and propose modifications (e.g., to timing, quantities, targeting-building on 1.1.3.1) if necessary, when considering climate risk.

3.1.3.2 Review the process of identifying annual needs for supply of diarrhoea treatment and propose modifications (e.g., to timing, quantities, targeting-building on 1.1.4.1) if necessary when considering climate risk.

3.1.3.3 Review the process of identifying annual needs for supply of therapeutic and supplementary feeding and propose modifications (e.g. to timing, quantities, targeting-building on 1.1.5.1) if necessary, when considering climate risk.

3.1.3.4 Annually review results of 3.1.3.1-3.1.3.3 to allocate funding to needs.

3.1.3.5 Develop and document procurement process (including security of supply) for procuring supplies to meet needs identified in 3.1.3.1 for malaria prevention.

3.1.3.6 Develop and document procurement process (including security of supply) for procuring supplies to meet needs identified in 3.1.3.2 for diarrhoea treatment requirements exacerbated during cholera for children under 5 years.

3.1.3.7 Develop and document procurement process (including security of supply) for procuring supplies to meet needs identified in 3.1.3.3 for therapeutic and supplementary feeding.

3.1.3.8 Activate annual procurement processes as appropriate reflecting decisions made in 3.1.3.4.

[237] UNICEF (2012) Fed to fail? The crisis of children's diets in early life. 2021 child nutrition report. UNICEF, New York, USA. Available at: https://www.unicef.org/reports/fed-to-fail-child-nutrition.

3.1.3.9 Support rollout of malaria prevention (LLINs and Seasonal Malaria Chemoprevention).

3.1.3.10 Support rollout of supplementary diarrhoea treatment (ORS + Zinc).

3.1.3.11 Support rollout of therapeutic and supplementary feeding for children under 5 years and pregnant and breastfeeding women.

Activity 3.1.4 Equip healthcare workers with MHPSS capacity to address mental health impacts of a changing climate

Considering the growing evidence that climate risk poses additional threats to mental health, particularly for women, and as a direct result their children (see Annex 8: Gender Assessment), this activity aims to expand the capacity of Maternal Newborn and Child Health and PHC health workers to identify and provide better MHPSS-informed support to communities within their daily health practice. This involves assessment of current practice norms relating to and impacting on MHPSS in existing MNCH and PHC services in the project target districts to inform the development of contextually appropriate capacity-building materials and job-aides, adapted from existing Save the Children tools that have been developed, tried and tested in different contexts. These include packages for building and integrating practical skills of health workers in PHC and young child health, specifically addressing the intersection between MHPSS, maternal wellbeing and Infant and Young Child Feeding (IYCF), that have been used with success internationally[238]. Additionally, increasing the MHPSS capacity of healthcare workers will include increasing their capacity to respond appropriately to the increasing need for support for women, girls, men and boys impacted by GBV, CEFM and loss of access to/availability of SRH services.

The assessment of current practice norms relating to and impacting on MHPSS in existing MNCH and PHC services in the project target districts will also, crucially, assess the extent to which healthcare workers understand the links between a changing climate and mental health and wellbeing. Given that data and practice are not yet at a stage where specific alert triggers can be set to distinguish different potential levels of threat for different mental health and wellbeing conditions, training materials and job aides will need to address how healthcare workers can use short-term (e.g., sub-seasonal weather forecasts, extreme event alerts) and longer-term (e.g., seasonal forecasts, climate projections) weather and climate information to prepare for expected changes in different mental health and wellbeing conditions, based on what is currently known about the links between a changing climate and mental health and wellbeing.

These complementary training materials and job aides will be complemented by a telephone-based clinical support mechanism for PHC and community-based health workers by connecting them to more experienced clinical advice at hospital level within the health system, about appropriate provision of clinical support and management for specific cases, and recognising that referral options are frequently very limited. As with Activity 3.1.2, the regular entry of health care providers into the system will necessitate that training is run regularly, and so in order to be sustainable and build local capacity, a cadre of national trainers will be trained who can then provide this training as needed.

This activity will incorporate the following sub-activities:

3.1.4.1 Review how MHPSS aspects are included in existing Maternal Newborn and Child Health and PHC services in 6 project districts, and outline process for strengthening climate risk-related MHPSS where appropriate

3.1.4.2 Adapt existing tools and training packages on climate-related MHPSS in Maternal Newborn and Child Health and PHC services to the Malawi context and obtain appropriate endorsement by MoH.

[238] It is used in Yemen (now adopted into Yemeni Ministry of Health national guidelines) and Palestine amongst others, and currently being introduced in Somalia and Nigeria.

3.1.4.3 Establish and build capacity of a national cadre of MNCH and PHC health workers as trainers using materials developed in 3.1.4.2.

3.1.4.3 Build the knowledge and skills of district health, social work and disaster response staff, and HSAs and SHSAs, for climate risk-related MHPSS in existing MNCH and PHC services (using national cadre of trainers from 3.1.4.2.

3.1.4.4 Establish mechanism for providing clinical support to healthcare staff identifying climate risk-related MHPSS needs through existing MCNH and PHC services.

Activity 3.1.5 Build capacity among district and community healthcare staff to address the gendered impacts of climate change

Reflecting the evidence that climate change impacts GBV, CEFM and SRHR, this activity aims to expand the capacity of healthcare staff at district and community level to identify and provide appropriate support to communities (beyond increasing mental health and psychosocial support as outlined in Activity 3.1.4). This involves the assessment of current practice norms relating to and impacting on GBV, CEFM and SRHR in the project target districts; the understanding of healthcare workers of the links between a changing climate and changes in GBV, CEFM and SRHR; and a review of existing protection mechanisms and services for GBV, CEFM and SRHR in the community and different government institutions (e.g., women's shelters, focal points at local police stations trained in GBV, etc.).

It will be essential to train healthcare staff at district and community level on the importance of GBV, CEFM and SRHR, how to overcome barriers including familial reluctance and harmful social norms and beliefs, and how to provide GBV, CEFM and SRHR services, including family planning methods. Given that data and practice are not yet at a stage where specific alert triggers can be set for increases in the incidence of GBV, CEFM and loss of access to SRH services, training will need to address how healthcare workers can use short-term (e.g., sub-seasonal weather forecasts, extreme event alerts) and longer-term (e.g., seasonal forecasts, climate projections) weather and climate information to prepare for expected increases in GBV, CEFM and loss of access to/quality of SRH services, based on what is currently known about the links between these issues and a changing climate. Finally, where GBV/CEFM/SRHR protection services and mechanisms may exist in the community and/or other government institutions, healthcare staff will be trained on the existence and operation of these, so that they can refer patients appropriately for further support.

Recognising that climate risk will increase the number of girls and women in need of treatment for GBV, CEFM and SRH, this activity will also review current processes for identifying annual needs for GBV, CEFM and SRH treatment supplies (e.g., post-exposure prophylaxis for HIV, HIV treatment, emergency contraception, safe abortion services) and propose modifications (e.g., to timing, quantities) if necessary, in light of expected climate risks. This step is a necessary first step to move towards improved procurement processes for procuring supplies to meet the increasing need for treatment for GBV, CEFM and SRH under a changing climate. This activity will also provide some support to meeting additional needs for treatment supplies, targeting the areas of greatest need.

This activity will incorporate the following sub-activities:

3.1.5.1 Assess the state of knowledge and practice regarding climate-related GBV, CEFM and SRHR among district and community healthcare staff in the 6 project districts; further, identify and catalogue existing protection mechanisms and services for GBV, CEFM and SRHR in the community and different government institutions

3.1.5.2 Consult women and girls in the communities, including women and girl activists, to solicit their perspectives and inputs on climate-related GBV, CEFM and SRHR issues and needed support.

3.1.5.3 Based on the results of 3.1.5.1 and 3.1.5.2, design and obtain MoH endorsement of a training module on climate and GBV, CEFM and SRHR, adapting any Malawi-specific existing tools and training packages, for inclusion in the training provided under Activity 3.1.2.

3.1.5.4 Build the knowledge and skills of district and community healthcare staff in 6 districts on climate and GBV, CEFM and SRHR (using national cadre of trainers from 3.1.2.2), including designating and training specific providers with clear responsibilities related to the care of survivors.

3.1.5.5 Review the process of identifying annual needs for GBV, CEFM and SRH treatment supplies and propose modifications (e.g., to timing, quantities) if necessary, based on expected climate risks.

3.1.5.6 Review the results of 3.1.5.5 to allocate funding for procurement of selected GBV, CEFM and/or SHR treatment supplies (targeting the areas of greatest need) and support rollout/dispensation of treatment.

6.1.8 OUTCOME 4: Community level health is more resilient in the context of changing climate risk
This outcome will address the need to raise awareness, strengthen skills and knowledge for collective action, and empower community members including other influential community health actors such as Traditional Healers, on the nature of climate risk to health and what individuals can do to better manage their risk. It addresses the barriers of low capacity of communities to reduce climate health risks, and of marginalised groups, particularly women and children, being more vulnerable to climate-related health impacts, and also provides an opportunity to embed Save the Children's tried-and-tested approaches to community engagement for collective action, empowerment, social and behaviour change, and promotion of equality. Capacity strengthening activities will build on Save the Children's strong experience in inclusive and participatory training methods, expanding existing toolkits and materials where appropriate (e.g., on nutrition). Capacity strengthening and training will be provided by qualified trainers in collaboration with relevant government departments and staff as well as Malawian academic institutions and international experts as appropriate. This will include established mechanisms such as the train-the-trainers approach.

Output 4.1 Stronger community capacity to reduce health risks from climate change.

***Activity 4.1.1 Equip community structures to provide knowledge and skills for climate-resilient WASH facilities to community members*.**

Climate change poses risks to safe water, sanitation, and hygiene, and ensuring that communities are aware of these risks and know how to manage them is essential. The impact of lack of water on young children was noted as a particular concern by women in the stakeholder engagement (Annex 8: Gender Assessment) and is also a cause of significant mental stress; disruption caused to WASH facilities (at schools) caused more problems to girls than to boys (Annex 8: Gender assessment); water and sanitation scarcity makes it more difficult for women and girls to manage menstrual hygiene which in turn limits their participation in school, workplace, and community (Annex 2: Section 3.3). This activity will use as its basis the guidelines for climate-resilient WASH facilities developed through Activity 2.1.4 to train complementary groups of people in the six project districts through a cascade mechanism, whereby existing structures are engaged to apply new knowledge and skills with wider community members, teachers and leadership to strengthen capacity through which tailored content and messages can be further shared and disseminated (making this a cost-effective approach). These groups will consist of Area Civil Protection Committees (ACPC), VHCs, and group village level traditional leaders, and the training will focus on the importance of and how to design community-level WASH facilities, on the basis that this understanding can then be cascaded through to villages and community members. This training will be facilitated by district-level training-of-trainers from health and education departments (so that teachers and health facilities operations and maintenance staff are able to implement and manage climate-resilient WASH in their institutions and homes). The initial training will be provided by a cadre of trainers from the national level, and all trainings will seek to include women. A core component of the training will emphasise the gender and social

differences in vulnerability to WASH-related issues, and the importance of ensuring that climate-resilient WASH is appropriately designed (including designed so as to reduce the risk of GBV), clean, safe, private and dignified, as well as accessible to other socially-marginalised groups (e.g. people with disabilities), in order to contribute to equitable adaptation. It will also highlight the importance of ensuring that particular efforts are made to include women, the elderly, youth, and people with disabilities in the cascade of training beyond ACPC and traditional leadership, and district health and education officials. This activity will also support the formation of management, maintenance and monitoring groups, led by women who will have been appropriately trained, to ensure that community-level WASH facilities remain safe, clean and accessible over time.

This activity will incorporate the following sub-activities:

4.1.1.1 Strengthen capacity of Area Civil Protection Committees (ACPC) and traditional leadership at group village level to understand and cascade knowledge on the design, implementation and management of climate-resilient WASH facilities (using cadre of trainers).

4.1.1.2 Train district and facility health and education staff on the design, implementation and management of climate-resilient WASH facilities.

4.1.1.3 Train women and support the formation of management, maintenance and monitoring groups, and reporting mechanisms, to ensure that community-level, climate-resilient WASH facilities remain safe, clean and accessible as they are designed to be.

Activity 4.1.2 Embed understanding of early warnings and alert protocols within communities, including children.

To complement the training of healthcare staff under Output 3.1 to understand and effectively communicate health EWARS information , this activity focuses on sensitizing and engaging communities to the meaning of the information and messages and appropriate responses so that, upon receipt, they are able to reduce their risk or know how to respond. This will be conducted through multiple channels to maximise efficiency through the chances of repeated content from different and trusted sources. Stakeholder engagement and data collection (Annexes 2 and 7) highlighted that many actors are involved in supporting early warnings of various types and targeting various groups through a diversity of project activities. Given the time that will have elapsed by the time of implementation, the first activity will be to update the analysis of who is working in these spaces in each district as a prerequisite to finalising tangible plans, which will seek out complementarities wherever possible to maximise efficiency. This will inform district-specific plans throughout the project implementation period that contain a structured and scaffolded process of awareness raising, community capacity strengthening for collective action, and sustained community engagement to ensure that the capacity of all members of the community is strengthened to receive, understand, and be able to act on early warning alerts. The district-specific plans will be developed by the implementation partner in collaboration with government officers from all relevant sectors.

Building on the capacity strengthening of health care staff to communicate early warning alerts, this activity will allow for the co-creation, pre-testing and provision of community-focused training materials and tools. These will be self-explanatory and typically visual materials appropriate and feasible to local context (which do not require literacy to understand). These can be used and distributed by health care staff, as well as distributed through other community mechanisms, for example through village health committees and civil protection committees, and local formal and non-formal leadership. They will be supplemented by other media, for example spots on community radio that remind of alert levels and action protocols (with the topic linked to the time of the year – for example malaria early warning information and messages prior to the onset of the rainy season; early warning messaging on cholera at the height of the rainy season when flood risk is higher). This activity will particularly target two groups: schools and the marginalised and vulnerable.

There is an emerging practice of effective disaster risk reduction training in schools, making children aware of Early Warning System alerts (non-health-specific) and actions to reduce and respond to risk (and a similar model is applied in other Save the Children GCF project proposals, for example FP184). School children will be targeted for specific awareness raising of early warning messages through materials that can be distributed through schools, and guidance for teachers on how to integrate this into the existing curriculum. This is partly because children need to understand early warning alerts on their own accord, but also because children have the potential to lead efforts as agents of change, influencing their peers, younger siblings and families, and passing crucial information to adults. Transmission of information is an important activity, considering low levels of literacy in some communities in Malawi.

Recognising the difficulty of "last mile" communication to vulnerable groups, dedicated attention will also be paid to particularly marginalised and vulnerable groups, including out-of-school children, the elderly, and people with disabilities (including children). These groups will be identified through the district youth and district social welfare officers and dedicated efforts will be made to ensure that they receive content in appropriate formats.

This activity will incorporate the following sub-activities:

4.1.2.1 Co-create and design process for awareness raising, training, and sustained community engagement over the project lifespan to build capacity to receive, understand, and act on early warning alerts.

4.1.2.2 Co-create, develop and deliver community-focused training materials and tools on early warnings and alert protocols using multiple media and channels.

4.1.2.3 Co-create with children and teachers, develop and distribute training materials for primary and secondary schools on early warnings and alert protocols and climate-resilient health and wellbeing, and guidance for teachers on using these within existing curricula.

4.1.2.4 Co-create, develop and distribute appropriate training materials on early warnings and alert protocols and climate-resilient health and wellbeing for out-of-school children, the elderly, people/children with disabilities (as identified by the district youth officer and district social welfare officer)

Activity 4.1.3 Train communities to reduce their own vulnerability to climate-induced health risk

Once healthcare staff have, themselves, been trained in climate risk to health and how to provide surveillance and adapt public health messaging, and engage communities, (in Output 3.1) they will be able to participate in similar training that engages community members to organise for collective action and raise awareness of how to reduce their own vulnerability to a broad range of climate-induced health risks, while supporting and role modelling improvements to their own health infrastructure and homes. This will include engagement and two-way dialogue sessions with Traditional Healers, who remain trusted and influential health actors across many parts of Malawi and frequently used by community members, particularly in rural areas.

The range of public health risk from climate change is variable and often socially-differentiated. This activity will develop a screening tool that considers multiple dimensions (e.g., physiological, occupational, gender vulnerability including GBV and CEFM, etc.) for use by individuals to identify the nature of climate risk to health to different individuals (e.g., themselves and their family members). This helps to highlight those most affected by climate and health risks, and segment audiences who can engage with content specifically tailored to their circumstances and situation. Content will be disseminated throughout the districts through Outcomes 3 and 4. Efforts could include public campaigning on climate and health risk through community events, including a mobile climate and health promotion unit that will travel through the six project districts distributing relevant information on early warning (using materials produced as part of Activity 4.1.2) as well as relevant health content targeting heat stress and highly heat-sensitive diseases and conditions (e.g. cardiovascular, respiratory, adverse pregnancy and birth outcomes), malaria, cholera and diarrhea,

nutrition and dietary diversity, mental health, GBV, CEFM and SRHR. The health content will include ensuring that community members have knowledge of what services are available (e.g. GBV protection services) to them to support them concerning the above-mentioned diseases and conditions. Linking with 4.1.2 and 4.1.5, events could include community theatre and discussion, to engage audiences in two-way communication around certain climate related health conditions leading to community household and collective action. The aim is fort individuals to have the knowledge, skills and competencies to manage their own risk and be effectively supported by the provision of improved quality health services and consistent, accurate and timely information through multiple and trusted channels. To support the dedicated content, this activity will also identify and capitalise upon opportunities to integrate climate and health content into other fora and channels. This includes programmes that are being used in the health, water, and agriculture and gender sectors, and the existence of community training materials that are already being used in these sectors. Particular focus in this activity will be placed on raising awareness of the socially-differentiated risk of climate-related health conditions.

There is widespread recognition of the importance of formative research to develop appropriate social and behaviour change communication[239]. Formative research allows understanding of the motivators/enablers and barriers to desired behaviours among target audience(s), so that content, interventions, messages and programmes are created that are specific to the needs of the target community, and as such that they are appropriate, acceptable as well as feasible – all key components for the successful uptake of interventions / content / messages by the target audience(s). Formative research is also essential for determining how best to reach each target audience with the relevant content , and how frequently content needs to be delivered and the audience exposed. These kinds of considerations are particularly important when considering how to reach marginalised and vulnerable groups, including out-of-school children, the elderly, and people/children with disabilities.

This activity will incorporate the following sub-activities:

4.1.3.1 Co-create, develop and distribute screening tool to enable assessment of individual risk (e.g., occupational, physiological, gender vulnerability etc.) to climate change health impacts.

4.1.3.2 Conduct formative research among target communities to develop appropriate and targeted content, interventions and messages, to enhance the likelihood that communities will take actions to reduce and respond to health risks.

4.1.3.3. Identify effective entry points and trusted sources and platforms for integrating climate-informed public health content and messaging by assessing other programmes, their structures used for delivery (e.g., group-based approaches) and targeting

4.1.3.4 Assess community-level materials (training, awareness-raising, SBC and key materials) produced through different ministries (health, water, agriculture, gender) to identify opportunities to adapt and integrate climate-informed public health content and messaging.

4.1.3.5 Apply formative research findings to work through appropriate channels with programmes (4.1.3.2) and sectors (4.1.3.3) to integrate climate-informed public health messaging into existing relevant materials and opportunities.

4.1.3.6 Co-create, design, equip and enable a mobile climate and health promotion unit and events programme for continuous engagement that inclusively strengthens capacity to manage individual and collective health risk from climate change.

[239] E.g., USAID (2012) Understanding formative research: methods, management,
and ethics for behaviour change communication: facilitator's guide 2012. USAID, Washington DC, USA. Available at: https://pdf.usaid.gov/pdf_docs/PA00JR68.pdf; CARE (2014) Formative research: a guide to support the collection and analysis of qualitative data for integrated maternal and child nutrition program planning. CARE, Atlanta, Georgia, USA. Available at: https://www.behaviourchange.net/document/37-formative-research-guide.

4.1.3.7 Engagement of Traditional Healers to orientate them to the project, discuss information about the impact of climate and health, their perceptions of climate and health, and their role in strengthening community knowledge, and capacities for adaptation.

4.1.4 Support families with pregnant and breastfeeding women and children under two to produce climate-resilient foods and provide quality complementary feeding to children under two

Existing development and adaptation deficits mean that chronic food and nutrition insecurity exists in Malawi, with significant proportions of the population requiring annual food aid in the "lean season" when the April harvest runs out 8-12 weeks after harvesting. The first 1,000 days from when a child is conceived until their second birthday is a period of particular vulnerability to this food and nutrition insecurity and also the wellbeing of the caregivers they rely upon[240]. This vulnerability is compounded by food loss and waste, and approaches to complementary infant and young child feeding that under-utilises diverse foods available because of lack of understanding of good nutritional practices. When infants and young children are not fed the right foods at the right time and in sufficient quantities, it has long-lasting effects on their survival, growth and development[241].

Recognising the current deficits, this activity will target malnutrition-vulnerable groups, e.g., households with pregnant women, breastfeeding mothers, and/or children under 2, by providing tangible support to enable these households to realise the food and nutrition security and dietary diversity on which they have been trained and make best use of available foods to support their and their young children's daily diets. As dictated by community needs, this activity may also include referral of children discharged from acute malnutrition treatment (for example under Activity 3.1.3), particularly those that have endured recurring cycles of malnutrition treatment and relapse.

This activity recognises the complex intersection of underlying causes of malnutrition which calls for multi-sectoral approaches to ensure sustained benefits, and thus adopts coordinated agriculture-health-nutrition interventions. Proven health centre, community groups, and household approaches will be used to support integrated household farming (through own and provided agricultural inputs, health centre demonstrations, training, and peer-to-peer mentoring) of climate-resilient nutritious foods, cooking demonstrations and training on food preservation, processing, and storage to address seasonal food shortages. Health centres will role model the same climate and nutrition smart approaches that are taught to communities and provide a learning space for staff and communities, as well as a space to multiply and share local resources such as seeds. The intervention groups will be used as a contact point and platform for discussing more with families about the use of foods produced (plants, trees, and animals) and other available foods, for more effective complementary feeding and responsive care of infants and young children, which the intervention aims to improve, as well as the whole family. Supportive interventions at health service and community level (such as groups) have been shown to have a positive and protective effect on mental health and resilience, coping mechanisms and adaptive capacity, strengthened social networks and reduced isolation – factors that play a particularly important role in improving outcomes for mothers and their infants in early life. Training sessions will also be used as platforms for further facilitated peer discussions with households of pregnant women and mothers about the use of grown and other foods for themselves and more effective complementary feeding and responsive care of infants and young children.

Programme approaches are built on Malawi's current Integrated Homestead Farming successes combined with Save the Children's evidence-based set of standardised approaches and interventions (called Common Approaches), including in relation to strengthening infant and young child feeding (titled 'Nourishing the Youngest'). The project will work with the National Agriculture Nutrition Technical working

[240] WHO et al. (2018) Nurturing care for early childhood development: a framework for helping children survive and thrive to transform health and human potential. World Health Organization, Geneva, Switzerland. Available at: https://www.who.int/teams/maternal-newborn-child-adolescent-health-and-ageing/child-health/nurturing-care.

[241] UNICEF (2012) Fed to fail? The crisis of children's diets in early life. 2021 child nutrition report. UNICEF, New York, USA. Available at: https://www.unicef.org/reports/fed-to-fail-child-nutrition.

group (a partnership between Ministry of Agriculture and Ministry of Health's Department of Nutrition stakeholders) to conduct a review of the Integrated Homestead Farming manual and programme using the existing standard of practices for quality materials.

This activity will incorporate the following sub-activities:

4.1.4.1 Review the integrated homestead farming module and modify to be stronger on climate-resilient nutrition.

4.1.4.2 Assess target villages in project districts to understand propensity to implement integrated homestead farming, including: functionality of care groups and Community Based Childcare Centres (CBCCs), existing integrated homestead farming and suitability; proportion of population who are vulnerable (households with young pregnant or breastfeeding mothers and/or children under 2). Based on assessment, create intervention strategy at village level in 500 villages.

4.1.4.3 Identify individual participants at village level - through sign-posting and referral via antenatal care, community activities of HSAs and SHSAs, and the CBCC - to convene groups of participants, who should be from households with the most vulnerable mothers, especially young and breastfeeding mothers.

4.1.4.4 Undertake procurement process for set-up, equipment and inputs for climate-resilient complementary nutritious food to be used by role models in health centre, staff, and community leader demonstration plots; and an additional 30 starter packs per village for the first 3 years. Saved seed and stock will be used and shared in pass-on programmes ever year and only used in the final year.

4.1.4.5 Support Integrated Homestead Farming role models (at health centres, care group leaders, lead farmers, traditional healers, etc.) in each target village along with agricultural extension workers, working with care group members in the village to provide initial shared understanding of homestead farming and how that can improve family and infant and young child nutrition and health.

4.1.4.6 Deliver training (by extension workers and lead farmers) on demonstration plots to households with vulnerable mothers, including modules on: using household waste; climate-resilient indigenous seeds and stock; hermetic bags; cooking demonstrations and training on food preservation, processing and storage; and distribute start-up kit to households.

4.1.4.7 Facilitate ongoing monitoring of vulnerable households by care group leaders and lead farmers in the implementation of integrated homestead farming.

Activity 4.1.5 Strengthen communities' capacities to reduce their vulnerability to the health impacts of climate change, particularly gendered impacts

Climate impacts affect men, women, children, youth and vulnerable populations differently. Community-led gender equality and social inclusion interventions are required so that girls, boys, women, men, the elderly and people with disabilities have equal access to the health care they need and are equally protected from the impacts of climate change.

To achieve greater gender equality and social inclusion in health outcomes, the project will adopt a community-based adaptation approach, fostering a community-led process through which those most affected by and interested explore, set priorities and plan collectively for improved health. As such, the project will engage communities (men, boys, girls, women, parents, religious and community leaders, representatives from existing community structures, as well as representatives of health service providers, government and relevant civil society organizations) in discussions (a series of reflective sessions) to explore gender, health, and climate related issues, prioritise, develop potential feasible solutions and visions of what the future might look like, and actions, and ways to monitor progress on those actions. The sessions require participatory facilitators to facilitate with segregated groups (groups of men, boys, women, girls, etc.) and then come together to reach consensus on desired community actions and to determine who will be the lead implementer of each action, and to share action plans and prioritise actions. Training and support will then be provided to these parties to equip them with necessary skills and competencies to carry out community actions. By working through this approach, communities will identify the socio-cultural barriers/enablers, resources, risk factors, especially for those most marginalised, to access health services

and begin to work towards positive change. They will also identify bottlenecks to accessing services - and will link with internal and external partners to address these barriers. This kind of community mobilisation approach, with multiple partners at community, district and provincial levels, facilitates critical reflection through two-way dialogue of the current situation leading to individual and collective action, and empowerment and to social change that can: increase the community level decision-making required by decentralization and democratization; address the different needs, problems, assets, beliefs and practices of diverse community groups through greater ownership and understanding; build mechanisms and systems through which communities can sustain an enabling environment for social change, and link effectively with internal and external partners; apply pressure to improve the quality of health services; and change social structures and norms in order for those most affected, especially for women and those most marginalized groups.

Discussions will have a particular focus on gender-based violence prevention, gender norms, joint household decision making around childcare, and positive masculinities, emphasising the benefits for the whole community of increased equality. Using evidence-based approaches to male engagement within the ecological model (working with individuals, families, with the support of non-formal and formal leadership and wider community), the project will provide a safe space for men to work together to identify harmful attitudes, beliefs and practices and to develop alternative, positive ways of being. These evidence-based curriculums utilise an approach which acknowledges the climate-induced stresses of being a man and the pressures that men and boys are under to provide for the family and to be strong. They demonstrate the benefits of working together as a team with wives and partners to help the family through climate-induced crises. They develop men's willingness to challenge each other and learn new and more equitable and supportive family relationships and non-violent problems solving. These skills, and the consequent transformation of social norms, are then promoted across the community, which leads to reductions in GBV and CEFM (women and girls experience less GBV and have more access to services; girls are no longer married young or against their will).

By targeting a range of harmful gender and social norms, these interventions have also been shown to lead to reductions in malnutrition and improvements in MCH, thus complementing Activity 4.1.4. Men can be engaged together with wives and extended family members on nutrition and social norms, food practices and care for children and mothers, equitable control of money and resources in the family, food sharing and consumption, encouraging men's role in child-care and child health, supporting wives and partners with household chores during breastfeeding, and taking children to the health facility during emergencies and for routine health checks / vaccination.

Finally, these interventions can also lead to improvements in mental health, since men can be engaged together with women on the negative community stigmas and norms surrounding mental health, as well as improve couples' communication and relationships around the care of children. Stigma comprises a major barrier to help-seeking in people with mental health difficulties in developing countries, particularly among vulnerable members of the population including the poor and women[242].

This intervention will draw on Save the Children's work in Southern Africa including Malawi, Mozambique, Kenya, Tanzania and DRC. Selected villages, out of those most vulnerable, will be supported with this intervention, the outcomes of which will be used for learning purposes.

Recognizing that over-engagement in these activities can interfere with daily living and livelihoods, particularly for women who often have multiple responsibilities, the project will take several measures: it will carefully schedule training sessions and activities to minimize disruption to participants' daily lives, including offering sessions at different times of the day or week to accommodate varying schedules. Regular feedback will be sought from participants to understand their experiences and adjust the frequency and

[242] E.g., Mascayano, F. et al. (2015) Addressing stigma relating to mental illness in low- and middle-income countries. Frontiers in Psychiatry 6. https://doi.org/10.3389/fpsyt.2015.00038; Kohrt, B.A. et al. (2018) The role of communities in mental health care in low- and middle-income countries: a meta-review of components and competencies. International Journal of Environmental Research and Public Health 15: 1279. https://doi.org/10.3390/ijerph15061279; Javed, A. et al. (2021) Reducing the stigma of mental health disorders with a focus on low- and middle-income countries.
Asian Journal of Psychiatry 58: 102601. https://doi.org/10.1016/j.ajp.2021.102601.

timing of activities, ensuring that interventions are both effective and manageable for all involved. The project will continually monitor the burden and cost of participation, particularly for women, assessing the impact on their time, livelihoods, and overall well-being, and making necessary adjustments to reduce any negative effects. Additionally, the project will work closely with community leaders and members to develop a schedule and approach that aligns with their needs and priorities, ensuring that capacity-building activities are respectful of participants' time and responsibilities.

This activity will incorporate the following sub-activities:

4.1.5.1 Co-design, develop and pre-test manuals and discussion guides for different levels of engagement / engagement groups (men, women, girls and boys, religious leaders, etc.).

4.1.5.2 Identify and train facilitators to facilitate the group discussions at different levels of engagement / within different engagement groups.

4.1.5.3 Establish different engagement groups (including women, girls, men, boys, non-formal and formal leadership, government and service providers as appropriate) and hold facilitated discussions amongst the groups through an iterative process that culminates with all groups brought together to reach consensus.

4.1.5.4 Set priorities for actions to address the issues that groups agreed on, determine who will be the lead implementer of each action, and provide training and support to these parties to equip them with necessary skills.

4.1.5.5 On a regular basis re-convene the engagement groups to listen, problem-solve, gain insights and update the outputs of 4.1.5.4 as necessary.

6.2 TARGET AREAS AND BENEFICIARIES

The system-wide enabling environment components of the project will be implemented at national level, for example the EWARS that is implemented at national level. However, to facilitate building resilience of the health system with an integrated approach targeting provision, healthcare delivery, and public health of communities, six districts have been selected for implementation across Outcomes 1-4. These districts have been selected based on the results of a customised vulnerability assessment.

Section 6.2.1 presents the results of a vulnerability assessment where indicators for sensitivity and adaptive capacity (which are the two components of vulnerability) were selected from among the range of indicators in climate vulnerability assessments, taking into account the availability of existing data at appropriate resolution. The overall scores for the indicators placed districts into five different categories, from very low vulnerability through to very high vulnerability, and six contiguous project districts were selected on the basis of this exercise in the southern part of the country. Section 6.2.2 presents the analysis conducted to identify the project target TAs within the project districts. Within the project districts, a lack of high-resolution data availability at TA level impeded the creation of sensitivity and adaptive capacity indices as was done at the district level. Therefore, available socio-economic and nutrition indicators were selected and compared against the Malawian national average to identify the project target districts. In addition to the quantitative analysis, stakeholder consultations validated the selections and informed the final selection of project TAs in two cases. Lastly, Section 6.2.3 sets out the direct and indirect beneficiaries of the project, as well as the health facilities in the project districts and TAs which will be targeted for climate-resilient infrastructure improvements. The selection was based on the findings of the vulnerability assessment (Section 6.2.1) and focused primarily on government-owned health centres (the main type of primary healthcare facility in Malawi), with four health centres operated by CHAM selected in three of the target TAs due to the lack of government-owned health centres in these districts.

6.2.1 Health vulnerability assessment

The following assessment of risk and vulnerability builds on the conceptual risk framework from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report, where risk is a function of

hazard, exposure, and vulnerability[243]. Climate hazards are climate events and trends with potential to cause disaster or harm to people or assets. Climate hazards are external drivers, such as changes in temperature and rainfall, and are not sector-specific. These climate trends and projections have been presented in Sections 3.1 and 3.2.

The exposure and vulnerability to these climate hazards, however, are usually sector-specific and are therefore here discussed in relation to the health sector. Exposure is defined by the IPCC 5th Assessment Report as the presence of people, environmental functions, services, and resources, infrastructure, or assets in places and settings that could be adversely affected by hazards. Exposure is here taken as equal for the districts in the target region as the analysis of climatic trends and projections was performed at the regional level (Sections 3.1 and 3.2). As outlined in Sections 3.1 and 3.2, the main climate drivers to which southern Malawi is exposed are increased mean temperatures, decreased mean precipitation, and increases in temperature- and precipitation-related extremes, leading to the following hazards of focus in the project: increases in droughts, floods and high/extreme heat events. Vulnerability is the predisposition to be adversely affected by a hazard and is assessed by considering the susceptibility to harm (sensitivity), and the ability to cope or overcome adverse conditions (adaptive capacity), of the system. Hence, vulnerability is a function of sensitivity and adaptive capacity.

Sensitivity is defined as "the degree to which a system or species is affected, either adversely or beneficially, by climate variability or change"[244]. Essentially, sensitivity asks whether a hazard would have a major or a minor impact on a system. For example, regarding sensitivity to heat, age influences sensitivity,' with very young children for instance being more heat-sensitive[245].

Adaptive capacity is defined as "The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences"[246]. For example, climate-resilient community health facilities that can effectively treat water borne diseases after a flood event exhibit adaptive capacity.

To ensure vulnerability assessments are sector-specific and specific to climate hazards, hazard-related sensitivity and adaptive capacity indicators must be chosen[247]. This allows the "vulnerable to what?" question to be answered. Hence the process of assessing health vulnerability to climate change followed the multi-step process outlined in **Error! Reference source not found.**.

[243] IPCC (Intergovernmental Panel on Climate Change) (2014). Climate Change 2014: synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report. IPCC, Geneva, Switzerland. Available online at: https://www.ipcc.ch/report/ar5/syr/.
[244] IPCC (2014) Annex II: Glossary [Agard, J. et al. (eds.)]. 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 [Barros, V.R. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757-1776.
[245] McGeehin, M. & Mirabelli, M. (2001) The potential impacts of climate variability and change on temperature-related morbidity and mortality in the United States. Environmental Health Perspectives 109 (Suppl. 2): 185-189. doi: 10.1289/ehp.109-1240665.
[246] IPCC (2014) Annex II: Glossary [Agard, J. et al. (eds.)]. 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 [Barros, V.R. et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757-1776.
[247] Sharma, J. & Ravindranath, N.H. (2019) Applying IPCC 2014 framework for hazard-specific vulnerability assessment under climate change. Environmental Research Communications. 1: 051004. doi: 10.1088/2515-7620/ab24ed.

Figure 25 Vulnerability assessment approach ; "S" stands for "sensitivity" and "AC" for adaptive capacity.

The identification of climate hazards (Step 1) has been described already above in the section on exposure (Sections 3.1 and 3.2). For Steps 2 and 3, the vulnerability assessment used quantitative methods that have been adopted in previous vulnerability assessments focused on climate change and health[248]. Secondary data sources were used as available at district level. A small number of potential indicators were not available, which would have been otherwise included, for example health facility infrastructure and admissions data, but they have been substituted by other proxies. Separate data was not available for city centers (Blantrye, Zomba, Lilongwe and Mzuzu City) and their respective districts, so one district vulnerability assessment was created. This issue must be acknowledged, as the city centers are likely to skew the results, and this consideration is relevant for Zomba (as is discussed in more detail later).

Indicators for sensitivity (Step 2, Figure 25) were selected from among the range of indicators in climate vulnerability assessments, taking into account the availability of existing data at appropriate resolution[249], and were grouped into the following categories: livelihoods, food and nutrition security, and demographics (

Table 8). The manner in which each indicator is taken as an indicator of sensitivity of a district to climate-related health risks is detailed in Table 8.

Table 8: indicators for sensitivity.

Category	**Sensitivity indicator**	**Rationale**
Livelihoods	Average farm size	Districts with a smaller average farm size face greater pressures from droughts, floods and dry spells. Households in Malawi that own smaller farm sizes have lower agricultural yields, lower incomes and worse food security[250]. Therefore, districts with smaller average farm sizes will have a higher proportion of lower-income households and households with food insecurity, with the poor generally being more susceptible to a range of diseases and

[248] Berry, P. et al. (2018) Assessing Health Vulnerabilities and Adaptation to Climate Change: A Review of International Progress. International Journal of Environmental Research and Public Health 15: E2626.
Helldén, D. (2021) Climate change and child health: a scoping review and an expanded conceptual framework. The Lancet Planetary Health 5: e164–e175.
[249] Beccari, B. (2016) A Comparative Analysis of Disaster Risk, Vulnerability and Resilience Composite Indicators. PLoS Currents. 8, ecurrents.dis.453df025e34b682e9737f95070f9b970.
[250] Descheemaeker, K. et al. (2016) Climate change adaptation and mitigation in smallholder crop–livestock systems in sub-Saharan Africa: a call for integrated impact assessments. Regional Environmental Change 16: 2331–2343. DOI: 10.1007/s10113-016-0957-8; Giller, K.E. et al. (2021) Small farms and development in sub-Saharan Africa: Farming for food, for income or for lack of better options? Food Security 13: 1431-1454. https://doi.org/10.1007/s12571-021-01209-0.

		health conditions[251], and one of the biggest risk factors to disease being food insecurity[252].
	% households with subsistence farming as the main economic activity	Subsistence farming comprises farming and associated activities which together form a livelihood strategy where the main output is consumed directly, with only a minor proportion of output (if any) marketed; in developing countries, subsistence farmers are generally the rural poor[253]. Therefore, districts with a high proportion of the population reliant on subsistence farming as the main livelihood strategy will have a high proportion of poor households, with the poor generally being more susceptible to a range of diseases and health conditions[254].
	% households with ganyu[255] as the main economic activity	Ganyu is a crucial poverty issue in Malawi because after own-farm production, ganyu is the most important source of livelihood for most poor households[256]. Those employed in ganyu are also more likely to be food insecure[257] and female-headed households[258]. Therefore, districts with a high proportion of the population reliant on ganyu as the main economic activity will have a high proportion of poor, food insecure, and female-headed households, with these population groups generally being more susceptible to a range of diseases and health conditions[259]. Further, extreme wet and dry events can reduce the supply of ganyu, meaning that those who rely on ganyu for income will struggle to make an income, and therefore be driven further into poverty.
	Very low food security	Malnutrition leads to weaker immune systems[261]. Poor nutrition status thus leads to increased sensitivity to a range of diseases and health conditions. Thus, districts with a high percentage of

[251] E.g., Yardley et al. (2011) Heat health planning: the importance of social and community factors. Global Environmental Change 21: 670-679. https://doi.org/10.1016/j.gloenvcha.2010.11.010.
[252] Katona, P. & Katona-Apte, J. (2008) The interaction between nutrition and infection. Clinical Infectious Diseases 46: 1582-1588. https://doi.org/10.1086/587658.
[253] Morton, J.F. (2007) The impact of climate change on smallholder and subsistence agriculture. PNAS 104: 19680-19685. Available online at: https://doi.org/10.1073/pnas.0701855104.
[254] E.g., Yardley et al. (2011) Heat health planning: the importance of social and community factors. Global Environmental Change 21: 670-679. https://doi.org/10.1016/j.gloenvcha.2010.11.010.
[255] Ganyu is informal short-term labour, for example that which is particularly performed on an ad hoc piece work basis.
[256] Whiteside, M. (2000) Ganyu labour in Malawi and its implications for livelihood security interventions -an analysis of recent literature and implications for poverty. Alleviation, Agricultural Research and Extension Network, Network Paper Number 99. Overseas Development Institute, London, UK. Available online: https://odi.org/en/publications/ganyu-labour-in-malawi-and-its-implications-for-livelihood-security-interventions-an-analysis-of-recent-literature-and-implications-for-poverty-alleviation/; Gono, H. et al. (2023) Casual wage labour, food security, and sustainable rural livelihoods in Malawi. Sustainability 15: 5633. https://doi.org/10.3390/su15075633.
[257] Coulibaly, J.Y. et al. (2015) Responding to crop failure: understanding farmers' coping strategies in southern Malawi. Sustainability 7: 1620-1636. https://doi.org/10.3390/su7021620.
[258] Kerr, R.B. (2005) Informal labor and social relations in northern Malawi: the theoretical challenges and implications of ganyu labor for food security. Rural Sociology 70:167-187. https://doi.org/10.1526/0036011054776370.
[259] Yardley et al. (2011) Heat health planning: the importance of social and community factors. Global Environmental Change 21: 670-679. https://doi.org/10.1016/j.gloenvcha.2010.11.010; Katona, P. & Katona-Apte, J. (2008) The interaction between nutrition and infection. Clinical Infectious Diseases 46: 1582-1588. https://doi.org/10.1086/587658; Yoosefi Lebni, J. et al. (2020) Challenges and opportunities confronting female-headed households in Iran: a qualitative study. BMC Women's Health 20: 183. https://doi.org/10.1186/s12905-020-01046-x.
[261] World Health Organization (WHO) (2023) Nutrition. WHO, Geneva, Switzerland. Available online at: https://www.who.int/health-topics/nutrition#tab=tab_1.

Food and nutrition security	(measured as multiple experiences of disrupted eating and reduced food intake[260])	underweight women will have higher population sensitivity to a range of diseases and health conditions.
	% children aged under 5 stunted and wasted	Malnutrition deprives a child of the nutrition necessary for growth and the maintenance of a health immune system, leading to increased sensitivity to a range of diseases and health conditions[262]; for instance, malnourished children are more likely to fall ill from diarrhoea[263]. Thus, districts with a high percentage of stunted and wasted children will have higher population sensitivity to a range of diseases and health conditions.
	% women aged 15-49 with anemia	Anaemia is an indicator of both poor nutrition and poor health[264], and malnutrition leads to weaker immune systems[265]. Poor health and nutrition status leads to increased sensitivity to a range of diseases and health conditions. Thus, districts with a high percentage of anaemic women will have higher population sensitivity to a range of diseases and health conditions.
	% underweight women (BMI <18.5)	Malnutrition leads to weaker immune systems[266]. Poor nutrition status thus leads to increased sensitivity to a range of diseases and health conditions. Thus, districts with a high percentage of underweight women will have higher population sensitivity to a range of diseases and health conditions.
Demographics	Population growth	Areas with rapid population growth are more likely to outstrip the availability of resources, such as food, water and access to healthcare facilities, particularly because climatic hazards will reduce the supply of, and access to, resources. Therefore, communities within districts with a high population growth rate are likely to be more sensitive to a range of diseases and health conditions.
	Population density	Areas with high population density will place greater pressure on the availability of resources, such as food, water and access to healthcare facilities, particularly because climatic hazards will reduce the supply of, and access to, resources. Therefore, communities within districts with a high population density are

[260] In the Malawian Integrated Household Survey Report very low food security is defined as "Households experience multiple indications of disrupted eating patterns and reduced food intake. They report reduction in food quality, variety, quantity and frequency of food consumed", NSO (2020) Fifth Integrated Household Survey 2019-2020, p. 191. https://doi.org/10.48529/yqn3-zv74.
[262] UNICEF (2019). The state of the world's children 2019. Children, food and nutrition: growing well in a changing world. UNICEF, New York, U.S.A. Available online at: https://www.unicef.org/reports/state-of-worlds-children-2019.
[263] World Health Organization (WHO) (2017) Diarrhoeal disease. WHO, Geneva, Switzerland. Available online at: https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.
[264] World Health Organization (WHO) (2023) Anaemia in women and children. WHO, Geneva, Switzerland. Available online at: https://www.who.int/data/gho/data/themes/topics/anaemia_in_women_and_children.
[265] World Health Organization (WHO) (2023) Nutrition. WHO, Geneva, Switzerland. Available online at: https://www.who.int/health-topics/nutrition#tab=tab_1.
[266] World Health Organization (WHO) (2023) Nutrition. WHO, Geneva, Switzerland. Available online at: https://www.who.int/health-topics/nutrition#tab=tab_1.

		likely to be more sensitive to a range of diseases and health conditions.
	% of female headed households	Female-headed households are among the poorest, and female household heads are unable to maintain their health due to problems such as poverty, poor socioeconomic status and multiple responsibilities[267]. Therefore, districts with a high percentage of female-headed households will have higher population sensitivity to a range of diseases and health conditions.
	% disabled people	People with disabilities have poorer health status than people with no disabilities[268] and are thus more sensitive to a range of diseases and health conditions. Thus, districts with a higher percentage of the population that is disabled will have higher sensitivity.
	% orphans	Orphans can have poorer physical and mental health status than non-orphans[269] and can therefore be more sensitive to a range of diseases and health conditions. Thus, districts with a higher percentage of the population that is orphaned will have higher sensitivity.
	% of under five-year-old children in the population	Infants and young children are often most sensitive to a range of diseases and health conditions[270]. For instance, in the case of malaria, children under five are one of the population groups with a higher risk of severe infection[271]. For another example, in low-income countries, children under three years old experience on average three episodes of diarrhoea every year[272].

Indicators for adaptive capacity (Step 2, Figure 25) were also selected from among the range of indicators in climate-vulnerability assessments, taking into account availability of existing data at appropriate resolution[273], and were grouped into the following categories: household WASH infrastructure, household characteristics, health facility infrastructure, and accessibility (Table 9). The manner in which each indicator is taken as an indicator of adaptive capacity of a district to climate-related health risks is detailed in Table 9.

[267] Yoosefi Lebni, J. et al. (2020) Challenges and opportunities confronting female-headed households in Iran: a qualitative study. BMC Women's Health 20: 183. https://doi.org/10.1186/s12905-020-01046-x.
[268] Krahn, G.L. et al. (2015) Persons with disabilities as an unrecognized health disparity population. American Journal of Public Health105 Suppl 2: S198-206. doi: 10.2105/AJPH.2014.302182.
[269] E.g. Lindblade, K.A. et al. (2003) Health and nutritional status of orphans <6 years old cared for by relatives in western Kenya. Tropical Medicine & International Health 8:67-72. https://doi.org/10.1046/j.1365-3156.2003.00987.x; UNAIDS/UNICEF/USAID (2004) Children on the brink 2004. A joint report of new orphan estimates and a framework for action. United Nations Children's Fund, New York, USA. Available online at: https://data.unaids.org/publications/external-documents/unicef_childrenonthebrink2004_en.pdf; Sahad, S.M. et al. (2017) Differences of mental health among orphan and non-orphan adolescents. International Journal of Academic Research in Psychology 4: 20-29. doi:10.46886/IJARP/v4-i1/3492.
[270] E.g., World Health Organization (WHO) (2013) Protecting health from climate change: vulnerability and adaptation assessment. WHO, Geneva, Switzerland. Available online at: https://www.who.int/publications/i/item/protecting-health-from-climate-change-vulnerability-and-adaptation-assessment.
[271] World Health Organization (WHO) (2023) Malaria. WHO, Geneva, Switzerland. Available online at: https://www.who.int/news-room/fact-sheets/detail/malaria.
[272] World Health Organization (WHO) (2017) Diarrhoeal disease. WHO, Geneva, Switzerland. Available online at: https://www.who.int/news-room/fact-sheets/detail/diarrhoeal-disease.
[273] Beccari, B. (2016) A Comparative Analysis of Disaster Risk, Vulnerability and Resilience Composite Indicators. PLoS Currents. 8, ecurrents.dis.453df025e34b682e9737f95070f9b970.

Table 9. Indicators for adaptive capacity.

Category	Adaptive Capacity indicator	Rationale
Household WASH infrastructure	% improved[274] household water source	Decreasing mean precipitation and drought are likely to reduce water availability, while floods destroy certain types of water infrastructure, leading to contamination of water sources. Decreased availability and quality of water increases health risks (e.g., by increasing dehydration, or by leading to increases in water-borne diseases). Those with improved water sources may therefore be better able to adapt.
	% with improved[275] household sanitation	Floods destroy certain types of sanitation infrastructure, leading to contamination of water sources which in turn can lead to increases in water-borne diseases. Those with improved sanitation may therefore be better able to adapt.
	% households with handwash facilities (water and soap/detergent)	Floods destroy certain types of sanitation infrastructure, leading to contamination of water sources which in turn can lead to increases in water-borne diseases. Households with handwash facilities may therefore be better able to adapt.
Household characteristics	% permanent dwellings	Permanent dwellings are less likely to be destroyed during heavy rainfall events or flooding than traditional dwellings[276]. Similarly, heat-related health risks may impact households with permanent dwelling less as the building materials do not absorb the heat or allow outside air inside, resulting in cooler inside temperatures[277]. More modern, permanent housing is also associated with lower malaria risk[278]. As such, districts with a higher percentage of permanent dwellings may be better able to adapt.
	Net enrolment at primary school	Higher educational achievements are associated with high adaptive capacity to climate change[279]. For instance, diseases are exacerbated by a failure to follow treatment regimes, which

[274] Improved drinking-water sources are defined by the WHO as "those that are likely to be protected from outside contamination, and from faecal matter in particular. Improved water sources include household connections, public standpipes, boreholes, protected dug wells, protected springs and rainwater collection. Unimproved water sources include unprotected wells, unprotected springs, surface water (e.g. river, dam or lake), vendor-provided water, bottled water (unless water for other uses is available from an improved source) and tanker truck-provided water." https://www.who.int/data/nutrition/nlis/info/improved-sanitation-facilities-and-drinking-water-sources#:~:text=Improved%20drinking%2Dwater%20sources%20are,protected%20springs%20and%20rainwater%20collection.

[275] Improved sanitation facilities are defined by the WHO as "those that hygienically separate human waste from human contact. Improved sanitation includes flush or pour-flush to piped sewer system, septic tank pit latrines, ventilated-improved pit latrines, or pit latrines with slab or composting toilets. Shared or public-use sanitation facilities are not considered to be improved. Also, flush or pour-flush to elsewhere, pit latrines without slabs or open pits, bucket latrines, hanging latrines or open defecation are not considered to be improved sanitation". https://www.who.int/data/nutrition/nlis/info/improved-sanitation-facilities-and-drinking-water-sources#:~:text=Improved%20drinking%2Dwater%20sources%20are,protected%20springs%20and%20rainwater%20collection.

[276] Kloukinas, P. et al. (2020) A building classification scheme of housing stock in Malawi for earthquake risk assessment. Journal of Housing and the Built Environment 35:507-537. https://doi.org/10.1007/s10901-019-09697-5.

[277] Jatta, E. et al. (2018) How house design affects malaria mosquito density, temperature, and relative humidity: an experimental study in rural Gambia. The Lancet Planetary Health 2: e498–e508. https://doi.org/10.1016/S2542-5196(18)30234-1.

[278] Tusting, L.S. et al. (2017) Housing Improvements and Malaria risk in sub-Saharan Africa: a multi-country analysis of survey data. PLoS Med 14: e1002234. https://doi.org/10.1371/journal.pmed.1002234.

[279] IPCC (Intergovernmental Panel on Climate Change) (2014) Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New
York, NY, USA, pp. 1-32.

		is directly related to poor education[280]. Therefore, districts with higher net enrolment at primary school are likely to have higher adaptive capacity.
	Female literacy rate	As above, higher educational achievements are associated with high adaptive capacity to climate change, and women's roles in the household and community spheres means they are regularly found to be the frontliners of adaptive capacity development to climate-related hazards[281]. For instance, one example of the role of women's formal education in adapting to the impacts of climate-related hazards pertains to the correct treatment of diarrhea following floods[282]. Therefore, districts with higher female literacy rates are likely to have higher adaptive capacity.
	% in poverty	Access to resources is commonly regarded as one of the most important components of adaptive capacity, with economic wealth a key resource[283]. Therefore, lower poverty rates are expected to be associated with high adaptive capacity to climate change.
Health facilities characteristics	Health facility bed capacity	Health facilities with greater bed capacity are better able to meet higher demands for beds because of increases in disease burdens.
	Healthcare workers per 10,000	More healthcare workers means the health service is better able to deal with increases in disease burdens.
	Number of healthcare facilities (per 100,000)	More healthcare facilities means the health service is better able to deal with increases in disease burdens.
	Health expenditure per capita	Areas with higher health expenditure will be better equipped to provide healthcare services.
Healthcare accessibility	Physical accessibility to health clinic (district average of distance [km] to the nearest health clinic from communities)	Heavy rains and flooding can cut off roads to healthcare facilities. Closer proximity to healthcare facilities means there is a better chance that people can still access health services.

[280] E.g., Ferreira, S.B., et al. (2005) Abandono do tratamento da tuberculose pulmonar em Cuiabá – MT – Brasil. Jornal Brasilieiro de Pneumologia 31:427-435. http://dx.doi.org/10.1590/S1806-37132005000500011.
[281] Azad, M.J. & Pritchard, B. (2023) The importance of women's roles in adaptive capacity and resilience to flooding in rural Bangladesh. International Journal of Disaster Risk Reduction 90: 103660. https://doi.org/10.1016/j.ijdrr.2023.103660.
[282] Ibid.
[283] Jakku, E. & Lynam, T. (2010) What is adaptive capacity. Report for the South East Queensland Climate Adaptation Research Initiative. South East Queensland Climate Adaptation Research Initiative. Climate Adaptation National Research Flagship, CSIRO, Black Mountain ACT, Australia. Available online at: https://www.researchgate.net/publication/259117037_What_is_adaptive_capacity.

	Physical accessibility to doctor or medical professional (district average of the distance from a community to nearest doctor or clinical officer)	Heavy rains and flooding can cut off roads to healthcare services. Closer proximity to doctors or medical professionals means there is a better chance that people can still access health services.
	Accessibility to urban center (district average of distance [km] to Lilongwe, Mzuzu, Blantyre or Zomba [km])	Communities that are closer to an urban center are likely to have a higher adaptive capacity due to the proximity to better health services and a range of livelihood and adaptation options to alleviate poverty and the health impacts of climate change[284].
	% distance to healthcare reported as a major problem by women	Extreme weather events increase the demand for health services[285] , whilst also disrupting accessibility to health services[286]. Extreme weather events exacerbate accessibility issues, with those with the longest travel times being most impacted[287]. This not only impacts a person's ability to access health services for climate change induced health issues but also routine appointments[288]. As such, communities that have shorter distances and less difficulty in accessing healthcare may be more able to deal with future climate-related health impacts.

In each category of indicators, an average of the indicators was taken before an average of the categories making up the sensitivity and adaptive capacity indices were taken and again divided into terciles to provide three groups representing high, medium and low sensitivity and adaptive capacity (Step 3, Figure 25). Indicators were placed into categories and a score was created for each category to avoid skewing towards categories with more indicators. Indicators and categories were given equal weighting, which is the most common practice, as the relative importance of each indicator is not well known and is likely to vary spatially[289]. For adaptive capacity, scores were inversed so a high adaptive capacity, which is positive, has a score of 1 and a low adaptive capacity a score of 3 (except for a couple of indicators, e.g., the percentage of people in poverty). Table 10 contains the indicators used in the vulnerability assessment, with indicator details, cut off points for the terciles, and data sources.

[284] Babatunde, R.O. & Qaim, M. (2009) Patterns of income diversification in rural Nigeria: determinants and impacts. Quarterly Journal of International Agriculture 48: 305-320.
[285] Codjoe, S.N.A., Gough, K.V., Wilby, R.L., Kasei, R., Yankson, P.W.K., Amankwaa, E.F., Abarike, M.A., Atiglo, D.Y., Kayaga, S., Mensah, P., Nabilse, C.K., Griffiths, P.L. (2020) Impact of extreme weather conditions on healthcare provision in urban Ghana. Social Science & Medicine. 258, 113072.
[286] Wilunda, C., et al. (2017) Barriers to utilisation of antenatal care services in South Sudan: a qualitative study in Rumbek North County. Reproductive Health 14: 65. Doi: 10.1186/s12978-017-0327-0.
[287] Makanga, P.T. et al. (2017) Seasonal variation in geographical access to maternal health services in regions of southern Mozambique. International Journal of Health Geographics 16: 1. Doi: 10.1186/s12942-016-0074-4.
[288] Dotse-Gborgbortsi, W., et al. (2022) Dam-mediated flooding impact on outpatient attendance and diarrhoea cases in northern Ghana: a mixed methods study. BMC Public Health 22: 2108. https://doi.org/10.1186/s12889-022-14568-w.
[289] Adger, W. Neil, Brooks, Nick, Bentham, Graham, Agnew, M., Eriksen, Siri, Adger, W. N., Brooks, N., Kelly, M., Bentham, G., Agnew, Eriksen, S. (2004) New indicators of vulnerability and adaptive capacity. Tyndall Centre for Climate Change Research.

Table 10: Indicators used in the vulnerability assessment, cut off points and data sources[290].

Category	Indicator	Low Sensitivity	Medium Sensitivity	High Sensitivity	Indicator detail	Data source
Livelihoods	% subsistence farming households	<44	44-60	>60	% households with subsistence farming is the main economic activity	IHS5 2019/20
	% ganyu	<14	14-20	>20	% households with ganyu is the main econoic activity	IHS5 2019/20
	Average farm size	>1.4	0.8-1.4	<0.8	Average farm size (acres)	IHS5 2019/20
Food and nutrition	Very low food security	<58.3	58.4-68	>68	% with very low food security (multiple periods of distrupted eating &reduced food intake)	IHS5 2019/20
	Stunted	<33	33-36.5	>36.5	% children under 5 with stunting	DHS 2015/16
	Wasted	<11.1	11.1-13	>13	% children under 5 with wasting	DHS 2015/16
	Anaemic women	<29.3	29.3 - 36	>36	% women age 15-49 who are anaemic	DHS 2015/16
	Underweight women	<5.8	5.8-7.6	>7.6	% women with a BMI <18.5	DHS 2015/16
Demographics	Population growth	<2.7	2.7-3.1	>3.1	Population growth rate 2008-2018	2018 Census report
	Population density	<155	155 - 222	>222	Average number of people per km2	2018 Census report
	Female headed households	<22.8	22.8-28.9	>28.9	% households that are female headed	2018 Census report
	Disabled	<10.3	10.3-11.4	>11.4	% of people age 5 and over with a disability including albinism and epilepsy	2018 Census report
	Orphans	<10.3	10.3-11.66	>11.66	% children aged 0-17 with no parents	2018 Census report
	Under 5	<14.0	14.0-14.7	>14.7	% population under 5	2018 Census report
Household WASH infrastructure	% improved household water source	>90	90-79	<79	% households with an improved water source	IHS5 2019/20
	% improved household sanitation	>33	33-19	<19	% households with an improved toilet facility	IHS5 2019/20
	% water source on premises	>24.7	24.7-14.3	<14.3	% households with a water sources on the premises	DHS 2015/16
	% with sufficient handwashing facilities	>20	14-20	<14	% households with sufficient handwashing facilities (water and soap/detergent)	DHS 2015/16
Category	**Indicator**	**Low adaptive capacity**	**Medium adaptive capactiy**	**High adaptive capacity**	**Indicator detail**	**Data source**
Household characteristics	% permenant dwellings	<38.9	38.9-54.5	>54.5		IHS5 2019/20
	Female literacy rate	<65.4	65.4-76	>76	% women aged 15 and above who are literate	IHS5 2019/20
	Net enrolment at primary	87.5	87.5-90.1	>90.1	% pupils in primary education	IHS5 2019/20
	% in poverty	>61.7	61.7-40	<40	% population below poverty line (poverty headcount index)	Malawi Poverty Report 2020
Healthcare facility characteristics	Health facility bed capacity	<8.2	8.2-11.3	>11.3	Number of inpatient beds per 10,000	HHFA 2018/19
	Healthcare workers per 10,000	<9.3	9.3-11.4	>11.4	Core health workforce per 10,000	HHFA 2018/19
	Healthcare facilities per 10,000	<0.51	0.51-0.78	>0.78	Number of health facilities per 10,000	HHFA 2018/19
	Health expenditure per capita	<3098	3098-3961	>3961	Health spending per capital (MWK)	HHFA 2018/19
Healthcare accessibility	Physical accessibility to health clinic	>4	2.5-4	<2.5	district average of distance (km) to the nearest health clinic from communities)	IHS5 2019/20
	Physical accessibility to doctor or medical professional	>10	5-10	<5	district average of distance (km) to the nearest doctor or clinical officer (km)	IHS5 2019/20
	Physical accessibility to main city	>130	130-76	<76	district average of distance (km) to Lilongwe, Mzuzu, Blantyre or Zomba (km)	IHS5 2019/20
	% distance to healthcare a big problem	>54.8	54.8-47.2	<47.2	% women who said distance to a health facility was a big problem to seeking medical advice or treatment	DHS 2015/16

The results of the health vulnerability assessment place districts in categories from very high to very low vulnerability (Table 11; **Error! Reference source not found.**). Vulnerability is relatively higher in the southern parts of Malawi, compared to the north. Breaking this down into the separate components, sensitivity shows a similar pattern to vulnerability: highest sensitivity in the south, and lowest in the North (Figure 27); whilst the lowest adaptive capacity is in the middle of the country, and the northern part of the Southern Region (Figure 28).

Table 11. Vulnerability assessment results by district.

District	Vulnerability
Phalombe Ntcheu Mchinji Mangochi Machinga Balaka	Very high
Dedza Dowa Thyolo Ntchisi Chikwawa Mulanje Salima	High
Nsanje Chiradzulu Neno Likoma	Medium
Nkhata Bay Kasungu Mwanza Nkhotakota Lilongwe	Low
Zomba Chitipa Rumphi Karonga Mzimba Blantyre	Very low

[290] NSO, 2020. Fifth Integrated Household Survey 2019-2020. https://doi.org/10.48529/yqn3-zv74, NSO, 2017; Malawi Demographic and Health Survey 2015-16. NSO, 2019. 2018 Malawi Population and Housing Census.https://malawi.unfpa.org/sites/default/files/resource-pdf/2018%20Malawi%20Population%20and%20Housing%20Census%20Main%20Report%20%281%29.pdf; Government of Malawi 2019. Harmonised Health Facility Assessment (HHFA) 2018/19; Ministry of Health and Population. Government of Malawi 2021; Malawi Poverty Report 2020. https://microdata.worldbank.org/index.php/catalog/3818/download/51154.

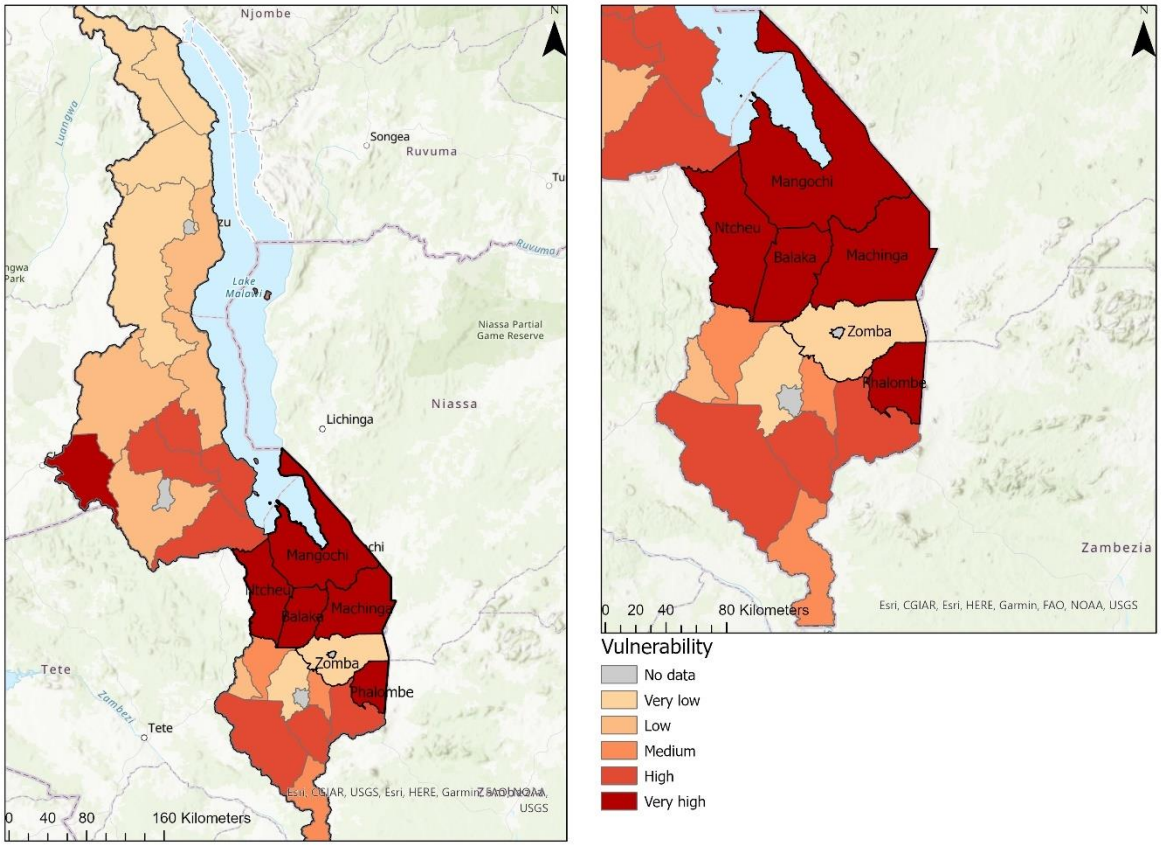

Figure 26 Vulnerability assessment with project districts outlined in black and labeled

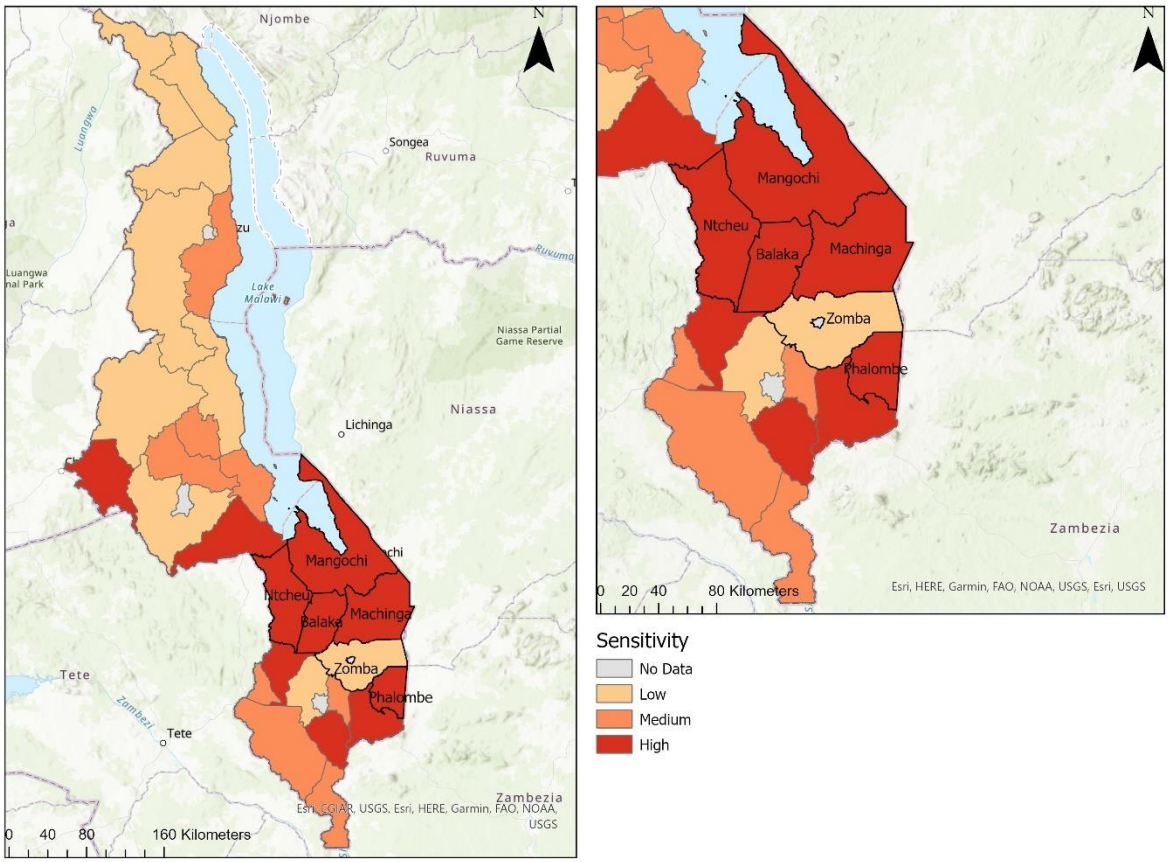

Figure 27 Sensitivity to climate risks with project districts outlined in black and labeled.

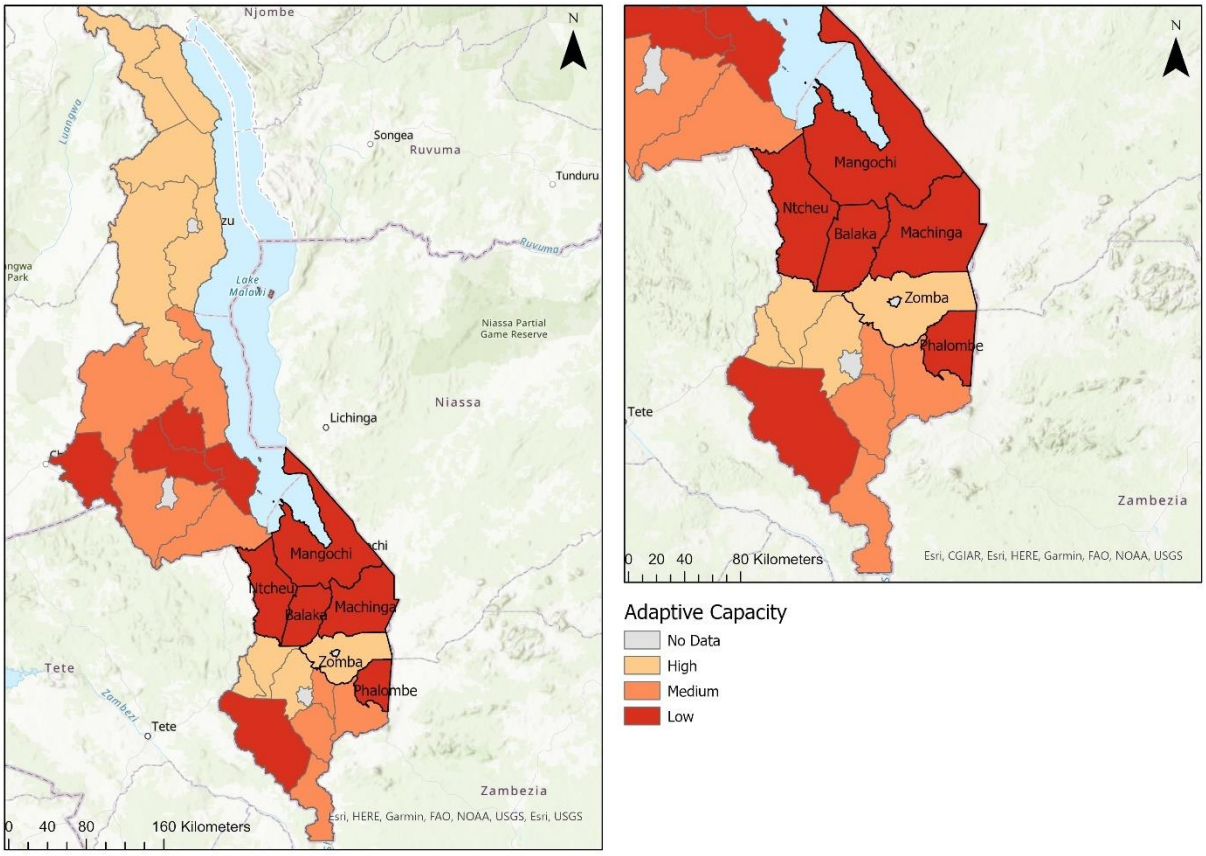

Figure 28 Adaptive capacity to climate risks with project districts outlined in black.

Based on these results, the project has selected six contiguous districts in the southern part of the country (comprising five in the Southern region and one in the Central region): Mangochi, Balaka, Machinga, Zomba, Phalombe and Ntcheu. Of the six project districts, only Zomba falls in a vulnerability category other than very high or high. It is classified as low in vulnerability, with low sensitivity and high adaptive capacity. This classification is likely due to the fact that this district surrounds the city of Zomba, which is a major urban centre, with concomitantly stronger socio-economic indicators that serve to reduce aggregate vulnerability. However, Zomba has one of Malawi's central hospitals, which is a referral hospital for the five surrounding districts that have medium to very high vulnerability. For the project to achieve its aim of taking a holistic health system approach to develop a climate-resilient healthcare system that will reduce the adverse effects of climate change on health and wellbeing, all levels of the health care system in Malawi need to be included. Therefore, the tertiary care level (comprising central hospitals) has to be included in the project and thus the district of Zomba is included as it is the only one of the six target districts with a central hospital.

6.2.2 Target Traditional Authorities

Within each of the target districts, between a quarter and half of the traditional authorities within the district will be targeted for the community-level public health activities under Outcome 4. This selection is made to maximise the likelihood of "spillover effects" in terms of benefits (particularly given that the entirety of the district will be targeted for planning related activities and strengthening the climate resilience of health care facilities and staff) whilst optimizing the efficiency of investment.

Lack of high resolution data availability at TA level impedes the creation of sensitivity and adaptive capacity indices as were done at district level. Instead, to determine which TAs should be targeted, available socio-

economic and nutrition indicators – that are generally also considered associated with vulnerability – were selected and compared against the Malawian national average. These indicators are the percentage of households living in a permanent structure, the percentage of households with improved toilet facilities, the percentage of households with farming as their main economic activity, the percentage of female-headed households, the literacy rate, and the percentage of under 5 stunting. Overall, based on these indicators, the selected TAs have high levels of poverty (with at least 26% of the population living below the poverty line) and female headed households (with most of the TAs having a higher-than-average percentage of female-headed households), both of which are associated with increased sensitivity to, and inability to cope with, climate risk (Table 12).

This means that the target population for activities targeted by TAs is 1 798 650, making up 43% of the total population of the six districts (Table 13). Within that TA population, proactive targeting will take place for women, particularly pregnant and breastfeeding women and mothers of children under two, the elderly, people with disabilities, and youth (see Annex 8: Gender and social inclusion assessment and action plan).

Table 12. Six key socioeconomic indicators at traditional authority level and how they compare to the national average. Orange indicates values that are worse than the national average.

District	Traditional Authority	% permanent household structure	% improved toilet facility	% farming main economic activity	% female headed households	Literacy rate	% under 5 stunting	# variables worse than national average
Balaka	STA Phalula	25.00	12.50	37.50	38.00	0.60	0.00	4
Balaka	TA Nkaya	18.75	31.25	58.33	33.00	0.71	71.43	5
Balaka	TA Amidu	9.38	25.00	71.88	37.50	0.51	33.33	4
Machinga	TA Mposa	9.38	15.63	46.88	38.00	0.51	16.67	5
Machinga	TA Mlomba	12.50	28.13	71.88	59.00	0.47	33.33	4
Machinga	TA Chikweo	9.38	25.00	68.75	38.00	0.61	33.33	4
Machinga	TA Kawinga	9.38	25.00	43.75	38.00	0.48	100.00	5
Machinga	TA Chiwalo							No data
Mangochi	TA Chilipa	12.50	43.75	50.00	50.00	0.41	33.33	4
Mangochi	TA Chowe	34.38	50.00	68.75	25.00	0.47	60.00	4
Mangochi	TA Makanjila	31.25	25.00	62.50	50.00	0.30	20.00	4
Mangochi	TA Mponda	14.58	29.17	58.33	42.00	0.49	27.78	4
Mangochi	TA Chimwala	18.75	21.88	59.38	53.00	0.68	55.56	6
Mangochi	TA Nankumba	14.58	37.50	43.75	46.00	0.55	30.00	4
Phalombe	TA Kaduya	21.88	14.06	31.25	28.13	0.53	18.18	3
Phalombe	TA Jenala	8.75	8.75	36.25	38.00	0.50	43.48	5
Phalombe	TA Chiwalo	6.25	12.50	56.25	28.00	0.39	100.00	5
Zomba	TA Kuntumanji	18.75	43.75	50.00	44.00	0.75	0.00	4
Zomba	STA Nkagula	56.25	6.25	18.75	13.00	0.79	100.00	2
Zomba	TA Mwambo	20.00	18.75	51.25	38.00	0.69	37.50	6
Zomba	TA Mkumbira							No data
Ntcheu	TA Goodson Ganya	23.44	45.31	54.69	45.31	0.78	25	3
Ntcheu	TA Mpando	27.08	29.17	56.25	35.42	0.589	50	5
Ntcheu	TA Kwataine	40.63	18.75	65.63	37.5	0.74	62.5	5
Ntcheu	TA Champiti	31.25	50	68.75	37.5	0.65	100	5
Malawi		**36.82**	**23.34**	**38.45**	**29.76**	**0.76**	**37.10**	

In addition to the quantitative analysis presented above, stakeholder consultations validated the selections. Consultations with government officials during field visits in December 2022 also informed the final selection of Traditional Authorities in two cases, where District Council consultation indicated that TA Goodson Ganya in Ntcheu district and TA Amidu in Balaka district were particularly prone to climate disasters and should therefore be prioritized over TA Chanthunya in Balaka District and TA Makwangwala in Ntcheu District (**Annex 7: Stakeholder engagement plan and summary of Stakeholder consultations**).

Table 13: The 25 Traditional Authorities that the project will target and the population of each.

District	Traditional Authority	Population
Ntcheu	TA Champiti	21 607
Ntcheu	TA Goodson Ganya	143 536
Ntcheu	TA Kwataine	53 379
Ntcheu	TA Mpando	77 612
		296 134
Balaka	TA Nkaya	45 351
Balaka	TA Phalula	19 486
Balaka	TA Amidu	46 314
		111 151
Machinga	TA Mposa	36 000
Machinga	TA Mlomba	62 263
Machinga	TA Chikweo	82 273
Machinga	TA Kawinga	92 144
Machinga	TA Chiwalo	13 149
		285 829
Mangochi	TA Chilipa	36 280
Mangochi	TA Chowe	112 155
Mangochi	TA Makanjila	66 914
Mangochi	TA Mponda	167 313
Mangochi	TA Chimwala	93 858
Mangochi	TA Nankumba	159 654
		636 174
Phalombe	TA Kaduya	79 357
Phalombe	TA Jenala	88 237
Phalombe	TA Chiwalo	43 933
		211 527
Zomba	TA Kuntumanji	48 079
Zomba	STA Nkagula	51 548
Zomba	TA Mwambo	151 997
Zomba	TA Mkumbira	6 211
		257 835
Grand total		**1 798 650**

Data source: National Statistical Office, 2018 Malawi Population and Housing Census.

Table 14: Summary of the targeting of TAs within districts and their population sizes. Data Source: National Statistical Office, 2018 Malawi Population and Housing Census

District	Number of TAs in district	Population of district	Number TAs selected in project	% TAs in project	Population of selected TAs	% Pop in selected project TAs
Balaka	12	438,379	3	25	111,151	25
Machinga	19	735,438	5	26	285,829	39
Mangochi	17	1,148,611	6	35	636,174	55
Phalombe	7	429,450	3	43	211,527	49
Zomba (rural)	11	746,724	4	36	257,835	35
Ntcheu	12	659,608	4	33	296,134	45

6.2.3 Project beneficiaries

Direct beneficiaries

The direct beneficiaries of the CHWBRC project are counted as the entire population of the 25 target Traditional Authorities (1,798,650 people) (Table 13), plus an additional 228 direct beneficiaries from national-level government staff, and district-level government staff from non-target districts, making 1,798,878 direct beneficiaries in total. This population will benefit directly in multiple ways described below. Among these direct beneficiaries, some people will benefit directly from various interventions, while others will benefit directly from at least one of the interventions.

Improved climate-resilient healthcare delivered as a result of the increased capacity of district-level authorities, healthcare staff, community health volunteers and community groups.

People living in the target TAs will benefit from the project's cascade model of health systems strengthening, spanning from the district-level authorities, through to Health Surveillance Assistants (HSAs), community health volunteers, village health committees and community health action groups. In each TA, Health Surveillance Assistants will be equipped with the tools, skills and – in some cases – additional treatments (described below) for diseases to treat their catchment population. HSAs within a TA are attached to one particular health centre. The project will target all government-owned health centres within each target TA, as well as all the government-owned health centres in the wider target districts (Figure 5). This ensures that *at a minimum* the entire population residing in each target TA have access to improved healthcare, since people may choose to visit health centres that are near them but located outside of the target TA, such as in a neighbouring non-target TA. Healthcare facility catchment areas overlap with each other and do not necessarily align with the administrative boundaries of TAs, as people may choose to visit whichever health facility is closest to them regardless of boundaries.

Increased climate resilience of healthcare infrastructure through solar energy and WASH upgrades

This will directly benefit the entire catchment population of the 79 target health facilities (selection described below). A conservative approach is taken to calculate direct beneficiaries and therefore only the population of the target TAs are counted as direct beneficiaries from the facility upgrades, even though all government-owned health centres and selected hospitals across the entire six target districts will be upgraded. This approach is taken for simplicity and clarity, given the overlap of catchment areas of different health facilities (both of the same level, such as health centres, and of different levels such as health centres that fall within a hospital's catchment area).

Climate-resilient additional water supply at schools and other small-scale WASH improvements

The school pupils and teachers at the 400 target schools located within the target TAs will benefit directly from rainwater harvesting systems installed and other small-scale climate-resilient WASH improvements. The average number of pupils per school across the target districts is 967, which multiplied by 400 gives 386,800 pupils directly benefitting. When adding teachers to this total (average number of teachers per schools across the target districts is 14.1), we estimate 5,633

teachers directly benefitting. The total for both school pupils and teachers is thus 392,625.[291] In addition to the teachers and pupils, some other community members living around schools may also benefit from this project intervention, but they will not be counted as beneficiaries.

Medical supplies for treatment of climate-sensitive diseases and conditions

Under Outcome 3, HSAs will provide treatments for cholera/diarrheal disease, malaria and acute malnutrition, which will directly benefit the following number of people in the target TAs:

- Cholera: 90,000 ORS+zinc treatments benefiting an estimated 30,000 people [3 treatments per case]
- Malaria: 90,000 nets benefiting 135,000 people[292] and 75,000 seasonal chemoprevention treatments benefiting at least 18,750 people[293]
- Moderate Acute Malnutrition and Severe Acute Malnutrition (up to 45,000 in total receiving treatment, through combination of therapeutic food, supplementary tablets and oils, antibiotics and cereal)

(Within the project budget for these treatments, the exact allocation to the specific diseases may be adjusted during implementation, based on the forecasted annual need for additional treatment due to climate impacts, which will be determined by the quantification exercise under Activity 3.1.3.)

Increased community capacity to address climate-health impacts and respond to early warnings

Under Outcome 4, the capacity of communities to reduce climate-health risks will be strengthened across the target TAs through a multi-faceted, cascaded approach. Knowledge and skills for the installation and management of climate-resilient WASH facilities will be shared at the district-level, TA-level, group village level and community-level (Activity 4.1.1.). Community capacity to receive, understand, and act on early warning alerts will be strengthened across 500 target communities (Activity 4.1.2). This will include 'Village civil protection committees', who operate at 'group village' level (i.e. groups of approx. 10 villages - see Section 2.3) and community-level training for school pupils and 'hard to reach' community members. Furthermore, 200 of the 500 target communities will be empowered through a "community action cycle" approach to address the gendered-impacts of climate change on health (Activity 4.1.5). Within the 500 target communities and more widely within the target TAs, people will also benefit from broader training and tools on climate and health (Activity 4.1.3). This will include mobile health awareness units that will travel between all villages in the target TAs, sharing knowledge on actions people can take and providing small health treatment items and malnutrition screening tools such as MUAC tapes.

Improved climate-resilient nutrition for families with pregnant women, breastfeeding mothers and children under 2

Under Activity 4.1.4, families with vulnerable mothers and pregnant and breastfeeding women will receive training (and inputs) on growing climate-resilient nutritious food and on improved nutrition practices. This activity will reach a minimum of 20 villages per TA (500 villages in total). An estimated 45,000 mothers in total will benefit directly, plus an estimated 105,000 children[294] in their families benefiting directly from improved nutrition, making a total of 150,000 direct beneficiaries.

[291] Ministry of Education, '2022 Malawi education statistics report'. Available here
[292] According to WHO one net benefits 1.8 people. WHO 2017. Recommendations for achieving universal coverage with long-lasting insecticidal nets in malaria control. Available here. A factor of 1.5 is used for calculation here.
[293] A treatment lasts 28 days and recommendations are for treatment over a 4-month period of peak malaria risk, hence 75,000 / 4 = 18,750 people.
[294] This is based on 2.3 children benefiting per family. The average number of children per mother in Malawi is 3.3.

Improved capacity of national government officials and district-level government officials in 22 non-target districts

In addition to the district government officials within the 6 project districts, a range of national government officials will be trained across separate activities. In total there will be 140 national-level government officials benefiting directly from training, tools and guidelines, and improved technology. Activities contributing to this are: 1.1.1; 1.1.2; 2.1.1; 2.1.3; 2.1.4; 3.1.2; 3.1.3; 3.1.4. The project also develops tools, guidelines and policies, as well as facilitates visits for government officials from non-project districts (22 districts) across activities to enable replicability of project interventions. In total, 88 district government officials across the 22 districts will directly benefit, through Activities 1.2.1, 2.1.2, and 2.1.3.

Targeting of healthcare facilities

The CHWBRC project will target 79 healthcare facilities (including five district hospitals and the central hospital in Zomba) in the target districts and target TAs for climate-resilient infrastructure improvements. This is based on the findings of the vulnerability assessment (Section 6.2.1) and focusing on government-owned health centres (the main type of primary healthcare facility in Malawi). In three of the target TAs there are no government-owned health centres (STA Phalula in Balaka district, and TA Mlomba and TA Mposa in Machinga district). To ensure coverage of the vulnerable populations in these TAs, four health centres operated by the Christian Health Association of Malawi (CHAM) have been selected for infrastructure improvements (Table 15). CHAM provides free public healthcare services at its health centres on behalf of the government under an MoU between the MoH and CHAM (further information in Section 2.4)

The focus on health centres is because they are the main type of primary healthcare facility and provide vital services to the most vulnerable people, including in rural areas. Health centres are nodes for primary healthcare in their wider areas (e.g. serving as bases for health workers such as HSAs) and targeting health centres for infrastructure upgrades thus also aligns with other project interventions on staff capacity building, and health surveillance and early warnings. See Section 2.4.1 above for an overview of the types of healthcare facilities in Malawi, as well as a map of healthcare facilities in the project districts (Figure 4) and within the target TAs (Figure 5).

In addition to health centres, 5 district hospitals will be targeted which represent the main hospital in each of the target districts, and one central hospital in Zomba (Zomba Central Hospital), which covers the entire Southern region of Malawi. As hospital facilities are substantially larger than health centres, climate-resilient solar energy and WASH upgrades at hospitals will focus on specific targeted needs, - with a similar budget per hospital as per health centre - rather than aiming to upgrade all of a hospital's facilities. The inclusion of hospitals forms part of the holistic health system strengthening approach of the CHWBRC and recognises the influential position of hospitals within the system. The targeted infrastructure upgrades of the hospitals will thus serve as models for the wider health system, will support the establishment of sentinel sites (Activity 1.1.3) and will align with the project's staff capacity building interventions at hospitals. Moreover, as secondary and tertiary facilities, hospitals serve people with the most severe illnesses and conditions, who are among the most vulnerable in the general population.

At project inception, a comprehensive assessment of health centres in the target districts will be conducted – both to confirm existence of government-listed facilities in the project districts, and to assess the existing energy and WASH infrastructure of each health centre. This approach is supported by the Ministry of Health and other stakeholders working in the health sector who agree on the importance of ground-truthing information from databases on health facilities and ensuring coordination and complementarity of upgrades at specific facilities. This will include technical assessments of solar energy needs and WASH facilities at each targeted health facility under Activity 2.1.2.1, covering *inter alia* state of connection to electricity grid and reliability of grid supply, any existing solar installations, water supply and sanitation facilities, and how these are impacted by climate events such as floods and droughts.

The health facility data presented in this Feasibility Study is a combination of an official government list provided by the Ministry of Health's policy and planning directorate in October 2023, and data from the 'District Health Information System – DHIS', which provided additional information on catchment populations and numbers of beds. In a few cases, these two official datasets did not fully correspond, with some facilities listed in only one or the other dataset. In Table 15 below, where there is no information on number of beds or catchment population, this means the health facility is in the government list but not the DHIS list.

The CHWBRC plans to target the facilities listed in Table 15 below. However, upon the initial assessment, the facilities may be adjusted based on the corroboration of data provided by the Ministry of Health, as well as the precise infrastructure needs for each health facility. Section 5.2 details exactly which infrastructure options will be available to facilities, with each facility receiving either one, or a combination of interventions depending on need and other possible interventions at particular health facilities.

Table 15 List of target healthcare facilities

Ref	Name	Ownership	Facility type	District	TA	Catchment population	Number of beds
1	Balaka District Hospital	Hospital	District Hospital	Balaka	Balaka Town	105,313	250
2	Balaka OPD Health Centre	MoH	Health Centre	Balaka	Balaka Town	-	-
3	Phalula Health Centre	CHAM	Health Centre	Balaka	STA Phalula	27,457	22
4	Namanolo Health Centre	MoH	Health Centre	Balaka	TA Amidu	36,825	1
5	Kalembo Health Centre	MoH	Health Centre	Balaka	TA Kalembo	37,044	31
6	Nandumbo Health Centre	MoH	Health Centre	Balaka	TA Kalembo	15,691	23
7	Chiendausiku Health Centre	MoH	Health Centre	Balaka	TA Msamala	14,810	1
8	Phimbi Health Centre	MoH	Health Centre	Balaka	TA Nkaya	26,741	23
9	Machinga District Hospital	Hospital	District Hospital	Machinga	Liwonde Town	62,239	241
10	Machinga Health Centre	MoH	Health Centre	Machinga	Machinga Boma	28,936	1
11	Namanja Health Centre	MoH	Health Centre	Machinga	STA Nchinguza	46,897	1
12	Nayuchi Health Centre	MoH	Health Centre	Machinga	STA Nchinguza	26,313	12
13	Chikweo Health Centre	MoH	Health Centre	Machinga	TA Chikweo	110,850	12
14	Nayinunje Health Centre	MoH	Health Centre	Machinga	TA Kapoloma	24,206	12
15	Ntaja Health Centre	MoH	Health Centre	Machinga	TA Kawinga	59,658	13
16	Mangamba Health Centre	MoH	Health Centre	Machinga	TA Liwonde	30,960	25
17	Nsanama Health Centre	CHAM	Health Centre	Machinga	TA Mlomba	56,757	11
18	Nthorowa Health Centre	CHAM	Health Centre	Machinga	TA Mlomba	-	-
19	Mposa Health Centre	CHAM	Health Centre	Machinga	TA Mposa	31,884	9

20	Ngokwe Health Centre	MoH	Health Centre	Machinga	TA Ngokwe	47,855	9
21	Mkwepere Health Centre	MoH	Health Centre	Machinga	TA Nyambi	27,672	16
22	Nyambi Health Centre	MoH	Health Centre	Machinga	TA Nyambi	42,839	13
23	Mangochi District Hospital	Hospital	District Hospital	Mangochi	Mangochi Town	986,867	192
24	Kapire Health Centre	MoH	Health Centre	Mangochi	Mangochi Town	15,805	2
25	Cape Mclear Dispensary	MoH	Health Centre	Mangochi	Mangochi Town	9,673	1
26	Phirilongwe Health Centre	MoH	Health Centre	Mangochi	STA Ntonda	27,084	7
27	Chilipa Health Centre	MoH	Health Centre	Mangochi	TA Chilipa	19,476	33
28	Mtimabi Health Centre	MoH	Health Centre	Mangochi	TA Chimwala	44,721	13
29	Malukula Health Centre	MoH	Health Centre	Mangochi	TA Chowe	12,162	1
30	Katuli Health Centre	MoH	Health Centre	Mangochi	TA Katuli	36,279	1
31	Makanjira Health Centre	MoH	Health Centre	Mangochi	TA Makanjila	48,992	20
32	Nangalamu Health Centre	MoH	Health Centre	Mangochi	TA Mbwana Nyambi	30,079	10
33	Njereza Health Centre	MoH	Health Centre	Mangochi	TA Mponda	-	-
34	Lungwena Health Centre	MoH	Health Centre	Mangochi	TA Namabvi	42,063	7
35	Chilonga Health centre	MoH	Health Centre	Mangochi	TA Nankumba	19,605	10
36	Nankumba Health Centre	MoH	Health Centre	Mangochi	TA Nankumba	33,887	1
37	Ntcheu District Hospital	Hospital	District Hospital	Ntcheu	Ntcheu Boma	14,013	291
38	Biliwiri Health Centre	MoH	Health Centre	Ntcheu	Ntcheu Boma	19,414	10
39	Kalimanjira Health Centre	MoH	Health Centre	Ntcheu	STA Mkutumula	16,508	6
40	Manjawira Health Centre	MoH	Health Centre	Ntcheu	STA Tsikulamowa	19,864	4
41	Lizulu Health Centre	MoH	Health Centre	Ntcheu	TA Chakhumbira	10,232	34
42	Champiti Health Centre	MoH	Health Centre	Ntcheu	TA Champiti	11,072	6
43	Bwanje Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	36,446	2
44	Kandeu Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	11,547	13
45	Kasinje Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	9,456	8
46	Dzunje Health Centre	MoH	Health Centre	Ntcheu	TA Kwataine	40,125	0
47	Bilila Health Centre	MoH	Health Centre	Ntcheu	TA Makwangwala	49,095	20
48	Doviko Health Centre	MoH	Health Centre	Ntcheu	TA Mpando	11,273	0
49	Katsekera Health Centre	MoH	Health Centre	Ntcheu	TA Mpando	64,363	32

50	Phalombe Health Centre	MoH	Health Centre	Phalombe	Phalombe Boma	55,874	8
51	Nambazo Health Centre	MoH	Health Centre	Phalombe	TA Chiwalo	44,248	7
52	Chitekesa Health Centre	MoH	Health Centre	Phalombe	TA Jenala	44,002	6
53	Mkhwayi Health Centre	MoH	Health Centre	Phalombe	TA Jenala	43,827	7
54	Migowi Health Centre	MoH	Health Centre	Phalombe	TA Kaduya	28,486	8
55	Mpasa Health Centre	MoH	Health Centre	Phalombe	TA Mkhumba	43,827	6
56	Gogo Nazombe Health Centre	MoH	Health Centre	Phalombe	TA Nazombe	20,623	1
57	Nkhulambe Health Centre	MoH	Health Centre	Phalombe	TA Nkhulambe	23,825	7
58	Phalombe District Hospital	Hospital	District Hospital	Phalombe		884,956	256
59	Makwapala Health Centre	MoH	Health Centre	Zomba	STA Nkagula	-	-
60	Khanda Health Centre	MoH	Health Centre	Zomba	STA Nkagula	-	-
61	M'mambo Health Centre	MoH	Health Centre	Zomba	STA Nkapita	26,072	22
62	Nasawa Health Centre	MoH	Health Centre	Zomba	STA Ntholowa	35,445	8
63	Lambulira Health Centre	MoH	Health Centre	Zomba	TA Chikowi	33,006	8
64	Bimbi Health Centre	MoH	Health Centre	Zomba	TA Kuntumanji	34,294	13
65	Namasalima Health Centre	MoH	Health Centre	Zomba	TA Kuntumanji	23,944	6
66	Machinjiri Health Centre	MoH	Health Centre	Zomba	TA Malemia	12,665	5
67	Naisi Health Centre	MoH	Health Centre	Zomba	TA Malemia	17,690	5
68	Chingale Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	26,782	8
69	Maera Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	9,534	10
70	Mwandama Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	15,910	10
71	Namadidi Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	19,209	0
72	Thondwe health centre	MoH	Health Centre	Zomba	TA Mlumbe	32,973	0
73	Chamba Health Centre	MoH	Health Centre	Zomba	TA Mwambo	42,727	1
74	Likangala Health Centre	MoH	Health Centre	Zomba	TA Mwambo	43,836	8
75	Makina Health Centre	MoH	Health Centre	Zomba	TA Mwambo	-	-
76	Zomba Central Hospital	Hospital	Central Hospital	Zomba		-	-
77	Chisi Health Centre	MoH	Health Centre	Zomba		7,286	4
78	Matawale Health Centre	MoH	Health Centre	Zomba		48,762	17
79	Sadzi Health Centre	MoH	Health Centre	Zomba		34,602	0

Indirect beneficiaries

Indirect beneficiaries to the project will be counted as the entire population of the six target districts, minus the population of the target Traditional Authorities. The district population will benefit from improved policies under the district health adaptation plans, improved health early warning and response system (EWARS) which will cover the entire districts – improved data collection capacity and new sentinel sites established in five out of the six project districts (Zomba – the sixth district – has already had a site established as a pilot by WHO).

The total population of the districts (4,157,812) minus the population of the target TA's (1,798,512) is **2,359,162,** which is the total indirect beneficiary number.

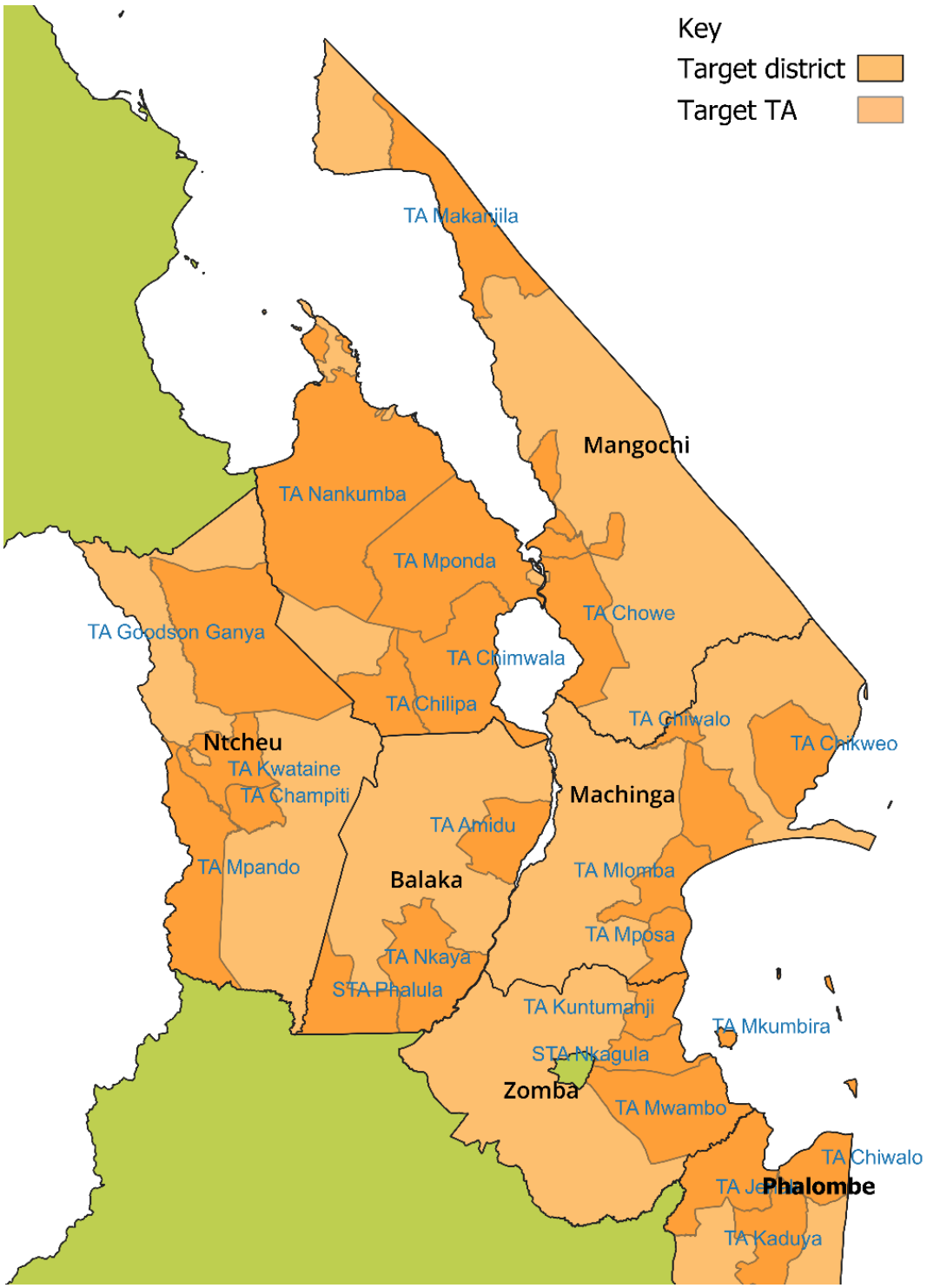

Figure 29 Map of target districts (Balaka, Machinga, Mangochi, Ntcheu, Phalombe, Zomba) and traditional authorities (TA) under the project interventions

7. RISK MANAGEMENT

7.1 PROJECT MANAGEMENT RISKS

A number of key risks will be inherent in affecting the successful implementation of the project. SC has a track record of implementing similar projects with a portfolio of more than 50 resilience-related projects and programmes valued at more than USD 300 million. This includes projects and programmes with explicit objectives to reduce climate and disaster risks and increase adaptive capacity and speed recovery from shocks and stresses. Mitigation measures for project level risks have been identified for each of the risks and detailed below (Table 16).

Table 16 Project Management Risks

Risks	Mitigation
Financial Management Limited capacity in the financial management systems, causing external fraud and corruption, resulting in misuse or theft of project funds	The fiduciary management procedures that will be utilised for the project under the Malawi Government will reduce the overall risk. This includes conducting annual audits, requesting regular financial reports, managing procurement through Save the Children, providing training on fraud policy and procedure. The MoH and SCI MW have agreed that most procurement within the project will use Save the Children's systems, with funds flowing through Save the Children for all large procurements including all goods and non-consulting services. This includes procured parties for infrastructure improvements to health facilities and schools. There will be a dedicated procurement officer within the PIU, who will work closely with ministry officials on any low-value procurement they are responsible for. In addition, the AE has established and effective corporate policies regarding financial management that further mitigate this risk. There are no intentions to distribute or disburse to beneficiaries, either directly or indirectly, cash, vouchers, commodities or other items of value.
Limited Technical capacity Lack of technical capacity and oversight for government and partner organisations, affects implementation, resulting in delays.	The project will mitigate this risk by ensuring National PIU and District PMU staffing include technical specialists on infrastructural elements (solar and WASH) to work with relevant government counterparts and supervise the work of the contractors. Division of labour between the EE's on supervisory responsibilities will be clarified to avoid delays in communication. The project will also provide direct technical assistance to Government departments and other delivery partners and supported through Save the Children's systems and national footprint. The breadth of the project will also help ensure community capacity is not overwhelmed. Working across all six provinces will enable the project to spread the investment across space and time. A slow and considered development of in-country, local and ongoing technical capacity and ownership supported by national and international expertise will help ensure sustainable engagement across government and the building of government skills and technical capacity throughout the life of the project. Strong partnerships between the AE, EEs and IEs is critical. During the design process, EEs worked closely with all partners throughout to ensure that all perspectives were considered. This will continue throughout implementation, including via the project's management structure and the stakeholder engagement plan **(Annex 7 of the Funding Proposal Package)** to ensure all partners work cooperatively towards agreed goals via agreed methods. The project will ensure adequate staffing for the partner organisations. Setting up of District PIU at DC offices,

	with strong District Leads to provide support and supervision, alongside government focal points, ensuring continuous visibility and coordination with relevant members of the District Technical and Executive Staff, will be critical for the visibility, ability leverage further resources and synergies with ongoing priorities, and sustainability of the project's work. Implementation table will ensure careful phasing of the work, close collaboration between 2 partners, spot checks by Programme Director and Technical Leads and specialists. The project governance structure promotes the inclusion of governmental IEs into the decision-making processes in an open and transparent manner further promoting shared ownership and trust.
Project Safety and Sustainability Lack of financial capacity for the government to continue, causes project activities ceasing, exposes key project infrastructure such as solar installations in health facilities to theft and damage.	The project will mitigate this by embedding sustainable approaches to changing the governance framework and empowering government ministries to increasingly lead implementation of project activities. This will help ensure the knowledge, experience, skills and staff positions supported by the project remain after the project ends. Project will ensure that the contractors identified make adequate budget provisions for security of the items installed. The project will also incorporate learnings from previous experiences from MoH and other donors. We will work with community structures to develop community norms and policing to ensure resources for sustainability and that training and guidelines are available for healthcare staff for upkeeping minor damages and repairs.
Lack of Community Ownership Communities are not engaged resulting in a lack of community ownership of the project hampering project sustainability and results.	SCI MW will partner with CRECCOM, a CSO well known for its strength in community mobilisation approaches to engage intensively with communities across the project cycle especially around activities in outcome 4. This will ensure community buy in and strengthen project ownership. In addition, Save the Children has a 40-year history of working in Malawi and has strong experience in ensuring that local communities are fully engaged in projects. Stakeholder engagement at the community level has proven this to be the case, with all community members consulted across a range of targeted areas expressing a desire to be involved in the project
Geographic scale of implementation The project will be implemented across multiple sites in 6 districts. This has the potential to stretch resourcing and require planning to ensure coordination across districts and villages.	Implementing a staggered approach to project scheduling will allow the slow building of capacity while not placing a sudden and over-whelming pressure on resources. Most activities once initiates will be implemented by sub-national government entities and staff therefore reducing the reliance on national staff. Taking a sub-national approach significantly reduces the risk of stretching national capacities and affecting the seed and quality of project implementation.
Climate induced disasters High exposure to climate hazards in Malawi, including increasing temperatures, changing rainfall patterns, causing extreme events such as floods and droughts, destroying project sites and investments.	To mitigate this risk project workplans and activity schedules will consider seasonal risks such as flooding and droughts in collaboration with MoH to determine best course of action and use of resources. In addition, the project will start implementing emergency nutrition or vaccine interventions identified during the inception phase of the project. The project will also leverage SC's and donor humanitarian resources to respond to any disasters. Project activities also embed understanding of early warnings

	and alert protocols within communities to reduce vulnerability to climate-induced risks.
Gender inequality and Gender Based Violence Malawi ranks 173 out of 188 on the UN's Gender Inequality Index and has the 8th highest child marriage rate in the world. Cultural attitudes and behaviours are bounded by patriarchal norms limiting women and girls' decision making and their effective and equitable climate change adaptation at the community level.	The project is designed by ensuring gender and social inclusion is embedded throughout all components of the project, ensuring equitable benefits and proactive targeting of women and girls for inclusion in activities. SC follows a Do No Harm approach and includes protection measures and accountability across all project activities. Communities, children, and staff are made aware of reporting procedures (GRM) and contact details of relevant staff (including local Child Safeguarding and Child Protection Focal Point. This is further detailed in Annex 8: Gender Assessment and Gender Action Plan and Annex 6: Environmental and Social Safeguards Assessment and Residual Risk Management Plan.
Insufficient Climate and Health Data Integration The project's success, particularly in establishing disease surveillance systems and developing early warning systems (e.g., Activity 1.1.2) may rely on accurate and timely integration of climate and health data. Lack of integrated data can hinder early warning system development, leading to increased disease burden, reduced health system resilience, and undermining the project's overall goal of enhancing climate resilience in the health sector.	The MoH have advised that an MoU for the sharing of data between the Meteorological department and the Ministry of Health has already been signed this year. Additionally, the Project Steering Committee which includes representatives from the relevant departments, will ensure facilitation efficient operation of the MoU and information sharing.
Data Availability and Quality Insufficient high-resolution data can hinder the accurate targeting of interventions, potentially affecting activities that rely on data collection, analysis, and application in intervention planning, such as those potentially linked to Activity 1.1.2.	The most recent available social and spatial data sets at district level and below are the 2018 Census and 2017 Integrated Household Survey, although districts produce socio-economic profiles that also capture local level data. The proposal development stage has already created access to additional relevant information, for example through the Ministry of Health on the latest distribution and classification of health care facilities. In addition many non-government actors are also collecting relevant data (including as part of monitoring and evaluation of complementary interventions). Having physical presence of project staff in districts through the district PIUs will enable easier access to available data. In addition the results of the various project M&E tools, notably the baseline survey, will inform intervention activity. The district PIUs and project MEAL officer will be tasked with ensuring that any data that is obtained throughout the project lifespan is categorised and metadata made available to the project team for further access, in accordance with the relevant data owners' requirements.
Limited Institutional Capacity and Coordination	The project will leverage the Project Steering Committee and the national-level Project Implementation Unit to enhance communication and collaboration between health and climate

Limited institutional capacity, and lack of coordination between health and climate agencies, can impede project execution and delivery of project activities; lack of coordination is most likely to affect project activities related to inter-agency collaboration, training, and capacity-building initiatives.	agencies and enhance smooth project execution and achievement of desired project outcomes.

8. CONCLUSIONS

Malawi is among the most climate-vulnerable countries in the world, ranking 161st out of 185 countries on the Notre Dame Global Adaptation Index in terms of its vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. The country is exposed to climatic changes, including increasing temperatures and changing rainfall patterns, and therefore to increasing extreme weather events such as floods (sometimes related to the occurrence of tropical cyclones in the Mozambique channel), droughts and high/extreme heat events .

These climatic hazards threaten human health, as well as the provision of health care, in several ways. While the impacts of climate change on health are numerous, wide-ranging, and manifest through several direct and indirect pathways, this project has isolated a number of core impacts for the Malawi context to address through its interventions. These interventions are structured to follow a holistic health system approach, as advocated by WHO, so that a climate-resilient healthcare system is developed that will reduce the adverse effects of climate change on health and wellbeing through a multi-pronged approach.

Institutional and technical capacity is necessary for managing and sustaining a climate-resilient health system. Within the sphere of strengthening institutional capacity for addressing climate risks in the health sector, under Outcome 1 the project will establish a health surveillance system and health early warning system at the national level that incorporates climate information; and will strengthen climate-resilient health policy and planning policy at the district level.

The health surveillance system and early warning system prioritises selected climate-sensitive diseases and conditions: malaria, diarrhoeal diseases, malnutrition, and diseases/conditions linked to heat exposure. The results of the vulnerability and adaptation assessment conducted under the GFCS Adaptation for Africa project showed that malaria, diarrhoeal diseases, and malnutrition are among the main causes of death in Malawi and that the situation will be exacerbated by climate change. Climate change is expected to increase the spread of malaria in previously malaria-free zones, and to increase the length of the malaria exposure season; to increase cholera/diarrhoeal diseases because rising temperatures favour the growth of bacteria, and because floods increase exposure to water-borne diseases; and to increase malnutrition through the effects of climatic changes on agriculture (e.g. decreases in quantity and quality of yields) which lead to food and nutrition insecurity. Heat exposure in Africa is associated with high mortality and morbidity, especially amongst vulnerable populations (e.g., people in low socio-economic brackets, pregnant women, infants, people with disabilities, etc.), but the African continent has large weaknesses in monitoring, early warning systems and response systems for heat, as does Malawi, despite the fact that temperatures will rise significantly in coming decades in Malawi under climate change. Hence, the project will develop targeted knowledge on climate parameters for malaria risk, cholera/diarrhea risk, malnutrition risk and the risk of select diseases/conditions linked to heat exposure. This targeted knowledge will be used to inform a climate-informed health surveillance system and early warning system (Activity 1.1.1), with the institutional architecture for managing its ongoing operation strengthened through Activity 1.1.2, and sentinel sites established at selected healthcare facilities to provide improved climate and health data for the system (Activity 1.1.3). The project will further build data entry capacity for the climate-informed health surveillance and early warning systems by training staff at district level in effective and efficient data collection regarding diseases, as well as building capacity for the district staff to use technology to more effectively link facility-level health data to the national dashboard (Activity 3.1.1).

At a more local level, the project strengthens district-level institutional capacity for addressing climate risks in the health sector by supporting the development of district Health Adaptation Plans in the project target districts (Activity 1.2.1), thus complementing and localising the draft Health National Adaptation Plan; whilst advocacy for stronger integration of climate-resilient health within adaptation planning at district and sub-district level (Activity 1.2.2) seeks to strengthen governance structures for the management of climate change risks and effects on health within the district (including multi-sectoral collaboration).

Still within the sphere of strengthening institutional capacity for addressing climate risks in the health sector at the district (local) level, healthcare staff are not well-capacitated to anticipate, prepare for and respond to the health impacts of a changing climate, a gap that the project will address through Outcome 3. The project will build knowledge among district and community healthcare staff to be able to understand and effectively communicate the early warning alerts arising from the health early warning system to the community level (Activity 3.1.2), as well as train them more generally on climate change impacts on health. Therefore, whilst this activity has an obvious focus on diseases prioritised by the health surveillance and early warning systems, this activity seeks to train district and community healthcare staff more widely on expected climate impacts on health. Whilst increased knowledge and understanding can reduce risk, the increasing negative health impacts from climate change create additional needs for medical supplies and technologies to reduce the incidence of climate-sensitive diseases and conditions, which will be provided as part of Outcome 3 to equip healthcare staff to manage the health impacts of a changing climate. Therefore, Activity 3.1.3 focuses on providing medical supplies and technologies for climate health risk reduction and response, with a focus on malaria, cholera and malnutrition, as priority diseases in the health surveillance and early warning system that can also be relatively easily supported within the scope of this project, given greater knowledge of their prevention/treatment baseline (as noted earlier, there are large weaknesses in Africa regarding response systems for heat exposure).

Whilst the project has pragmatically identified a focused set of diseases/conditions for the health surveillance and early warning system (a focus that cascades down throughout the project in capacity-building activities), there are two specific sets of health impacts of a changing climate that Section 3.3 has identified as important that are, at the same time, highly under-prioritised in the African context. These consist of the mental health impacts and the gendered impacts of a changing climate. The state of current science and practice does not yet allow for the inclusion of such impacts within a health surveillance and early warning system. But the growing recognition in the climate change health field of the importance of these impacts necessitates laying the groundwork for capacitating the health sector to address them, and such effort also represents an important area of innovation for the project. Therefore, the project will equip healthcare staff with MHPSS capacity to address the mental health impacts of a changing climate (Activity 3.1.4); and with capacity to address the gendered impacts of a changing climate, these being impacts on GBV, SRHR, and CEFM (Activity 3.1.5).

Mirroring the fact that healthcare staff are not well-capacitated to anticipate, prepare for and respond to the health impacts of a changing climate, communities too have low levels of capacity to address climate-related health impacts. Therefore, Outcome 4 seeks to empower community members regarding the nature of climate risks to health and what individuals and communities can do to better manage these risks. Given that the health surveillance and early warning system is a key component of the project, communities also must be capacitated to understand early warnings and alert protocols (Activity 4.1.2). Communities must also be trained more generally on climate change impacts on health (Activity 4.1.3), as well as empowered to reduce their vulnerability to the health impacts of climate change (Activity 4.1.5). The latter activity recognises that community-led gender equality and social inclusion interventions are required so that girls, boys, women, men, the elderly and people with disabilities have equal access to the health care they need and are equally protected from the impacts of climate change; the community-led processes followed in this activity lend themselves particularly well towards addressing the impacts of climate change on GBV, SRHR, CEFM, mental health and malnutrition. With respect to the latter health risk, given that the achievement of a sound nutritional basis occurs within the home, the project will also address malnutrition by supporting families with pregnant women, breastfeeding mothers and children under 2 to provide appropriate infant feeding and grow climate-resilient complementary nutritious food (Activity 4.1.4). Finally, given the importance of climate-resilient WASH facilities to reduce the likelihood of transmission of diarrheal diseases, the

project will equip community structures with knowledge and skills for climate-resilient community WASH facilities (Activity 4.1.1).

Finally, climate hazards also pose threats to the capacity of the health care system, for example, flooding causes physical damage to health care infrastructure (buildings, WASH facilities, equipment and medical supplies) which impedes the availability of health care. For instance, cyclone Freddy caused the destruction of over 300 health facilities across Malawi, Zimbabwe and Mozambique, and in the aftermath of extreme weather events, critical infrastructure such as roads are also destroyed which limits people's abilities to access facilities. Health infrastructure in Malawi is not well equipped to withstand climate extremes and provide climate-resilient healthcare. The project therefore seeks to facilitate the adaptation of the healthcare system physical infrastructure to climate risk through the development and application of standards and guidelines for climate-resilient health facilities and strengthened resilience of health facilities (Outcome 2). The project will develop a national standard for climate-resilient healthcare facilities (Activity 2.1.1), and then apply that standard (to the extent possible within Save the Children Australia's ESS Accreditation of Category C) to select health care facilities in the project districts (Activity 2.1.2) to address the current challenge that health care facilities are not withstanding climate extremes; and it will build capacity more broadly on the use of the standard elsewhere in the country, including in non-project districts (Activity 2.1.3). Climate-resilient WASH facilities are particularly important to address the health impacts associated with floods, drought and high temperatures, because they reduce the likelihood of water-borne disease transmission (diarrheal diseases) during floods, and because they address the provision of water of sufficient quality and quantity to ensure good health. Therefore, the project will also develop a guideline on climate-resilient WASH for use in public facilities, i.e., schools and public buildings beyond health facilities (Activity 2.1.4). Building on this guideline, the project will then implement climate-resilient WASH solutions at select public schools in the project districts (Activity 2.1.5), recognising that school facilities are more numerous and used by more people more frequently than healthcare facilities.

The multi-pronged approach described above, that targets several foundational aspects of climate-resilient health systems - the institutional and enabling environment (Outcome 1), healthcare infrastructure (Outcome 2), healthcare service provision, including through staff capacity (Outcome 3), and community climate health resilience (Outcome 4) – allows for the development of a climate-resilient healthcare system that will reduce the adverse effects of climate change on health and wellbeing.

9. APPENDIX 1: LIST OF HEALTH CARE FACILITIES IN THE PROJECT DISTRICTS

Ref	NAME	OWNERSHIP	TYPE	ZONE	DISTRICT
1	Balaka Blm Clinic	Non-Government	Clinic	South West Zone	Balaka
2	Balaka Dream Clinic	CHAM	Clinic	South West Zone	Balaka
3	Balaka Private Clinic	Private	Clinic	South West Zone	Balaka
4	Buleya	Government	Clinic	South West Zone	Balaka
5	Chithandizo Private Clinic	Private	Clinic	South West Zone	Balaka
6	Dziwe	Government	Clinic	South West Zone	Balaka
7	Kwitanda Health Centre	Non-Government	Clinic	South West Zone	Balaka
8	Makunganya Private Clinic	Private	Clinic	South West Zone	Balaka
9	Mbera Health Centre	Government	Clinic	South West Zone	Balaka
10	Njerenje	Government	Clinic	South West Zone	Balaka
11	Nyanyala	Government	Clinic	South West Zone	Balaka
12	Chimatiro	Government	Dispensary	South West Zone	Balaka
13	Balaka District Hospital	Government	District Hospital	South West Zone	Balaka
14	Chiendausiku Health Centre	Government	Health Centre	South West Zone	Balaka
15	Comfort Clinic	CHAM	Health Centre	South West Zone	Balaka
16	Kalembo Health Centre	Government	Health Centre	South West Zone	Balaka
17	Kankao Health Centre	CHAM	Health Centre	South West Zone	Balaka
18	Namanolo Health Centre	Government	Health Centre	South West Zone	Balaka
19	Nandumbo Health Centre	Government	Health Centre	South West Zone	Balaka
20	Phalula Health Centre	CHAM	Health Centre	South West Zone	Balaka
21	Phimbi Health Centre	Government	Health Centre	South West Zone	Balaka
22	Ulongwe Health Centre	CHAM	Health Centre	South West Zone	Balaka
23	Utale 1 Health Centre	CHAM	Health Centre	South West Zone	Balaka
24	Utale 2 Health Centre	CHAM	Health Centre	South West Zone	Balaka
25	Balaka OPD Health Centre	Government	Health Centre	South West Zone	Balaka
26	Mwima Health Post	Government	Health Post	South West Zone	Balaka
27	Nambira Health Post	Government	Health Post	South West Zone	Balaka
28	Chamba Dispensary	Government	Dispensary	South West Zone	Machinga
29	Kawinga Dispensary	Government	Dispensary	South West Zone	Machinga
30	Liwonde Medical Clinic	Private	Dispensary	South West Zone	Machinga
31	Mbonechela Dispensary	Government	Dispensary	South West Zone	Machinga
32	Mlomba Dispensary	Government	Dispensary	South West Zone	Machinga
33	Mota-Engil Liwonde Clinic	Private	Dispensary	South West Zone	Machinga
34	Mtambo Private Clinic	Private	Dispensary	South West Zone	Machinga
35	Machinga District Hospital	Government	District Hospital	South West Zone	Machinga
36	Chikweo Health Centre	Government	Health Centre	South West Zone	Machinga
37	Gawanani Health Centre	CHAM	Health Centre	South West Zone	Machinga
38	Machinga Health Centre	Government	Health Centre	South West Zone	Machinga

39	Mangamba Health Centre	Government	Health Centre	South West Zone	Machinga
40	Mkwepere Health Centre	Government	Health Centre	South West Zone	Machinga
41	Mpiri Health Centre	CHAM	Health Centre	South West Zone	Machinga
42	Mposa Health Centre	CHAM	Health Centre	South West Zone	Machinga
43	Namandanje Health Centre	CHAM	Health Centre	South West Zone	Machinga
44	Namanja Health Centre	Government	Health Centre	South West Zone	Machinga
45	Nayinunje Health Centre	Government	Health Centre	South West Zone	Machinga
46	Nayuchi Health Centre	Government	Health Centre	South West Zone	Machinga
47	Ngokwe Health Centre	Government	Health Centre	South West Zone	Machinga
48	Nsanama Health Centre	CHAM	Health Centre	South West Zone	Machinga
49	Ntaja Health Centre	Government	Health Centre	South West Zone	Machinga
50	Nthorowa Health Centre	CHAM	Health Centre	South West Zone	Machinga
51	Nyambi Health Centre	Government	Health Centre	South West Zone	Machinga
52	Chapusa	Government	Health Post	South West Zone	Machinga
53	Chimbira	Government	Health Post	South West Zone	Machinga
54	Chisuwi	Government	Health Post	South West Zone	Machinga
55	Chitundu	Government	Health Post	South West Zone	Machinga
56	Likhonyowa	Government	Health Post	South West Zone	Machinga
57	Mbanira	Government	Health Post	South West Zone	Machinga
58	Molipa	Government	Health Post	South West Zone	Machinga
59	Chipamba Health Post	Government	Health Post	South West Zone	Machinga
60	Chipamba Health Post	Government	Health Post	South West Zone	Machinga
61	Alinafe private clinic	Private	Clinic	South West Zone	Mangochi
62	Assalam Clinic	Other	Clinic	South West Zone	Mangochi
63	Billy Riordan Memorial Dispensary	Non-Government	Clinic	South West Zone	Mangochi
64	Chikole Health Centre	Government	Clinic	South West Zone	Mangochi
65	Chiunda Dispensary	Government	Clinic	South West Zone	Mangochi
66	Iba Dispensary	Government	Clinic	South West Zone	Mangochi
67	Jalasi Health Centre	Government	Clinic	South West Zone	Mangochi
68	Kadango Dispensary	Government	Clinic	South West Zone	Mangochi
69	Tutu Private Clinic	Other	Clinic	South West Zone	Mangochi
70	Tutu Private Clinic	Other	Clinic	South West Zone	Mangochi
71	Mehboob Clinic	Private	Clinic	South West Zone	Mangochi
72	Atupele Pvt Clinic	Private	Dispensary	South West Zone	Mangochi
73	Chapola	Private	Dispensary	South West Zone	Mangochi
74	Chiponde Dispensary	Government	Dispensary	South West Zone	Mangochi
75	Chiumbangame Dispensary	Government	Dispensary	South West Zone	Mangochi
76	DMI-St. John the Baptist University Clinic	Private	Dispensary	South West Zone	Mangochi
77	Madalitso Pvt Clinic	Private	Dispensary	South West Zone	Mangochi
78	Madinah Social Services Mobile Clinic	Private	Dispensary	South West Zone	Mangochi
79	Maganga	Private	Dispensary	South West Zone	Mangochi
80	Misolo	Private	Dispensary	South West Zone	Mangochi
81	Perekamoyo, William D. Mphatso	Private	Dispensary	South West Zone	Mangochi

82	Stuka Pvt Clinic	Private	Dispensary	South West Zone	Mangochi
83	Tulame Pvt Clinic	Private	Dispensary	South West Zone	Mangochi
84	Msaka Dispendary	Government	Dispensary	South West Zone	Mangochi
85	Mangochi District Hospital	Government	District Hospital	South West Zone	Mangochi
86	Chilipa Health Centre	Government	Health Centre	South West Zone	Mangochi
87	Chilonga Health care	Government	Health Centre	South West Zone	Mangochi
88	Katema Health Centre	CHAM	Health Centre	South West Zone	Mangochi
89	Katuli Health Centre	Government	Health Centre	South West Zone	Mangochi
90	Lugola Health Centre	CHAM	Health Centre	South West Zone	Mangochi
91	Lulanga Health Centre	CHAM	Health Centre	South West Zone	Mangochi
92	Lungwena Health Centre	Government	Health Centre	South West Zone	Mangochi
93	Luwalika Health Centre	CHAM	Health Centre	South West Zone	Mangochi
94	Makanjira Health Centre	Government	Health Centre	South West Zone	Mangochi
95	Malembo Health Centre	CHAM	Health Centre	South West Zone	Mangochi
96	Malukula Health Centre	Government	Health Centre	South West Zone	Mangochi
97	Mase Health Centre	CHAM	Health Centre	South West Zone	Mangochi
98	Mtimabi Health Centre	Government	Health Centre	South West Zone	Mangochi
99	Nangalamu Health Centre	Government	Health Centre	South West Zone	Mangochi
100	Nankumba Health Centre	Government	Health Centre	South West Zone	Mangochi
101	Nkope Health Centre	CHAM	Health Centre	South West Zone	Mangochi
102	Phirilongwe Health Centre	Government	Health Centre	South West Zone	Mangochi
103	Somba Health Centre	Non-Government	Health Centre	South West Zone	Mangochi
104	Kapire Health Centre	Government	Health Centre	South West Zone	Mangochi
105	Njereza Health Center	Government	Health Centre	South West Zone	Mangochi
106	Cape Mclear Dispensary	Government	Health Centre	South West Zone	Mangochi
107	Monkeybay DIC-Pakachere	Non-Government	Health Centre	South West Zone	Mangochi
108	Bamusi Post	Government	Health Post	South West Zone	Mangochi
109	Maleta Health Post	Government	Health Post	South West Zone	Mangochi
110	Maoni Health Post	CHAM	Health Post	South West Zone	Mangochi
111	Mwatakata Health Post	Government	Health Post	South West Zone	Mangochi
112	Ngatala Health Post	Government	Health Post	South West Zone	Mangochi
113	Ngatala Health Post	Government	Health Post	South West Zone	Mangochi
114	Lupetere Health Post	Government	Health Post	South West Zone	Mangochi
115	Makoli Health Post	Government	Health Post	South West Zone	Mangochi
116	Nalikolo Health Post	Government	Health Post	South West Zone	Mangochi
117	Koche Community Hospital	CHAM	Hospital	South West Zone	Mangochi
118	Monkeybay Community Hospital	Government	Hospital	South West Zone	Mangochi
119	Mulibwanji Hospital	CHAM	Hospital	South West Zone	Mangochi
120	Namwera Health Centre	Government	Hospital	South West Zone	Mangochi
121	St. Martins Mission Hospital	CHAM	Hospital	South West Zone	Mangochi
122	St. Mary's Hospital	CHAM	Hospital	South West Zone	Mangochi
123	Chikande Health Centre	Government	Clinic	Centrals West Zone	Ntcheu

124	Kapeni Health Centre	Government	Clinic	Centrals West Zone	Ntcheu
125	Masasa Dispensary	Government	Clinic	Centrals West Zone	Ntcheu
126	Mlangeni Health Centre	Government	Clinic	Centrals West Zone	Ntcheu
127	Matewere Village Clinic	Private	Dispensary	Centrals West Zone	Ntcheu
128	Phanga Dispensary	Government	Dispensary	Centrals West Zone	Ntcheu
129	Solomon Village Clinic	Mission/Faith-based (other than CHAM)	Dispensary	Centrals West Zone	Ntcheu
130	Ntcheu District Hospital	Government	District Hospital	Centrals West Zone	Ntcheu
131	Bilila Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
132	Biliwiri Health Cnetre	Government	Health Centre	Centrals West Zone	Ntcheu
133	Bwanje Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
134	Champiti Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
135	Chigodi Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
136	Chikowa Dispensary	Government	Health Centre	Centrals West Zone	Ntcheu
137	Doviko Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
138	Dzunje Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
139	Ganya Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
140	Gowa Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
141	Kalimanjira	Government	Health Centre	Centrals West Zone	Ntcheu
142	Kandeu Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
143	Kasinje Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
144	Katsekera Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
145	Lake View Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
146	Lizulu Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
147	Manjawira Health Centre	Government	Health Centre	Centrals West Zone	Ntcheu
148	Matanda Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
149	Mlanda Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
150	Mtonda Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
151	Mzama Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
152	Nsipe Rural Hospital	CHAM	Health Centre	Centrals West Zone	Ntcheu
153	Senzani Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
154	Tsangano Health Centre	CHAM	Health Centre	Centrals West Zone	Ntcheu
155	Extending Hope	Private	Health Centre	Centrals West Zone	Ntcheu
156	Bayani	Government	Health Post	Centrals West Zone	Ntcheu
157	Machereza Health Post	Government	Health Post	Centrals West Zone	Ntcheu
158	Livulezi Health Centre	CHAM	Health Post	Centrals West Zone	Ntcheu
159	Mikoke	Government	Hospital	Centrals West Zone	Ntcheu
160	Sr. Tereza Rural Hospital	CHAM	Hospital	Centrals West Zone	Ntcheu
161	Kalinde	Government	Dispensary	South West Zone	Phalombe
162	Mulungu Alinafe	Private	Dispensary	South West Zone	Phalombe
163	NAMASOKO DISPENSARY	Government	Dispensary	South West Zone	Phalombe
164	Phalombe District Hospital	Government	District Hospital	South West Zone	Phalombe
165	Chiringa CHAM	CHAM	Health Centre	South West Zone	Phalombe
166	Chitekesa	Government	Health Centre	South West Zone	Phalombe

167	Migowi	Government	Health Centre	South West Zone	Phalombe
168	Mkhwayi Health Centre	Government	Health Centre	South West Zone	Phalombe
169	Mpasa Health Centre	Government	Health Centre	South West Zone	Phalombe
170	Mwanga	CHAM	Health Centre	South West Zone	Phalombe
171	Nambazo	Government	Health Centre	South West Zone	Phalombe
172	Gogo Nazombe	Government	Health Centre	South West Zone	Phalombe
173	Nkhulambe	Government	Health Centre	South West Zone	Phalombe
174	Phalombe	Government	Health Centre	South West Zone	Phalombe
175	Sukasanje	CHAM	Health Centre	South West Zone	Phalombe
176	Nambiti	Government	Health Post	South West Zone	Phalombe
177	Waruma	Government	Health Post	South West Zone	Phalombe
178	Holy Family Mission	CHAM	Hospital	South West Zone	Phalombe
179	Chiringa Maternity	Government	Unclassified	South West Zone	Phalombe
180	Zomba Central Hospital	Government	Central Hospital	South West Zone	Zomba
181	MAIMED HEALTH CARE SERVICES	Private	Clinic	South West Zone	Zomba
182	Airwing Dispensary	Government	Clinic	South West Zone	Zomba
183	Chancellor College	Parastatal	Clinic	South West Zone	Zomba
184	Charity Fellium Private Maternity Clinic	Private	Clinic	South West Zone	Zomba
185	chavula ,Henry k.Mpunga private clinic	Private	Clinic	South West Zone	Zomba
186	Chinamwali Private Clinic	Private	Clinic	South West Zone	Zomba
187	City Clinic Zomba	Government	Clinic	South West Zone	Zomba
188	Compassionate Mission Clinic	Private	Clinic	South West Zone	Zomba
189	Lifelane Private clinic	Private	Clinic	South West Zone	Zomba
190	Masm Medi Clinic Zomba	Private	Clinic	South West Zone	Zomba
191	Mikuyu	Government	Clinic	South West Zone	Zomba
192	Namikango	CHAM	Clinic	South West Zone	Zomba
193	Ngwelero Health Centre	Government	Clinic	South West Zone	Zomba
194	Ntata, Anthony C.	Private	Clinic	South West Zone	Zomba
195	State House Dispensary	Government	Clinic	South West Zone	Zomba
196	Zomba Central Prison Clinic	Government	Clinic	South West Zone	Zomba
197	Hope Medi Clinic	Private	Clinic	South West Zone	Zomba
198	Dental Studio-Zomba Clinic	Private	Dispensary	South West Zone	Zomba
199	Domasi College Clinic	Government	Dispensary	South West Zone	Zomba
200	Mbwana Private Clinic	Private	Dispensary	South West Zone	Zomba
201	Mikuyu Adult Clinic	Government	Dispensary	South West Zone	Zomba
202	Mikuyu Young Clinic	Government	Dispensary	South West Zone	Zomba
203	Mitondo, Peter R. P. Prime Pri	Private	Dispensary	South West Zone	Zomba
204	Namalitha	Aquaid Lifeline	Dispensary	South West Zone	Zomba
205	Ndau Clinic	Private	Dispensary	South West Zone	Zomba
206	Palms Private Clinic	Private	Dispensary	South West Zone	Zomba
207	RWJ Wallace Limited Clinic	Private	Dispensary	South West Zone	Zomba

208	Umodzi Clinic - Aquaid Lifeline Project	Private	Dispensary	South West Zone	Zomba
209	Zomba DHO Pharmacy	Government	Dispensary	South West Zone	Zomba
210	Bimbi Health Centre	Government	Health Centre	South West Zone	Zomba
211	Chamba Health Centre	Government	Health Centre	South West Zone	Zomba
212	Changalume Barracks	Government	Health Centre	South West Zone	Zomba
213	Chilipa Health Centre	CHAM	Health Centre	South West Zone	Zomba
214	Chingale Health Centre	Government	Health Centre	South West Zone	Zomba
215	Chipini Rural Hospital	CHAM	Health Centre	South West Zone	Zomba
216	Chisi Health Centre	Government	Health Centre	South West Zone	Zomba
217	H Parker Sharp Dispensary	CHAM	Health Centre	South West Zone	Zomba
218	Lambulira Health Centre	Government	Health Centre	South West Zone	Zomba
219	Likangala Health Centre	Government	Health Centre	South West Zone	Zomba
220	M'mambo Health Centre	Government	Health Centre	South West Zone	Zomba
221	Machinjiri Health Centre	Government	Health Centre	South West Zone	Zomba
222	Maera Health Centre	Government	Health Centre	South West Zone	Zomba
223	Magomero Rural Hospital	CHAM	Health Centre	South West Zone	Zomba
224	Makwapala Health Centre	Government	Health Centre	South West Zone	Zomba
225	Matawale Health Centre	Government	Health Centre	South West Zone	Zomba
226	Matiya Rural Hospital	CHAM	Health Centre	South West Zone	Zomba
227	Mayaka Health Centre	CHAM	Health Centre	South West Zone	Zomba
228	Mwandama Health Centre	Government	Health Centre	South West Zone	Zomba
229	Naisi Health Centre	Government	Health Centre	South West Zone	Zomba
230	Namadidi Health Centre	Government	Health Centre	South West Zone	Zomba
231	Namasalima Health Centre	Government	Health Centre	South West Zone	Zomba
232	Nasawa Health Centre	Government	Health Centre	South West Zone	Zomba
233	Nkasala Health Centre	CHAM	Health Centre	South West Zone	Zomba
234	Sadzi Health Centre	Government	Health Centre	South West Zone	Zomba
235	Thondwe Dispensary	Government	Health Centre	South West Zone	Zomba
236	Chuluchosema Health Centre	Mission/Faith-based (other than CHAM)	Health Centre	South West Zone	Zomba
237	Khanda Health Centre	Government	Health Centre	South West Zone	Zomba
238	Makina Health Centre	Government	Health Centre	South West Zone	Zomba
239	Chuluchosema	Mission/Faith-based (other than CHAM)	Health Centre	South West Zone	Zomba
240	St. Robert	Mission/Faith-based (other than CHAM)	Health Centre	South West Zone	Zomba
241	Chinguma	Government	Health Post	South West Zone	Zomba
242	Lungazi	Government	Health Post	South West Zone	Zomba
243	Ngotangota	Government	Health Post	South West Zone	Zomba
244	Sitima Health Post	Government	Health Post	South West Zone	Zomba
245	Cobbe Barracks	Parastatal	Hospital	South West Zone	Zomba
246	Domasi Rural Hospital	Government	Hospital	South West Zone	Zomba
247	Pirimiti Rural Hospital	CHAM	Hospital	South West Zone	Zomba

248	Police College Hospital	Other	Hospital	South West Zone	Zomba
249	St. Lukes Mission Hospital	CHAM	Hospital	South West Zone	Zomba
250	Zomba Mental Hospital	Government	Hospital	South West Zone	Zomba

10. APPENDIX 2. ELIGIBILITY CRITERIA

Region and District Eligibility Criteria

The Malawi GCF project design process has since its inception engaged multiple stakeholders through the Joint Human Health and Climate Change Core Team (JHCCCT) which has representation of multiple stakeholders from the Academia, Civil Society Organizations in Climate Change, the UN Agencies, International Organizations, the Government (Ministry of Health Preventive Health Department) and the Enviromental Affairs Department under the Ministry of Natural Resources and Climate Change. Save the Children commissioned a vulnerability assessment study to identify priority project's target districts from where key health facilities and communities were selected.

The majority of the proposed GCF districts are from the Southern Region as a prioritised region for climate adaptation within the National Adaptation Plan (2206) and draft National Adaptation Plan (2016) due to its high exposure to climate risks and impacts (floods, extreme temperatures and droughts), in combination with high vulnerability. The climatic risks have over the years increased in frequency, magnitude and scope over time (Feasibility Study- Annex 2, Section 3.1.3). Heavy and/or persistent precipitation, together with changes in land use and land cover5, has led to a considerable increase in flood risk across the Shire River basin in southern Malawi. The impacts of flooding (often caused by tropical cyclones) (in particular, flooding) have also been increasing in recent years in the southern region (including the project districts). The frequency, duration and severity of droughts in southern Malawi has increased since the early 1980s, consistent with observed changes in temperature. While records for extreme temperatures and heatwaves were either not available, robust historical analysis, a set of temperature-based extreme indices, were examined in the climate projections. The projected trends in changes in temperature-based extremes supported the notion that southern Malawi will be exposed also to heat-related hazards, particularly considering the region's current temperature range and extremes, and the increase in mean annual temperature over time. Beyond the Southern region identified as more vulnerable to climatic conditions, specific districts within the region were selected following a robust vulnerability assessment looking at health, socioeconomic indicators related to the high levels of poverty and food insecurity, gender inequality, persistent malnutrition, environmental degradation and dependence on rain-fed agriculture, limited access to water and sanitation facilities, and high unemployment. Vulnerability was also measured using the sensitivity and adaptative capacity indicators. In each category of indicators, an average of the indicators was taken before an average of the categories making up the sensitivity and adaptive capacity indices were taken and again divided into terciles to provide three groups representing high, medium and low sensitivity and adaptive capacity. Indicators were placed into categories and a score was created for each category. The results of the health vulnerability assessment place districts in categories from very high to very low vulnerability. Vulnerability was identified to be relatively higher in the southern parts of Malawi, compared to the north. Sensitivity showed a similar pattern to vulnerability: highest sensitivity in the south, and lowest in the North; whilst the lowest adaptive capacity is in the middle of the country, and the northern part of the Southern Region.

Table 1: Vulnerability by district

District	Vulnerability
Phalombe	Very high
Ntcheu	
Mchinji	

Mangochi Machinga Balaka	
Dedza Dowa Thyolo Ntchisi Chikwawa Mulanje Salima	High
Nsanje Chiradzulu Neno Likoma	Medium
Nkhata Bay Kasungu Mwanza Nkhotakota Lilongwe	Low
Zomba Chitipa Rumphi Karonga Mzimba Blantyre	Very low

Based on the health vulnerability results, the project has selected six contiguous districts in the southern part of the country (comprising five in the Southern region and one in the Central region): Mangochi, Balaka, Machinga, Zomba, Phalombe and Ntcheu. Of the six project districts, only Zomba falls in a vulnerability category other than very high or high. It is classified as low in vulnerability, with low sensitivity and high adaptive capacity. This classification is likely due to the fact that this district surrounds the city of Zomba, which is a major urban centre, with concomitantly stronger socio-economic indicators that serve to reduce aggregate

vulnerability. However, Zomba has one of Malawi's central hospitals, which is a referral hospital for the five surrounding districts that have medium to very high vulnerability. For the project to achieve its aim of taking a holistic health system approach to develop a climate-resilient healthcare system that will reduce the adverse effects of climate change on health and wellbeing, all levels of the health care system in Malawi need to be included. Therefore, the tertiary care level (comprising central hospitals) has to be included in the project and thus the district of Zomba is included as it is the only one of the six target districts with a central hospital.

Health Facility Eligibility Criteria

As indicated above, the GCF project will deliberate target health facilities at all levels of primary (health facility and community rural hospitals), secondary (district hospitals) and tertiary (one central hospitals that serves all the six districts- Zomba central hospital) to ensure a comprehensive resilient health system to ultimately reduce the burden of climate induced diseases of Malaria, Cholera/Diarrhoea and Acute Malnutrition. Health facilities have been selected according to the initial criteria as set out in the Feasibility study (section 6.2). However, upon implementation, a more detailed study of the full set of facilities will be conducted, and the list may be updated depending on ongoing programs, updated information and current infrastructure in place. The project will target 79 healthcare facilities for physical upgrades to enhance climate resilience based on the following criteria:

1. All government-funded health centres within the six target districts will be selected (comprising 75 in total)
2. In three traditional authorities (TAs), four additional health centres funded by the Christian Health Association of Malawi (CHAM) will be selected, due to absence of government-funded health centres within those TAs.
3. One district or central hospital within each district will be selected (five district hospitals, and one central hospital in Zomba district, all government-funded)
4. The focus is on health centres due to their unique status as the most common primary health facility within the relevant catchment areas, serving the most vulnerable and remote community members within the Traditional Authorities while being large enough to host a substantial group of Health Surveillance Assistants (HSAs) and undergo physical infrastructure modifications. The selected health centres are of different sizes and have a range of catchment populations as per table 2 below:

Table 2: Health Facility Eligibility Criteria

Ref	Name	Ownership	Facility type	District	TA	Catchment population	Number of beds
1	Balaka District Hospital	Hospital	District Hospital	Balaka	Balaka Town	105,313	250
2	Balaka OPD Health Centre	MoH	Health Centre	Balaka	Balaka Town	-	-
3	Phalula Health Centre	CHAM	Health Centre	Balaka	STA Phalula	27,457	22
4	Namanolo Health Centre	MoH	Health Centre	Balaka	TA Amidu	36,825	1

5	Kalembo Health Centre	MoH	Health Centre	Balaka	TA Kalembo	37,044	31
6	Nandumbo Health Centre	MoH	Health Centre	Balaka	TA Kalembo	15,691	23
7	Chiendausiku Health Centre	MoH	Health Centre	Balaka	TA Msamala	14,810	1
8	Phimbi Health Centre	MoH	Health Centre	Balaka	TA Nkaya	26,741	23
9	Machinga District Hospital	Hospital	District Hospital	Machinga	Liwonde Town	62,239	241
10	Machinga Health Centre	MoH	Health Centre	Machinga	Machinga Boma	28,936	1
11	Namanja Health Centre	MoH	Health Centre	Machinga	STA Nchinguza	46,897	1
12	Nayuchi Health Centre	MoH	Health Centre	Machinga	STA Nchinguza	26,313	12
13	Chikweo Health Centre	MoH	Health Centre	Machinga	TA Chikweo	110,850	12
14	Nayinunje Health Centre	MoH	Health Centre	Machinga	TA Kapoloma	24,206	12
15	Ntaja Health Centre	MoH	Health Centre	Machinga	TA Kawinga	59,658	13
16	Mangamba Health Centre	MoH	Health Centre	Machinga	TA Liwonde	30,960	25
17	Nsanama Health Centre	CHAM	Health Centre	Machinga	TA Mlomba	56,757	11
18	Nthorowa Health Centre	CHAM	Health Centre	Machinga	TA Mlomba	-	-
19	Mposa Health Centre	CHAM	Health Centre	Machinga	TA Mposa	31,884	9
20	Ngokwe Health Centre	MoH	Health Centre	Machinga	TA Ngokwe	47,855	9
21	Mkwepere Health Centre	MoH	Health Centre	Machinga	TA Nyambi	27,672	16
22	Nyambi Health Centre	MoH	Health Centre	Machinga	TA Nyambi	42,839	13

23	Mangochi District Hospital	Hospital	District Hospital	Mangochi	Mangochi Town	986,867	192
24	Kapire Health Centre	MoH	Health Centre	Mangochi	Mangochi Town	15,805	2
25	Cape Mclear Dispensary	MoH	Health Centre	Mangochi	Mangochi Town	9,673	1
26	Phirilongwe Health Centre	MoH	Health Centre	Mangochi	STA Ntonda	27,084	7
27	Chilipa Health Centre	MoH	Health Centre	Mangochi	TA Chilipa	19,476	33
28	Mtimabi Health Centre	MoH	Health Centre	Mangochi	TA Chimwala	44,721	13
29	Malukula Health Centre	MoH	Health Centre	Mangochi	TA Chowe	12,162	1
30	Katuli Health Centre	MoH	Health Centre	Mangochi	TA Katuli	36,279	1
31	Makanjira Health Centre	MoH	Health Centre	Mangochi	TA Makanjila	48,992	20
32	Nangalamu Health Centre	MoH	Health Centre	Mangochi	TA Mbwana Nyambi	30,079	10
33	Njereza Health Centre	MoH	Health Centre	Mangochi	TA Mponda	-	-
34	Lungwena Health Centre	MoH	Health Centre	Mangochi	TA Namabvi	42,063	7
35	Chilonga Health centre	MoH	Health Centre	Mangochi	TA Nankumba	19,605	10
36	Nankumba Health Centre	MoH	Health Centre	Mangochi	TA Nankumba	33,887	1
37	Ntcheu District Hospital	Hospital	District Hospital	Ntcheu	Ntcheu Boma	14,013	291
38	Biliwiri Health Centre	MoH	Health Centre	Ntcheu	Ntcheu Boma	19,414	10
39	Kalimanjira Health Centre	MoH	Health Centre	Ntcheu	STA Mkutumula	16,508	6
40	Manjawira Health Centre	MoH	Health Centre	Ntcheu	STA Tsikulamowa	19,864	4

41	Lizulu Health Centre	MoH	Health Centre	Ntcheu	TA Chakhumbira	10,232	34
42	Champiti Health Centre	MoH	Health Centre	Ntcheu	TA Champiti	11,072	6
43	Bwanje Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	36,446	2
44	Kandeu Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	11,547	13
45	Kasinje Health Centre	MoH	Health Centre	Ntcheu	TA Goodson Ganya	9,456	8
46	Dzunje Health Centre	MoH	Health Centre	Ntcheu	TA Kwataine	40,125	0
47	Bilila Health Centre	MoH	Health Centre	Ntcheu	TA Makwangwala	49,095	20
48	Doviko Health Centre	MoH	Health Centre	Ntcheu	TA Mpando	11,273	0
49	Katsekera Health Centre	MoH	Health Centre	Ntcheu	TA Mpando	64,363	32
50	Phalombe Health Centre	MoH	Health Centre	Phalombe	Phalombe Boma	55,874	8
51	Nambazo Health Centre	MoH	Health Centre	Phalombe	TA Chiwalo	44,248	7
52	Chitekesa Health Centre	MoH	Health Centre	Phalombe	TA Jenala	44,002	6
53	Mkhwayi Health Centre	MoH	Health Centre	Phalombe	TA Jenala	43,827	7
54	Migowi Health Centre	MoH	Health Centre	Phalombe	TA Kaduya	28,486	8
55	Mpasa Health Centre	MoH	Health Centre	Phalombe	TA Mkhumba	43,827	6
56	Gogo Nazombe Health Centre	MoH	Health Centre	Phalombe	TA Nazombe	20,623	1

57	Nkhulambe Health Centre	MoH	Health Centre	Phalombe	TA Nkhulambe	23,825	7
58	Phalombe District Hospital	Hospital	District Hospital	Phalombe		884,956	256
59	Makwapala Health Centre	MoH	Health Centre	Zomba	STA Nkagula	-	-
60	Khanda Health Centre	MoH	Health Centre	Zomba	STA Nkagula	-	-
61	M'mambo Health Centre	MoH	Health Centre	Zomba	STA Nkapita	26,072	22
62	Nasawa Health Centre	MoH	Health Centre	Zomba	STA Ntholowa	35,445	8
63	Lambulira Health Centre	MoH	Health Centre	Zomba	TA Chikowi	33,006	8
64	Bimbi Health Centre	MoH	Health Centre	Zomba	TA Kuntumanji	34,294	13
65	Namasalima Health Centre	MoH	Health Centre	Zomba	TA Kuntumanji	23,944	6
66	Machinjiri Health Centre	MoH	Health Centre	Zomba	TA Malemia	12,665	5
67	Naisi Health Centre	MoH	Health Centre	Zomba	TA Malemia	17,690	5
68	Chingale Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	26,782	8
69	Maera Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	9,534	10
70	Mwandama Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	15,910	10
71	Namadidi Health Centre	MoH	Health Centre	Zomba	TA Mlumbe	19,209	0
72	Thondwe health centre	MoH	Health Centre	Zomba	TA Mlumbe	32,973	0
73	Chamba Health Centre	MoH	Health Centre	Zomba	TA Mwambo	42,727	1
74	Likangala Health Centre	MoH	Health Centre	Zomba	TA Mwambo	43,836	8

75	Makina Health Centre	MoH	Health Centre	Zomba	TA Mwambo	-	-
76	Zomba Central Hospital	Hospital	Central Hospital	Zomba		-	-
77	Chisi Health Centre	MoH	Health Centre	Zomba		7,286	4
78	Matawale Health Centre	MoH	Health Centre	Zomba		48,762	17
79	Sadzi Health Centre	MoH	Health Centre	Zomba		34,602	0

Traditional Authority Eligibility Criteria

The Malawi GCF project is designed to maximise impact by combining national-level and district-level activities that will improve the enabling environment for climate and health (Outcome 1, Outcome 3) with targeted investments at 79 health facilities in six target districts (Outcome 2), investments to equip healthcare staff to be better prepared to manage climate risks in six districts (Outcome 3) and community-level interventions in 500 villages across 25 TAs that are highly or extremely vulnerable to climate change (Outcome 4).The selected health facilities and communities are located in the six target districts of Ntcheu, Balaka, Machinga, Mangochi, Phalombe and Zomba.Traditional Authorities (TA's) have been selected according to the criteria described in the Vulnerability Assessment in the Feasibility Study, section 6.2. Sentinel sites have not been explicitly selected, but based on literature, discussions with other key stakeholders (e.g. WHO, Ministry of Health) and the existing pilot sentinel site for the Health Early Warning and Response system, they are likely to be large hospitals within the district of operation (often district hospitals). However, this will be discussed and validated with relevant stakeholders within MoH and other departments as part of component 1.

Compared to the district, the lack of high-resolution data availability at TA level impeded the creation of sensitivity and adaptive capacity indices as was done at the district level. As such, TAs were targeted based on available socio-economic and nutrition indicators which were compared against the Malawian national average. Based on these indicators, the selected TAs have high levels of poverty and female-headed households as summarized in table 3 below:

Table 3: Traditional Authority Eligibility Criteria

District	Traditional Authority	% permanent household structure	% improved toilet facility	% farming main economic activity	% female headed households	Literacy rate	% under 5 stunting	# variables worse than national average

Balaka	STA Phalula	25.00	12.50	37.50	38.00	0.60	0.00	4
Balaka	TA Nkaya	18.75	31.25	58.33	33.00	0.71	71.43	5
Balaka	TA Amidu	9.38	25.00	71.88	37.50	0.51	33.33	4
Machinga	TA Mposa	9.38	15.63	46.88	38.00	0.51	16.67	5
Machinga	TA Mlomba	12.50	28.13	71.88	59.00	0.47	33.33	4
Machinga	TA Chikweo	9.38	25.00	68.75	38.00	0.61	33.33	4
Machinga	TA Kawinga	9.38	25.00	43.75	38.00	0.48	100.00	5
Machinga	TA Chiwalo							No data
Mangochi	TA Chilipa	12.50	43.75	50.00	50.00	0.41	33.33	4
Mangochi	TA Chowe	34.38	50.00	68.75	25.00	0.47	60.00	4
Mangochi	TA Makanjila	31.25	25.00	62.50	50.00	0.30	20.00	4
Mangochi	TA Mponda	14.58	29.17	58.33	42.00	0.49	27.78	4
Mangochi	TA Chimwala	18.75	21.88	59.38	53.00	0.68	55.56	6
Mangochi	TA Nankumba	14.58	37.50	43.75	46.00	0.55	30.00	4
Phalombe	TA Kaduya	21.88	14.06	31.25	28.13	0.53	18.18	3
Phalombe	TA Jenala	8.75	8.75	36.25	38.00	0.50	43.48	5
Phalombe	TA Chiwalo	6.25	12.50	56.25	28.00	0.39	100.00	5
Zomba	TA Kuntumanji	18.75	43.75	50.00	44.00	0.75	0.00	4
Zomba	STA Nkagula	56.25	6.25	18.75	13.00	0.79	100.00	2
Zomba	TA Mwambo	20.00	18.75	51.25	38.00	0.69	37.50	6
Zomba	TA Mkumbira							No data
Ntcheu	TA Goodson Ganya	23.44	45.31	54.69	45.31	0.78	25	3
Ntcheu	TA Mpando	27.08	29.17	56.25	35.42	0.589	50	5
Ntcheu	TA Kwataine	40.63	18.75	65.63	37.5	0.74	62.5	5

Ntcheu	TA Champiti	31.25	50	68.75	37.5	0.65	100	5
Malawi		**36.82**	**23.34**	**38.45**	**29.76**	**0.76**	**37.10**	

In addition to the quantitative analysis presented above, stakeholder consultations validated the selections. Consultations with government officials during field visits in December 2022 also informed the final selection of Traditional Authorities in two cases, where District Council consultation indicated that TA Goodson Ganya in Ntcheu district and TA Amidu in Balaka district were particularly prone to climate disasters and should therefore be prioritized over TA Chanthunya in Balaka District and TA Makwangwala in Ntcheu District.

Determination of target population within the selected TAs:

In the 25 TAs, 20 villages per TA are yet to bel be selected for some of the Outcome 3 and 4 activities, to make up a total of 500 target villages. These villages will be selected in consultation with the District Health Management Team (DHMT), Save the Children, the Implementing Partners leading implementation of outcome 3 and 4 activities as sub awardees under the Save the Children budget. Consultations will also be made with the relevant authorities at the district and Traditional Authority level, including the national partners working at village level, as well as visiting villages within each authority to understand the functionality of existing systems (e.g. community health volunteers) The communities will be selected based on a combination of the following factors:

a. Willingness to participate in the project intervention
b. Involvement in previous donor-funded projects (priority given to communities without prior projects)
c. Existence of ongoing donor-funded projects
d. Social vulnerability
e. Population size
f. Proximity to school

The project will reach 1,798,650 direct beneficiaries and 2,359,162 indirect beneficiaries. The direct beneficiaries consist of the total population of the target Traditional Authorities, whereas the indirect beneficiaries consist of the population of the target districts, less the populations within the target Traditional Authorities. Beneficiaries are yet to be selected, and will be done so at the start of the project implementation period. For interventions at village level, this will involve setting individual or household level vulnerability criteria and especially for the kitchen gardens intervention, will include most pregnant or breastfeeding women in each village. Beneficiaries at village-level for other interventions include youth, people with disabilities and other marginalized groups (such as out of school youth) as a priority. The breakdown of total beneficiaries as in table 4 below:

Table 4: Population within the selected 25 Traditional Authorities

District	Traditional Authority	Population
Ntcheu	TA Champiti	21 607
Ntcheu	TA Goodson Ganya	143 536
Ntcheu	TA Kwataine	53 379

Ntcheu	TA Mpando	77 612
		296 134
Balaka	TA Nkaya	45 351
Balaka	TA Phalula	19 486
Balaka	TA Amidu	46 314
		111 151
Machinga	TA Mposa	36 000
Machinga	TA Mlomba	62 263
Machinga	TA Chikweo	82 273
Machinga	TA Kawinga	92 144
Machinga	TA Chiwalo	13 149
		285 829
Mangochi	TA Chilipa	36 280
Mangochi	TA Chowe	112 155
Mangochi	TA Makanjila	66 914
Mangochi	TA Mponda	167 313
Mangochi	TA Chimwala	93 858
Mangochi	TA Nankumba	159 654
		636 174
Phalombe	TA Kaduya	79 357
Phalombe	TA Jenala	88 237
Phalombe	TA Chiwalo	43 933
		211 527
Zomba	TA Kuntumanji	48 079
Zomba	STA Nkagula	51 548
Zomba	TA Mwambo	151 997
Zomba	TA Mkumbira	6 211
		257 835
Grand total		**1 798 650**

Data source: National Statistical Office, 2018 Malawi Population and Housing Census.

Eligible Interventions for Households and Villages (Outcome 3 and Outcome 4)
Equip community structures to provide knowledge and skills for climate-resilient WASH facilities to community members
Embed understanding of early warnings and alert protocols within communities, including children
Train communities to reduce their own vulnerability to climate-induced health risk
Support families with pregnant and breastfeeding women and children under two to produce climate-resilient foods and provide quality complementary food to children under two
Strengthen communities' capacities to reduce their vulnerability to the health impacts of climate change, particularly gendered impacts
Build capacity among district and community healthcare staff to address the gendered impacts of a changing climate
Build capacity among district and community healthcare staff to disseminate early warnings to communities
Upgrade WASH facilities at schools to improve children's health under climate change

Table. Selection of Final Beneficiaries, Project Areas and Eligible Interventions

Output	Activity	Final Beneficiaries' selection criteria	Project Area selection criteria

Output 1.1Climate-informed health surveillance system and Early Warning and Response System (EWARS)	Activity 1.1.1 Strengthen the health surveillance system by identifying alert triggers for key climate-sensitive health conditions	Beneficiaries will be key senior leadership in Ministry of Health, Ministry of Natural Resources-Department of Climate Change and Metrological Services engaged through a workshop	The selection criteria for the targeted project area is based on the Vulnerability Analysis as described in the above sections and more details could be accessed in the feasibility study. 1. Alignment with government ambition on Health National Adaptation Plans 2. Alignment with government policies/regulations for climate change adaptation, including food security, livelihoods, natural resource management, disaster risk reduction and gender equity and social inclusion; and 3. Current enabling activities (i.e. opportunity to build on existing projects on Early Warning Response System, and existing policy platforms on human health and climate being led by the Ministry of Health Preventive Health and the Environmental Affairs Department).
	Activity 1.1.2 Strengthen the institutional architecture for managing the ongoing operation of the climate-informed Early Warning and Response System (EWARS)	At least 60 government officials (national and district) will be trained in cascading EWARS from national to district and sub-district levels	
	Activity 1.1.3. Establish sentinel sites at selected healthcare facilities to provide improved climate and health data for the health Early Warning and Response System (EWARS)	No specific individual beneficiary selection criteria are applied to this activity as this will be mostly a facility based activity where 5 sentinel sites will be established selected from the targeted health facilities in the project districts.	
Output 1.2 District Health Adaptation Plans	Activity 1.2.1 Facilitate preparation and local endorsement of District Health Adaptation Plans in 6 project districts	No specific individual beneficiary target criteria is relevant to this activity as this all relevant district level government officials from Health, Environment will be engaged in the development of the District Health Adaptation Plan (DHAP) and will be trained in the implementation of the DHAP in all the 6 project districts.	
	Activity 1.2.2 Advocate for stronger integration of climate-resilient health within adaptation	No specific individual beneficiary criteria defined for this activity as all relevant stakeholders will be engaged in the advocacy of integration of climate-resilient health in adaptation planning at district-level	

	planning at district and sub-district level		
Output 2.1 Climate-resilient health centres, district and central hospitals and schools for community health	Activity 2.1.1 Develop a national standard for climate-resilient healthcare facilities	Key National Officials from all relevant ministries, departments and agencies of government (health, environment and natural resources) and representatives from key civil society actors in human health and climate work will be engaged in the development of the climate resilient health facility physical infrastructure.	
	Activity 2.1.2 Strengthen climate resilience of healthcare facilities	No specific individual selection criteria is applied to this activity as solar power and improved WASH facilities will be installed in all the 79 targeted health facilities	
	Activity 2.1.3 Build capacity of Malawi's health sector to apply the climate-resilient healthcare facility standard	75 officials from non-project districts will be selected from the relevant departments of health, environment, education and will be trained on health adaptation standards and engaged in study visits to learn from the model health facilities.	
	Activity 2.1.4 Develop guidelines for climate-resilient WASH facilities	Health sector and WASH sector officials will be engaged to create guidelines on climate-resilient WASH facilities to be applied across different sectoral areas	
	Activity 2.1.5 Upgrade WASH facilities at schools to improve children's health under climate change	No specific individual beneficiary selection criteria are applied to this activity as Improved WASH facilities installed in all the targeted 400 schools	
Output 3.1 Healthcare staff trained in managing	Activity 3.1.1- Build data collection capacity to strengthen surveillance	No specific individual beneficiary selection criteria are applied to this activity as the capacity building will be provided to 25 district staff (district health office) from the 6 districts; and 90 Health Surveillance Assistants (HSAs) and Senior HSAs from all the 79 health facilities	

climate-related disease monitoring, health messaging, and disease treatment and prevention	of climate-related diseases		
	Activity 3.1.2 Build capacity among district and community healthcare staff to disseminate early warnings to communities	HSAs and SHSAs will be trained on EWARS representing all the targeted 79 facilities; Community Healthcare Volunteers (CHV) coming from all the 25 selected TAs will be trained on the EWARS mechanism	
	Activity 3.1.3 Provide medical supplies and technologies for climate health risk reduction and response	No specific individual beneficiary selection criteria is relevant to this activity as medical supplies and technologies will be procured and distributed to all the 79 targeted health facilities.	
	Activity 3.1.4 Equip healthcare workers with MHPSS capacity to address mental health impacts of changing climate	This training will target district health, social workers, disaster risk management staff and 1000 Senior Health Surveillance Assistants and Health Surveillance Assistants from all the 79 health facilities working in Maternal NewBorn Child Health (MNCH) and Primary Health Care service units.	
	Activity 3.1.5 Build capacity among district and community healthcare staff to address the gendered impacts of a changing climate	2,000 district and community-level level staff will be selected from all the 6 districts among all the 79 targeted health facilities	

Output 4.1 Stronger community capacity to reduce health risks from climate change	Activity 4.1.1 Equip community structures to provide knowledge and skills for climate-resilient WASH facilities to community members	No specific individual beneficiary selection criteria are applied to the capacity building component of this activity as 100% of the target communities will benefit. 375 Area Civil Protection Committees from the targeted 25 TAs will reached.	
	Activity 4.1.2 Embed understanding of early warnings and alert protocols within communities, including children	Individual criteria focuses on school children, elderly people and people with disabilities across the 500 target communities	
	Activity 4.1.3 Train communities to reduce their own vulnerability to climate-induced health risk	No specific individual selection criteria is applied to this activity as 2 mobile health awareness units will visit all the 500 villages in all the 25 targeted TAs; and traditional healers (100%) in all the targeted villages will be trained on climate-induced health risks	
	Activity 4.1.4 Support families with pregnant and breastfeeding women and children under two to produce climate-resilient foods and provide quality	35,000 pregnant andbreastfeedingwomen and children under two will be identified in all the 500 villages through existing care groups	

	complementary food to children under two		
	Activity 4.1.5 Strengthen communities' capacities to reduce their vulnerability to the health impacts of climate change, particularly gendered impacts	No specific individual criteria applied to this activity as all the community members will be engaged through the 10,000 trained facilitators in all the 500 villages.	