Ministry of Natural Resources and Climate Change

Department of Climate Change and Meteorological services

STATE OF MALAWI CLIMATE IN 2024

CREWS CLIMATE RISK & EARLY WARNING SYSTEMS

WORLD METEOROLOGICAL ORGANIZATION

The State of Malawi Climate in 2024

Department of Climate Change and Meteorological Services

(DCCMS)

February, 2025

Foreword

The Ministry of Natural Resources and Climate through the Department of Climate Change and Meteorological Services (DCCMS) is pleased to present the *State of Malawi Climate in 2024* report. This document provides a comprehensive analysis of Malawi's climate conditions and extreme weather events observed throughout the year, offering crucial insights into their socio-economic impacts. The year 2024 was marked by significant climate variability, with the influence of El Niño driving shifts in rainfall patterns, temperature anomalies, and the occurrence of extreme weather events such as droughts, floods, and storms. These climatic events had far-reaching consequences across various sectors, including agriculture, water resources, energy, health, and infrastructure. As climate change continues to pose challenges, timely and data-driven reporting is essential for informed decision-making, disaster preparedness, and resilience building.

This report underscores the importance of climate monitoring and early warning systems in safeguarding lives and livelihoods. It also highlights the critical role of collaboration among stakeholders, including government agencies, development partners, researchers, and communities, in strengthening climate adaptation and mitigation strategies.

We extend our appreciation to the dedicated team of meteorologists, climate scientists, and researchers who contributed to the preparation of this report. We also acknowledge the support of our partners and stakeholders in enhancing climate resilience and ensuring that the nation remains well-prepared to address future climate challenges.

We hope this report serves as a valuable resource for policymakers, planners, and all stakeholders in understanding Malawi's climate trends and taking proactive steps towards a more sustainable and climate-resilient future.

Yusuf Mkungula, PhD
Secretary for Natural Resources and Climate Change

Preface

"The State of Malawi Climate in 2024," published by the Department of Climate Change and Meteorological Services in the Ministry of Natural Resources and Climate Change, summarizes the significant weather and climate events that occurred in Malawi, with a focus on specific period of 2023/2024 rainfall season and the year 2024. The report also analyzes the socioeconomic impacts of these weather and climate phenomena, painting a picture of Malawi's weather and climate experience during 2024.

The publication is structured into six chapters: **Chapter 1** that provides a general introduction and background information, outlining Malawi's climatic conditions and common extreme weather events. **Chapter 2** delves into the major drivers of Malawi's weather and climate, examining observed drivers, rain-bearing systems, and wind patterns in 2024. **Chapter 3** presents an analysis of observed weather in 2024, including the spatial and temporal distribution of rainfall and the monthly and annual temperature performance. **Chapter 4** discusses the extreme weather and climate events that impacted the country during the 2023/2024 season and 2024, such as droughts, floods, and heatwaves. **Chapter 5** explores the impacts of these extreme events on various socioeconomic sectors, including Disaster Risk Management (DRM), Water Resources Management (WRM), Agriculture and Food Security (AFS), Transport, Health, and Education; and finally, **Chapter 6** offers a summary and conclusion of the publication, highlighting key takeaways.

In summary, the year presented significant challenges including low agricultural production due to drought. At the same time, Lake Malawi appreciated with excess water level that disrupted tourism and hydropower production and affected communities along the Lake and Shire River.

Lucy Mtilatila, PhD
Director of Climate Change and Meteorological Services

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Abbreviations

ADB	African Development Bank
APES	Agriculture Production Estimate Survey
CAB	Congo Air Boundary
CAP	Common Alert protocol
DCCMS	Department of Climate Change and Meteorological Services
DMI	Dipole Mode Index
DoDMA	Department of Disaster Management Affairs
EGENCO	Electricity Generation Company
ENSO	El Niño and Southern Oscillations
FEWS NET	Famine Early Warning Systems Network
GBV	Gender-Based Violence
IOD	Indian Ocean Dipole
IPC	International Phase Classification
ITCZ	Inter-Tropical Convergence Zone
JFM	January-February-March sub season
KABOM	Kamuzu Barrage Operational Model
KIA	Kamuzu International Airport
LEAD	Leadership for Environment and Development
MASL	metres above sea level
MDF	Malawi Defence Force
MJO	Madden-Julian Oscillation

MT	Metric Ton
MW	Mega Watts
NWRA	National Water Resources Authority
OND	October-November-December sub season
SPEI	Standardized Precipitation Evapotranspiration Index
SST	Sea Surface Temperature
TC	Tropical Cyclone
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

State of Climate of Malawi 2024

Key Messages

El Niño Influence on Climate

Below-normal rainfall in southern and central regions, while near-normal to above-normal rainfall in the north.

Rising Temperatures and Heatwaves

Record-high temperatures with extreme heat events exceeding 40°C, affecting health, agriculture, and water availability. Ngabu reported the highest maximum temperature of 43.9℃

Socio-Economic Impacts

Over 5.7 million people facing food insecurity. Over 17 thousand households affected due to floods

Prolonged Dry spells and Drought

Impacted agriculture, water resources, and food security, particularly in southern and central regions.

Health and Climate-Related Risks

Increased cases of heat-related illnesses, malnutrition, and waterborne diseases. Calling for a stronger health response.

Extreme Rainfall

Caused flash flooding leading to displacement, infrastructure damage, livelihoods loss. 24Hrs rainfall of 475mm was reported Nkhunga in Nkhotakota.

Disaster Risk and Early Warning

Played a critical role in mitigating climate impacts. Need for more investment in forecasting and communication to strengthen disaster preparedness

Lake Malawi Water Levels

Historic high of 476.38AMSL Lakeshore flooding displacing households, and affecting fisheries and tourism. With econimic loss of over 8 billion kwacha.

Chapter one

1.0 Background Information

Located in southeastern Africa, the landlocked nation of Malawi is bordered by Zambia to the west, Tanzania to the north, and Mozambique to the east and south. Situated between 9° and 17.3° South latitude and 32° and 36° East longitude, Malawi encompasses a total area of 118,484 km². Lake Malawi, a dominant feature occupying roughly one-fifth of the country, extends from north to south within the Great Rift Valley and covers approximately 29,600 km². This body of water is Africa's third-largest lake and the ninth-largest in the world (Haghtalab et al. 2019). The Shire River, Lake Malawi's sole outlet, flows south to join the Zambezi River. Malawi's diverse terrain ranges dramatically from the low-lying Shire Valley, dipping below 50 meters in elevation, to the heights of Mulanje Mountain in the south, which rises to approximately 3,000 meters above sea level (Malawi Country Hydromet Diagnostics Report, 2023). Malawi's estimated population exceeds 21 million (Worldometers, 2023).

Administratively, the country is divided into three regions: northern, central, and southern, with 28 districts. It has a diversity of natural resources including fertile cropland, ideal for agriculture and forests which cover about 30% of the country's land (Environmental Affairs Department, 2010).

1.1 Climatic Conditions

1.1.1 Temperature and Rainfall Patterns

Malawi's climate is subtropical, characterized by two seasons; summer and winter. The climate is significantly modified by the varying country's topography. Summer is wet but hot and starts from October to April. During the rainfall season, temperature can reach 37^{o}C with relative humidity ranging between 50 to 80 percent. Annual rainfall ranges between 700mm to 2,500mm with the highest amounts being experienced over the highlands while the lowlands experience the lowest amounts. About 95% of the annual precipitation falls during the wet summer season particularly from November to April with the highest rainfall experienced in January and February (Ngongondo et al. 2011).

The winter season, lasting from May to September, is characterized by cool, dry conditions as a high-pressure system over the Indian Ocean drives a flow of cool, dry air inland (Ngongondo et al. 2011). While generally dry and cold, the period from May to August can experience occasional rain showers or drizzles, particularly in higher altitude regions. Maximum temperatures during winter typically range from 17°C to 27°C, while minimum temperatures fall between 4°C and 10°C. Temperatures begin to rise again in September.

1.1.2 Extreme Weather Events

Malawi's socio-economic progress is severely hampered by extreme weather events, including droughts, floods, and cyclones. These events disproportionately impact the rain-dependent agricultural sector (Stevens & Madani 2016). Specifically, maize, Malawi's primary staple crop, is highly vulnerable to rainfall variations, especially during the critical flowering stage two months post-planting. Water stress during this period significantly reduces yields (Anghileri et al. 2022), leading to food insecurity due to drought and inconsistent rainfall patterns. Conversely, excessive rainfall often triggers devastating floods, resulting in damage to homes, crops, and infrastructure, displacement of communities, and even loss of life.

1.1.3 The Objective of the State of Climate Reports

Since 2022, the Ministry of Natural Resources and Climate Change has been publishing Annual State of Climate reports, offering an overview of significant climate events from the preceding year. These reports summarizes key parameters like rainfall and temperature patterns, and also includes the impacts of extreme climate events that occurred. The reports aim to be a comprehensive resource, compiling climate events and their consequences for convenient reference.

This report consists of six chapters. Chapter 1 offers background information on Malawi, including its climatic conditions such as temperature and rainfall patterns, as well as instances of extreme weather events. Chapter 2 examines the primary factors influencing weather and climate events in Malawi. In Chapter 3, the weather and climatic parameters observed in 2024 are presented. Chapter 4 details the extreme weather and climatic events that occurred during that year. Chapter 5 discusses the socio-economic impacts resulting from these extreme weather events. Finally, Chapter 6 concludes the report, with references provided at the end of the document.

Chapter Two

2.0 The Major drivers of weather and climate events in Malawi

A complex interplay of local, regional, and global influences shapes Malawi's weather and climate. Key contributing factors include the country's diverse topography, the lake effect from Lake Malawi, mean sea level pressure variations, surface and upper-level wind patterns, and sea surface temperature dynamics across the tropical Pacific, Indian, and Atlantic Oceans.

2.1 Observed Weather and Climate Drivers in 2024

Sea surface temperatures in the tropical Pacific, Indian, and Atlantic Oceans significantly influence Malawi's weather and climate. These temperatures drive large-scale atmospheric circulation patterns, such as the El Niño-Southern Oscillation (ENSO) in the Pacific and the Indian Ocean Dipole (IOD), which impact rainfall, temperature, and other meteorological conditions. Additionally, climatic systems like the Intertropical Convergence Zone (ITCZ) and the movement of air masses play a vital role in shaping weather patterns across the country.

2.1.1 The Sea Surface Temperatures (SSTs)

SST variations in the world's oceans are key drivers of global weather and climate, as they influence large-scale atmospheric circulation patterns. These temperature fluctuations play a critical role in shaping phenomena like the ENSO, the IOD, and the Madden-Julian Oscillation (MJO). Changes in warming of sea surface temperatures (SST) are closely associated with shifts in rainfall patterns, either enhancing or reducing precipitation over Malawi.

2.1.1.1 The El Niño and Southern oscillations (ENSO)

The ENSO is a climate phenomenon with three distinct phases: El Niño, La Niña, and Neutral. El Niño is marked by a warming of SSTs in the central and eastern tropical Pacific Ocean, resulting in above-average SSTs. In contrast, La Niña is characterized by cooling, leading to below-average SSTs in the same region. The Neutral phase represents conditions where SSTs in the tropical Pacific are near average, falling between the extremes of El Niño and La Niña.

The phases are categorized based on SST anomalies: El Niño occurs when anomalies exceed +0.5 °C, La Niña when they drop below -0.5°C, and Neutral when they remain between -0.5 °C and +0.5 °C. These thresholds provide a framework for identifying and defining ENSO conditions.

In the 2023/2024 season, weather patterns were influenced by El Niño, which persisted until April before transitioning to a Neutral phase. Historically, the El Niño phenomenon has been associated with reduced rainfall amounts across Southern Africa, including Malawi. Observations of the ENSO for 2024 align with historical trends, highlighting its significant impact on regional climate variability as depicted in Figure 1.

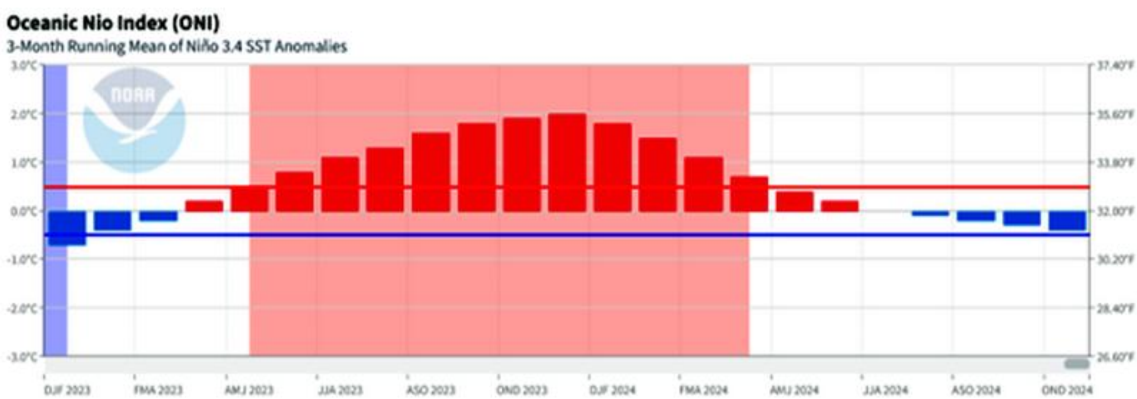


Figure 1: Observed Sea Surface Temperature anomaly for Nino 3.4 from DJF 2023 to OND 2024 (NOAA, 2025)

2.1.1.2 The Indian Ocean Dipole (IOD)

The IOD is a well-established ocean-atmosphere interaction in the Indian Ocean that significantly influences weather and climate patterns in the region. It is characterized by irregular oscillations in SST anomalies, where the western Indian Ocean alternates between being warmer (positive phase) and cooler (negative phase) relative to the eastern Indian Ocean. The IOD is classified as positive when the Dipole Mode Index (DMI) exceeds +0.4, negative when it drops below -0.4, and neutral when it lies between -0.4 and +0.4. These thresholds are essential for identifying and defining the various phases of the IOD.

In 2024, weather patterns were shaped by a positive phase of the Indian Ocean Dipole (IOD), which persisted until December as depicted in the Figure 2.

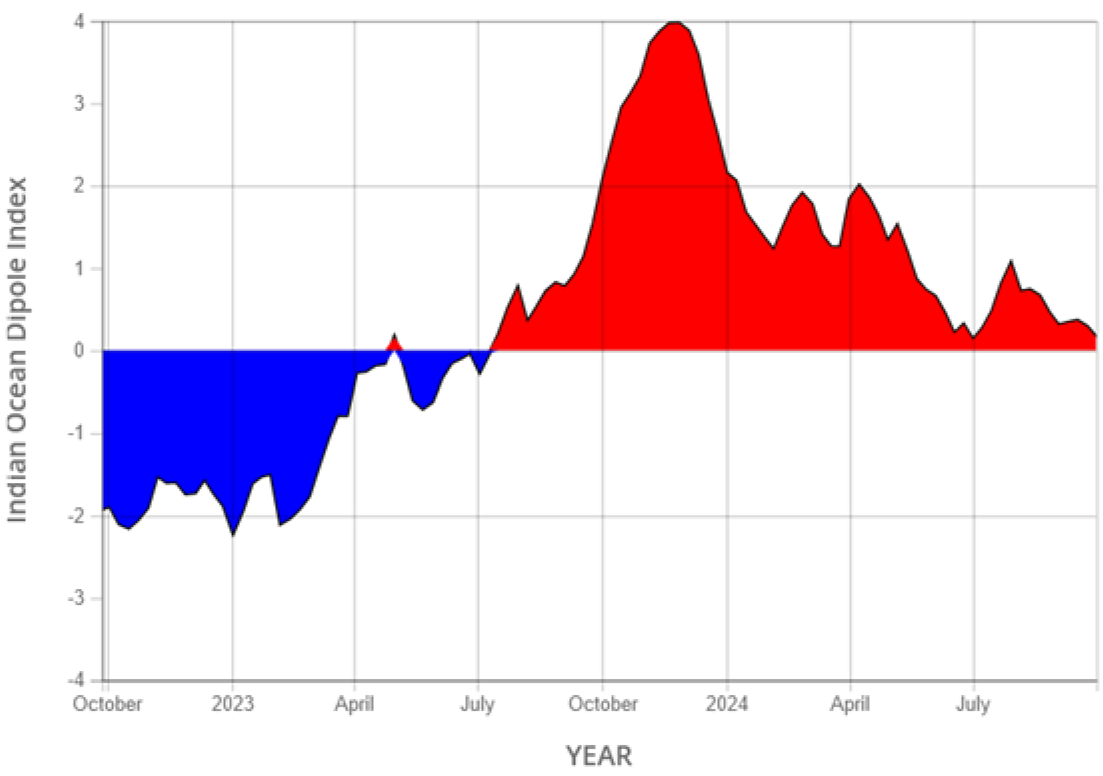


Figure 2: Observed Indian Ocean Dipole Index from October 2023 to December 2024 (NASA, 2025)

2.1.1.3 The Madden-Julian Oscillation (MJO)

The MJO is a type of intra-seasonal atmospheric variability observed over tropical oceans. It manifests as an eastward-moving disturbance that cycles every 30 to 90 days. The active phase of the MJO is associated with increased tropical disturbances, while its inactive phase suppresses such activity in a given region. Although the MJO originates in the tropics, its influence extends to both tropical and mid-latitude regions.

In Southern Africa, the MJO affects cloud cover, rainfall distribution, and wind patterns. It also influences monsoonal rains and can enhance the development of tropical cyclones in the region.

Figure 3 illustrates the African region corresponding to phases 1 and 8 as well as 3 and 4 phases of the MJO for Indian Ocean region. During the March 2024 rainfall season, the MJO was notably active in the region. It was also active in the Indian Ocean in January (red colour) and March (blue) compared to February (green). This atmospheric influence played a crucial role in the formation and intensification of severe tropical storm Filipo, which indirectly enhanced rainfall over Malawi in March 2024.

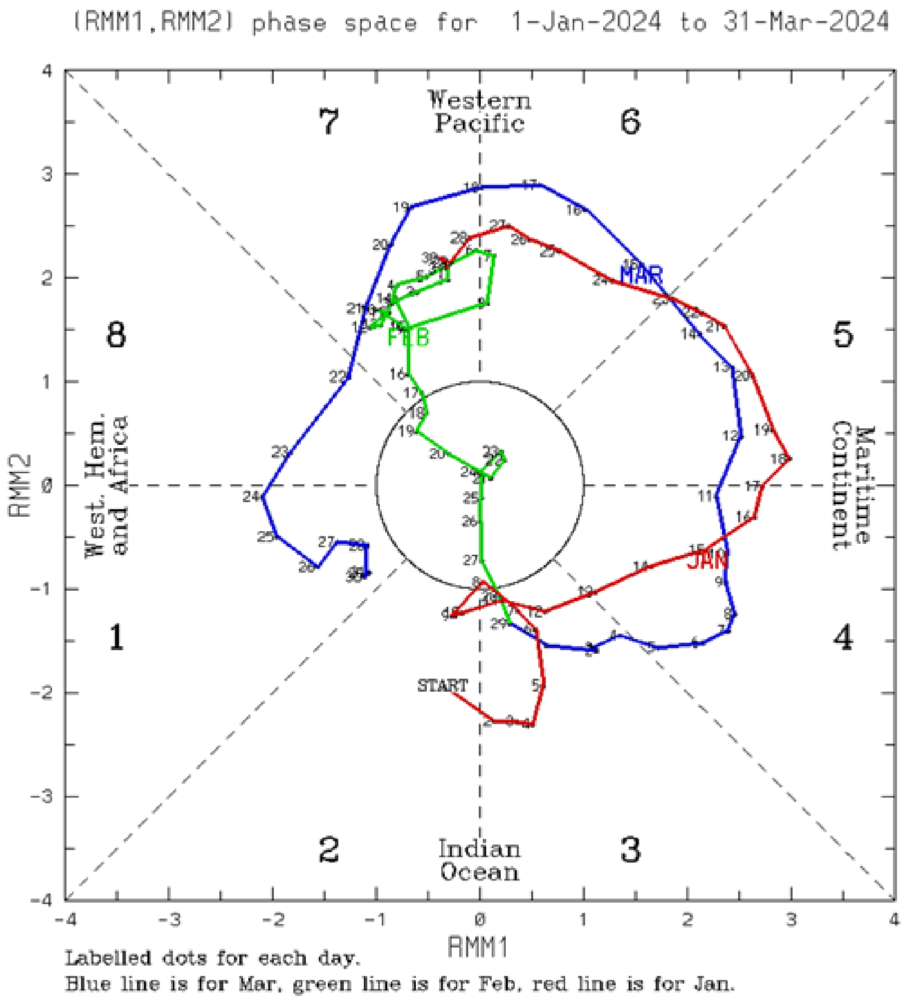


Figure 3: Observed Madden-Julian Oscillation (MJO) between January and March, 2024 (Australian, 2025). Red is for January, green is for February and blue is for March

2.2 Observed Rain Bearing Systems and Wind Regimes

The commonly observed rain-bearing systems in Malawi include convergence ahead of a pressure rise, the Inter-Tropical Convergence Zone (ITCZ), the Congo air mass, easterly waves, and tropical cyclones.

During the winter season, Malawi experiences distinct weather patterns characterized by Mwera winds and Chiperoni conditions. A summary of the occurrences, in terms of the number of days per month that rain-bearing systems and wind regimes were observed during the 2023/2024 El Nino season. No tropical cyclones influenced the weather in Malawi. The combined effects of ITCZ and Congo air mass was predominant in the month of January as compared to the other months, Figure 4.

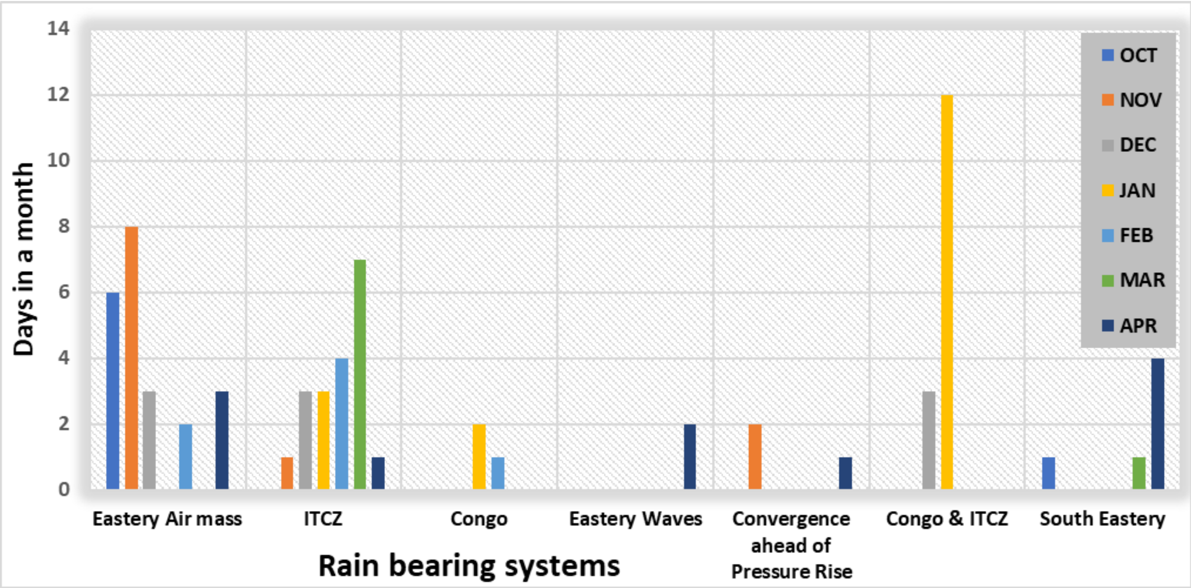


Figure 4: Observed Rain Bearing Systems in the 2023/2024 Rainfall Season

2.2.1 Convergence ahead of pressure rise

The convergence ahead of a pressure surge occurs when a stronger south-easterly air mass converges with an easterly air mass. This phenomenon is most common at the onset of the rainfall season, typically in October and November. Both air masses usually originate from the southern hemisphere. The rainfall resulting from this convergence is often accompanied by lightning, hail, and potentially damaging winds and gusts.

In 2023/2024 season, this system was very rare, as it only happened twice in November. The strong winds associated with this system caused significant damage, including the blowing off roofs, particularly in central and southern Malawi.

2.2.2 The Inter-tropical Convergence Zone (ITCZ)

During the rainfall season of 2023/2024 the Inter-tropical Convergence Zone (ITCZ) was not set earlier. This affected the rainfall season because ITCZ is one of the main rain bearing systems, which normally enhances the onset of the season. The weak ITCZ in November and December only prevailed once and thrice respectively. However, it was enhanced in January, where it posed a threat of flash flooding over some areas due to heavy rains, Figure 4.

2.2.3 The Congo Air Mass

This refers to air masses originating from the Congo Basin, which are moisture-laden and contribute to rainfall in Malawi when they encounter topographical barriers or interact with other weather systems. The Congo air mass comprises westerly winds that originate from the Atlantic Ocean, traverse the tropical forests of the Congo Basin, and bring precipitation to Southern African countries, including Malawi. This air mass is characterized by intermittent thunderstorms and continuous rainfall covering a wide geographical area and lasting for extended period. The surface convergence zone, where low-level westerlies from the Congo Basin meet easterlies from the Indian Ocean trade winds, is known as the Congo Air Boundary (CAB).

In 2023/2024 season, the Congo air mass was significantly suppressed. Its presence was largely confined to January, during which it primarily manifested as intermittent pulses rather than maintaining a consistent impact. The final observed instance of the Congo air mass during this period occurred on 27th January 2024. Nevertheless, the system was able to produce intermittent rains, mainly over central and northern areas.

2.2.4 Easterly Waves

The end of the rainfall season in Malawi is characterized by rains associated with easterly waves, which originate from the eastern regions of tropical oceans and move westward at speeds of 20 to 40 km/hr. These waves generate rainfall by disrupting the normal isobaric pressure patterns, producing a wave-like effect that enhances precipitation.

During the 2023/2024 season, easterly waves were suppressed and only occurred a couple of time in the month of April, Figure 4.

2.2.5 Tropical Cyclones

The 2023/2024 cyclone season in the South-West Indian Ocean (SWIO) was more active than average, with a total of nine named storms. Five of these intensified into tropical cyclones, and two reached intense tropical cyclone status, including Anggrek, which originated from the Australian region (as shown in Figure 5). The season began on November 15, 2023, with Tropical Cyclone Alvaro forming in December 2023, and concluded with Tropical Cyclone Laly. While none of these storms directly impacted Malawi, Alvaro (in December) and Filipo (in March) indirectly contributed to increased rainfall in the country due to their influence on the Congo air mass and the Inter-Tropical Convergence Zone (ITCZ). Throughout the season, the Department of Climate Change and Meteorological Services (DCCMS) issued informational advisories to the public regarding the storms' paths and intensities, despite no direct impact being anticipated for Malawi.

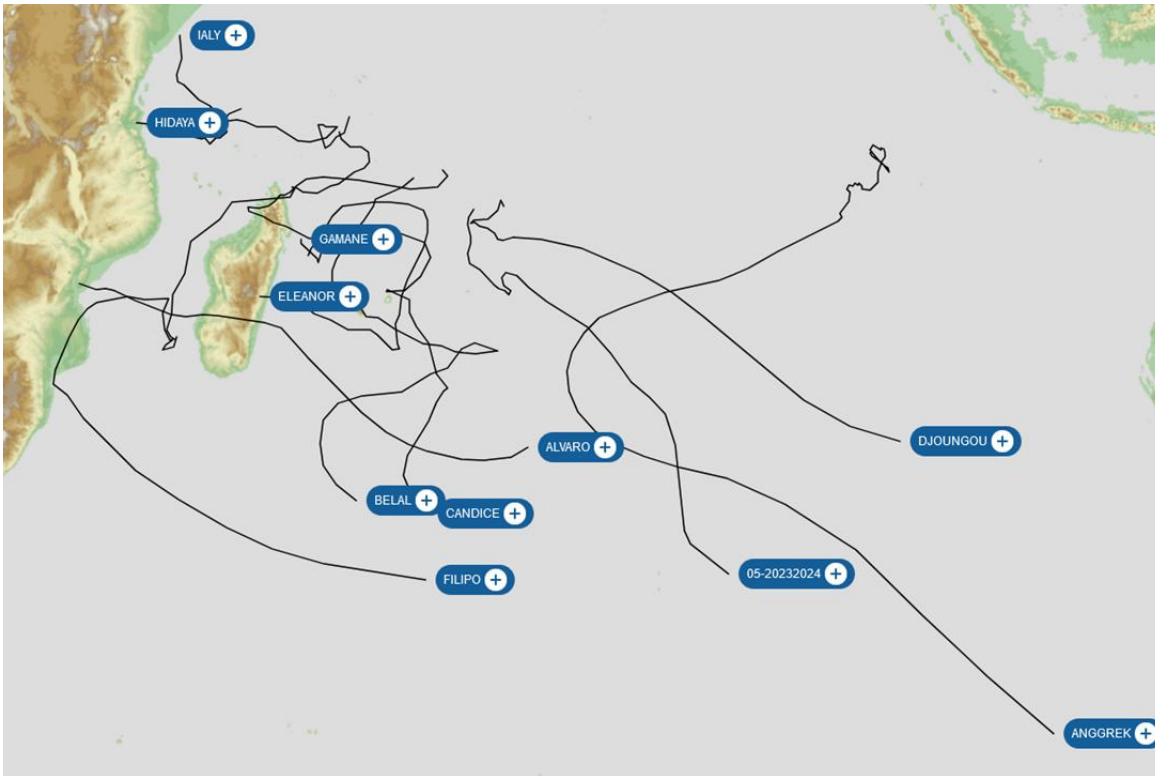


Figure 5*:* 2023/2024 cyclonic activities over South-west Indian Ocean (SWIO) region. Source: https://meteofrance.re/fr/cyclone

2.2.6 Mwera winds and Chiperoni Weather Conditions

Winter weather patterns in Malawi are primarily shaped by cool, moist air masses originating from the southern Indian Ocean, driven by high-pressure systems migrating between the Azores and St. Helena Islands. Strong high-pressure systems along South Africa's southeast coast draw in a cool, moist south-easterly airflow into the country. This results in chilly weather, overcast skies and light rain, commonly called "*Chiperoni*," particularly over highland areas. Furthermore, Lake Malawi experiences moderate to strong southerly winds, locally known as Mwera and this cause high water waves. In 2024, the intensity and strength of the high-pressure system was dominant for many months. The highest wave height observed from Nkhata Bay was 4.4 meters with a significant wave height of 2.5 meters on 4th October as shown in Figure 6.

The chiperoni weather caused very cold weather conditions (thus temperatures below 11 °C) during early morning hours over many areas. On 25th July, 2024, Mimosa Meteorological station reported the lowest temperature anomaly of -8.9 °C with the new absolute minimum temperature of 6.9 °C from 7.5 °C which was recorded on 24th July 2019.

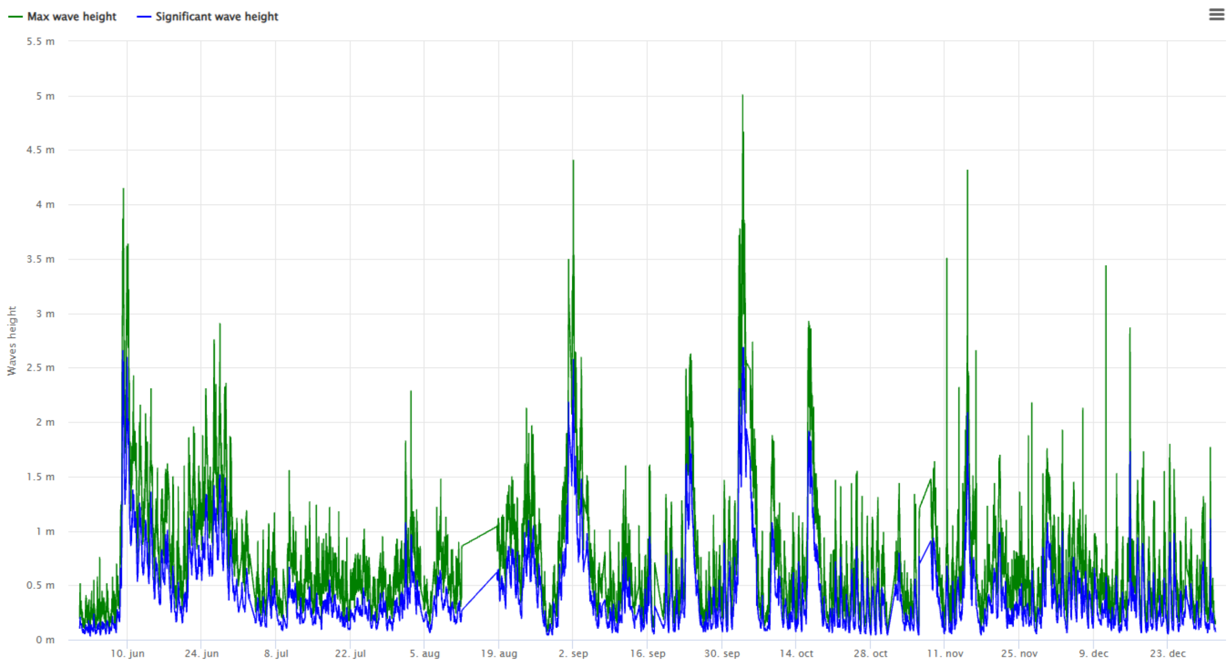


Figure 6: The observed wave height from Nkhata Bay Lake buoy on Lake Malawi.

During the 2024 winter, wind patterns varied across Malawi. In Southern Malawi, Mimosa experienced frequent and moderately strong Mwera winds (south-easterlies) that reached up to 43 km/h, occurring over 40% of the time (Figure 8, right). In contrast, Chipoka saw predominantly moderate southerly winds, present more than 35% of the time (Figure 8, left). Further inland at Dzalanyama, westerly winds were dominant, exceeding 60% of the time, but with a lower maximum speed of 22 km/h (Figure 7, left). Meanwhile, in the Northern Region, Lunyangwa in Mzuzu was characterized by southerly winds exceeding 75% of the time, reaching a maximum recorded speed of 29 km/h (Figure 7 right).

The windrose diagram for Lunyangwa Station (left) and Dzalanyama station (right)

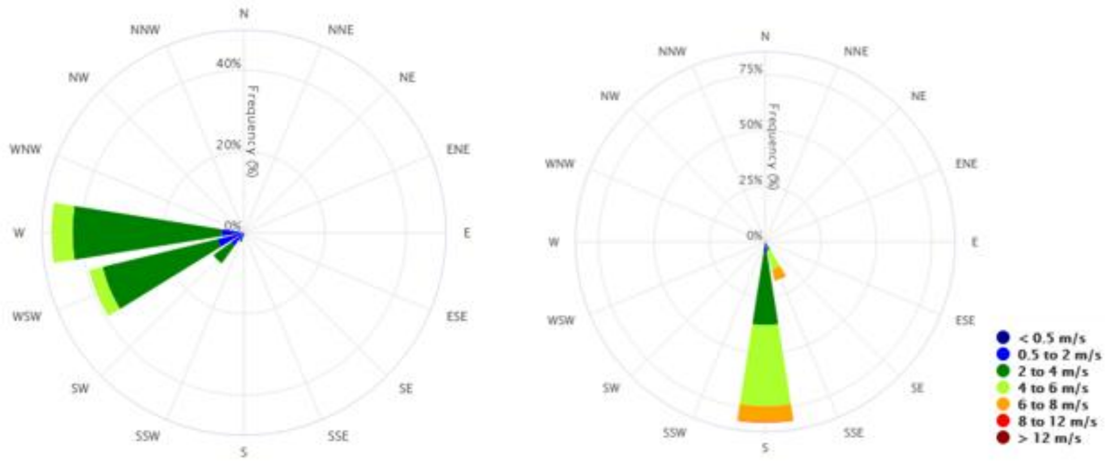


Figure 7: Observed Wind Speed and direction between May and September from Lunyangwa Station in the North (left) and Dzalanyama Station in the Central (right). 1m/s = 3.6km/hr, 2m/s = 7.2km/hr, 4m/s = 14.4km/hr, 6m/s = 21.6km/hr, 8m/s = 28.8km/hr, 12m/s = 43.2km/hr

The windrose diagram for Chipoka (left) and Mimosa (right)

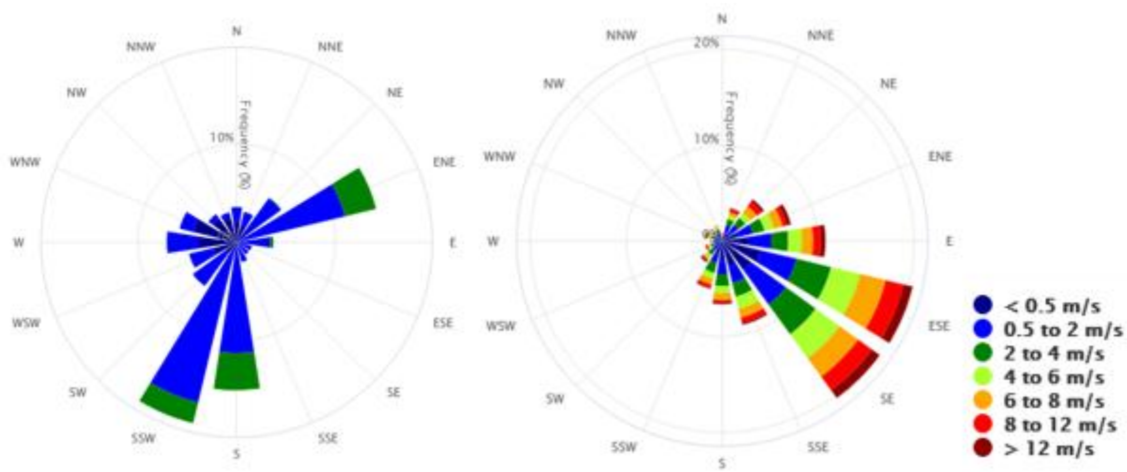


Figure 8: Observed Wind Speed and direction between May and September from Chipoka Station along the Lake shore in Salima (left) and Mimosa Station in the South (right). 1m/s = 3.6km/hr, 2m/s = 7.2kn/hr, 4m/s = 14.4km/hr, 6m/s = 21.6km/hr, 8m/s = 28.8km/hr, 12m/s = 43.2km/hr

Chapter Three

3.0 Observed weather and climatic parameters analysis

3.1 Rainfall

Malawi has a unimodal rainfall season running from October to May with a peak in the month of January. The rainfall season typically commences in the south of the country progressing northwards. In recent years, the characteristics of the season have been shifting, including the onset, cessation, rainfall intensity, spatial and temporal distribution, as well as the occurrence of extreme rainfall events. A detailed look at the 2023/2024 rainfall season is given in subsequent sections.

3.1.1 Seasonal Rainfall Distribution

The country experienced steady rains from mid-December 2023. This was generally delayed seasonal onset over the country, some areas particularly over southern Malawi their season delayed by over four (4) weeks from their normal time. Variation in onset dates is shown as a map in Figure 9(a). The cessation of rainfall was normal for the majority of areas in the country, with the tailing off starting from southern and central parts of Malawi in the last dekad of March 2024 and progressing northwards, as depicted by the middle map, Figure 9(b). In terms of seasonal length, most areas experienced a season ranging from 110 to 130 days, which is generally normal, despite periods of prolonged dry spells being evident, particularly during January and February 2024. Seasonal length is depicted by the map on the right side, Figure 9(c) below.

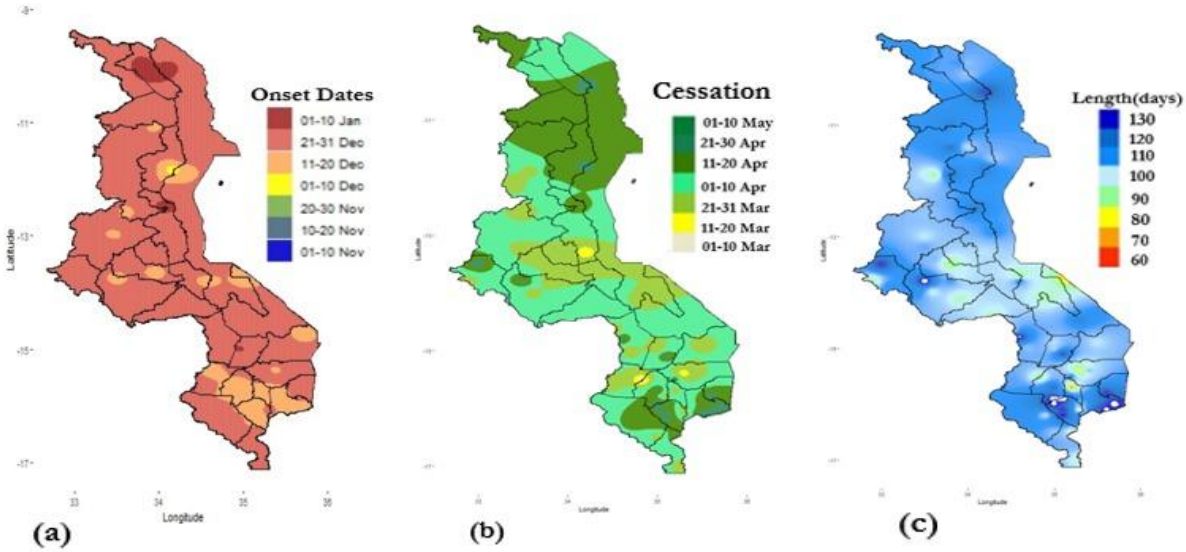


Figure 9: 2023/24 seasonal onset (a), cessation (b) and length (c)

In Figure 10 (left), for the sub-season, October - November - December (OND), normal to below-normal rainfall amounts were recorded over majority of areas with few pockets of normal to above-normal rainfall amounts in some areas in all the eight Agricultural Development Divisions (ADD).

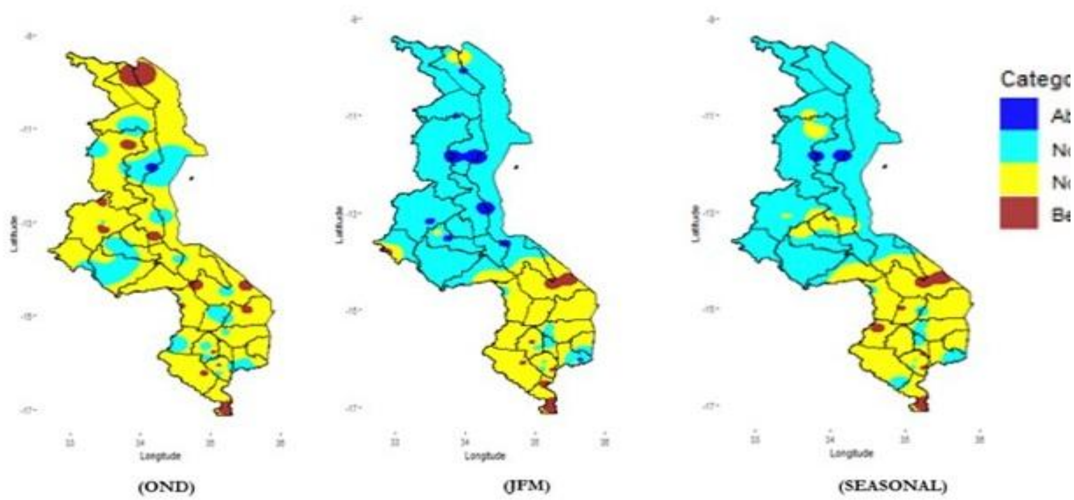


Figure 10: Seasonal and sub-seasonal rainfall distribution as percentage of normal

However, for the sub-season January - February - March (JFM), generally normal to above-normal rainfall amounts were observed over the northern and central parts of the country including few of southern highlands. Normal to below-normal rainfall amounts with pockets of below normal were observed over the majority of southern half of the country as shown in JFM map in Figure 10 (middle).

The overall, 2023/2024 rainfall season was generally normal to above-normal over the northern half of the country while normal to below-normal total rainfall amounts with pockets of below normal were observed over the southern half of the country. This is shown in Figure 10 (right). Southern Malawi received below normal rainfall amounts throughout the season.

3.1.2 Monthly rainfall distribution

Figure 11 contains maps of monthly rainfall distribution across Malawi. During the month of October 2023, normal to above-normal rainfall amounts were experienced over majority of southern and some central areas of the country with normal to below-normal rainfall amounts over northern areas as shown in Figure 11(a). Mulanje Boma reported the highest monthly rainfall of 391.1mm.

November 2023 was normal to above-normal over parts of Nkhata Bay, Nkhotakota, Lilongwe, Kasungu, Mchinji, Dedza and Ntcheu with normal to below-normal rainfall amounts recorded elsewhere as shown in Figure 11(b). The distribution of the rains in most areas was very erratic during this month, and the highest monthly rainfall of 268.5 mm was recorded at Chintheche Agriculture in Nkhata Bay.

December 2023 was worse than October and November, where normal to below-normal rainfall amounts were experienced over the majority of the areas Figure 11(c). Though the rainfall amounts were below normal, the normal range for December is higher than that of October and November. The total monthly rainfall was highest at Chiradzulu Agriculture, which reported 311.8mm during this month.

The month of January 2024 was the wettest of the season, where normal to above normal rainfall amounts were experienced over the majority of areas of the country with well above normal conditions over northern areas and normal to below over some few southern areas as shown in Figure 11(d) below. Thyolo Boma reported the highest monthly rainfall total for January of 576.7 mm.

For February 2024, normal to above normal rainfall amounts were experienced over northern and parts of central areas, while normal to below normal rains were experienced over the majority of southern areas and parts of the central as shown in Figure 11(e) below. The worst hit districts were Mwanza, Balaka, parts of Neno, Blantyre and Zomba. The highest monthly rainfall amount of 475.8 mm was reported from Lifuwu in Salima District.

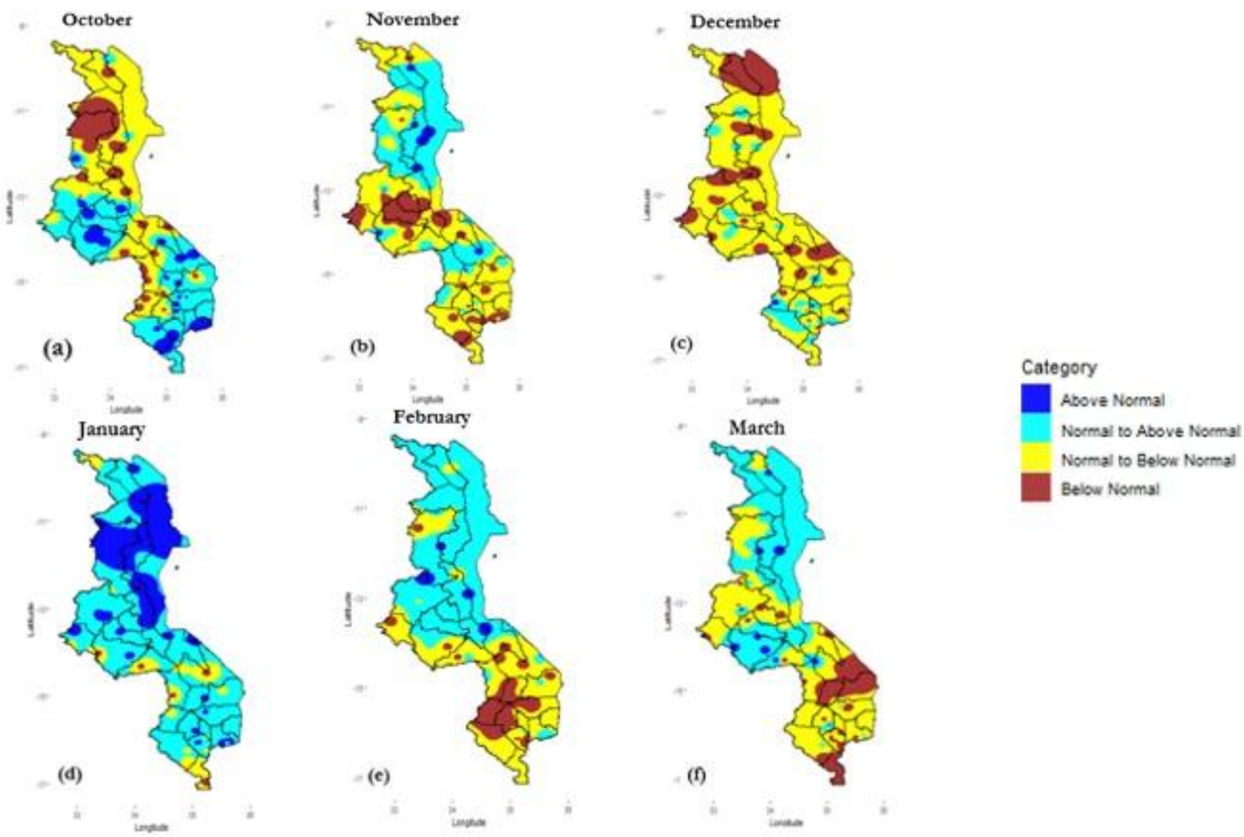


Figure 11: Monthly rainfall distribution as percentage of normal during 2023/2024 rainfall season (a) October, (b) November, (c) December, (d) January, (e) February and (f) March

Similarly, March 2024 was also drier than normal over the southern areas and parts of the central areas. During this month, the worst hit districts were Balaka, parts of Machinga and Zomba. Generally normal to above-normal amounts were observed over parts of the northern and central areas of the country including Lilongwe, Nkhotakota, Nkhatabay, Karonga, Chitipa and Bolero, Figure 11(f). Chintheche Agriculture in Nkhatabay registered the monthly total amount of 1037.5 mm during this month.

3.1.3 Cumulative rainfall

Cumulative rainfall data for the 2023/2024 season were analyzed to assess their characteristics and performance in comparison to the long-term average from 1991 to 2020 at selected points. The cumulative deviation from the long-term average indicates the overall performance of rainfall at the end of the season in comparison from the average. Much as the rainfall season indicates that 2023/2024 season, was normal to above normal in the northern areas and normal to below over the south, the cumulative rainfall plots show that Karonga was below average throughout the season, except the months of October and November which was within the normal, Figure 12. Mzuzu rainfall was oscillating within the average during the whole season, while Nkhatabay was slightly above normal and Nkhotakota was within average at the beginning of the season and became above normal from January 2024.

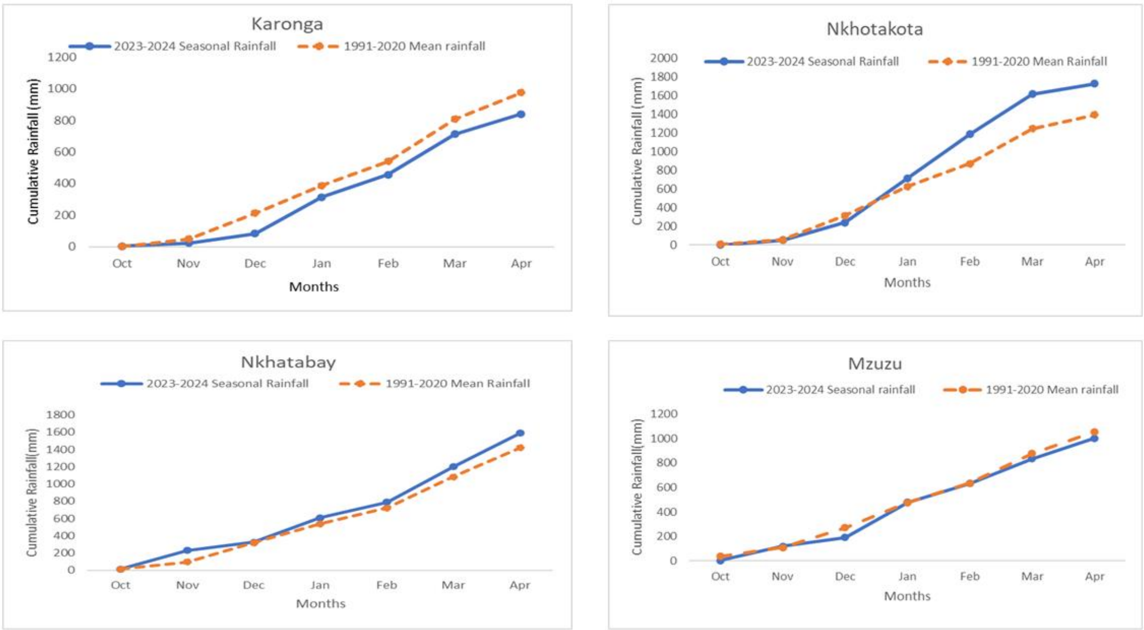


Figure 12: Cumulative rainfall for Karonga, Nkhotakota, Nkhata Bay and Mzuzu stations for 2023/2024 season versus 1991-2020 mean

Southern parts of the country generally received normal to below-normal rainfall as shown in Figure 13. Zooming for area specific it indeed shows that many places such as Chichiri and Ntcheu were below average while Ngabu was also below average but recovered during the month of April, mainly due to the indirect effect of Tropical Cyclone Filipo. Chitedze was generally, within the normal range throughout the rainfall season.

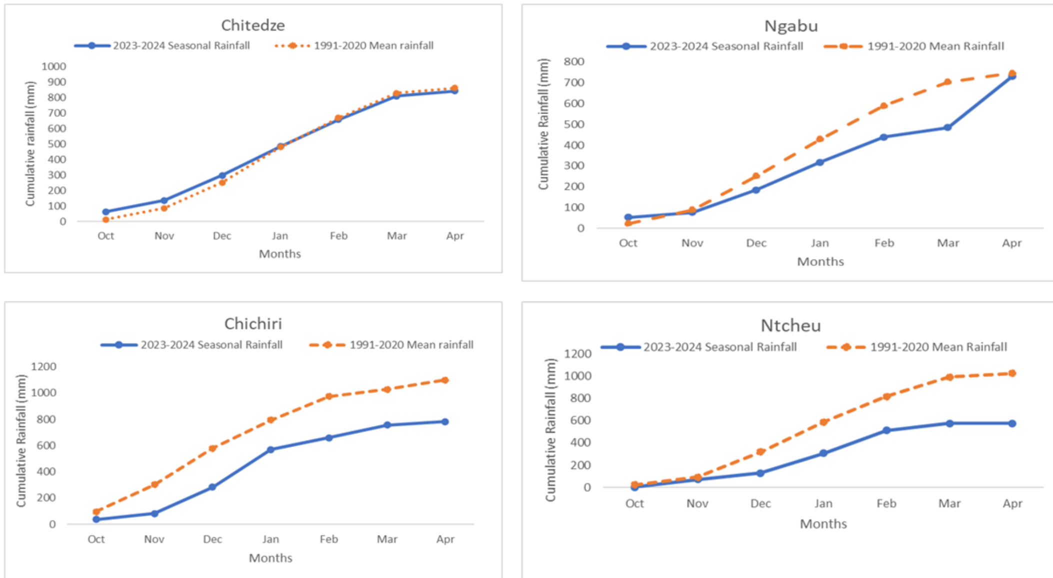


Figure 13: Cumulative rainfall for Nkhotakota, Chitedze, Salima and Lujeri stations for 2023/2024 season versus 1991-2020 mean

3.2 Temperature

In this section, an analysis of mean, maximum and minimum temperature values for the year 2024 is presented. The temperature anomalies were calculated against the mean of the base period of 1991 to 2020.

The results indicate that 2024 was generally warmer than average across all parameters (minimum, mean and maximum temperature) for most parts of Malawi.

3.2.1 Annual Mean Temperature

As shown in the mean temperature anomaly in Figure 14, 2024 was generally warmer than normal. On average the mean temperature was +0.9°C warmer than normal, and it was higher in some parts. For instance in Dedza, the increase was +1.6°C, Ngabu +1.5°C and Chileka +1.4°C. However, the mean annual temperature ranged from 19.8°C at Mzuzu Airport to 28.8°C at Ngabu in Chikwawa.

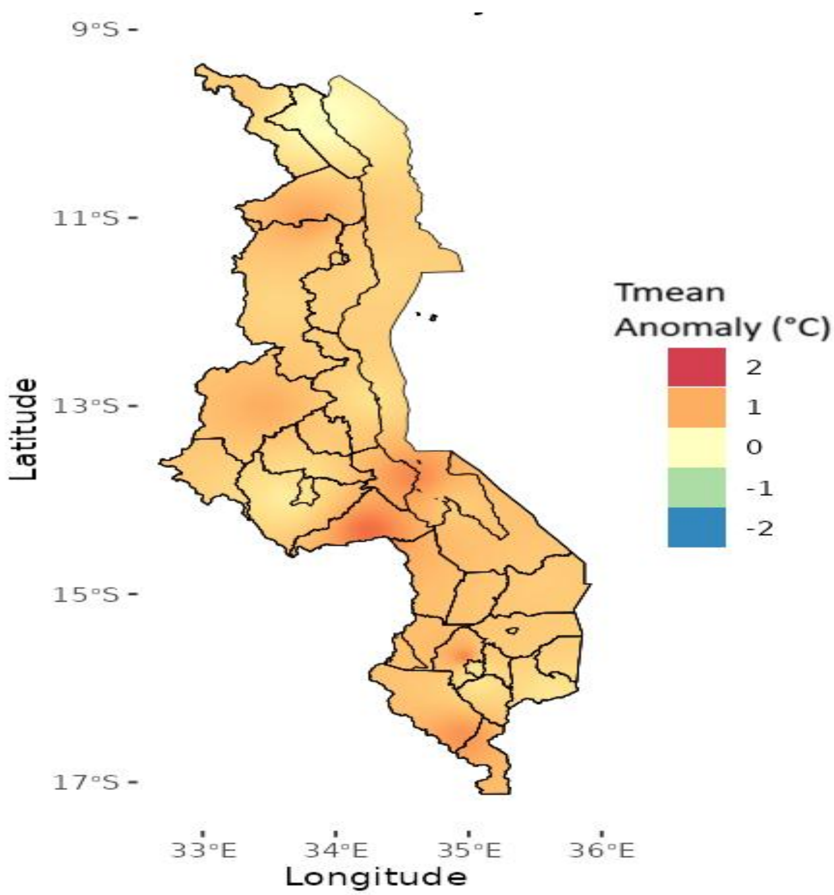


Figure 14: The map showing annual minimum temperature anomaly

3.2.2 Monthly Mean Temperature

At monthly scales, the mean temperature anomalies ranged from -0.5 °C in October to +1.4 °C in December. October was slightly cooler than normal, but it was +4.7°C degrees higher than normal in December at Ngabu, +3.1°C at Chileka and 2.9°C at Mangochi Boma.

January mean temperature anomaly ranged from -0.7°C at Bolero in Rumphi to +1°C at Ngabu in Chikwawa. However, the overall temperature anomaly was +0.1°C for this month, Figure 15. Though the temperature anomalies ranged from -2.8°C at Mangochi Boma to +2.2°C at Ngabu in Chikwawa, the overall change for the month of February was +0.9°C, signifying warmer than January temperatures, since the mean temperatures for these two months are similar. While during the month of March, the temperature anomaly ranged from -0.9°C at Chichiri in Blantyre to +1.8°C at Ngabu in Chikwawa and the overall change for the month was +0.8°C. From January to April, April had the largest anomaly of +1.1°C where the temperature changes ranged from -0.1°C at Kasungu Boma to +2.8°C at Mimosa in Mulanje.

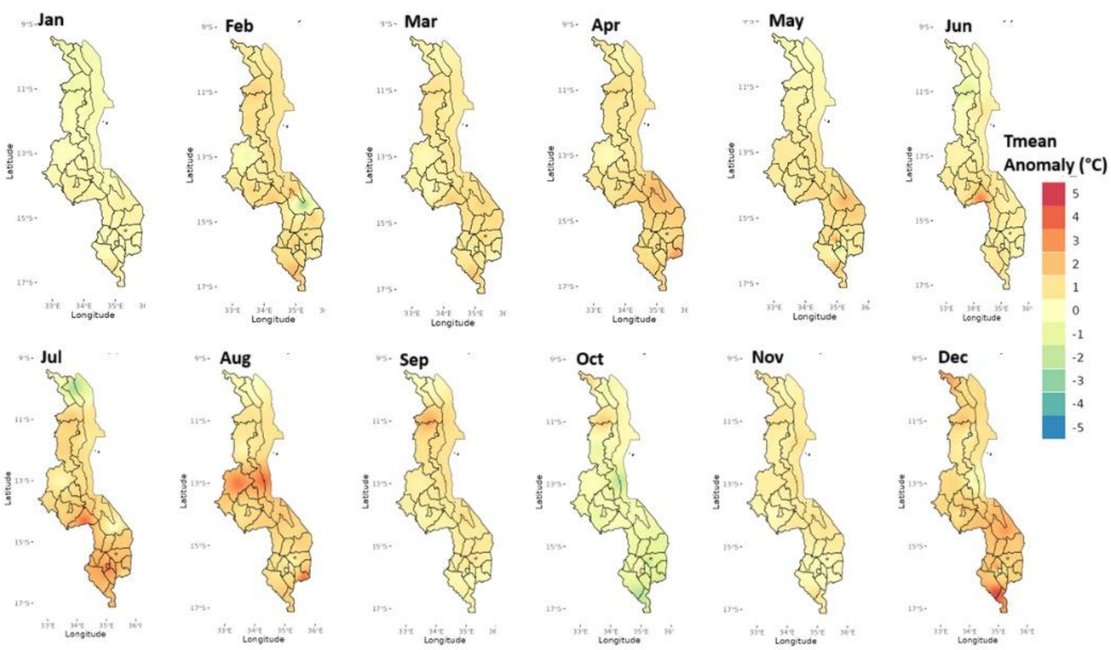


Figure 15: Maps showing monthly mean temperature anomalies

The winter months were also warmer than average, the temperature changes ranged from +0.6°C in June to +1.3°C in July and August. The ranges were so large in these months, for instance the temperature changes ranged from -2.0°C at Bvumbwe to +3.0°C at Chileka in May. Similarly, the ranges were between -1.5°C at Bolero to 3.3°C at Dedza in June. In July, the temperature changes ranged from -2.4°C at Karonga Boma to +3.7°C at Dedza Boma while in August, the mean temperature anomaly ranged from -0.2°C at Karonga Boma to +3.8°C Nkhotakota Boma, Figure 15. Dedza was generally warmer than normal in winter while Karonga was cooler than normal. September mean temperature anomaly was +0.7°C while November was +0.5°C,

3.2.3 Annual Maximum Temperature

Similar to annual mean temperature, annual maximum temperature analysis depicts hotter than normal temperatures across the country as displayed in Figure 16. As evidenced from the analysis, the maximum temperature had an anomaly of +1.1 °C on average. In addition, the central district of Dedza exhibited an annual positive deviation of +2.3 °C; this warming is noteworthy as Dedza is climatologically known to be a cold district. Otherwise, the location with least temperature increase was Bolero in Rumphi which has and increase of +0.2°C, Figure 16. The highest maximum temperature of the year was recorded at Ngabu on 14 December 2024 of 43.9°C.

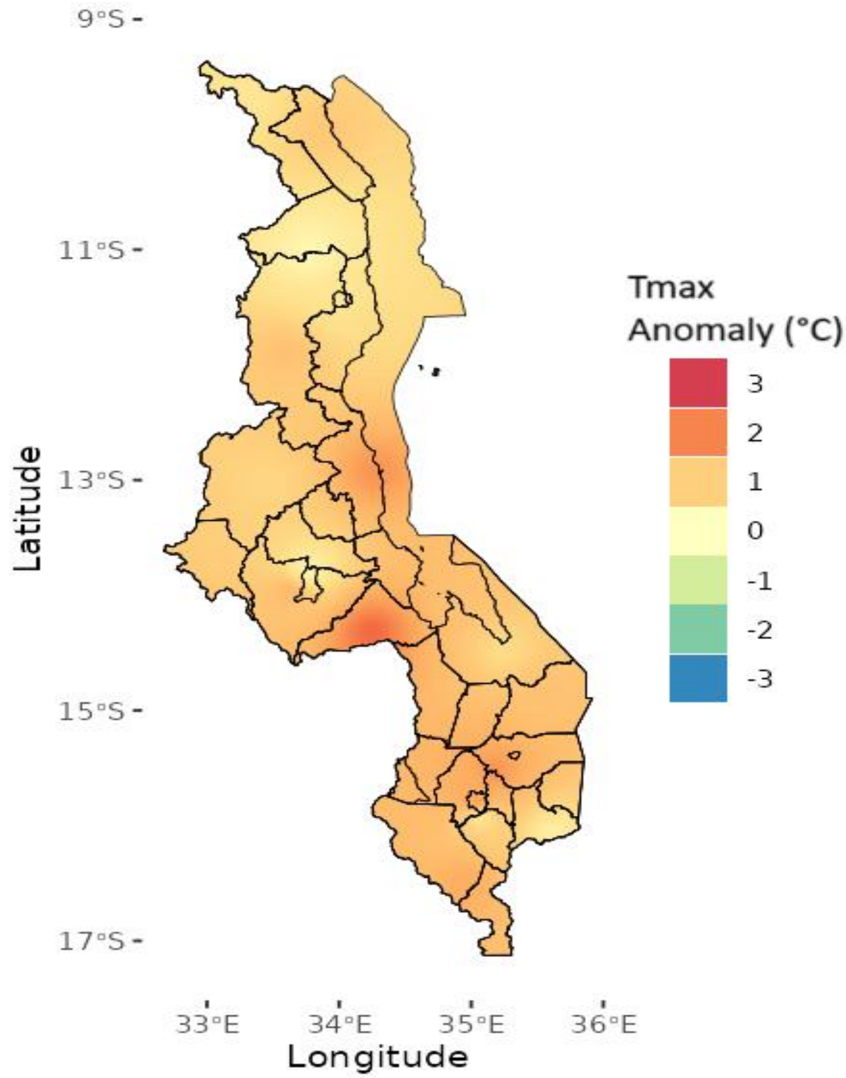


Figure 16: The map showing annual maximum temperature anomaly

3.2.4 Monthly Maximum Temperature

Figure 17 shows the monthly maximum temperature anomaly maps from January to December 2024. Again, similar to mean monthly temperature, monthly maximum temperature analysis reveals that July and December had greater temperature anomaly of +3.5°C and +2.9°C on average respectively, Figure 17.

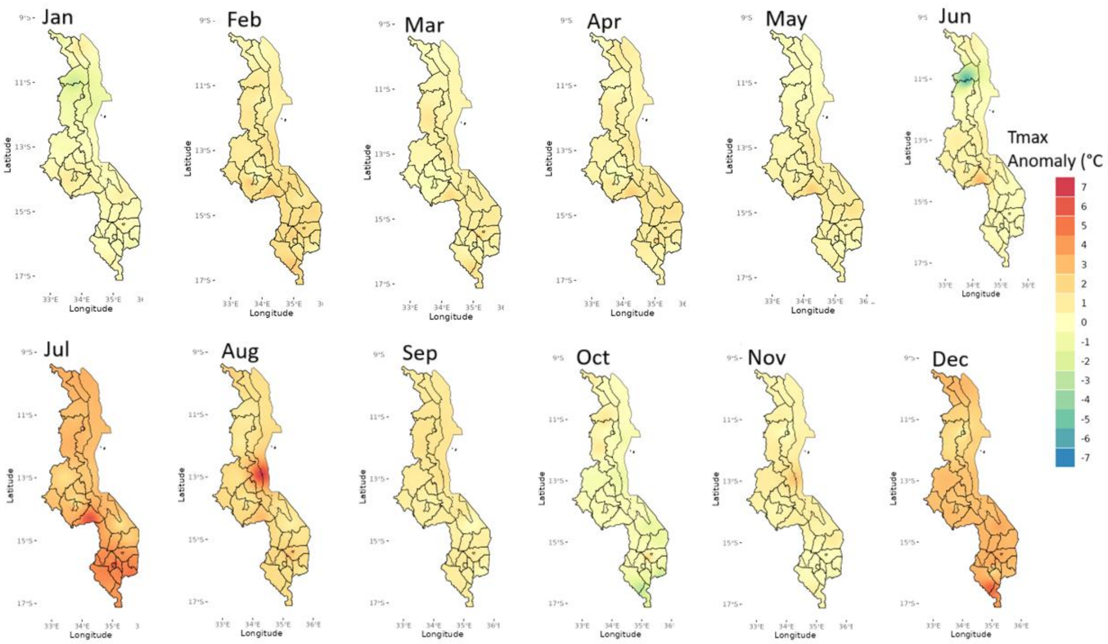


Figure 17: The maps showing monthly maximum temperature anomaly

During the winter month of July, Dedza in the central was +6.4 °C warmer while Chichiri in Blantyre was +6.6 °C warmer than long term records. Although temperatures were higher in many areas in June, Rumphi nonetheless had a significant negative anomaly of maximum temperature of -5.8°C. Some areas, in January, June and October, were cooler than normal as shown in the maps.

3.2.5 Annual Minimum Temperature

Very cold conditions of below 11 °C prevailed over Lilongwe, Dedza and Chitedze in the center, Mzimba and Mzuzu in the north and Mimosa (Mulanje) and Bvumbwe in the southern highlands during the winter months of June and July. Among the sites with the lowest temperatures were Chitedze and Mimosa which recorded 7 °C during the first and third week of July respectively.

A generally warmer than average trend was exhibited by annual minimum temperature anomalies across Malawi as seen in Figure 18. The average positive anomaly was 0.7 °C, and warmest districts were parts of Nsanje, Chikwawa, Chitipa, Rumphi, Dedza, Mangochi, Zomba and Blantyre, Figure 18.

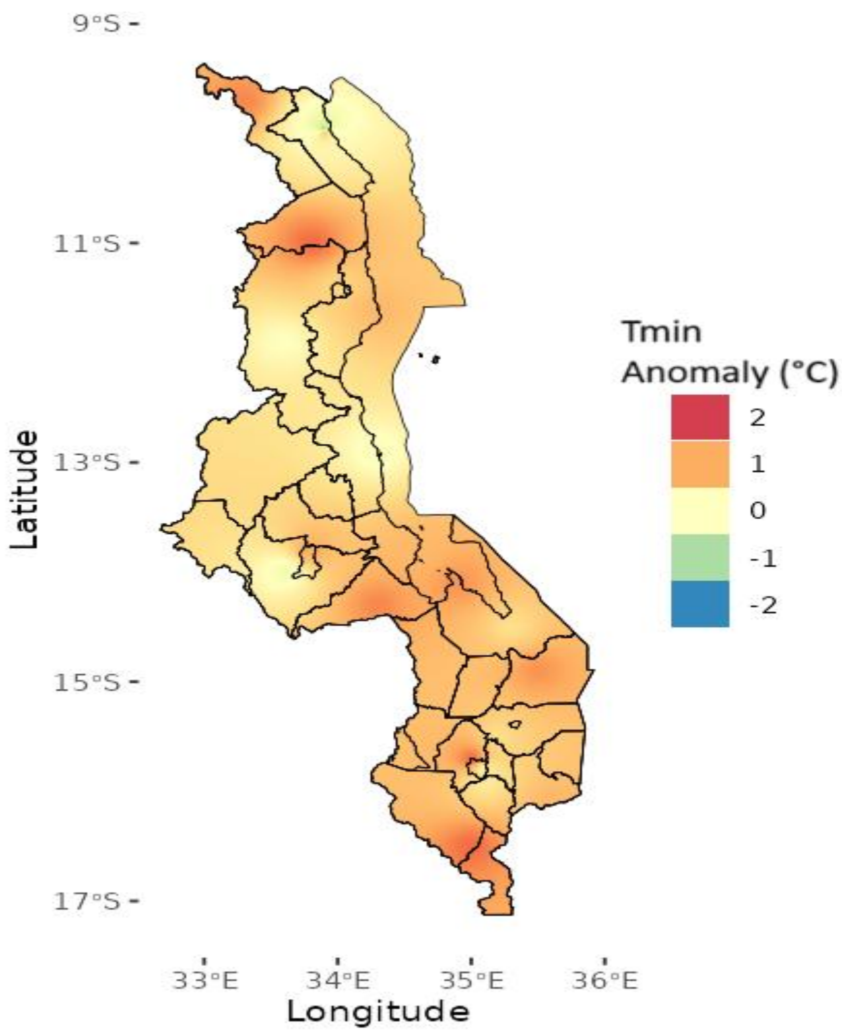


Figure 18: The map showing the annual minimum temperature anomaly

3.2.6 Monthly Minimum Temperature

Monthly minimum temperature anomaly analysis reveals that minimum temperatures were higher than normal in many areas across the country, as shown in Figure 19. There was an exception however, in July and October in some places which depicted colder than normal conditions. In February, Mangochi had a considerable negative departure of -7.1°C. Conversely, Mimosa in Mulanje reported anomaly of +6.4°C in August. Another bigger anomaly was +5.1°C recorded at Ngabu in Chikwawa in December.

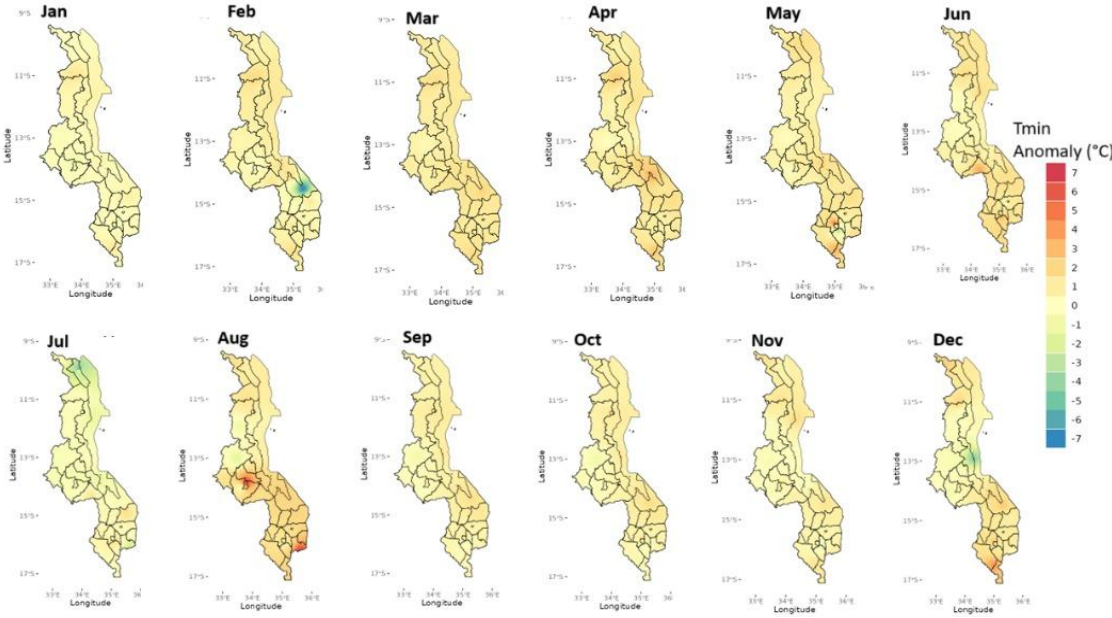


Figure 19: Maps showing monthly minimum temperature anomaly

Chapter Four

4.0 Extreme weather and climatic events

4.1 Standardised Precipitation Evapotranspiration Index (SPEI)

Recognizing drought as a major threat to agriculture, the economy, and the environment, the DCCMS included a drought analysis in its 2023/24 rainfall forecast. This analysis centered on the El Niño Southern Oscillation (ENSO), uncovering a strong link between El Niño and increased drought risk in Malawi. Historical data showed a 54.7% chance of drought during El Niño phases, significantly higher than during La Niña or neutral phases. With a strong El Niño predicted for the 2023/24 season, the DCCMS anticipated a high drought risk, particularly in southern Malawi, a region historically prone to reduced rainfall during El Niño events.

The Standardized Precipitation-Evapotranspiration Index (SPEI) is employed to monitor meteorological droughts by analyzing the balance between precipitation and evapotranspiration. As such, it focuses specifically on meteorological factors and does not reflect agricultural or hydrological drought conditions. This approach allows for a more comprehensive assessment of drought across varying timescales. In this study, SPEI was used to evaluate drought severity in Malawi, utilizing data from 21 weather stations collected between 1991 and 2024. The 1-month SPEI values for the 2023/2024 season are depicted in Figure 20.

Malawi experienced a notable dry spell during the October-December 2023 sub-season, significantly impacting agriculture and socio-economic well-being. October 2023 saw moderate to severe drought grip much of southern Malawi, parts of the central region, and the far north, with these areas receiving very little rainfall. While other areas of the country experienced near-normal dry conditions, even this less severe dryness posed challenges for both communities and ecosystems dependent on consistent rainfall.

As the season progressed into November 2023, the drought conditions intensified and expanded to additional areas across Malawi. The prolonged dry spell meant that most regions of the country were grappling with moderate to severe drought, heightening concerns about water availability, food security, and the well-being of affected populations. The situation deteriorated further in December 2023, with drought conditions worsening significantly across much of Malawi.

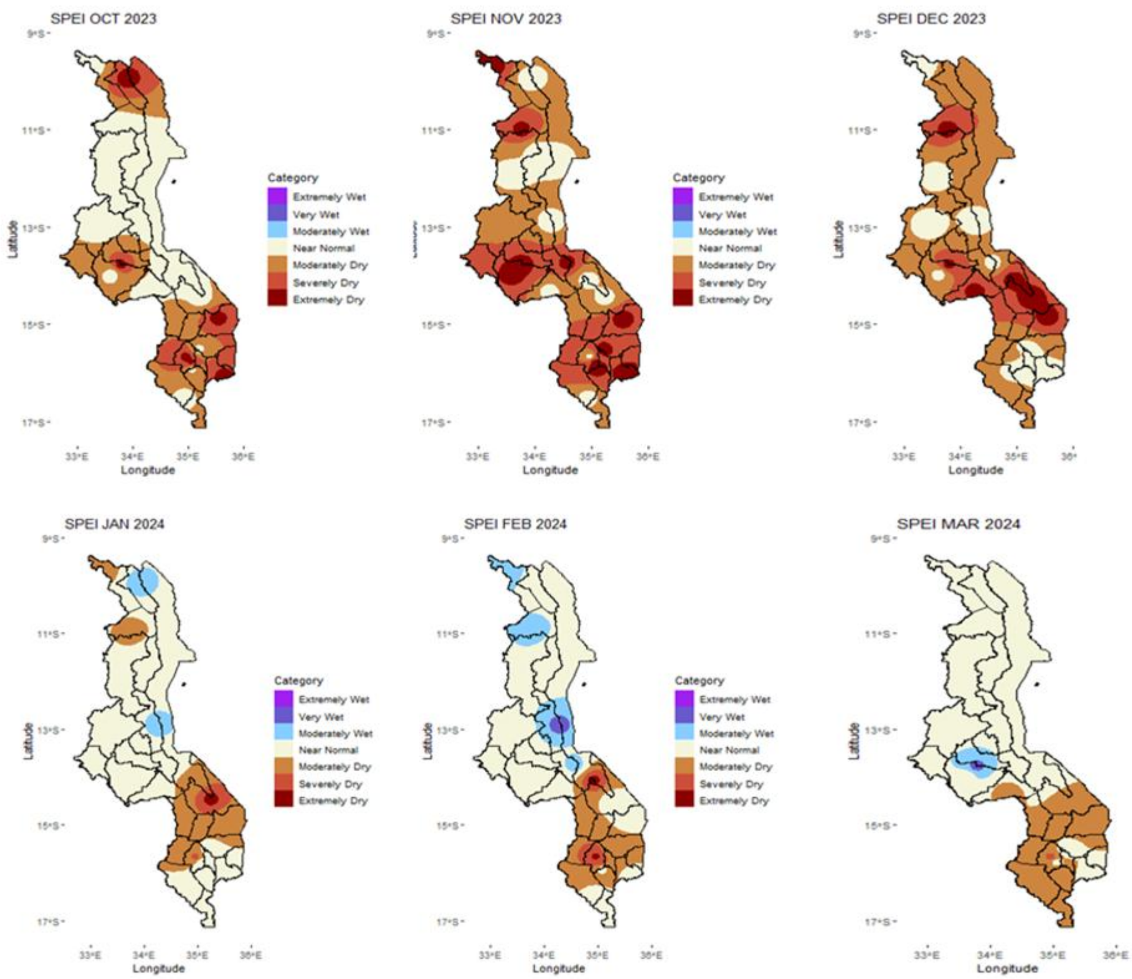


Figure 20: SPEI analysis for the 2023/2024 rainfall season

As the January-February-March (JFM) sub-season of the 2023/2024 rainfall season unfolded, most central and northern areas of Malawi experienced near-normal to wet conditions. These regions benefited from consistent rainfall, which helped alleviate the impacts of the preceding dry period. However, much of the southern part of the country faced persistent moderate to severe drought conditions, as highlighted in the maps for January, February, and March 2024. In January, pockets of dry spells were observed in some areas, with the situation worsening toward the end of the month. These prolonged dry spells extended into February and, in some cases, persisted into March. The intensity of these dry conditions was particularly severe in the southern districts of Malawi, where the impacts were most pronounced. February saw some of the harshest drought effects, disrupting agricultural activities and worsening water shortages. By March, dry spells continued to affect certain southern areas, further stressing livelihoods and food security.

The persistent dry conditions in southern Malawi during this sub-season have been linked to the El Niño phenomenon, which was active during this period. In the Northern Region, drought conditions were most severe at the start of the season, from October to December. However, these areas saw some recovery later in the season, with rainfall improving between January and March. This contrasting temporal distribution of drought conditions between the northern and southern regions highlights the localized impacts of El Niño, which exacerbates variability in rainfall patterns. El Niño typically disrupts normal weather patterns, often resulting in reduced rainfall and prolonged dry spells in southern Africa, including southern Malawi. While El Niño is typically associated with below-average rainfall in the southern half of the country, the severity and persistence of the drought during this season were notably more impactful than in past El Niño seasons, Figure 21.

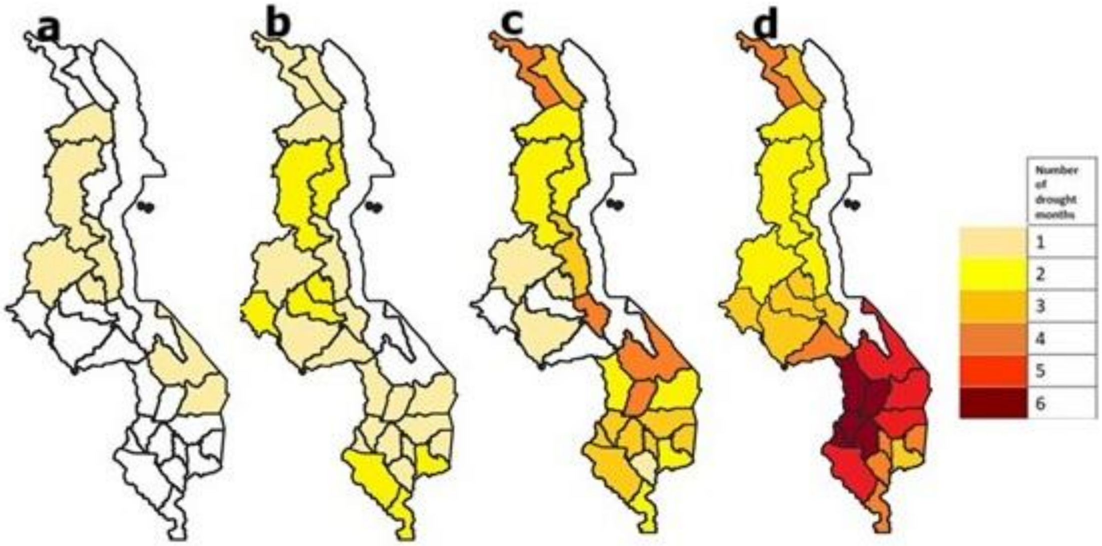


Figure 21: Persistence of drought over the months, analyzed using the Standardized Precipitation Evapotranspiration Index (SPEI). Comparing the 2023/2024 (d) season with similar El Niño seasons of 1982/1983 (a), 1997/1998 (c), 2009/2010 and 2015/2016

Figure 21 highlights the persistence of drought across the months, particularly severe in the southern districts during the 2023/2024 season. It highlights the prolonged dry conditions experienced in various regions of Malawi, with notable severity in the southern districts. The graphic visually depicts how drought conditions spanned nearly the entire season in some areas, comparing this season with previous analogous El Niño seasons. This season performed poorly compared to previous rainfall seasons that occurred under similar El Niño conditions. Historical rainfall seasons with El Niño conditions comparable to the current projections include 1982/1983, 1997/1998, 2009/2010, and 2015/2016. However, the 2023/2024 season was marked by more erratic rainfall distribution and prolonged dry spells, particularly in the southern regions of Malawi.

The prolonged dry spells during the 2023/24 season led to erratic rainfall distribution across Malawi, significantly affecting agricultural activities and water availability. Southern areas were the hardest hit, with meteorological drought persisting almost throughout the entire season from October to March in districts such as Balaka, Ntcheu, Neno, Mwanza and Blantyre, illustrated in Figure 21(d). Other districts, including Machinga, Mangochi, Zomba and Chikwawa, experienced drought conditions for five months, while Chitipa, Nsanje, Dedza, Phalombe, Chiradzulu and Thyolo faced four months of drought. The persistent drought conditions underscore the vulnerability of Malawi's agricultural and water systems to climate variability. These findings emphasize the need for robust climate adaptation strategies, including improved forecasting systems, drought-resilient agricultural practices, and targeted interventions to mitigate the socio-economic impacts of prolonged dry spells.

4.2 Extreme rainfall and flood events

Although the 2023/24 rainfall season was characterized by prolonged dry spells, some weather stations reported exceptionally high 24-hour rainfall amounts, which triggered flash flooding. For example, in Nkhunga rainfall station in Nkhotakota received 475mm of rainfall on 27th February 2024, and Ngabu in Chikwawa recorded a highest 24-hour rainfall of 235.4mm on 11th April 2024, as shown in Figure 22. The image below shows some notable 24-hour rainfall amounts that were recorded. These intense rains caused flash flooding in lakeshore districts such as Nkhatabay, Nkhotakota, and Karonga and others like Dowa**.** Additionally, the occurrence of hailstorms increased throughout Malawi, causing significant concern, particularly among farmers. These storms affected crops, many of which were at an advanced stage of growth.

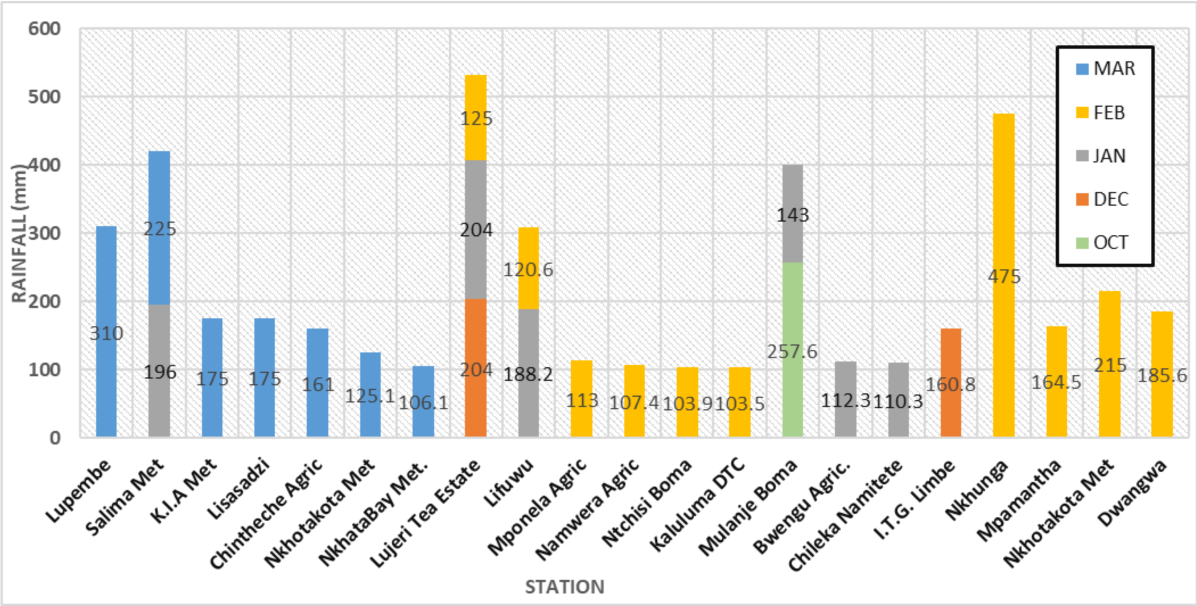


Figure 22: A graph showing highest 24-hour rainfall with more than 100mm between October 2023 and March

As forecasted by the department, the country experienced more rainy days from December 2023 to April 2024, particularly in the northern regions. January saw an increase in the number of rainy days, with almost the entire country experiencing more than 15 days of rain. However, in the remaining months, especially in the southern regions, the number of rainy days was generally fewer than 10 per month.

In December 2024, tornadoes were reported in Dedza District, occurring on different dates but within a short period of time, while hailstorms were observed in multiple areas, causing significant damage to housing infrastructure and crops. Tornadoes are rare events in Malawi, making this occurrence particularly unusual, as two tornadoes were observed within the same locality. The hailstorms were widespread and severe, with some hailstones noted for their unusually large diameter. Thunderstorms accompanied by cloud-to-ground lightning strikes have also led to an increased number of lighting related deaths and casualties across the country.

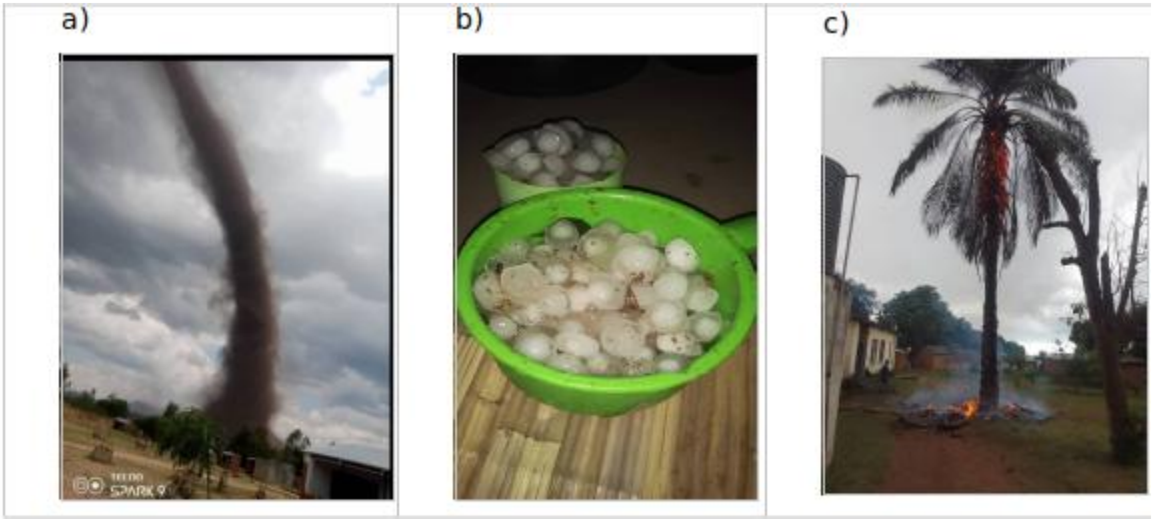


Figure 23: (a) Tornado observed in Dedza District, (b) unusually large hailstones, and (c) tree burning caused by a lightning strike, highlighting the increase in lightning-related deaths and casualties across the country

4.3 Extreme temperature events

In the context of climate change, the frequency of extreme temperature events is expected to increase. Heat stress resulting from high temperatures significantly impacts the health of vulnerable populations. In Malawi, high temperatures are normally anticipated, particularly during the summer months from October to February.

The summer of 2024 was characterized by isolated cases of extreme heat events, with some areas experiencing temperatures exceeding 40 °C. Ngabu meteorological station, for instance, recorded temperatures between 40 °C and 44 °C between October and December 2024 which are 5.0 °C and 1° C warmer than the long-term average for these months.

Hot to very hot temperatures were also recorded at meteorological stations in Mulanje, Blantyre, Karonga, Nkhatabay, Machinga and Thyolo. For example, Chileka in Blantyre recorded 35.9 °C on 27th September 2024. A Heatwave warning was issued once in December 2024. During these periods, temperatures exceeded the mean temperature by more than 3 °C. On average, the annual maximum temperature was 3 °C warmer than the long-term average.

The number of very hot days, defined as days with maximum temperatures exceeding 37 °C, was 88 in Chikwawa (Ngabu) while the number of days with maximum temperatures above 30 °C in 2024 was 11 in Thyolo (Bvumbwe), Blantyre (Chichiri) 2 and (Chileka) 78, Chitipa 1, Lilongwe 7 (KIA), Karonga 59, Mulanje 54 (Mimosa), Nkhata Bay 82, Nkhotakota 103, Ntaja 58 and Chikwawa (Ngabu) 301. It shows that over 80% of the days in Chikwawa have maximum temperature that exceeds 30 °C.

Although Malawi generally enjoys a warm tropical climate, there are sporadic cases of extreme cold temperatures experienced from May to August, which are considered the winter months. The lowest temperatures are typically observed between May and July though early days of August can also be extremely cold.

During the winter season of 2024, the minimum temperature of 4.6 °C was recorded at Mzuzu Meteorological Station in July 2024. Other significant temperatures were recorded in Lilongwe (6.5 °C at Chitedze in July and 7.5 °C at KIA in August) and 7.5 °C at Dedza in July. The number of cold nights, defined as nights where temperatures are below 11 °C, was 18 in Lilongwe (KIA station), 10 in Nkhata Bay, 13 in Thyolo (Bvumbwe), 7 in Blantyre (Chichiri) and 1 in Salima.

These cold temperatures mostly impact vulnerable groups like children and the elderly who struggle to adapt to the drastic weather changes. Respiratory issues, cold-related illnesses, and discomfort become prevalent, adding strain to an already burdened healthcare system.

Chapter Five

5.0 Social-economic impacts of extreme Weather and climate events

Due to climate change the occurrence of extreme weather events has been increasing and are noticeable over many areas. This is causing significant social and economic impact in Malawi. During the 2023/2024 season it is of paramount importance to note that the affected households with a variety of hazards was 21333 whereas 3644 households were affected by stormy rains, 656 households were affected by strong winds and 17033 households were affected by floods in Karonga and Nkhotakota as shown in Figure 24 below (Source: DoDMA). Various sectors of the economy that were severely impacted by severe weather events include agriculture, transport, energy, health, education, water resources, and disaster risk reduction.

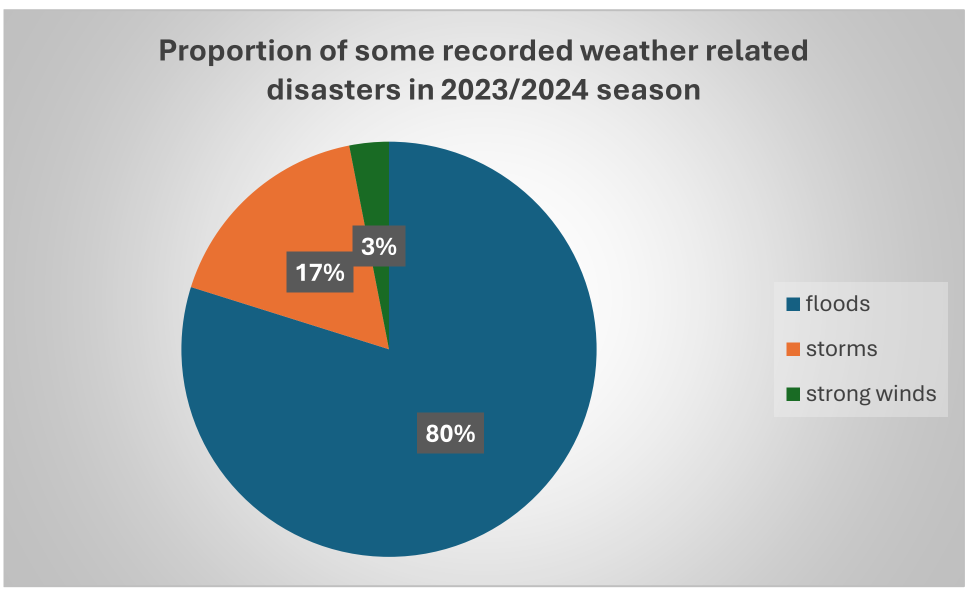
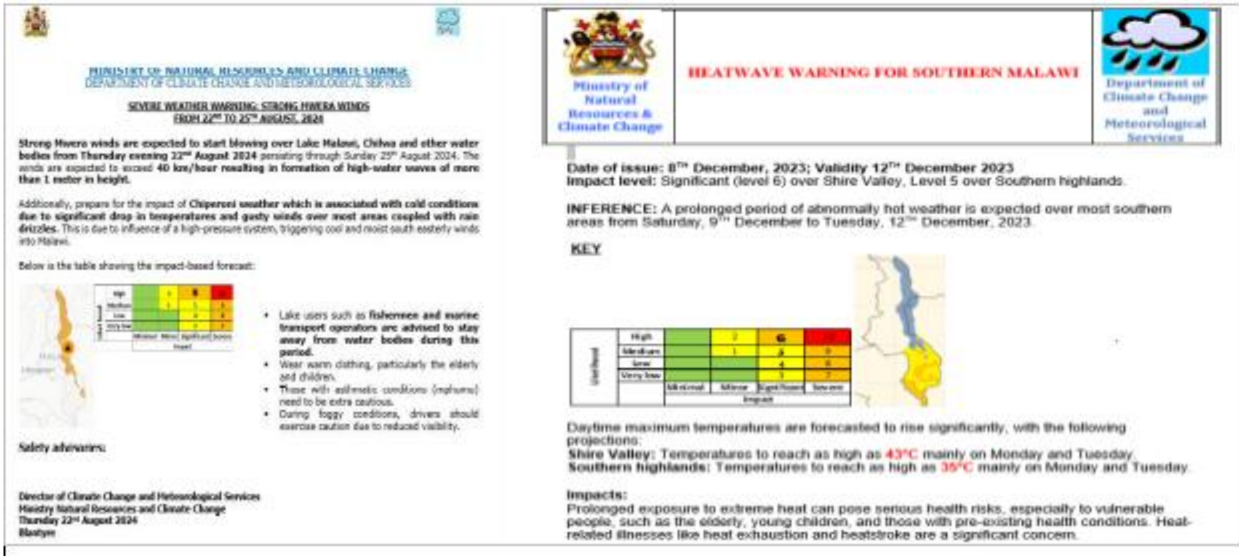


Figure 24: Number of Households affected during the 2023/2024 rainfall season (Source: DODMA)

5.1 Disaster Risk Management

The Department of Climate Change and Meteorological Services (DCCMS) has been providing weather forecasts and also issuing severe weather warnings for various hazardous weather conditions. Figure 25 is an example of some of the warnings issued by the DCCMS. Common hazards during the winter season include strong south-easterly winds (Mwera) which typically affect Lake Malawi and also chilly weather (Chiperone) which brings cold spells. During summer, Malawi faces hazards such as strong winds, heat waves, flash floods, thunderstorms, and prolonged dry spells.

DCCMS has the main role in Malawi's Early Warning System, monitoring and analysing systems that influences the prevailing weather conditions, leading to prediction of future weather patterns. Once weather information, including warnings, is generated, it is packaged in a user-friendly format for dissemination. The department provides impact-based weather forecasts on a daily and weekly basis, often translating them into local languages such as Chichewa, Yao, and Tumbuka, to ensure that the targeted audience understands and can timely respond appropriately to severe weather warnings. The products are communicated to the users through different channels like TV, email, radio, and social media platforms like WhatsApp, Facebook, X (formerly Twitter), and YouTube. The number of people receiving these messages has tremendously increased, for instance, on Facebook; DCCMS has more than 25,000 followers.



MINISTRY OF NATURAL RESOURCES AND CLIMATE CHANGE
DEPARTMENT OF CLIMATE CHANGE AND METEOROLOGICAL SERVICES

SEVERE WEATHER WARNING: STRONG MWERA WINDS
FROM 22ND TO 25TH AUGUST, 2024

Strong Mwera winds are expected to start blowing over Lake Malawi, Chilwa and other water bodies from Thursday evening 22nd August 2024 persisting through Sunday 25th August 2024. The winds are expected to exceed **40 km/hour resulting in formation of high-water waves of more than 1 meter in height.**

Additionally, prepare for the impact of **Chiperoni weather which is associated with cold conditions due to significant drop in temperatures and gusty winds over most areas coupled with rain drizzles.** This is due to influence of a high-pressure system, triggering cool and moist south easterly winds into Malawi.

Below is the table showing the impact-based forecast:

- Lake users such as **fishermen and marine transport operators are advised to stay away from water bodies during this period.**
- Wear warm clothing, particularly the elderly and children.
- Those with asthmatic conditions (mphumu) need to be extra cautious.
- During foggy conditions, drivers should exercise caution due to reduced visibility.

Safety advisories:

Director of Climate Change and Meteorological Services
Ministry Natural Resources and Climate Change
Thursday 22nd August 2024
Blantyre

Ministry of Natural Resources & Climate Change

HEATWAVE WARNING FOR SOUTHERN MALAWI

Department of Climate Change and Meteorological Services

Date of issue: 8TH **December, 2023; Validity** 12TH **December 2023**
Impact level: Significant (level 6) over Shire Valley, Level 5 over Southern highlands.

INFERENCE: A prolonged period of abnormally hot weather is expected over most southern areas from Saturday, 9th December to Tuesday, 12th December, 2023

KEY

Daytime maximum temperatures are forecasted to rise significantly, with the following projections:
Shire Valley: Temperatures to reach as high as 43°C mainly on Monday and Tuesday.
Southern highlands: Temperatures to reach as high as 35°C mainly on Monday and Tuesday

Impacts:
Prolonged exposure to extreme heat can pose serious health risks, especially to vulnerable people, such as the elderly, young children, and those with pre-existing health conditions. Heat-related illnesses like heat exhaustion and heatstroke are a significant concern.

Figure 25: Some of the warnings issued in 2024; Mwera warning issued on 22nd August 2024 (left) and a Heatwave warning for Southern Malawi Issued on 08 December, 2024 (right)

During the 2023/2024 rainfall season, one of the hazards experienced was prolonged dry spells which later due to high temperatures were manifested into meteorological drought. This adversely affected crop production including maize production, as maize is highly sensitive to moisture stress during critical growth stages.

In contrast to the southern areas, the northern half of Malawi experienced some floods. Between February and March 2024, Heavy rains and over flowing rivers caused a lot of floods in districts such as Karonga and Nkhotakota which resulted in significant loss of lives and injuries, as well as extensive damage to homes, household property, and public infrastructure, including roads, bridges, water points, and schools. Of the 17,033 households affected in these two districts, over 70 percent were displaced and forced into temporary camps, where they required ongoing support in terms of food, non-food items, restoration of services, and rehabilitation of public infrastructure.(DoDMA, 2024).

Heavy rainfall, accompanied by thunderstorms, affected a broader area, impacting various sectors such as agriculture, infrastructure, and public health and safety. Micro flash flooding was particularly prevalent in January. The Department of Disaster Management Affairs (DoDMA) reported that approximately 3,440 hectares of crop fields were damaged in Dowa due to flooding caused by the Kasangadzi River, particularly in the areas of Traditional Authorities Mponela, Dzoole, and Msakambewa on 14th January 2024. These severe weather events underscored the vulnerability of communities to both drought and flooding, highlighting the urgent need for effective disaster response and resilience-building measures. Some areas in Mzimba District such as Jenda were also affected by storms and were supplied by relief items were such aas food (Figure 28 depicts families from Jenda Section in Mzimba district who received some support)

Flooding along Lake Malawi caused the significant displacement of households as water levels reached the highest point of 476.33 meters above sea level (MASL). All buildings and crop fields below the 477masl line were affected. In 2024, Lake Malawi experienced a remarkable rise in water levels, surpassing those of the past 12 years. The levels peaked at 476.38 MASL between April 21-25, 2024, exceeding historical averages. Areas around the lake, were particularly impacted.

Figures 26 and 27 contain images of some of the flooded housing areas and farms in Karonga, Nkhotakota and damaged houses in Mzimba districts.

Figure 26: Flooded housing areas and maize fields in Karonga and Nkhotakota. Source: Malawi news online, April 2024

*F*igure 27: Damaged houses and blown roofs in March 2024 in Mzimba District. Source: Zodiak Online 5 and 12 March 2024)

During the 2023/2024 season, many communities reported significant impacts on crop production due to dry conditions, which affected much of the country.

Figure 28: Households pose for a photo after receiving Relief items from Well Wishers in Mzimba (Source: Zodiak Online, 06 March, 2024.)

The intensity of lightning activities is always high during the rainfall season in Malawi and recently the country has been experiencing an increase in the number of people being hit by lightning. A report from DODMA indicated that 5 people died during the 2023/2024 rainfall season, Mchinji and Ntcheu registered 2 deaths each while Nkhata Bay had 1. This has also impacted livestock, as 54 cattle were struck dead by lightning on November 20 in Traditional Authority (TA) Simphasi, Mchinji as shown in Figure 29.

Figure 29: 54 cattle struck dead by lightning on November 20 in TA Simphasi, Mchinji, highlighting the impact on livestock

5.2 Agriculture and food security

Malawi's economy is predominantly agricultural based. Agriculture accounts for 30% of Gross Domestic Product and generates over 80% of national export earnings. Furthermore, the agriculture sector employs 64% of Malawi's workforce. (National Agriculture Policy, 2016).

Malawi is extremely vulnerable to weather and climate shocks. Malawi's agricultural production is mainly rain fed. With evident changes in seasonal rainfall characteristics such as onset, cessation, seasonal length among others, agricultural production and indeed food security is greatly affected at all levels of the country. A summary of 2023/2024 season agricultural performance is given in the sections below.

5.2.1 Agricultural production

There were several factors which affected agricultural production in the 2023/2024 season. Of the weather and climatic factors, prolonged dry spells during the sub-season January-February-March (JFM) particularly over southern half of the country provided suitable conditions for pests and diseases as captured in Table 1 and Table 2. Extreme rainfall experienced in some parts of the country like Dwangwa in Nkhotakota and Mponela in Dowa led to flooding which resulted in crop washaways. These had a negative impact on agricultural production both at local and national scale.

ADD	Degree	Area Affected(Ha)	Area Controlled (Ha)	Level of Infestation (%)	Affected FHs
Karonga	Mild	18,982.00	12,249.00	11	42,208
Mzuzu	Moderate	28,103.00	9,819.00	19	41,996
Kasungu	Moderate	94,149.00	32,311.00	25	189,479
Lilongwe	Mild	352,732.00	209,667.00	9	524,168
Salima	Moderate	20,977.00	8,664.00	12	41,595
Machinga	Moderate	73,196.00	22,359.00	15	207,111
Blantyre	Mild to severe	83,769.80	22,871.90	24	189,765
Shire Valley	Severe	23,386.00	15,877.00	54	63,753
Total		**695,294.80**	**333,817.90**	**21**	**1,300,075**

Table 1: 2023_2024 Fall Armyworm infestation as per Farm Household (APES, 2024)

ADD	Crop Stage	Degree of Damage	Affected Area (Ha)	Affected FHs
Karonga	Vegetative to Maturity	Moderate to severe	12,265	42,474
Kasungu	Vegetative to Maturity	Moderate to severe	164,456.48	129,455
Lilongwe	Vegetative to Maturity	Moderate to severe	192,525	141,924
Shire-Valley	Vegetative to Maturity	Moderate to severe	117,399	223,068
Salima	Vegetative to Maturity	Mild to severe	49,056	152,894
Blantyre	Vegetative to Maturity	Moderate to severe	382,519	711,098
Machinga	Vegetative to Maturity	Moderate to severe	243,237.90	437,508
Total			**1,004,167**	**1,732,441**

Table 2: 2023_2024 impact of prolonged dry spells as per Farm Household (APES, 2024)

In terms of field crops production, there was generally a reduction in production mainly due to unfavourable weather conditions. At ADD level, all ADDs registered a reduction in production except Karonga which registered an increase of 36%. Otherwise, at national level the reduction in maize production was at 22.7%. Groundnuts crop was highly affected followed by sesame. More details in Table 3 and Table 4 below.

Field Crops					
Crops	Third Round 2023/24	Second Round 2023/24	Third Round 2022/23	% Change against	
	Production(mt)	Production(mt)	Production(mt)	2024 R2	2023 R3
Maize	2,712,578	2,926,190	3,509,837	-7.3	-22.7
Rice	126,981	138,711	124,344	-8.5	2.1
Millet	33,596	37,930	49,631	-11.4	-32.3
Sorghum	81,402	102,195	126,333	-20.3	-35.6
Groundnuts	277,591	411,279	468,045	-32.5	-40.7
Cotton	6,147	8,175	13,822	-24.8	-55.5
Sesame	11,031	15,031	9,686	-26.6	13.9
Sunflower	12,954	16,167	15,674	-19.9	-17.4
Wheat	364	362	190	0.6	91.6
Pulses	868,578	929,369	1,019,766	-6.5	-14.8
Beans	194,175	211,624	235,089	-8.2	-17.4
Pigeon Peas	416,704	446,888	456,033	-6.8	-8.6
Cow Peas	44,897	52,895	56,691	-15.1	-20.8
Soya Beans	180,380	179,076	235,487	0.7	-23.4

Table 3: 2023_2024 National Field crops production (APES, 2024)

Maize Production			
ADD	Third Round 2023/24	Third Round 2022/23	% Change against Third Round 2022/23
	Production(mt)	Production(mt)	Production(mt)
Karonga	206,574	152,101	35.8
Mzuzu	349,497	354,406	-1.4
Kasungu	848,452	1,035,327	-18
Lilongwe	614,827	808,157	-23.9
Salima	107,510	156,886	-31.5
Machinga	290,580	423,146	-31.3
Blantyre	206,938	438,929	-52.9
Shire Valley	88,200	140,885	-37.4
NATIONAL	2,712,578	3,509,837	-22.7

Table 4: 2023_2024 National Maize Crop Production (APES, 2024)

Horticultural crops were also affected mainly due to unfavourable weather conditions as captured in table 5 below. Potatoes were highly impacted where the production reduced by -10.6%. There are still some crops that did well, such as pineapples, which the production increased by 32.5%, followed by mangoes at 2.4% and tomato production at 2%.

Horticultural Crops					
Crop	Third Round 2023/24	Second Round 2023/24	Third Round 2022/23	% Change against	
	Prodn(mt)	Prodn(mt)	Prodn(mt)	2024 R2	2023 R3
Cassava	5,946,214	5,959,051	6,195,735	-0.2	-4
S/Potato	6,962,391	7,692,362	7,609,426	-9.5	-8.5
Potato	1,404,014	1,569,727	1,516,396	-10.6	-7.4
Pineapples	254,730	192,224	370,626	32.5	-31.3
Mangoes	1,364,080	1,331,476	1,357,653	2.4	0.5
Oranges	86,925	87,053	94,225	-0.1	-7.7
A. Pears	99,468	101,863	117,768	-2.4	-15.5
Tomatoes	701,631	687,783	694,260	2	1.1
Banana	1,161,226	1,170,810	1,077,474	-0.8	7.8
Cabbage	229,999	243,944	241,686	-5.7	-4.8
Onions	273,758	297,984	291,689	-8.1	-6.1
Tangerines	241,228	253,614	263,431	-4.9	-8.4
Lemons	21,953	22,374	24,273	-1.9	-9.6

Table 5: 2023_2024 National Horticultural Crops Production (APES, 2024)

In terms of livestock, all classes of livestock registered an increase in population. Amongst conventional livestock, significant increases have been registered in pigs (8.4%) while amongst non-conventional livestock, significant increases have been registered in guinea pigs (11%).The increases are attributed to increased births/hatches or transfers-in due to improved management practices which includes good housing, feeding as the pasture and food were available, breeding and disease control resulting into more births than deaths as well as government and stakeholder injections and pass-on programmes. More details in Table 6 below.

Livestock Production			
Species	**Third Round 2023/24**	**Third Round 2022/23**	**% Change against 2022/23**
Cattle	2,269,084	2,187,583	3.7
Goats	14,090,773	12,994,613	8.4
Sheep	459,959	427,754	7.5
Pigs	12,475,657	11,507,091	8.4
Chickens	222,614,505	211,129,975	5.4
Rabbits	4,441,356	3,978,376	11.6
G/Fowls	3,537,672	3,264,591	8.4
Turkey	556,230	527,770	5.4
G/Pigs	926,486	834,601	11
Pigeons	15,223,670	14,064,017	8.2
Ducks	5,640,253	5,003,171	12.7
Quails	12,858,095	11,891,654	8.1

Table 6: 2023_2024 National Livestock Production (APES, 2024)

A pictorial summary of rainfall season impact on agriculture is displayed in Figure 30 below.

Figure 30: Pictorial summary of rainfall season impact on Agriculture

5.2.2 Food security

In as far as food security is concerned, the situation is reported worse-off this season when compared with last season. 14.3% of farm households (FHs) do not have food from their own production as compared to 5.9% experienced at the same time last season. Shire-valley ADD has the highest rate of food insecure households (37.2%), with the lowest being Kasungu (2.3%) as displayed in table 7 below. This increase in food insecurity is highly attributed to low harvest experienced during the 2022/23 farming season due to tropical storms and dry spells.

	2023/24 Season			2022/23 Season		
ADD	**No. of FHs**	**No. of FHs without**	**Food Situation %**	**No. of FHs**	**No. of FHs without**	**Food Situation(%)**
Karonga	138,016	3,608	2.6	131,502	7,763	5.9
Mzuzu	355,831	9,103	2.6	347,753	5,215	1.5
Kasungu	566,154	12,871	2.3	566,15	7,376	1.3
Salima	246,762	14,601	5.9	246,762	5,752	2.3
Lilongwe	807,548	47,036	5.8	807,548	26,551	3.3
Machinga	857,481	177,395	20.7	829,290	64,327	7.8
Blantyre	920,130	238,377	25.9	857,412	82,210	9.6
Shire Valley	227,720	84,804	37.2	216,524	35,188	16.3
National	4,119,642	587,795	14.3	4,002,941	234,382	5.9

Table 7: 2023_2024 Farm Households without food from own production as of June 2024 (APES, 2024)

According to the Malawi Vulnerability Assessment Committee (MVAC) June 2024 report, the food situation is anticipated to deteriorate further with a projected 5.7 million people (28% of the sampled population) to be in at least level 3 of Integrated Food Security Phase Classification which is the acute food insecurity due to the low crop production. More details in Figure 31.

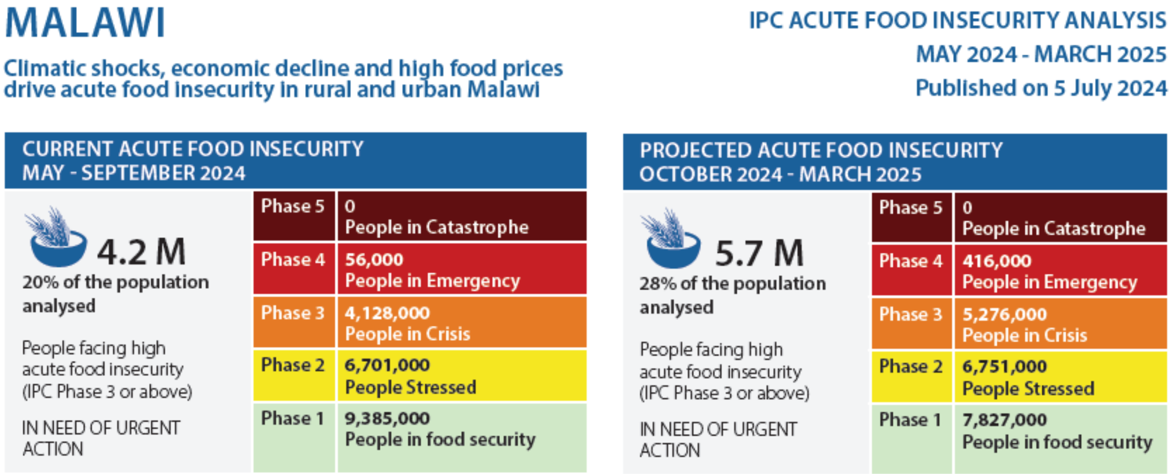


Figure 31: Acute food insecurity situation (IPC Malawi, Malawi: IPC Acute Food Insecurity Analysis, May 2024 - March 2025)

5.3 Water Resources

Water resources are the cornerstone of Malawi's development, supporting agriculture, energy production, ensuring environmental sustainability, domestic needs, and ecological health. In 2024, the quality, quantity, and accessibility of these resources were profoundly influenced by changing weather patterns, exacerbated by the impacts of climate change. Weather directly influences water availability, access and quality in a given area.

Weather patterns, particularly rainfall, which is the primary source of surface and groundwater recharge in Malawi affects the amount, accessibility and quality of water available in lakes, rivers and ground reservoirs. Variations in weather, such as droughts or excessive rainfall, can significantly impact water supply. In the year 2024, the country experienced uneven rainfall distribution, with prolonged dry spells in some parts of the central and southern regions reducing river flows and reservoir levels. This impacted irrigation schemes, hydroelectric power generation, and household water availability, particularly in rural areas. Conversely, periods of intense rainfall caused localized flooding, overwhelming catchment systems and leading to water wastage and possibly ineffective management of water resources which is essential for promoting sustainable development.

Heavy rains, while critical for recharge, also led to increased sedimentation and pollutant runoff into rivers and lakes. Poor drainage systems in urban areas and soil erosion during storms exacerbated contamination, affecting water for drinking and irrigation. Additionally, elevated temperatures possibly heightened the risk of algal blooms in stagnant water bodies, further degrading water quality.

5.3.1 Lake Malawi Water Levels

Lake Malawi covers a surface area of 28,760 square kilometers and is estimated to have a total volume of 7,725 x 10^9 cubic meters at a mean lake level of 474.00 meters above sea level (Environmental Affairs Department, 2010). In 2024, Lake Malawi experienced a significant rise in water levels, surpassing those recorded over the past decade, this could indicate that the total surface area of the lake has been increasing over the past decade, as shown in Figure 32 below;

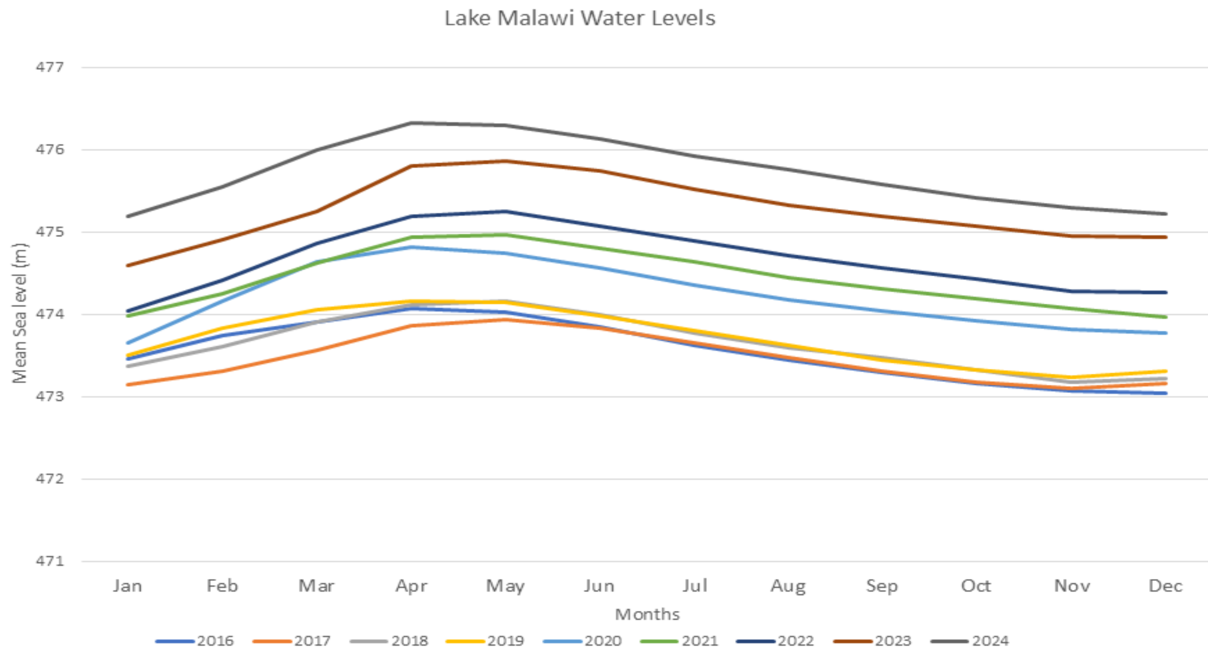


Figure 32: Lake level for Lake Malawi from 2016 to 2024. Source – National Water Resources Authority

The levels exceeded historical averages, peaking at 476.38 meters above sea level (MASL) between April 21 and 25, 2024. This rise caused severe damage to property and livelihoods in low-lying areas. According to the National Water Resources Authority (NWRA), the water levels rose by 44 centimetres, reaching 476.33 MASL on May 7, 2024, compared to 475.89 MASL on the same date in 2023. The water level of Malawi has been on the rise for the past 6 years. This year's water levels are the second highest recorded, just below the 1980 peak of 477.22 MASL. The increase is attributed to above-normal rainfall received during the 2023/2024 season in both the northern region of Malawi and southern Tanzania, the primary catchment area for the lake. The damage as shown in Figure 33 caused by the rising waters resulted in an estimated K6.3 billion in property damage and K2.5 billion in lost revenue for hotels and lodges along the lake as shown in Figure 34.

Figure 33: Shows one of the lodges submerged in Lake Malawi due to rising water levels (source: World Bank)

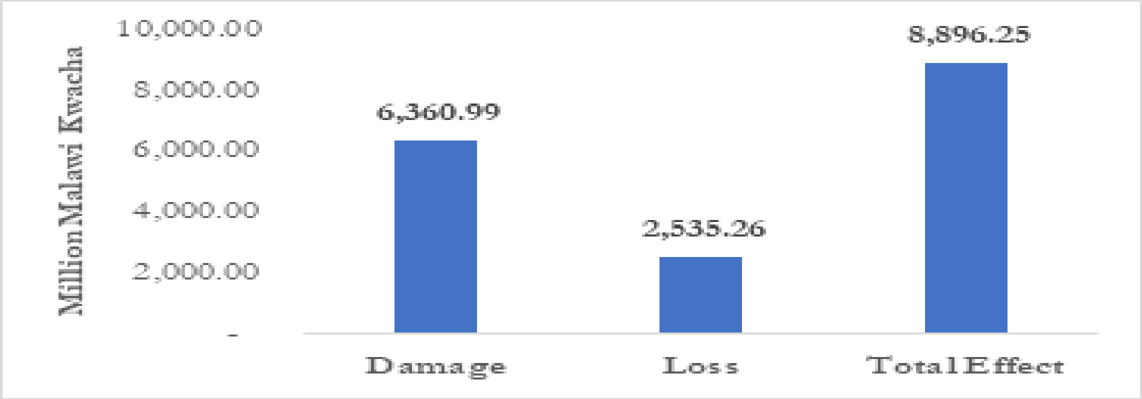


Figure 34: Estimated damage, loss and total effect of Lake Malawi water rise on lakeshore tourism businesses. Source: NPC, MoFEA, NSO, DoDMA Rapid Assessment (May 2024)

The rising water levels in Lake Malawi caused significant disruption to both ecosystems and human livelihoods. Flooding and erosion of shoreline areas damaged habitats for plants, fish, birds, and amphibians, threatening vital ecosystems. The rise in water levels also displaced fish species, by altering breeding and feeding areas, potentially reducing their populations and affecting local fisheries. Additionally, increased flooding led to pollution from runoff and sewage, which worsened water quality and harmed aquatic life. Wetland ecosystems, which provide nurseries for fish and breeding grounds for birds, have been impacted by excessive flooding, disrupting their balance (Bekalu, 2024). Furthermore, the displacement of over 1,200 families has led to the loss of homes and livelihoods, while increasing pressure on already stressed ecosystems in unaffected area.

5.4 Transport

5.4.1 Road Transport

The road sector was also impacted by extreme weather events in the year 2024. Several roads and bridges were affected in certain parts of the country. On the 26th and 27th of February 2024, heavy rains hit central and northern regions, causing flooding. This flooding resulted in significant damage to roads and bridges in the districts of Karonga and Nkhotakota in Malawi. Figure 35 show the impact of flooding on road transport.

Figure 35: Flooding in Nkhotakota which affected roads and bridges. Source: Malawi news online (April 2024)

5.4.2 Air Transport

The vast majority of flight delays, diversions and cancellations are weather related. Conditions like precipitation, wind, and fog greatly affect how safe and enjoyable flying can be.

On 15th December 2024, Tropical Cyclone Chido led to the diversion and cancellation of flights to Chileka International Airport owing to poor visibility and strong winds.

5.4.3 Rail Transport

Rail transport is also significantly impacted by extreme weather events and damage to infrastructure. This disruption hinders the transportation of goods and services. In 2024, there were few cases reported that impacted rail transport due to extreme weather events. There was a rail washaway at Molipa Hills in Machinga district which disturbed rail operations for almost a week. The climate information that is shared with Nacala Logistics Limited helps their operational planning of their movements.

5.4.4 Marine Transport

Marine transport services, especially on Lake Malawi, are mainly affected by the impact of extreme southerly/southeasterly winds, which typically intensify during the winter months of May to August. According to Mana reports, on 11th August 2024, it was reported that 2 out of 3 fishers were missing after they were swept away by strong water currents whilst fishing in the lake.

5.5 Energy

Extreme weather events in Malawi continue to have a profound impact on the energy sector, causing costly disruptions to power production and supply.

Renewable energy systems, particularly solar panels, are highly vulnerable to damage from high winds and hail, further compounding the challenges faced by the sector. In addition, the efficiency of the solar panels is also affected by climate more particularly cloud cover. In 2024, the solar energy share in Malawi was estimated to be at 10 to 20% according to the Ember (2024).

During the 2024 season, Lake Malawi experienced a significant rise in water levels, which could have adversely affected hydropower production if not properly managed. The water levels exceeded historical averages, peaking at 476.38 meters above sea level between April 21 and 25, 2024. According to the Kamuzu Barrage Operational Manual (KABOM), the National Water Resources Authority (NWRA) should have released 900 m^3 per second to regulate the lake levels. Instead, water was released steadily, reaching 1010 m^3 per second on May 11, 2024, which helped stabilize the water level at around 476.19 meters above sea level, below the critical threshold of 477 meters set by Malawi's zoning regulations. While this strategy demonstrated resilience in hydropower management, the slow release of water delayed the recession of the swollen lake, negatively impacting settlements along its shores. In addition, high Shire River flows brought some challenges to hydropower production including accumulation of debris that affect the production.

To address these challenges, the Ministry of Energy must develop innovative strategies to protect downstream energy systems and other economic infrastructure from natural disasters such as floods and sudden water level rises. These measures are critical for ensuring the resilience and reliability of Malawi's energy sector in the face of climate-related disruptions.

Figure 36: Power lines damaged due to storms

Additionally, Malawi experienced a surge in blackouts throughout the year due to increased storms, which caused extensive damage to power production lines and other energy infrastructure as shown in Figure 36. Wet conditions during and after rainfall events also posed significant safety risks, delaying repair and maintenance efforts. To ensure reliable electricity supply, implementing an early warning system for ESCOM and EGENCO is crucial; this will allow them to proactively identify potential risks, implement mitigation strategies, and plan maintenance well in advance.

5.6 Health

Like in 2023, the year 2024 was not without weather/climate-related health implications. Deaths and injuries due to weather events such as lightning, strong winds and heavy rainfall were reported from various places across the country. By 3rd December, 2024, since the onset of 2024/2025 rainfall season, DoDMA recorded 11 deaths, 8 of which were due to lightning. The department, further, also recorded 79 injuries. Cyclone Chido, further, claimed lives of 13 and injured 29 between 13 and 16th Dec 2024 (DoDMA, 2024).

Severe acute malnutrition, additionally, was noted and that it had increased by 13 % comparing with the January of 2023. (World Health Organization, 2024) There were also new cases of Cholera, about 173 between January and March, and three deaths due to the pandemic (UNICEF, 2024), although on 5th August 2023, cholera had been declared no longer a National Public Health Emergency (World Health Organization, 2024).

This information delineates how weather/climate events remarkably impact health, and subsequently implies the need for continued disaster preparedness to deal with these ruinous ramifications of weather/climate events.

5.7 Education

Impacts of extreme weather and climate events manifested clearly in the education sector in Malawi during 2024. The profound impacts include damage to education infrastructure, administrative challenges, gender disparities, psychological and emotional strain and loss of lives. In 2024, extreme weather events such as heat waves, flash floods, strong winds, thunderstorms and tropical cyclone disrupted the education system in Malawi profoundly.

At the beginning of 2024, the prolonged dry spell eventually resulted in poor food production in Malawi. This led to the declaration of state of disaster in 23 districts by His Excellency the President Dr. Lazarus Chakwera in March 2024. The situation adversely impacted education sector whereby the number of pupils attending school reduced drastically. For instance, in some areas absenteeism rose as high as 50% according to Malawi-El-Nino-SitRep-May-2024. Furthermore, the report observes that rural livelihoods were heavily impacted such that economic capacity to support education reduced. Under such conditions, families resort to negative coping mechanisms when faced with a choice between feeding and sending children to school. This compels adolescents to join their guardians in searching for manual labour to supplement household income to buy food. Rapid Gender Assessment for El Niño (2024) highlights that girls are affected more as they are forced to travel further to collect food or water increasing their vulnerability to gender-based violence (GBV) and sexual exploitation and abuse.

The education sector was also impacted by floods which occurred in March 2024. Nkhotakota district in central Malawi received torrential rains in March 2024, where more than 80,000 people were affected and over 10,500 displaced. More than 18,700 learners (9,280 boys and 9,517 girls), including 109 with disabilities, were affected by the floods in 24 schools (20 primary and two secondary schools). In 12 schools, out of 44 classrooms, 12 were occupied by people displaced by the floods, thus disrupting learning. (UNICEF, 2024).

From October to December 2024, temperatures were higher than usual, which increased the chances of heat waves especially over southern Malawi. DCCMS through Common Alert protocol (CAP) issued several heatwave warnings which included 25 to 30 October 2024 and 19 to 23 December 2024. The higher than normal temperatures affected wellbeing of learners in schools which causes poor concentration during classes thereby lowering general performance. Towards the end of the year strong winds blew off roofs of school blocks in Mzimba and Rumphi districts in the northern region of Malawi and also Neno in the south among other districts. In Mzimba district for example, Baula Primary School lost its roof to strong winds on 29 November (MANA online, 2024). Worse still, four students from Kaungwe CDSS in Dowa district, central Malawi lost their lives as they were struck by lightning on 29 November 2024. Cyclone Chido also affected the Education sector through loss of learning days when schools were closed from 16 December to 18 December 2024.

Chapter Six

6.0 Conclusion

The 2023/2024 rainfall season in Malawi was characterized by a delayed start, especially in the South where some areas experienced delays of up to four weeks. Prolonged dry spells also impacted some regions in January and February 2024. While the rainy season ended normally and its overall length was generally typical, total rainfall varied significantly across the country. The northern half received generally normal to above-normal rainfall, while the southern half experienced normal to below-normal rainfall, with some areas receiving significantly less than usual. Consequently, prolonged dry spells and insufficient rainfall led to 23 out of 28 districts being declared disaster areas.

An analysis of Mean, Maximum and Minimum temperature values for the year 2024 against the mean of the base period of 1991 to 2020 indicate that the year 2024 was generally warmer than average across the three parameters for most areas of Malawi. Some areas had maximum temperature anomalies of as high as +4°C. Nonetheless, isolated areas such as Karonga manifested a minimum temperature anomaly of up to -5 °C in 2024. Extreme high temperatures were also recorded during the course of the year 2024. For example, Ngabu in the lower Shire valley recorded an absolute value of 43.9 °C in December 2024. On the lower side, temperatures as low as 7 °C were recorded over Lilongwe during the winter months of May to July. And Mzuzu Airport reported the lowest minimum temperature of 4.6 °C

Malawi experienced moderate to extreme drought condition during the season 2023/2024. An analysis of Standardized Precipitation Evapotranspiration Index (SPEI) for the year 2024 indicates that during October to December 2023 the country experienced late onset coupled with prolonged dry spells resulting in moderate to severe drought conditions for a larger part of Malawi. November and

December 2023 were worst months. Come January to March 2024, the situation had improved over the North and Central areas. However, the South continued to experience severe drought conditions. The government declared 23 out of 28 districts of the country as disaster areas due to the severe drought conditions induced by El Nino conditions. On the flip side of the coin, the country also experienced extreme weather events, including intense rainfall episodes that resulted in flash floods in parts of lakeshore districts such as Nkhatabay, Nkhotakota, and Karonga and others like Dowa. Hailstorms also caused havoc in some parts of Malawi, causing significant damage to field crops such as maize and tobacco.

The summer of 2024 was characterized by isolated cases of extreme heat events, with some areas experiencing temperatures exceeding 40°C between October and December 2024. The number of very hot days, defined as days with maximum temperatures exceeding 37 °C, was 88 (about 3 months) in Chikwawa. On the other hand, the winter season of 2024 recorded minimum temperature as low as 4.6 °C in Mzuzu in July 2024. The number of cold nights, defined as nights where temperatures are below 11 °C, was low compared to the long-time average.

The various extreme weather events experienced during the year resulted in diverse negative impacts on socio-economic sectors. These include the agricultural sector whereby the prolonged dry spells resulted in a significant reduction of Malawi's agricultural productivity hence negatively impacting on both food security and economic returns from the Agricultural sector. Food security wise, the Malawi Vulnerability Assessment Report estimated that about 5.9 million people are at the risk of hunger during the 2024/2025 lean season. Due to heavy rains experienced over the northern and central lakeshore districts, both riverine and flash floods resulted in loss of lives and property, injuries to people, as well as destruction of property, destruction of infrastructure, among others. Further to this, the rising Lake Malawi levels during the year resulted in both flooding of lakeshore areas as well as submerging of property along the shores of the lake. During the year there was also a rise in the number of lightning occurrences. These resulted in the loss of over 10 lives, and on one particular incident, 54 heads of cattle were killed by lightning in Mchinji district. Various other sectors were also affected namely, Energy, Health, Education, Transport, among others. All this calls for the robust climate services and early warning system that supports decision making.

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