FROM CLIMATE RISK TO RESILIENCE: UNPACKING THE ECONOMIC IMPACTS OF CLIMATE CHANGE IN MALAWI

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PREFACE

This report, focused on Malawi, forms part of "From Climate Risk to Resilience," a series of country studies that analyze and explore the potential economic and social impacts of climate change on Kenya, Malawi, Mozambique, and Zambia, focusing on climate-vulnerable and critical economic sectors. The series is produced by the International Food Policy Research Institute (IFPRI), as commissioned by the African Climate Foundation (ACF), with additional support from the CGIAR Research Initiative on Foresight.

Each report summarizes an extensive literature review and internal views and recommendations in four main areas. Section 1 unpacks recent and projected changes to the country's climate profile and patterns, including updated climate scenario analysis modelling. Section 2 considers the potential implications of these projected climate changes for key economic sectors and for the economy as a whole. It also touches on the fiscal, trade, and other macroeconomic implications of climate change. Section 3 provides an overview of each government's existing and planned climate adaptation measures and priorities, as well as key challenges. Section 4 concludes with strategic considerations and suggestions, informed by the country's specific circumstances, and the subsequent steps that could support mobilization of funding for climate adaptation and resilience measures.

The purpose of these reports is twofold. First, they serve as a starting point for further national comprehensive climate change assessments, backed by evidence and climate scenario analysis. Such assessments would facilitate the quantification of climate change impacts, offer a nuanced understanding of potential costs and losses, consider trade-offs across various development indicators, and therefore help governments in identifying and prioritizing strategic public investments in a climate change context (building on existing efforts and strategies). It is intended that the "From Climate Risk to Resilience" reports will lay the foundation for further engagement with respective governments, development institutions, the private sector, and nonprofit organizations.

Second, "From Climate Risk to Resilience" forms part of ACF's foundational work on the development of country-led national Adaptation and Resilience Investment Platforms (ARIPs). ARIPs aim to provide in-country support to assist African governments in adopting a transformative approach to climate adaptation (one that enhances both climate and economic resilience). In particular, ARIPs would mobilize funding at scale and in a sustainable manner for prioritized climate adaptation and resilience measures (for example, by funding national comprehensive climate change assessments, linking them to a pipeline of adaptation projects under an investment plan, and providing support for the necessary institutional arrangements and investor engagement). "From Climate Risk to Resilience" informs ACF's work on ARIPs by: (i) providing an overview to potential investors, donors, and other stakeholders on the need for climate adaptation measures in the in-scope countries; (ii) outlining background research and preliminary considerations for the strategic identification of ARIPs' potential funding priorities (to be further informed by national comprehensive climate change assessments); and (iii) guiding development of a collaborative approach to address climate change risks, involving various stakeholders at different societal and governmental levels, as well as regional and international stakeholders.

EXECUTIVE SUMMARY

Climate change is not projected to materially alter Malawi's climate profile. Instead, it is likely to exacerbate existing climate vulnerabilities by increasing the frequency and intensity of cyclones, floods, and droughts. This is largely due to increased uncertainty around future precipitation levels. These adverse effects have already started to materialize and are expected to increase substantially over the next decades, particularly if efforts to reduce global greenhouse gas emissions by high-emitting countries are insufficient. Climate change is also projected to increase average annual temperatures across the country.

Climate change is expected to significantly affect Malawi's economy, mainly because of its dependence on climate-sensitive economic sectors and its low capacity to take adaptation measures due to preexisting macroeconomic vulnerabilities. Malawi's sensitivity to climate shocks is underpinned by significant environmental degradation, in particular deforestation, watershed degradation, and poor soil management.

The two main impact channels are likely to be agriculture and road infrastructure. In agriculture, the increased uncertainty around future precipitation levels in Malawi will likely result in higher variability in crop yields. Climate change is projected to exacerbate preexisting environmental degradation challenges, including soil erosion. These effects are particularly problematic due to Malawi's high poverty rate, lack of economic diversification (the agriculture sector represents one-third of the economy and employs over 70 percent of the workforce), and significant dependence on rainfed production (about 80 percent of the population). Climate change is likely to significantly impact Malawi's road infrastructure, mainly due to increased risk of flooding, which would have broader economic and social knock-on impacts.

The Government of Malawi (GoM) is well aware of these risks and has taken proactive measures to address them. These include various sectoral and economywide strategies, climate policies, and frameworks that consider the need for adaptation measures. Malawi is also in the process of developing a more comprehensive National Adaptation Plan (NAP).

However, these efforts have failed to materialize into meaningful mobilization of funding for adaptation. This is due to various factors, including challenges in translating high-level adaptation plans into investment pathways (and bankable infrastructure projects), difficulties in accessing climate finance given the complexity of the current climate finance architecture, and macroeconomic vulnerabilities, in particular unsustainable public debt levels.

This report recommends that a potential ARIP in Malawi support the GoM in taking a transformative approach to climate adaptation and resilience, particularly for the agriculture sector and for road infrastructure. This is because climate change is likely to have the most impact on Malawi's economy through these channels and because research finds that prioritizing agricultural development would be most effective at both incentivizing economic growth and reducing poverty. More precisely, the report suggests that an ARIP could focus on: (i) supporting the GoM in advancing its NAP process,

including development of adaptation and resilience investment pathways, linked to project pipelines and underpinned by robust cost-benefit analysis of climate adaptation and resilience measures; (ii) enabling the mobilization of funding for climate adaptation at scale and in a sustainable manner for Malawi's economy; and (iii) improving domestic, regional, and international engagement and coordination on adaptation and resilience strategy development, implementation, and evaluation, including effective disbursement of funding mobilized through the platform in line with the national-level strategy.

LIST OF ACRONYMS

ARIP	Adaptation and Resilience Investment Platform
CSA	Climate-smart agriculture
DRM	Disaster risk management
EAD	Environmental Affairs Department
GoM	Government of Malawi
GDP	Gross domestic product
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution

1. OVERVIEW OF CLIMATE CHANGE IMPACT ON MALAWI

Climate profile

Malawi is a narrow, landlocked country in southeast Africa, bordered by Zambia, Tanzania, and Mozambique. It is highly vulnerable to climate change, ranking 161st out of 185 countries on the Notre Dame Global Adaptation Initiative (ND-GAIN) Index in 2021 (ND-GAIN 2021).

Malawi has a tropical continental climate. It has a rainy season from November to April and a dry season from May to October. About 20 percent of its territory is covered by water (mostly Lake Malawi, which Malawi shares with Mozambique). The country has two main drainage systems (the Zambezi River Basin and the Lake Chilwa Basin) and two main aquifers (FAO 2006). Nearly 90 percent of the runoff occurs between December and June. Almost all irrigation is from surface water. The remaining land area is covered mainly by permanent meadows, pastures, and forests.

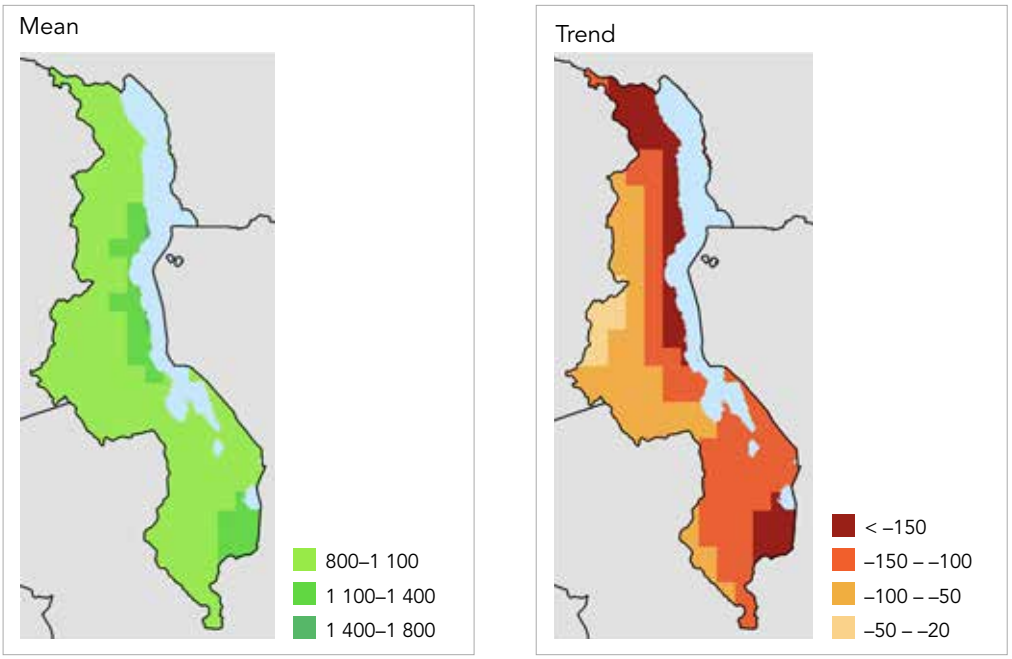
Malawi is prone to a range of natural disasters, including intense rainfall and floods, seasonal droughts, and occasional cyclones. For example, for the period 2010–2022 Malawi experienced 16 major flooding events, a rainfall-related landslide, five storm disasters, and two severe droughts (World Bank Group 2022). The most vulnerable area to floods is the Lower Shire Valley (in the south), whereas droughts affect all parts of Malawi, particularly Karonga, Salima, Zomba, and Shire Valley (Chabvungma, Mawenda, and Kambauwa 2014; Makwinja 2019). Overall, the direct cost of floods and droughts is estimated at 1.7 percent of gross domestic product (GDP) every year (Malawi, Ministry of Natural Resources, Energy and Mining 2016). Cyclone Idai, which hit Malawi in March 2019, caused devastating floods that affected an estimated 975,600 people, submerged or washed away mature crops, and destroyed irrigation infrastructure. Tropical Storm Ana in 2022 caused damages estimated to be equivalent to 1.5–2.7 percent of Malawi's GDP—most notably, requiring extensive and costly rehabilitation of the Kapichira Dam (World Bank Group 2022). While the full scale of Cyclone Freddy's (March 2023) economic impact is yet to be estimated, the cyclone is seen as the worst on record for Malawi, having led to over 1,000 deaths (Kwakwa 2023), destroying 204,833 hectares of crops, and likely to cause significant downward revisions of economic growth estimates (Chiphwanya 2023). For example, Fitch Ratings is revising its 2023 real GDP growth forecast for Malawi from 3.7 percent to 0.7 percent due to the impact of the floods on Malawi's agriculture sector (Fitch Solutions 2023).

Recent climate trends

Annual rainfalls have decreased in recent years, particularly in the southeast and in the north along the coastline of Lake Malawi. Typical annual precipitation in Malawi is reasonably high (Figure 1) and can support cultivation of many crops, with local averages ranging between 800 and 1,500 millimeters (mm) per year, with the highest rainfall along Lake Malawi and Lake Chilwa in the south. However, regression analysis on the precipitation trend shows large downward trends throughout the country, with the largest areas in the east and south, and smaller trends moving westward. Some areas have 200 mm less annual rainfall in the time period near 2015 compared to that around 1975.

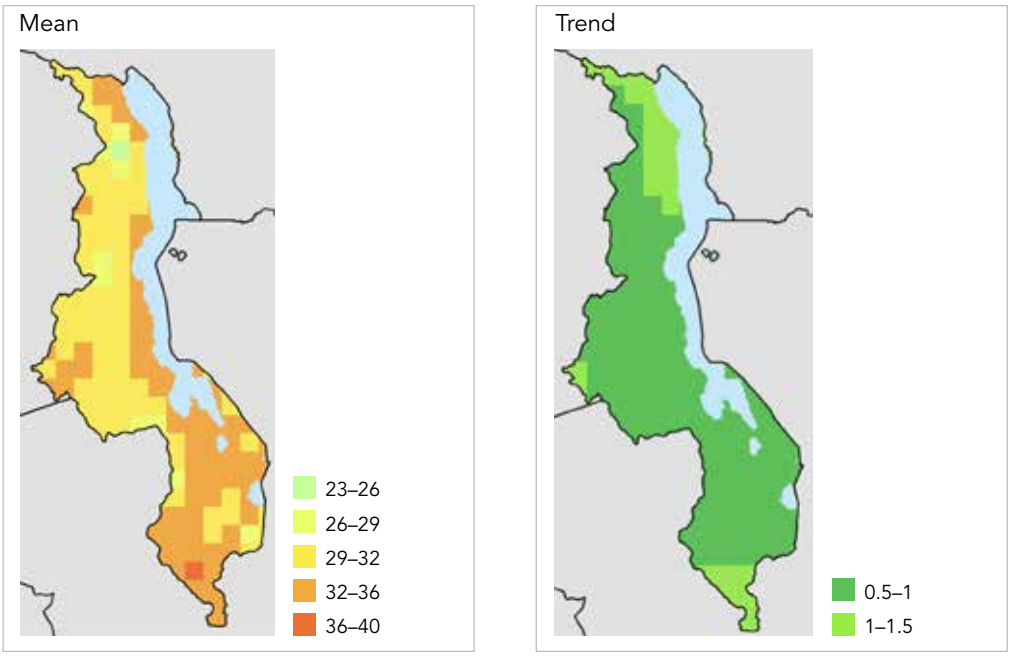
The evidence shows a slight increase in average temperatures. Figure 2 shows the same type of information as Figure 1, but for temperature instead of precipitation. Mean daily maximum temperature for the warmest month of the year for the period 1985–2015 ranged from 25°C to 37°C, with the highest temperatures in the southern part of the country and along the banks of Lake Malawi. Between 1975 and 2015, the temperature trended upward, with ranges from 0.7°C to 1.2°C.

Figure 1: Mean annual rainfall, 1985–2015, and trend in rainfall, 1975–2015 (mm)



Source: Princeton Global Forcings dataset (based on Sheffield et al 2006)

Figure 2: Mean daily maximum temperature for the warmest month of the year, 1985–2015, and trend in that temperature, 1975–2015 (°C)

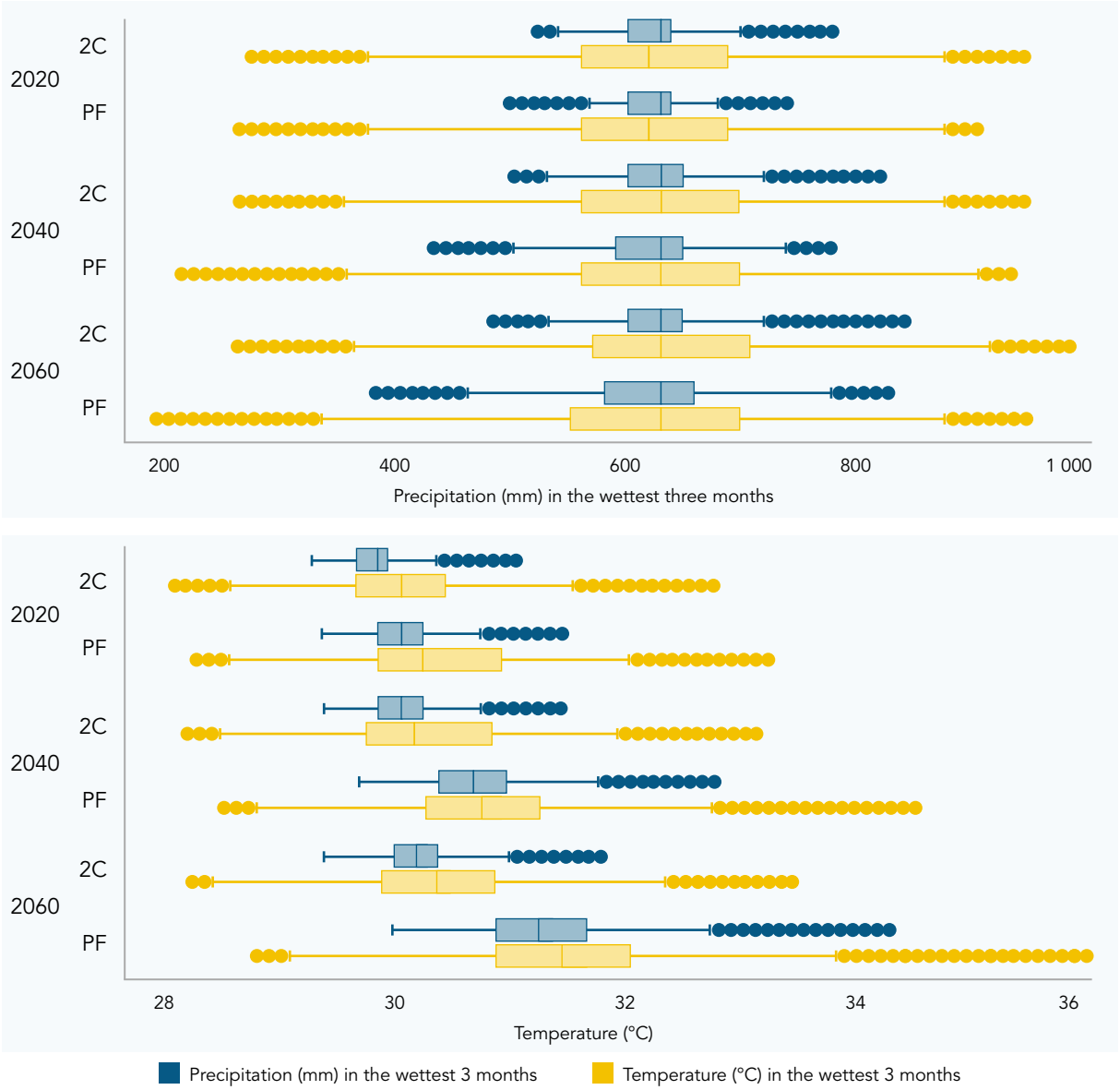


Source: Princeton Global Forcings dataset (based on Sheffield et al 2006)

Projected climate trends

The median temperature is expected to continue to increase between the 2020s and 2060s, and significantly higher if global efforts to reduce emissions are ineffective. Using a large ensemble of climate projections for 2000 to 2069, Thomas et al. (2022b) produced frequency distributions for precipitation and temperature (Figure 3). "2C" is the lower emissions scenario and "PF" is the higher emissions scenario. The change in variance of the daily maximum temperature in the hottest months of the year is small for the lower emissions scenario but large for the higher emissions scenario. Other studies project an increase in the average annual temperatures across the country due to climate change (CIAT and World Bank 2018; IFAD 2020; World Bank Group 2022).

Figure 3: Projected trends in precipitation and mean daily maximum temperature for the warmest month for the wettest three-month period, 2020s to 2060s

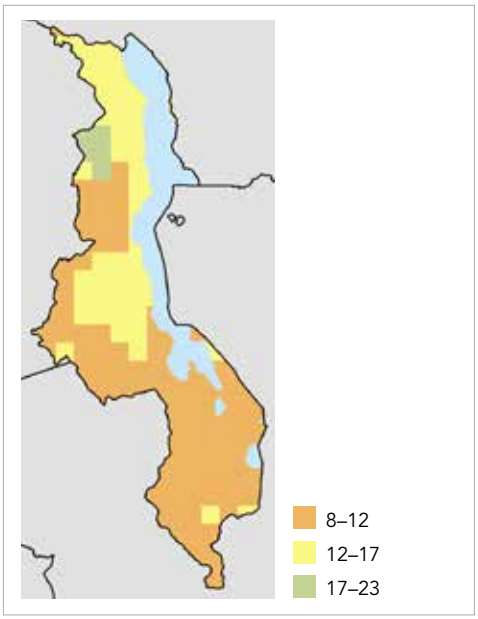


Source: Thomas et al. (2022b)

Note: Values are for the total precipitation for the wettest three months of the year for each pixel for the given decade, and mean daily maximum temperature for the warmest month during the wettest three months of the year for each pixel, for the given decade.

The combined variability and uncertainty of precipitation during the wettest months in Malawi, particularly under a high emissions scenario, increase the likelihood of drought, especially in the south. Although very little change is expected in mean precipitation of the wettest three months at the national level, for the highest emissions scenario (that is, the "reference" scenario, which is slightly higher than the "PF" scenario) small reductions in median precipitation and slightly higher variance in precipitation imply a doubling of the frequency of droughts in the south and potentially a 50 percent increase for most of the rest of the country. This future variability stems from both precipitation trends and increased uncertainty in the future (Thomas et al. 2022b).

Figure 4: Frequency of 20-year low-rainfall events under climate change, reference scenario, 2060s (baseline 2020s 2C scenario)



Source: Thomas et al. (2022b)

CIAT and World Bank (2018) also find an increased likelihood of lower rainfall, particularly in the southern parts of Malawi, as well as more dry days per year overall. Similarly, IFAD (2020) expects an overall decrease in the annual and seasonal precipitation in Malawi by mid-century, including a total reduction of seasonal rainfall of 10.5 percent for the period October–April.

The increased uncertainty around precipitation levels leads to varying conclusions about the impact on growing season patterns. Vizy et al. (2015) project that climate change will likely shorten the length of the growing season, particularly in the south (possibly by as much as 20–55 days shorter in the southernmost districts by mid-century), and to a lesser extent in central districts. While this is consistent with lower levels of precipitation over the wet season, the study expects the shorter growing season to be primarily associated with an earlier demise date, rather than a change in the onset date for the season. In contrast, IFAD (2020) projects most districts to experience an increased delay and inconsistencies in the onset of rainfall, although the analysis notes that this may vary on an interannual basis and spatially within each season. This uncertainty poses challenges for farmers on how best to adapt their agricultural practices to minimize adverse impacts on productivity from changes in seasonal patterns.

Climate change is likely to lead to a higher frequency of flooding in Malawi. This is supported by the findings of both Arndt et al. (2014) and CIAT and World Bank (2018). Overall, the increased occurrence of both droughts and floods poses significant risks for the agriculture sector, as farmers will have to deal with more variable yields, and taking climate adaptation measures will be more challenging.

2. CLIMATE CHANGE IMPACT ON KEY ECONOMIC SECTORS

Malawi's economy comprises several climate-sensitive sectors. Agriculture, forestry, and fisheries make up 22.7 percent of Malawi's GDP (World Bank Data n.d.-a) and account for 62 percent of Malawi's total employment, as of 2021 (World Bank Data n.d.-b). Tobacco is the most important cash crop, accounting for around 50 percent of Malawi's export earnings. Other agricultural exports include tea, sugar, and cotton (MITC n.d.). In total, agricultural products account for at least 85 percent of Malawi's exports (Fitch Solutions 2023). Hydropower—another climate-sensitive sector—accounts for the majority of Malawi's electricity generation: approximately 98 percent in 2018 (JICA 2020), though the share has gone down slightly with the installation of two utility-sized solar plants. Moreover, Malawi has underdeveloped infrastructure, including roads, energy, and water supply, damages to which can amplify the adverse impacts of climate change on other sectors.

A few studies have assessed the impact of climate change on Malawi's economy. Although the estimates differ on the impact on GDP and poverty, they are consistent on the main likely impact channels: adverse impacts on agriculture and damages to road infrastructure. Differences in the estimates are largely because the studies focus on different aspects of climate change and use various modelling methods, as well as varying assumptions and approximations.

Malawi's updated Nationally Determined Contribution (NDC) estimates a direct overall cost due to climate change equivalent to losing at least 5 percent of the country's GDP each year (Malawi, Government of Malawi 2021). The National Climate Change Management Policy notes that the agriculture sector is likely to suffer the greatest losses from climate change (Malawi, Ministry of Natural Resources, Energy and Mining 2016).

Arndt et al. (2019) find relatively lower implications of climate change for economic growth in Malawi until 2050. Under an unconstrained global emissions scenario, they estimate the total GDP loss by about 2050 to be less than one year of economic growth at the baseline growth rate (estimated at 4.4 percent). That said, the study finds that climate change is likely to impose consistent losses over long periods of time (and estimates an average loss over the period 2007–2050 of about US$610 million, at 2007 prices discounted at 5 percent). In addition, Arndt et al. (2014) find that climate change impacts on the Malawian economy are likely to become more pronounced with time and to be driven by reduced agricultural yields and more damage to road infrastructure due to increased frequency and intensity of extreme events. Arndt et al. (2019) also find the water sector in Malawi to be the least sensitive to climate change.

Another study (World Bank Group 2022) considers five future climate scenarios and estimates that climate change could reduce Malawi's GDP by numbers that exceed the losses projected by the NDC (assuming the current low-growth development trajectory continues). Similar to Arndt et al. (2014), it finds that damage to roads and bridges is likely to be the main channel of climate change impact on Malawi's economy, particularly under a wet scenario, as the country's road infrastructure is vulnerable to floods. The second most impactful channel is estimated to be reduction in labor productivity (particularly under a hot climate scenario). This is followed by productivity losses for crops from changes in temperature and precipitation under a dry scenario. Other channels include the impact

from climate change on human health and on livestock (although the latter is not expected to be that material before 2050). While climate change could disturb power generation due to changes in water flow, the analysis finds such damages to be negligible (similar to Arndt et al. 2019), as planned facilities are mostly below Lake Malawi, which reduces upstream hydrological variability by storing water and releasing it relatively steadily. This, however, excludes the potential impact from flood damages to hydropower infrastructure, which can be significant, as detailed below.

Even relatively small GDP losses from climate change could have a significant impact in Malawi given the high proportion of people living in extreme poverty and the country's overall very low ability to absorb climate shocks. Malawi has one of the lowest GDP per capita rates in the world (US$394 in 2021). Four in five Malawians experienced moderate to severe food insecurity in 2019–2021, as poverty worsened because of the COVID-19 pandemic, the war in Ukraine, and climate disasters (World Bank Group 2022). The rest of this section details the impact of climate change on the most affected sectors.

Agriculture

As noted above, the agriculture sector represents a significant portion of Malawi's economy and employs a majority of the labor force. Table 1 shows the top 10 crops by area based on the average for 2018 to 2020. Maize is clearly the most significant crop in terms of land area, roughly equal to that of the next six leading crops for the country.

Table 1: Top 10 crops in Malawi by harvested area, average of 2018–2020, and annualized yield growth by regression, 2009–2018

Crop	Hectares harvested	Annualized yield growth
Maize	1 726 566	–3.6%
Groundnuts	401 695	–2.8%
Beans	356 594	–1.0%
Sweet potatoes	292 271	NA
Pigeon peas	251 254	6.6%
Cassava	240 778	0.9%
Soybeans	182 941	–0.1%
Sorghum	112 501	0.4%
Cowpeas	103 340	–0.8%
Tobacco	91 924	NA

Source: FAOSTAT (FAO 2022) and authors' calculations based on FAOSTAT (FAO 2020)

Only a small proportion of cultivated land is irrigated in Malawi, mainly controlled by commercial estates (GAFSP n.d.). Even though use of irrigation has been growing (reaching 61,977 hectares by 2019), it involves significant costs (Mapila et al. 2022). As a result, crop productivity in Malawi remains highly sensitive to rainfall levels.

Large-scale producers are almost exclusively involved in production of tobacco, tea, sugar, and macadamia for export. Small-scale producers are mostly subsistence farmers cultivating maize, rice, cassava, legumes, and sweet potato. Overall, 80 percent of Malawi's population lives in households that practice rainfed agriculture (CIAT and World Bank 2018).

Agricultural productivity has been declining for many key crops, with the annual yield growth rate of the top three crops by area all negative (Table 1). Only pigeon pea yield is growing at greater than 1 percent per year. Investment needs to be made in the agriculture sector to increase productivity to promote better resilience to adverse climate events.

The increasing probability of low-yield years in agriculture increases the severity of potential economic shocks. Such impacts are likely to be significantly greater in a high emissions scenario. For maize, low-yield events could occur two times more often because of climate change.

Table 2 shows the effect of climate change and climate uncertainty on yields of five crops in Malawi. The base value are the yields of the 2020s, and those are compared to the yields of the 2040s and the 2060s. The table shows changes in median yields and changes for the fifth percentile – the 1-in-20-year low yield. Changes at the median value are generally low to moderate, especially by the 2040s, and especially for the lower emissions scenario. In the 2040s, the highest median losses are only 3.4 percent for sorghum under the high emissions scenario, followed by beans and maize. The yields fall even more for the 1-in-20-year event in the 2020s to the 2040s, with the greatest losses for soybeans under the high emissions scenario, at 6.7 percent.

Table 2: Projection for change in yields under climate change and change in frequency of 1-in-20-year low-yield events for high and low emissions scenarios

		2020s	2040s			2060s		
Crop	Scenario	p5 yield/ p50 yield	p50	p5	New frequency for 1-in-20	p50	p5	New frequency for 1-in-20
Maize	Low	82.5%	–0.6%	–3.0%	15.7	–1.2%	–1.9%	16.9
Maize	High	81.6%	–2.3%	–3.4%	13.1	–6.2%	–12.7%	8.0
Groundnuts	Low	61.5%	0.1%	–0.3%	19.8	–0.2%	2.0%	21.8
Groundnuts	High	59.9%	–0.7%	–1.1%	19.1	–2.2%	–6.5%	13.8
Beans	Low	73.7%	–0.6%	–3.9%	16.7	–0.6%	–1.3%	18.6
Beans	High	71.4%	–2.4%	–3.8%	14.4	–5.5%	–13.4%	12.2
Soybeans	Low	59.0%	0.1%	–0.4%	19.7	0.8%	–2.2%	21.3
Soybeans	High	59.0%	–0.7%	–6.7%	15.1	–2.7%	–14.9%	11.4
Sorghum	Low	81.5%	–1.6%	–4.8%	15.5	–2.5%	–5.4%	12.9
Sorghum	High	78.3%	–3.4%	–4.4%	14.6	–8.1%	–15.8%	7.3

Source: Thomas et al. (2022a).

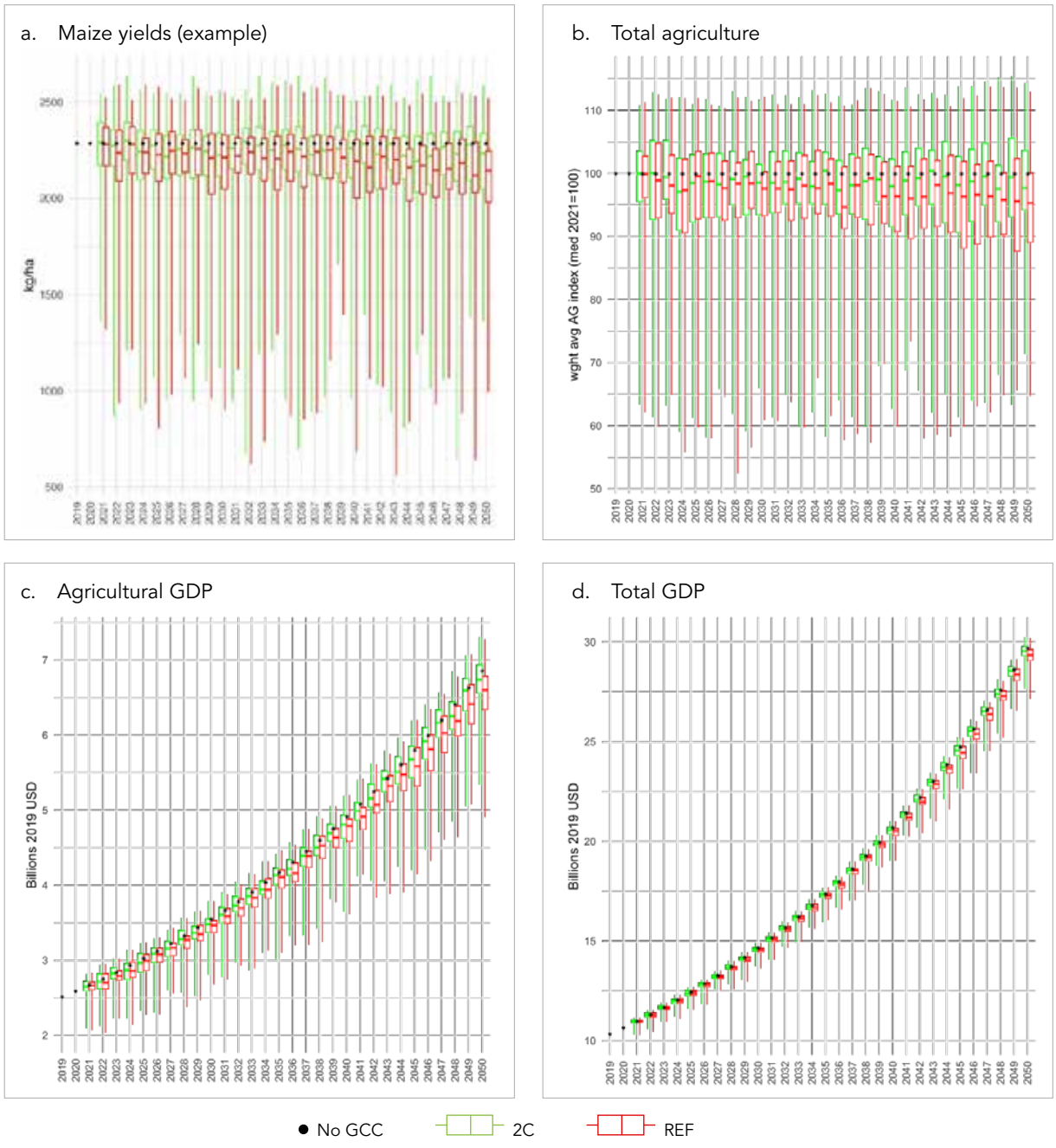
Note: "P5" refers to the fifth percentile while "P50" refers to the median value for the percentage change in crop yields. "New frequency for 1-in-20" refers to the number of years within which an event that historically has happened once in 20 years is expected to occur. A lower number for "new frequency for 1-in-20" therefore indicates an increase in the frequency with which such events occur.

Changes to crop yields significantly depend on how global emissions evolve over the course of the century. For the low emissions scenario, in the 2060s the median yield declines slightly from the 2040s, but generally the fifth percentile yield actually improves from the 2040s, with the frequency of 1-in-20-year events generally decreasing. Not so for the high emissions scenario, in which both the median and the fifth percentile decline from the 2040s, and the 1-in-20-year events increase in frequency. For example, a 1-in-20 low yield event from the 2020s for maize would occur every 8.0 years in the 2060s. For sorghum, it would be every 7.3 years.

While the median changes in crop yields are expected to be relatively low in Malawi, particularly in a low emissions scenario, significant uncertainty exists. Figure 5 shows how much lower the fifth percentile yields in the 2020s are compared to the median yields: for maize and sorghum, they are roughly 20 percent lower. But for soybeans and groundnuts, they are 40 percent lower, which means that the coefficient of variation is high for those two crops relative to the others.

The increasing probability of drought-related low yields could significantly impact Malawi's overall economic development. Figure 5 illustrates the effects of the escalating probability of droughts and associated low crop yields on Malawi's economic growth (under the business-as-usual development

Figure 5: Increasing probability of droughts increases probability of more severe economic shocks



Source: Thomas et al. (2022a) and derivations based on Mukashov, Thurlow, and Thomas (2023 forthcoming)

scenario). Specifically, the rising chance of droughts of individual crops such as maize (Panel a) forms a growing risk of decreased productivity across the entire agriculture sector (Panels b and c). This, in turn, could result in a higher probability of severe economic shocks over the years, particularly under more severe climate change scenarios (Panel d). Preliminary estimates suggest that under a more severe climate change scenario, the severity (or frequency) of economic shocks tied to drought-induced low yields could be three times higher in the 2040s than in the 2020s.

The World Bank Group (2022) finds that climate change is unlikely to significantly impact the production of irrigated crops (such as sugar cane, coffee, tea, and fruits), as the availability of irrigation water is not affected by rainfall declines. The study also finds relatively small impact on livestock until 2050 but expects a significant adverse impact over the second half of the century, as temperatures surpass the maximum heat tolerance for both livestock and pasture grasslands. This could provide some level of resilience to households, at least in the short to medium term, as approximately 51 percent own livestock (mostly cattle, goats, pigs, and poultry).

Climate change is expected to exacerbate Malawi's soil loss challenges. Soil erosion has been a significant environmental issue in Malawi, as per the Malawi National Environmental Action Plan (1994), partly due to inadequate soil management and deforestation. In addition, climate change is projected to increase the intensity of rainfalls in Malawi, which would increase soil erosion, both in areas that already have poor soil health and in new ones (Chapman et al. 2021). This increases the likelihood of flood damage, as erosion (as well as deforestation) adversely affects soil's water absorbency. Thus, more extensive land management efforts will be needed to reduce the negative impact of climate change on the agriculture sector in Malawi.

Road infrastructure

Malawi's road infrastructure is likely to be significantly affected by climate change. Arndt et al. (2014) find increased damage to road infrastructure and reduced agricultural yields to be the primary climate change impact channels on Malawi's economy. The main climate-related driver of road infrastructure damage is expected to be increased frequency and intensity of flooding. Changes to the frequency and intensity of rainfall can increase maintenance costs, especially for unpaved roads, which represent 84 percent of Malawi's road network of about 25,000 kilometers (km) (Malawi, Roads Authority n.d.). Higher temperatures could lead to faster degradation of paved roads. Arndt et al. (2014) find that in the absence of adaptation measures, greater precipitation intensity and increased flood return periods in Malawi could result in shortening the road network length by <3.5 percent by 2050,[1] with implications for economywide activities and national GDP.

A separate study by the World Bank Group (2022) finds that climate change could increase the cost of building, operating, and maintaining Malawi's roads and bridges by US$100 million per year for 2036–2050 relative to historical levels. Chinowsky et al. (2015) estimate that Malawi may face an annual average cost of US$165 million to repair its road infrastructure from climate change-related damages (that is, from precipitation, temperature, and flooding changes) if it does not take any adaptation measures. This translates to a 13 percent opportunity cost in total by 2050 (based on a median climate scenario) or, in other words, a lost potential of expanding the existing paved road network or upgrading the existing unpaved roads by 3,530 km of paved road.

1 The analysis assumed road budgets remain a fixed proportion of real government expenditure.

Hydropower sector

Malawi's energy sector, and in particular its infrastructure, is highly susceptible to climate shocks. The Shire River is the only outlet of Lake Malawi and is responsible for over 90 percent of the existing hydropower-generation capacity in Malawi (Bhave et al. 2019). This geographical concentration of Malawi's hydropower plants exposes the sector to losses from extreme events, such as flooding. For example, Tropical Storm Ana damaged the Kapichira Power Station, one of the three hydropower stations on the Shire River, reducing Malawi's power generation capacity by 32 percent. This resulted in prolonged power blackouts, lasting above eight hours per day at times. The GoM needed more than one year and a US$60 million loan from the World Bank to repair the plant and improve its resilience (Nzangaya 2023). That said, predicted changes to precipitation levels in Malawi are not expected to affect hydropower output significantly. Fant et al. (2015) find that Malawi is the least sensitive country in the Zambezi region to losses of hydropower generation due to change in general weather patterns (for example, excluding extreme tail events). Arndt et al. (2019) similarly do not find the implications of climate change for the Malawi hydropower output to be particularly large. This is in part because climate change is not expected to significantly affect precipitation levels in Malawi, and because Malawi is an upstream country within the Zambezi River Basin.

Broader macroeconomic impacts and vulnerabilities

Malawi has a very low level of economic diversification and industrialization. As discussed, the country is heavily dependent on climate-sensitive sectors, particularly agriculture. Malawi has a small industrial sector that is mainly focused on processing agricultural products, such as tobacco and sugar. A small manufacturing sector produces textiles, footwear, and consumer goods. The services sector is dominated by the government, which accounts for a significant portion of employment and GDP. This concentration in highly climate-sensitive sectors and overreliance on critical infrastructure creates a multiplier effect for the economic and social impacts of the increased probability of extreme events described above.

Malawi's fiscal position is currently unsustainable. The International Monetary Fund (IMF) assessed Malawi's external and overall public debt as "in distress" as of July 2022 (negotiations for a debt restructuring are ongoing) (IMF 2022). The fiscal deficit reached 8.8 percent of GDP in 2022, as government debt rose to 76.6 percent of GDP. This means that about one-third of the GoM's domestic revenues would need to go toward interest expenditure in 2022/23. The deterioration in Malawi's fiscal position is partly due to external borrowing to finance infrastructure projects and respond to the COVID-19 pandemic. It further deteriorated due to an increase of commodity prices as a result of the Russia–Ukraine war, which led to higher food prices, further devaluation of the Malawi kwacha, an acute foreign exchange shortage, and a spiraling of inflation to 26.7 percent as of October 2022 (Raga 2023; World Bank 2023). Malawi's economic vulnerability, including debt unsustainability, is exacerbated by the continuous climate-related shocks. The government implemented fiscal consolidation measures to reduce the deficit, including reducing nonpriority spending and improving revenue collection. Despite these positive trends, Malawi still faces significant fiscal challenges, including in addressing poverty and inequality, given the need for increased investment in social services, infrastructure, and improved climate change resilience.

Climate change is likely to affect Malawi's trade balance through several channels. First, unprocessed agricultural outputs (mainly tobacco but also, to a lower extent, tea, cotton, groundnuts, and coffee) represent 60 percent of Malawi's exports (ITA 2022). As climate change increases the variability of agricultural productivity, it could result in greater reductions of exports in low-yield years.

This would make Malawi more dependent on imports to manage food security, which would exacerbate persistent trade imbalances and currency devaluation, with knock-on effects for macroeconomic and price stability. Malawi mainly imports food from Mozambique, South Africa, and Zambia (World Bank 2020). These countries are also vulnerable to climate change, which means that climate shocks and impacts on the region could additionally push prices up and reduce availability of food in Malawi.

As a landlocked country, Malawi is dependent on its road infrastructure to access ports in neighboring countries. The transport sector is a key climate change impact channel as climate shocks (in Malawi or in neighboring countries) could increase export costs beyond the potential impact on the agriculture sector.

Malawi's financial system is underdeveloped. Malawi's financial sector comprised 47 percent of GDP in 2020, of which banks accounted for 25.5 percent of GDP, the pension system 12.4 percent, and insurance 10 percent. Agricultural loans stood at 17 percent of total lending, which is high relative to other banking sectors in the region and means that climate change could pose risks to financial stability. Access to agricultural finance for small farm holders and access to agricultural insurance are both very limited, with agricultural production equivalent to less than 1 percent of agricultural GDP being insured (World Bank Group 2022).

3. MALAWI'S CLIMATE ADAPTATION AND RESILIENCE PLANNING AND PREPAREDNESS

Malawi's climate change policy frameworks

The GoM has made substantial efforts to understand the impact of climate change and consider potential measures. Annex A details key policy documents, as well as the governance framework for climate change response in Malawi.

The GoM published an ambitious **"Malawi 2063"** vision document that focuses on broader development goals but includes climate change considerations. It aims to achieve inclusive economic growth through (Malawi, National Planning Commission 2020): (i) a productive, commercialized, and diversified agriculture sector; (ii) a strong manufacturing sector driven by vibrant agriculture and mining sectors; and (iii) development of urban centers and tourism hubs across the country. It emphasizes the need for disaster risk management (DRM) in relation to climate change.

Malawi's updated NDC identifies measures with adaptation and resilience co-benefits in the areas of electricity generation, transport, buildings, industry and manufacturing, agriculture, minerals industry, solid waste, waste water, crop management, livestock, forestry, and land use.

In 2020, Malawi published a **National Adaptation Plan Framework** that details its approach to developing a NAP. It recommends focusing efforts on the following activities:

- Addressing capacity gaps and weaknesses in undertaking the NAP process
- Analyzing current climate and future climate change scenarios
- Assessing climate vulnerabilities and identifying adaptation options at sector, subnational, national, and other appropriate levels
- Integrating climate change adaptation into national and subnational development and sectoral planning
- Developing a long-term national adaptation implementation strategy
- Reviewing the NAP process periodically to assess progress and effectiveness.

Mobilization of capital for adaptation and resilience

Malawi was the first African country to launch a National Climate Change Investment Plan (for 2013–2018). The investment plan, developed by the Environmental Affairs Departments of the Ministry of Environment and Climate Change Management, identified four key themes: (i) adaptation investments; (ii) mitigation investments; (iii) research technology development and transfer investments; and (iv) capacity development investments (Malawi, Ministry of Environment and Climate Change Management 2013). The plan set up 11 programs across these themes.

A key objective of the plan regarding adaptation and resilience was to make the agriculture, forestry, and fisheries sector more productive and sustainable. In particular, it proposed prioritization of funding for:

(i) Reducing land degradation in targeted watershed areas for reduced soil erosion and improved soil productivity through an integrated watershed management program.

(ii) Improving climate change community resilience through agricultural production to: improve soil fertility and land use management in key areas in Malawi; and enhance sustainable irrigation farming systems in selected districts prone to climate change effects.

(iii) Climate change proofing infrastructure development.

(vi) Enhancing disaster risk management.

Nevertheless, most of the activities in the Investment Plan are yet to be implemented, as Malawi faces significant challenges in funding the proposed measures.

The National Planning Commission has undertaken steps to conduct cost-benefit analyses for key policy measures. The Malawi Priorities Project sets out recommendations for government measures in various areas (Mapila et al. 2022). While the scope of the project is broader than climate adaptation, climate change-related risks are taken into account to some extent, particularly in relation to select policy measures in agriculture and natural resource and environmental management. The report recommends prioritizing improvements to early warning systems to reduce flooding risk. The development of climate-smart agriculture (CSA) practices is also explored and encouraged (especially the use of drought-tolerant varieties of maize, groundnuts, and beans under minimum tillage using recommended spacing and fertilizer rates as well as rice intensification).

The GoM established a National Climate Change Fund (Malawi, Environmental Affairs Department 2020). Its objective is to be a single institutional framework that will act as a basket for domestic and international resources to help coordinate climate change funds, leverage climate finance, and support tracking of climate financing and investment[2] (Malawi, Environmental Affairs Department 2019). As of August 2022, two Global Climate Facility projects had been approved, both with co-financing from other agencies: one supporting the modernization of early warning systems, and one to develop renewable energy projects in regions with power deficits. There are also projects with the Adaptation Fund and the Global Environment Facility (World Bank Group 2022). Operational guidance for and a climate change adaptation window of the Fund are being designed (Malawi, Environmental Affairs Department 2020). The GoM is also working on a public-private financing

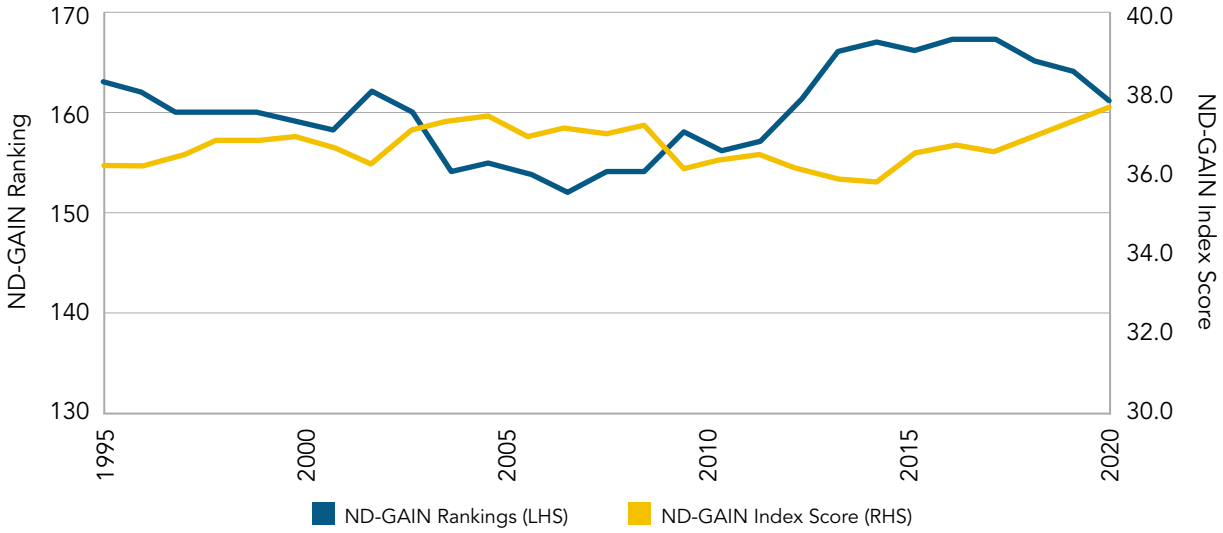
2 Including a Finance Management Information System to track inflows of climate resources toward climate change-related interventions by different stakeholders, including international nongovernmental organizations (NGOs), bilateral and multilateral institutions, development banks, United Nations programs, academic institutions, the private sector, and various nonstate actors.

strategy for climate change adaptation (CIAT and World Bank 2018). Annex B provides a short summary of Malawi's climate finance landscape.

Challenges to country preparedness

Malawi remains very vulnerable to climate change although its climate resilience has improved since 2015. Figure 6 illustrates the development of Malawi's ND-GAIN Index over time. In 2021, the country ranked 161st out of 185 ranked countries. Its vulnerability score was driven by the projected adverse impact from climate change on cereal crop yields, limited dam capacity, and insufficient medical staff. Similar to neighboring countries, its low readiness score was due to low social readiness, particularly in terms of education and innovation.

Figure 6: Malawi's ND-GAIN Index for 1995–2021



Source: Notre Dame Global Adaptation Initiative (ND-GAIN) Index (ND-GAIN 2021). Chen et al. (2015) provide details on the methodology for calculating the readiness and vulnerability indexes..

While the above shows an enabling policy environment and a positive trend in climate resilience, Malawi faces significant challenges in mobilizing funding for adaptation and resilience. According to the Malawi Environmental Affairs Department (EAD), the key constraints to accessing climate finance include: (i) **inadequate institutional and technical capacity to develop bankable project proposals**; (ii) **rigorous processes to access climate finance** application and disbursement (including accreditation of national entities); (iii) **challenges to crowd in the private sector** to finance climate action[3] (and lack of financial data and reporting on investments by the private sector and some NGOs); (iv) **low awareness on how to access climate finance**; and (v) **inadequate evidence** to support the rationale for climate finance in climate projects (Malawi, Environmental Affairs Department 2019).

3 While the government launched a national private-public partnership program in 2011, nearly all the private capital mobilized (US$1.1 billion) was from a single rail deal with a mining firm. A significant drawback to investment in the road sector, for example, is the high amount of arrears owed to the private sector, currently estimated at US$100 million—almost equal to the road sector's annual budget (World Bank Group 2022).

Additional factors constrain Malawi's ability to take adaptation and resilience measures, such as:

Malawi's limited budget capacity: Expenditure allocated to environment and climate change management was less than 1 percent in 2019 (Malawi, Environmental Affairs Department 2019). And actions are to a large extent focused on disaster risk management,[4] as opposed to a more transformative approach to adaptation. Overall, raising funding for adaptation is challenging given the persistent fiscal imbalance, as discussed. Malawi has struggled to direct funding to climate actions without having its National Climate Change Fund fully operational (Malawi, Environmental Affairs Department 2019).

Distribution of funds for climate action at subnational level: Local authorities in Malawi do not receive explicit development transfers for climate change projects (although transfers for DRM activities have increased, which could target climate-related objectives but such actions are not coordinated). This means that most funds for climate actions and DRM are fragmented and off-budget (which has led to a proliferation of parallel mechanisms for monitoring, evaluation, verification, and reporting). This also means that most funding is only available at government level and investment opportunities are identified centrally, often in emergency situations, which can be ineffective and lack necessary robustness of procurement processes and local consultation (World Bank Group 2022). England et al. (2018) note the inability of funding to reach the district level, where development plans are required to include climate adaptation considerations.

Coordination challenges: CIAT and World Bank (2018) identify the government's insufficient stakeholder engagement, including with civil society organizations, and overall coordination among stakeholders in climate change as key challenges, leading to duplication of effort, unsustainability of interventions, and low adoption levels of CSA practices. The World Bank Group (2022) highlights the minimal consideration of climate change within public investment management processes. England et al. (2018) similarly point out the insufficient coordination between policy development and implementation processes, underpinned by weak institutional linkages and interagency competition.[5]

Monitoring and evaluation (M&E) processes: Despite some progress, the M&E system managed by the Department of Economic Planning still does not have a national target for climate change adaptation and mitigation efforts and does not adequately capture data on climate or DRM interventions. This makes it difficult to evaluate progress and inform NDC updates (World Bank Group 2022).

4 For example, as of June 2022, the government had implemented two DRM financial instruments, a sovereign drought insurance policy through the African Risk Capacity, and a scalable social cash transfer program using contingent financing supported by the World Bank to respond to climate shock (World Bank Group 2022).

5 Examples include: disagreements between the Finance Ministry and the Department of Irrigation over who should manage the funds for irrigation scheme projects; and the challenges EAD faces in instigating changes in sectoral planning or policy development.

4. ADAPTATION STRATEGIES AND RECOMMENDATIONS

This report aims to support and inform the approach and design of a potential Adaptation and Resilience Investment Platform (ARIP) in Malawi that would help mobilize funding for adaptation at scale. This section provides further literature review and suggestions for what such an ARIP could prioritize and/or explore, including in terms of how best to support the government's response to the risks that climate change poses to Malawi's key economic sectors. The recommendations also consider how to improve both climate and economic resilience in the country.

First, while Malawi's concentration in agriculture exposes it to increased climate-related risks due to climate change, further development of the agriculture sector would be most effective at reducing poverty. Mukashov, Thurlow, and Thomas (2023 forthcoming) examine the climate change context of the longstanding narrative in development economics asserting that in Sub-Saharan African countries, an agriculture-led growth strategy is generally preferred over a nonagriculture-led one due to its stronger poverty-growth linkages (Valdés and Foster 2010; Diao, Hazell, and Thurlow 2010; Dorosh and Thurlow 2018). The authors consider primary agriculture, the sector most vulnerable to climate change, as the principal source of economic uncertainty and test the agriculture-led growth narrative in the context of climate-associated yield uncertainty for Malawi calculated by Thomas et al. (2022a). They analyze the impact of uncertain yields over the years on two hypothetical accelerated growth scenarios for Malawi: intensive growth in the Agrifood System (AFS) and intensive growth outside the Agrifood System (Non-AFS).

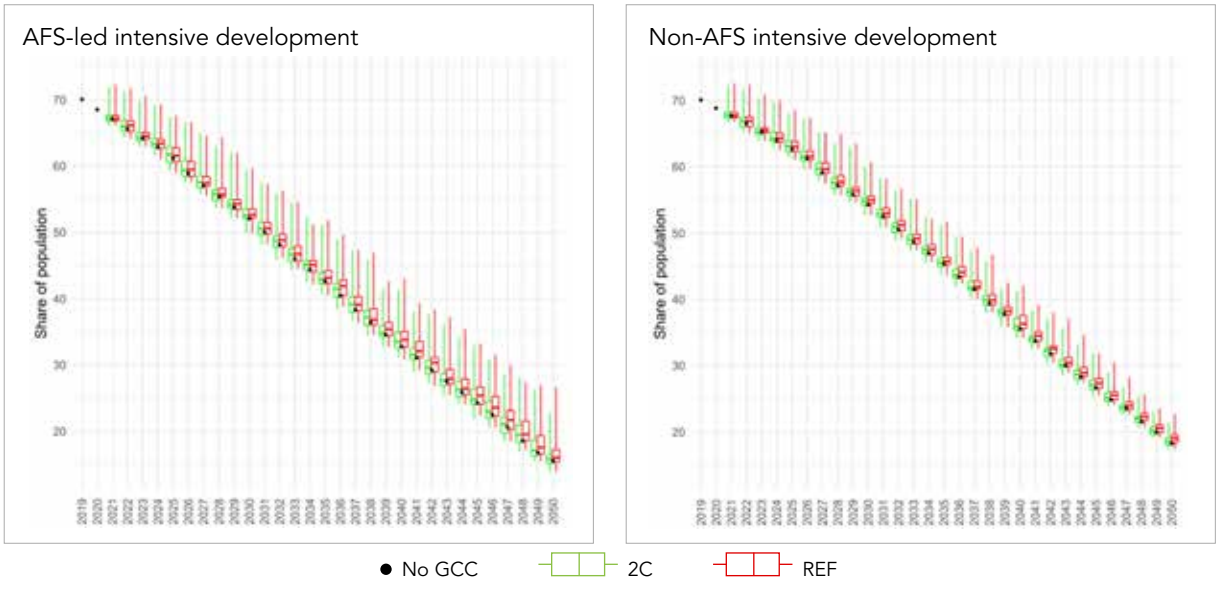
Unsurprisingly, the authors find that the vulnerability of the entire economy to potential weather/climate shocks is greater under the AFS strategy than under the Non-AFS strategy, due to the higher economic weight of agriculture. As such, the AFS strategy may be associated with higher economic uncertainty. For example, the variability of poverty headcount rates is higher under AFS-led development (Figure 7, Panel a). At the same time, the authors find that the AFS strategy outperforms Non-AFS in terms of stochastic dominance. Specifically, in both the 2020s and 2040s, the AFS strategy demonstrates first-order stochastic dominance over the Non-AFS strategy in terms of expected outcomes by decade for poverty and undernourishment rates across all climate scenarios (Figure 7 Panels b, c, and d).[6] In simpler terms, irrespective of weather/climate uncertainty, the AFS strategy is expected to result in better poverty and undernourishment outcomes than the Non-AFS strategy in both the short and long term. Therefore, the authors conclude that accelerated expansion of AFS sectors, even without climate adaptation measures, remains an important part of Malawi's development strategy, despite increasing climate uncertainty. Mukashov, Thurlow, and Thomas (2023 forthcoming) consider two extreme strategic choices with one tilted very strongly to agriculture and the other tilted very strongly to nonagriculture. The optimal strategic choice likely lies somewhere in between, where investments are targeted toward value chains in agriculture and

6 On a year-by-year basis, the AFS strategy does not stochastically dominate the Non-AFS strategy as there is approximately a 10 percent chance that poverty outcomes will be less favorable under AFS than Non-AFS.

nonagriculture that yield an investment portfolio that trades off between rates of gain in important metrics (GDP growth, poverty, jobs, exports, etc.) and the variance of those metrics.

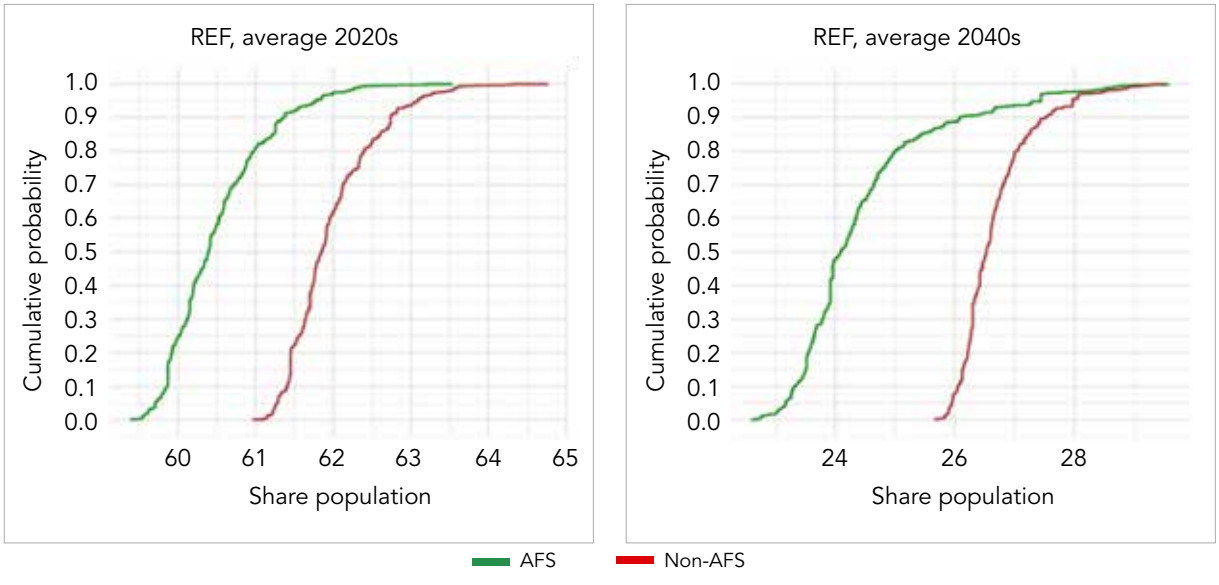
Figure 7: Impact of increasing yield uncertainty on Malawi's intensive development scenarios

a. **Poverty headcount rate (intl PPP US$1.90 per day): Dynamics over the years**



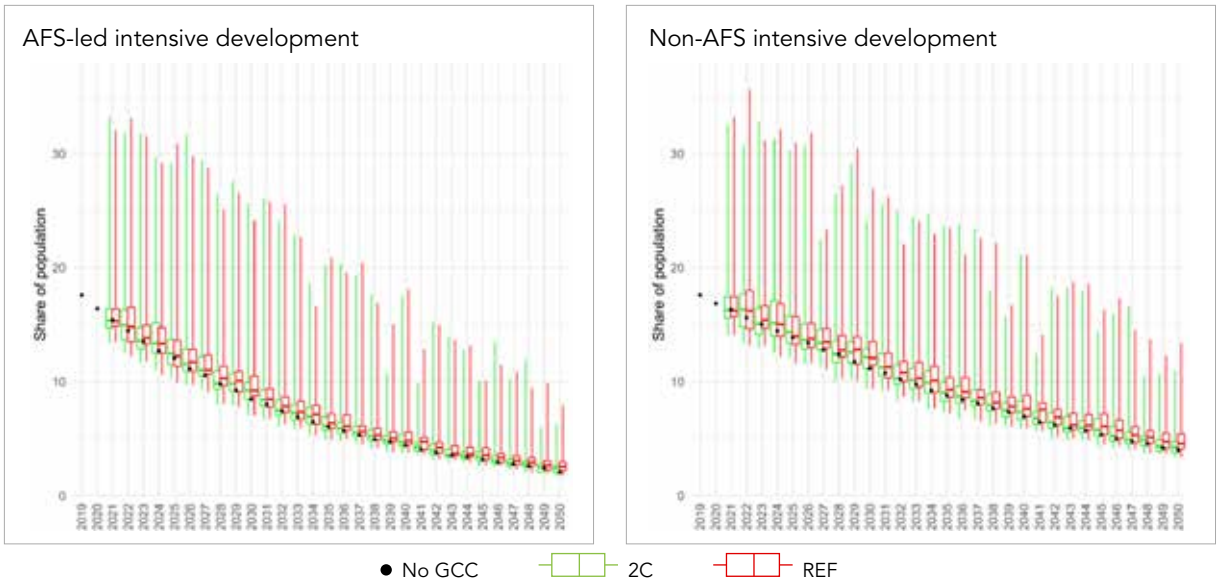
Source: Mukashov, Thurlow, and Thomas (2023 forthcoming).

b. **Poverty headcount rate (intl PPP US$1.90 per day): Density comparison (average 2020s vs. 2040s)**



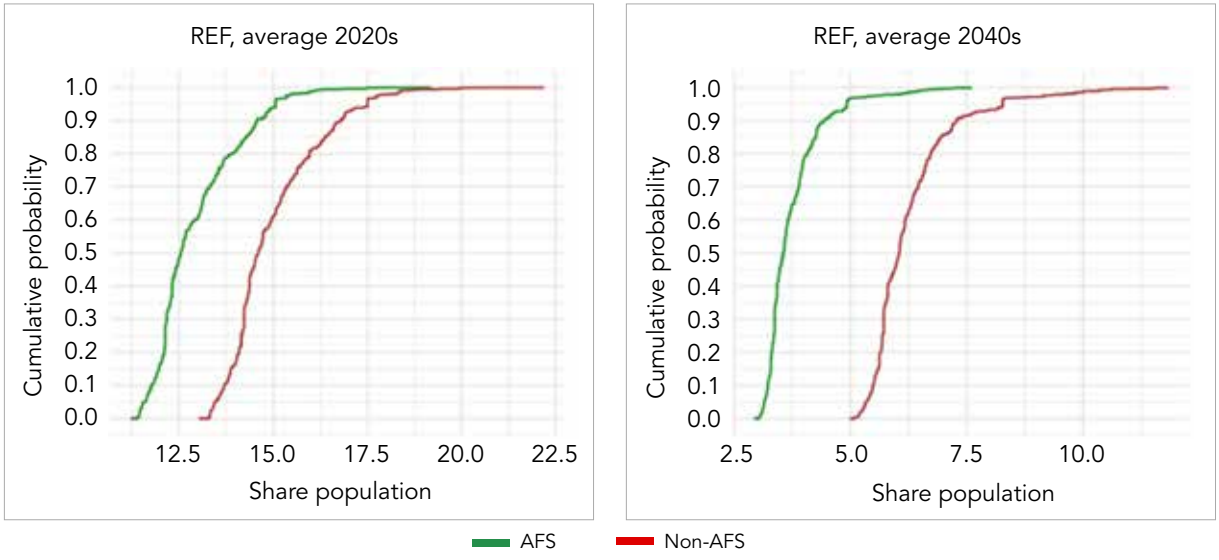
Source: Mukashov, Thurlow, and Thomas (2023 forthcoming).

c. Undernourishment headcount rate: Dynamics over the years



Source: Mukashov, Thurlow, and Thomas (2023 forthcoming).

d. Undernourishment headcount rate: Density comparison (average 2020s vs. 2040s)



Source: Mukashov, Thurlow, and Thomas (2023 forthcoming).

Agriculture

An ARIP in Malawi could facilitate research to assess the costs and benefits of pursuing various climate adaptation measures for the agriculture sector. Such analysis could help inform how most effectively to channel funding into improving the resilience of Malawi's economy, and could therefore help transform Malawi's planned adaptation measures into investment pathways that can mobilize funding at scale. While the analysis by Mukashov, Thurlow, and Thomas (2023 forthcoming) does not specifically focus on adaptation within the agriculture sector, the authors emphasize the significance of agriculture to Malawi's overall development. In the context of the multifaceted vision of Malawi's structural transformation (Malawi 2063), which equally emphasizes all sectors including agriculture, industrialization, and services, the findings by Mukashov, Thurlow, and Thomas (2023 forthcoming) underscore the potential benefits of continuing to invest in agriculture as a leading sector. Despite the growing climate-associated uncertainties, agriculture remains a powerful lever leading to lower poverty rates and decreased levels of undernourishment. Agriculture-focused development that offers more opportunities for off-farm complementary employment will be important to manage and improve welfare, particularly for households with more limited landholding sizes (Benson and De Weerdt 2023).

In light of these findings, new research could help comprehensively analyze and compare the range of adaptation options within agriculture. A number of micro-level studies have already begun to investigate specific aspects of various climate adaptation strategies within Malawi's agriculture sector. For example, Amadu, McNamara, and Miller (2020a) developed a typology of farm-level CSA practices in southern Malawi, and Amadu, McNamara, and Miller (2020b) analyzed the effects of CSA aid investment on maize yields. Sitko, Scognamillo, and Malevolti (2021) used household-level data and analyzed climate adaptive agricultural practices (CAPs) in the context of households' risk perception leveraged through receiving food aid.

Such studies, while offering valuable insights based on ex post micro-level empirical evidence on certain climate adaptation methods in agriculture, cannot fully represent policy trade-offs. A relevant example is the study by Warnatzsch and Reay (2020), who used a crop model to highlight how the uncertainty surrounding future precipitation in Malawi is associated with maladaptation risk for maize cultivars. The authors stressed the need for more reliable precipitation projections for decision making. However, given the inherent uncertainty of climate scenarios themselves, the emergence of "robust precipitation projections" is doubtful.

For example, investment in irrigation can help reduce the severity of droughts wherever irrigation is feasible. However, it carries a significant investment cost and the model of funding would need to be considered in the context of Malawi's debt position. Development of drought-resistant varieties could be an effective strategy against droughts. But in general, such seeds have lower yields than regular seeds and would therefore underperform current practices in periods without extreme weather events. Other complementary measures might include better use of insurance products and improved seasonal forecasting. While scope may exist for the insurance sector to play a larger role, such protection may need to be heavily subsidized given the majority of Malawi's farmers are small-scale with limited resources (and there would likely be issues with accessibility to such products).

The Malawi Priorities Project represents a good example of the government's willingness to use cost-benefit analysis to inform policy decisions. In the area of climate adaptation for the agriculture sector, a robust research-based approach could help inform the development of Malawi's NAP, by: (i) covering a broader set of climate adaptation and resilience measures; (ii) considering the implications of the inherent uncertainty regarding future climate projects for policy trade-offs, as well as the uncertainty underpinning the underlying assumptions; and (iii) capturing more comprehensively the

costs and benefits of adaptation measures (including knock-on effects to other economic sectors and society).

Research could help the GoM explore the benefits of adopting a more transformative approach to climate adaptation and resilience. This means not only to focus on adaptation measures that would help preserve current agricultural practices but to consider more strategically how the agriculture sector could be transformed to limit the adverse impact of expected climate changes. In this respect, some studies suggest a regional reshuffle of the crop mix altogether. For example, staple cassava crop yields are predicted to be adversely affected in the southern and central regions but may benefit from increased suitable areas and productivity in the north. Or production of beans and maize in areas expected to be negatively impacted by increased temperatures and lower rainfall could be substituted for more climate-resilient species, such as cowpeas, groundnuts, sorghum, and millet (IFAD 2020). Such policy decisions would require consideration of the expected climate variations regionally, as well as of the broader implications on trade, workforce, and logistical practices.

In this context, significant modelling would be needed to fully analyze and consider the policy trade-offs across the spectrum of climate adaptation options within agriculture. The objective of these modelling efforts could be to develop a framework that not only compares the expected policy returns of each adaptation option, but also quantifies the associated risks. This approach would provide policymakers with the necessary tools to select the most suitable options based on their preferred balance of policy risk and policy return. It is important to note that the development of such tools is essential not only for Malawi, but for all countries vulnerable to climate change. However, in Malawi, use of country-specific data might be necessary for accurate and effective decision making.

Road infrastructure

Malawi would benefit from proactively adapting its road infrastructure. Chinowsky et al. (2015) find that Malawi would see the most economic benefit, relative to other countries in the region, from taking adaptation measures for its transport sector. In particular, the estimated median cost of adaptation measures up to 2050 (US$132 million) is lower than the total cost of damage repairs for the same period (US$134 million).[7] Adaptation measures would bring about significant additional benefits, such as lower road maintenance costs, reduced disturbance to other economic sectors, and various social benefits. Dedicating funds toward ongoing road infrastructure maintenance would also help limit the adverse impact of climate events.

Developing a national climate adaptation investment plan

The GoM has carried out important foundational work to develop its response to climate change risks. An ARIP in Malawi could support the government in building on these efforts toward implementing an effective climate adaptation and resilience national strategy. To achieve that, an ARIP could be designed to:

Support the GoM in mobilizing funding at scale for climate adaptation. Despite the government's efforts to date in developing its climate change strategy, attracting financing for climate adaptation remains a key constraint, as highlighted above. An ARIP could be an implementation tool for some of the recommendations in Malawi's National Adaptation Plan Framework on mobilizing private sector finance for investment in climate risk management. It could also support the government in

7 These cost estimates represent total median-level impacts (discounted to 2010).

building on these ongoing efforts. This could include exploring how to make investment in climate adaptation in Malawi more attractive, including by engaging a broader set of domestic and international investors (such as by using an up-to-date ARIP to support negotiations on mobilization of capital at scale); providing technical advice to the government on options for attracting more private sector investment; and/or facilitating considerations and negotiations with prospective investors and donors on how funding could be accessed and deployed in a manner that is sustainable for the country (given current fiscal challenges, as well as the constraints in navigating the complexities of the existing climate finance architecture).

Support Malawi's ongoing efforts toward advancing its NAP process, including to produce an updated investment plan. This could help implement the recommendations in Malawi's National Adaptation Plan Framework, such as development of the tools and capacity for coordination and execution of the NAP process, establishment of a long-term implementation strategy, and development and implementation of the NAP. In particular, technical support to the GoM could help address the observed challenges in turning climate adaptation and resilience proposals into investment plans and linking them to a pipeline of projects. This could include facilitating robust cost-benefit analysis, as discussed above, to inform the government's prioritization of climate adaptation and resilience measures. Moreover, such analysis would help the development of sectoral investment pathways that: (i) support the mobilization of funding at scale (rather than on a project-by-project basis); and (ii) inform the private sector's own climate risk management strategy and investment opportunities. While climate adaptation and resilience measures should be considered across the whole economy, the findings of this report suggest prioritizing the agriculture and transport sectors.

Improve engagement and coordination on climate adaptation and resilience efforts—both domestically and internationally. Establishment of an ARIP in Malawi could provide an opportunity to explore how it could be structured in a manner that helps address the reported challenges regarding engagement across ministries, and with local authorities and other stakeholders (while complying with relevant legal frameworks and established processes, such as for consultation, decision making, etc.). It could also enable examination of: how climate considerations should be embedded into different policies, strategies, and procedures (across relevant ministries); how the impact of climate adaptation and resilience measures should be monitored, reported, and evaluated; and how financing mobilized through the platform would be most effectively disbursed. Moreover, such a platform approach could facilitate regional cooperation on adaptation strategy development, which would be important to prevent maladaptation and ensure an effective approach to the management of regional natural resources, such as the Zambezi River Basin. This in turn could help reassure prospective investors and support unlocking funding for adaptation and resilience projects in Malawi.

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ANNEX A:
MALAWI'S GOVERNANCE AND REGULATORY FRAMEWORK ON CLIMATE CHANGE ADAPTATION AND RESILIENCE

Key climate change-related plans and strategies

The National Agriculture Investment Plan (Malawi, Ministry of Agriculture, Irrigation and Water Development 2018) aims to transform the sector by 2030, in line with the Malawi 2063 Vision. The Investment Plan envisages measures across four programs, including:

- *Policies, institutions, and coordination:* Focuses on stakeholder coordination for implementation, monitoring, and evaluation; strengthening capacity for evidence-based planning and reviews; and improving the environment for agribusiness investment.
- *Resilient livelihoods and agricultural systems:* Promotes sustainable use of land, water, fisheries, and forestry; support for vulnerable communities and subsistence farmers; grain reserves and small stock management, etc. The plan also includes interventions for addressing legal and gender issues related to land tenure.
- *Production and productivity:* Promotes diversification toward high-value crops and livestock breeds in priority value chains; irrigation rehabilitation and development (increasing irrigation areas by 43,700 hectares); support for farming mechanization and training. The plan proposes the following priority subsectors: oilseeds, legumes, horticultural crops, livestock, roots and tubers, and rice. Traditional crops, such as maize and tobacco, and traditional exports, such as sugar cane, tea, and coffee, also remain of strategic importance.
- *Markets, value addition, trade and finance:* Includes investment in transport, storage infrastructure, efforts to boost intra-Africa trade, agrifood parks and special economic zones for agro-processing and exports, and provision of start-up capital and matching grant.

On **transport**, the key actions in Malawi 2063 (Malawi, National Planning Commission 2020) are to:

- Improve road infrastructure in rural areas, so that 50 percent of Malawians live within 2 km of an all-season road—up from 23 percent in 2016. The goal is to build new and upgraded sealed roads and rehabilitate the road along the shore of Lake Malawi.
- Increase the share of passenger transport for road, rail, and waterways from around 10 percent to around 30 percent by 2040.
- Complete the rail network by reconnecting the Sena line from Limbe, Malawi, to the Port of Beira, Mozambique. Key sections of this line were washed away during the floods of 1997 and 2015 and have yet to be repaired.

On **energy supply**, the MIP-I—the 10-year implementation program of the Malawi 2063 Vision (Malawi, National Planning Commission 2021)—highlights the need to diversify the country's energy supply by tapping into solar, coal, and thermal energy "in ways that avoid or minimize environmental degradation." However, the GoM plans to achieve 50 percent electricity access by 2030 (through a combination of on- and off-grid options), which would include development of more hydropower plants (in Mpatamanga, Kholombidzo, and Fufu).

On **environmental sustainability**, the MIP-I calls for: (i) ecosystem conservation and environmental management; (ii) waste management and a green economy; (iii) climate change management; (iv) environmental and climate finance; and (v) disaster preparedness.

The National Transport Master Plan (2017–2037) (Malawi, Ministry of Transport and Public Works 2020) includes a Strategic Climate Change Adaptation Plan to mainstream climate risks into transport planning, asset management, and operations. Priorities include: (i) adapting technical and design codes to increase infrastructure resilience and improve enforcement of those codes; (ii) undertaking a comprehensive assessment of existing bridge infrastructure to form the basis of a prioritized bridge replacement and maintenance plan, together with a vulnerability assessment of critical road links on the national roads network; and (iii) prioritizing and ensuring adequate financing for road maintenance.

The GoM began its National Adaptation Plan (NAP) process in 2014. It set out a roadmap (2016) and undertook a stocktaking to support development of its **National Adaptation Plan Framework** (2020). The framework, developed by the Ministry of Natural Resources, Energy and Mining (MNREM), sets out objectives, guidelines, and institutional arrangements for the NAP process. It recommends the following next steps:

- Develop tools and capacity for coordination and execution of the NAP process
- Integrate NAP adaptation priorities in ministry spending plans
- Mobilize private sector finance for investment in climate risk management
- Develop the NAP document
- Develop a long-term implementation strategy
- Compile and disseminate learning about the NAP process
- Monitor and review the NAP process
- Access Green Climate Fund (GCF) readiness support for revision of the first NAP
- Implement the NAP.

Malawi's **Nationally Determined Contribution (NDC)** (latest submission July 2021) outlines the government's action on climate adaptation and mitigation for 2015–2040. On adaptation, the document sets out 10 strategic adaptation options relating to three areas: (i) institutional framework; (ii) knowledge, technology, and financing; and (iii) resilience of the most vulnerable. This includes "elaboration and implementation of a resource mobilization plan." Preliminary estimate of costing of the actions in the NDC is around US$4.5 billion for adaptation measures through 2040. The total funding requirements for the adaptation contribution are estimated at around 53 percent conditional on international support and 47 percent unconditional.

The National Climate Change Management Policy (NCCMP 2016) is the main strategy guiding the GoM's actions on climate change adaptation, mitigation, research, technology development and transfer, and capacity building. It helps improve coordination and harmonization of the approach to climate change management.

The National Disaster Risk Management Policy (NDRMP 2015) (Malawi, The Secretary and Commissioner for Disaster Management Affairs 2015) does the same for DRM. Moreover, the government's National Disaster Risk Financing (DRF) Strategy and Implementation Plan, 2019–2024 (Malawi, Ministry of Finance, Economic Planning and Development 2020), aims to provide support for greater financial resilience for government, firms, and households.

The National Resilience Strategy (NRS) 2018–2030 (Malawi, Department of Disaster Management Affairs 2018) promotes more coherent, coordinated, and efficient approaches to food security, climate change, and disaster response. The strategy covers priorities such as building climate-resilient infrastructure, enhancing adaptive capacity, and improving access to climate information and early warning systems.

The Environmental Management Act (Malawi, Government of Malawi 2017) concerns the conservation and management of the environment in Malawi and prescribes environmental standards. It also supports the operations of the EAD, including climate change management.

Malawi's governance framework regarding climate change risks

The following institutions share responsibilities for climate action in Malawi:

The Environmental Affairs Department (EAD), the Department of Climate Change and Meteorological Services (DCCMS), and the Department of Disaster Management Affairs (DoDMA) are responsible for monitoring and disaster-related policies.

The National Technical Committee on Climate Change and Disaster Risk Management (NTCCC-DRM) provides technical guidance to the National Steering Committee on Climate Change (NSCCC), which is chaired by the Secretary to the Office of the President and Cabinet and includes ministries, departments, and agencies.

Other institutions that govern climate action in Malawi include: the Department of Economic Planning and Development, Department of Water Resources (DWR), Department of Agriculture Planning Services, Department of Fisheries, Department of National Parks and Wildlife (DNPW), Department of Forestry, Department of Policy and Planning, National Adaptation Plan Core Team, Expert Working Group on Adaptation, National Technical Committee on Climate Change (NTCCC), National Technical Committee on the Environment (NTCE), and Malawi Environmental Protection Authority (MEPA) (SLYCAN Trust 2021).

At the district level, activities are implemented through the District Executive Committee, which has subcommittees on the environment and civil protection.

At the community level, actions are executed through area and village development committees, which also have subcommittees on the environment and natural resources (World Bank Group 2022).

The National Climate Change Fund has a separate governance structure. It is housed by the Ministry responsible for Climate Change Management (MoECCM), but its management is through a semi-autonomous technocratic team, while the National Steering Committee on Climate Change has overall responsibility for oversight (Malawi, Government of Malawi 2021).

ANNEX B:
MALAWI'S CLIMATE FINANCE LANDSCAPE

Several dedicated funds have been established to support climate action and DRM at both the national and local level. Under the Forest Act, a Development Trust Fund was established to finance investments in forest landscape restoration across the country. The DPR Act has the DPR Fund to support activities toward disaster risk reduction, preparation, prevention, mitigation, and early warnings. As noted above, the GoM began consultations with stakeholders for the establishment of a National Climate Change Fund in 2019 (World Bank Group 2022).

Some of the dedicated climate change funds that Malawi has accessed to date include the Global Environment Facility (GEF), the Adaptation Fund (AF), and the Climate Investment Fund (CIF) (CIAT and World Bank 2018).

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