Ceres2030 Deep Dives into
the Nexus of Food Systems,
Climate Change, and Diets

Country Diagnostic Report:

MALAWI

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Abstract

The purpose of this report is to provide an overview of findings from the first round of activities for the four components of the project, namely the nutrition profile (Task 1), the data assessment (Task 2), relevant parts of the literature review (Task 3), and the findings of the first consultations (Task 4). Our research is based on diverse sources of information, including the relevant outcomes of the Ceres2030 project, public policy documents, peer-reviewed literature, and international databases. Using these sources of information, this report provides an overview of the current economic, social, and climate (mitigation and adaptation) trends in Malawi, as well as projections based on the Ceres2030 project model. We also include a brief review of relevant policy documents addressing undernourishment and agricultural development, along with an overview of the approach and early findings from country consultations. The report concludes with a brief summary of relevant national trends and planned next steps in the country-level research and analyses.

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1.0 Introduction

This report provides an overview of the findings from the first round of activities for the four components of the project, namely the nutrition profile (Task 1), the data assessment (Task 2), relevant parts of the literature review (Task 3), and the findings of the first consultations (Task 4). The findings reported here address research questions 1 and 3:

1. What are the expected trends in terms of diets for the three countries? and

3. What is the definition of a healthy diet for a country, considering cultural and economic specificities and the nutritional value of different food items?

This report also contributes to addressing research question 4:

4. What are the policy instruments and the food system[1] innovations required to achieve healthier diets?

This report is based on diverse sources of information, including the relevant outcomes of the Ceres2030 project, government policy documents, peer-reviewed literature, and international databases, such as those on official development assistance (ODA). When working with these sources, we outline relevant trends and key aspects of planned economic modelling without providing detailed background explanations or definitions, as we assume an informed audience.

This report provides an overview of current trends in undernourishment and basic economic indicators in Malawi and summarizes projections for these indicators using the Ceres2030 model. We also outline the current trends in nutrition profiles and challenges by population groups from related data sources and data processing efforts. The report also describes trends in greenhouse gas (GHG) emissions, climate change impacts, especially on agriculture and nutrition, as well as adaptation measures proposed in key policy documents. We include a brief review of relevant policy documents addressing undernourishment, resilience building, and agricultural development, along with an overview of the approach and early findings from country consultations. The report concludes with a brief summary of relevant national trends and planned next steps in the country-level research and analyses.

The key messages are as follows:

- **Poverty and hunger today.** The high prevalence of extreme poverty (69%) and undernourishment (19%) in Malawi is mostly due to a high proportion of poor farmers who have insufficient income or food reserves to protect them during the growing season or from crop failure.

- **Poverty and hunger by 2030.** In the next decade, the agricultural sector will continue to develop to respond to the increase in national food demand, in particular for animal products. The economic growth will assist in the reduction of chronic

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[1] A food system gathers "all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the output of these activities, including socio-economic and environmental outcomes" (High Level Panel of Experts on Food Security and Nutrition, 2014, p. 2).

undernourishment, but without additional measures, the poverty level will remain extremely high even by 2030, according to our projections (see Table 1).

- **GHG emissions and deforestation to 2030.** According to our projections, GHG emissions from agriculture, particularly livestock, will increase by 4.4% per year compared to the global average of 0.2% and 1.2% for the rest of Africa, South of the Sahara (Ceres2030 estimates). Land-use change from forestry to agriculture will continue to grow, leading to a reduction in forested area of about 10% over the next decade. Both trends underscore the need to take critical measures—particularly in terms of increased productivity and sustainable intensification of the livestock sector—to allow the country to achieve its economic and environmental objectives (see Table 1).

- **Vulnerability to climate change and extreme events.** Currently, climate change and variability combined with extreme events, such as droughts and floods, have considerably affected agricultural production, food security, and nutrition. The country's National Adaptation Programme of Action (2006), National Climate Change Management Policy (2016), and National Resilience Strategy (2018) have articulated the anticipated climate change impacts, as well as possible interventions to ensure a coordinated and harmonized approach to climate change mitigation and adaptation.

- **Poor diet diversity, especially for low-income households.** For both low- and high-income households, cereals, grains, and cereal products occupy the largest share of diets in terms of value, particularly due to the consumption of maize flour used to make *nsima*, a form of thick porridge that is a national staple in Malawi. Both low- and high-income households spend a similar share of value on roots, tubers, and plantains, and nuts and pulses. Vegetables take up a much larger share for poor households (18.7%) relative to wealthy households (10.6%), while meat and animal products take up a much larger share for higher-income households (23.7%) compared to those in the lowest quintile of income distribution (10.4%) (see Figure 6).

- **No definition of "healthy diets."** Currently, there is no definition of "healthy diet" in Malawi. However, a number of national strategies and plans focus on addressing undernourishment, food security, and nutrition challenges, and the UN Food Systems Summit (UN FSS) has tabled a draft report to advance a global definition. Since food-based dietary guidelines are not available for Malawi, we plan to examine how locally available foods can be combined to constitute a diet that meets micronutrient needs and explore its implications for sustainability under different policy scenarios. For example, because Malawi's diet is largely maize based, we would look at how other foods can fit into a largely maize-based diet rather than considering complete substitutions for maize. The diets developed will be on a regional basis (north, central, south) and will account for elasticities as estimated to modify current consumption patterns to be closer to adequate key nutrient levels for most people.

- **Role of ODA in the food system.** ODA plays an important role in Malawi, in particular for addressing problems in the food system. A small portion of these allocated resources is also directed at addressing climate change, especially promoting climate-resilient solutions to food system problems. On average, from 2014 to 2018, USD 360 million per year was disbursed to projects directly affecting the food system. This accounted for one quarter of total ODA grants and philanthropic donations (OECD, 2021) (see Table 5).

2.0 Assessing Domestic Progresses Toward Healthy and Sustainable Food Systems

2.1 Recent Evolution of Relevant Indicators, Including but not Limited to Sustainable Development Goal 2 Targets

Malawi is located in Southern Africa, with a 2020 population of 18.6 million. The country has a tropical climate with variable temperatures, but with a relatively high elevation ranging from 800 to 1200m, leading to cooler temperatures. Agriculture forms the basis of the Malawian economy, representing over 38% of GDP and employing over 85% of the labour force. However, agriculture remains highly inefficient in generating income: the value added per worker in agriculture is about one tenth of what prevails in the rest of Malawi's economy. Approximately 70% of agricultural production comes from smallholder farmers (Government of Malawi [GoM], 2021).

Extreme poverty (at the USD 1.90 per day international poverty line) remains high in Malawi compared to Africa, South of the Sahara (69% versus 42% in 2016) (World Bank, Development Research Group, 2021). The prevalence of undernourishment (PoU) is comparable to the level in the region. In 2018, the PoU was 19% in Malawi versus an average of 18% in Africa, South of the Sahara (Food and Agriculture Organization of the United Nations [FAO], 2021). At the same time, food insecurity remains high, especially in rural areas, with 52% of the population experiencing severe food insecurity in 2018, versus 21% on average in Africa, South of the Sahara for the same year (FAO, 2021). These numbers reflect the fact that many of the poor in Malawi are farmers, who, while producing sufficient calories at the annual level (as reflected by the PoU), face a high burden from crop failures and the hungry season covering the time between planting and harvesting (as reflected by the prevalence of severe food insecurity). Climate change is exacerbating these issues such that, despite being one of the poorest population groups, farmers are facing one of the greatest burdens in adapting to the impacts of climate change. Poverty and food security indicators for Malawi are shown in Figure 1. As undernourishment has remained roughly constant over the last decade and the population has grown, the volume of agricultural production has increased.

The Malawian diet is mainly composed of cereals—primarily maize, starchy roots (cassava and potatoes), and starchy fruit (plantain)—contributing to high rates of micronutrient deficiencies and representing a leading cause of undernutrition (Bezner et al., 2019). Current studies indicate that diets in the country have gaps in total calories consumed and quality, such as limited calories derived from nutrient-dense foods (such as meat, fish, eggs, dairy, legumes, fruits, and vegetables). In this context, the population is impacted by micronutrient deficiencies (Aberman et al., 2018; Kansanga et al., 2021). The low quality of the diet is consistent with low levels of income and a high prevalence of poverty: a very small fragment of the Malawian population appears to be able to afford nutritious or healthy diets (30% and 6%, respectively) (FAO et al., 2020).

Figure 1. Prevalence of extreme poverty and hunger in Malawi
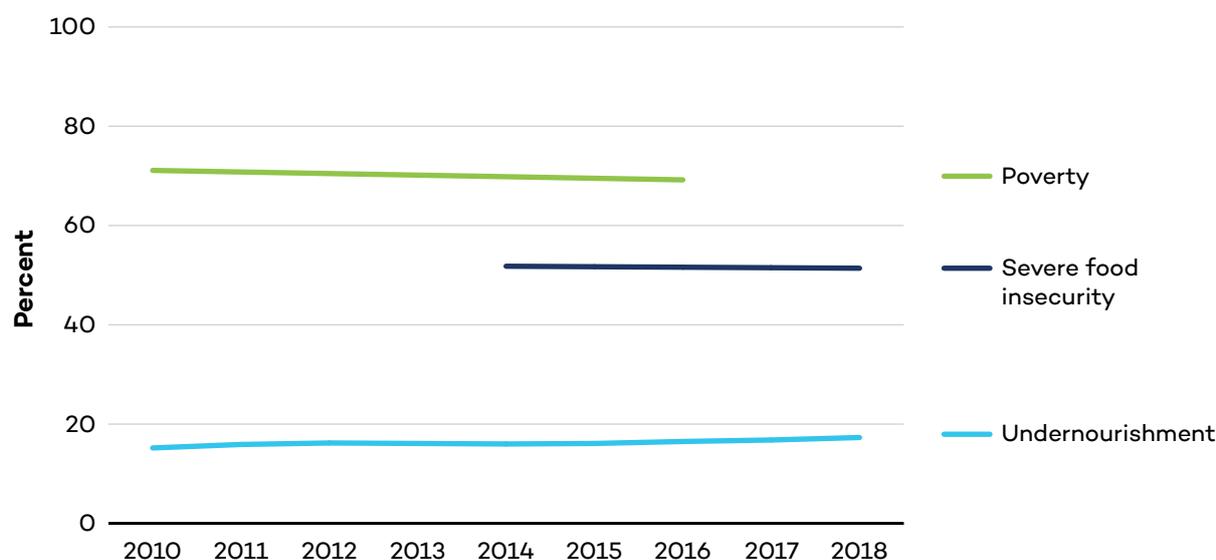
Sources: Extreme poverty is defined as poverty headcount ratio at USD 1.90 per day (2011 purchasing power parity (PPP)) (% of population), from PovcalNet via World Bank Open Data (World Bank, Development Research Group, 2021). Undernourishment is the PoU (percent) from (FAO, 2021).

In terms of specific population groups, 1% of children under 5 are affected by wasting and 39% are affected by stunting (Figure 2).[2] While wasting rates have remained variable over the last decade, stunting has decreased on average, from 49% in 2009 to 39% in 2018. Anemia affects one in three women of reproductive age, or 34.4%, which is slightly lower than the average for Africa, South of the Sahara (Global Nutrition Report, 2020). However, this still represents a considerable challenge, and little progress has been made in recent years (Global Nutrition Report, 2020). The prevalence of obesity is very low in the country (4% in 2008 to 6% in 2016) (FAO 2021). However, the Global Nutrition Report (2020) estimated that in 2015 31.5% and 14.8% of women and men, respectively, were overweight. This signifies that obesity may become an increasing concern in Malawi. In other countries, overnutrition has often risen with economic development, leading to a double burden of malnutrition and overnutrition (WHO, 2017). Malawi might avoid the double burden by adopting policies to promote healthy and sufficient diets. Specifically, gender-sensitive nutrition interventions may be required given the apparent gender dimension of overweight and obesity.

Malawi devotes over 70% of all arable land to maize production, and maize accounts for almost half of the Malawian diet (GoM, 2016). With approximately 95% of all cultivated land in the country under rain-fed agricultural production (GoM, 2016), the agricultural sector is extremely vulnerable to climate change and weather variability (see Section 3). At the same time, agriculture, especially increasing animal production, is a strong contributor to GHGs, and mitigation efforts need to be considered.

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[2] The figure for wasting appears low given the statistics on stunting and short-term food insecurity in Malawi. The authors are investigating this disparity as part of their ongoing work.

Figure 2. Nutrition in Malawi by selected population groups

children under 5 affected by
WASTING

1%

children under 5 affected by
STUNTING

39%

women age 15–49 affected by
ANEMIA

34%
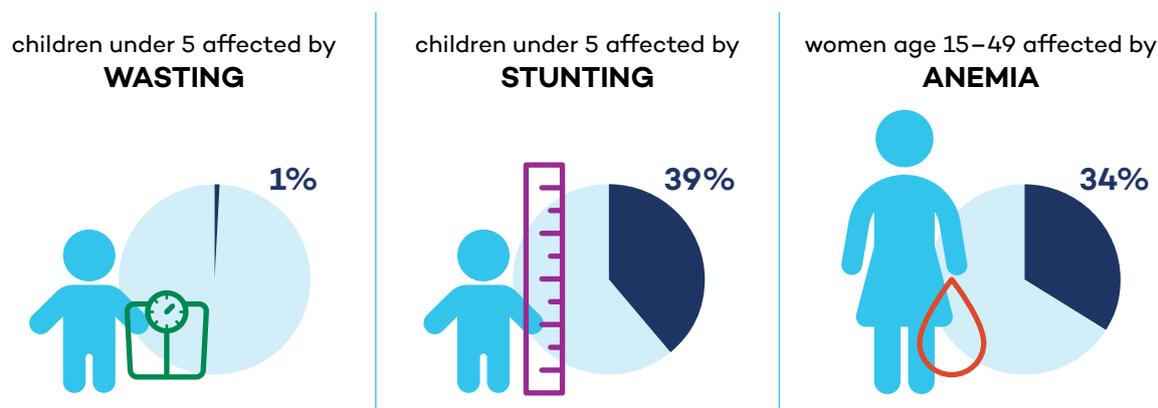
Source: Wasting is the percentage of children under 5 affected by wasting, 2018. Stunting is the percentage of children under 5 years of age who are stunted, 2018. Anemia is the prevalence of anemia among women of reproductive age (15–49 years), 2016. All indicators are sourced from (FAO, 2021).

Malawi's per capita emissions overall are low, as would be expected in a low-income and largely agricultural economy (1.1 tonnes CO_2 equivalent per person in Malawi on average from 2013 to 2017, compared to 3.5 tonnes for all least-developed countries and 7.5 tonnes globally) (FAO, 2021). Emissions from agriculture[3] and agriculture-related land use[4] per dollar of agricultural production are even lower by comparison, at 1.8 tonnes per thousand constant 2014–2016 international dollars (10.9 tonnes for least-developed countries, 3.0 tonnes at the global level) (FAO, 2021). However, emission intensities for livestock products tend to be on par or worse than world averages, and emissions for these products have already been identified as a key problem for global warming and a lever to mitigate global warming. Estimated emissions per kilogram of goat meat were 27 kg CO_2eq for Malawi in 2017, near the world average of 30 kg CO_2eq. Emissions for cow milk and cattle meat are very high: 3 kg CO_2eq/kg of milk for Malawi, three times the world average of 1 kg CO_2eq/kg of milk, and 34 kg CO_2eq/kg of meat for Malawi, 33% higher than the 26 kg CO_2eq/kg of meat at the

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[3] Agricultural emissions include emissions from crop and livestock production and associated activities: enteric fermentation, manure management (application on pasture, on soils), cultivation of organic soils, rice cultivation, synthetic fertilizers, crop residues, burning of crop residues, burning of savanna, and on-farm energy use. They do not include, and are measured separately from, agriculture-related land-use emissions. See the methodological note available at http://www.fao.org/faostat/en/#data/GT for detail. While on-farm energy use is included in the modelling, it is omitted from some items here due to data gaps.

[4] Agriculture-related land-use emissions include emissions from cropland, grassland, net forest conversion, and fires from the burning of organic soils and humid tropical forests. They do not include, and are measured separately from, agricultural emissions. See the methodological note available at http://www.fao.org/faostat/en/#data/GL for detail. While agricultural emissions can largely be conceptualized as flows (emissions that are released each year due to production activities, such that emissions and production occur in the same year), agriculture-related land-use emissions can be better conceptualized as stocks (emissions come from a one-time action such as deforestation or draining of histosols, with emissions occurring over one or many years but not linked to the year of production).

global level (FAO, 2021).[5] However, livestock production needs to increase in order to meet nutrition goals. Thus, improving the emission efficiency of livestock production as the livestock sector grows could play an important role in Malawi keeping its emissions within its targets.

From 2008 to 2018, GHG emissions from agriculture nearly doubled, driven in large part by increasing livestock production (Figure 3). The number of livestock units more than doubled in the last decade, increasing by 162% from 2008 to 2018. Other sources of emissions are those from fertilizer application, which fluctuate considerably more from year to year than emissions from other agricultural sources, reflecting variations in use. Finally, emissions from burning (i.e., of crop residues burned in the field and burning of savanna) and crop residues play a smaller role in total agricultural emissions than they did a decade ago (FAO, 2021).

Figure 3. Agricultural GHG emissions in Malawi
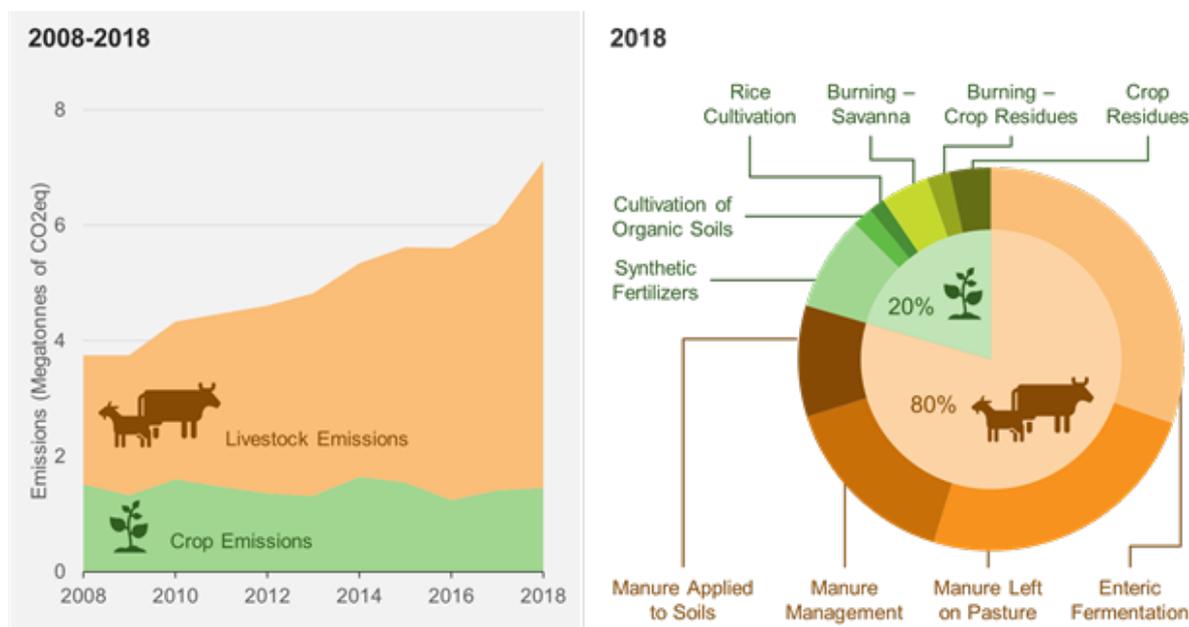
Source: Data from (FAO, 2021). Design of right panel adapted from (CIAT and World Bank, 2018).

Emissions from agriculture were relatively consistent from 2008 to 2018, averaging 8.6 megatonnes of CO_2eq per year. While this is still greater than agricultural emissions (7.1 megatonnes of CO_2eq per year in 2018, as shown in the left panel of Figure 3), agricultural emissions are likely to be overtaking agriculture-related land-use emissions. This means

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[5] There is a great deal of variation among countries with these emission intensity estimations. For example, while Malawi had an emissions intensity of 34 kg CO_2eq/kg for cattle meat in 2017, the average was 66 kg CO_2eq/kg for least-developed countries, 16 CO_2eq/kg for the European Union, and 12 CO_2eq/kg for the United States. So, while Malawi's emission intensity for livestock may be fairly low compared to countries in its same income bracket, livestock emissions are clearly very much a problem given that they are identified as such, even for economies with lower emissions intensities. Notably, emission intensity for livestock is notoriously difficult to estimate, especially in least-developed countries. Any comparison of Malawi to another least-developed country using these statistics must therefore consider challenges with the accuracy of the data.

that while emissions from one-time actions like deforestation and soil drainage to expand agricultural land continue today, whether the emissions are from current actions or are ongoing emissions from historical actions (e.g., soils drained for agriculture continue to generate emissions for many years), the year-to-year production activities are becoming the larger source of emissions (FAO, 2021).

Measures to reduce GHG emissions from the agricultural sector include sustainable intensification of the livestock sector, using different feed, ensuring veterinary support, as well as improving manure management, optimizing fertilizer use, encouraging the application of manure and crop residues, and reducing the use of fertilizers (GoM, 2015). Measures to address GHG emissions from forestry and land-use change include promoting forest conservation and afforestation (GoM, 2015).

2.2 Baseline Results Regarding a Business-as-Usual Situation Based on Modelling Results

Existing projections, based on the Ceres2030 model and without considering additional investments are summarized in Table 1. It shows that Malawi will face strong demographic pressure, with an annual population increase of 2.7% in the next decade, and a low per capita GDP that will remain among the lowest in the world despite relatively strong economic growth projected at 4.6% per year.

The agricultural sector will continue to develop as the demand for food increases, particularly for animal products. This will lead to a significant increase in production emissions, an increase of 4.4% per year, as shown in Table 1. Land-use change from forestry to agriculture will also continue to grow, leading to a reduction in forested area by about 10% in the next 10 years. Both trends show the need to take important measures, in particular, in terms of sustainable intensification to allow the country to achieve its environmental objectives. Finally, the economic growth and the expansion of agricultural production will contribute to a consistent trend toward the reduction of chronic hunger and extreme poverty. While eliminating chronic hunger appears to be within reach, the poverty level will remain extremely high even in 2030.

Table 1. Summary results regarding existing model projections for Malawi

Indicator	2020	2030	Annual growth rate
Population, millions	19.100	24.800	2.7%
Real GDP, million USD 2017	7,148.000	11,240.000	4.6%
Real GDP per capita (USD)	373.655	452.324	1.9%
Agricultural production emissions, megatonnes CO_2eq	7.000	10.809	4.4%
Agricultural land, million ha	5.495	5.714	0.4%
Forest, million ha	2.336	2.199	-0.6%
Prevalence of extreme poverty USD 1.90	69.000	54.200	-2.4%
Prevalence of extreme poverty USD 1.90 among farmers	73.000	59.100	-2.1%
PoU	19.000	6.200	-10.6%

Source: MIRAGRODEP Simulations, Ceres2030 baseline.

In Figure C1 (see Appendix C), we present the Ceres2030 projections in terms of food consumption for Malawi. They show a steady increase in terms of overall caloric consumption, with a slight improvement over time of animal-based proteins but also a significant rise in "free sugar" consumption. These estimates have to be approached with some degree of caution since the existing data used in the model (based on FAO, 2021) show some differences with the latest microeconomic data available, presented in this report.

2.3 Climate Change and Weather Variability Exposure and Adaptations

Climate variability and climate change are already affecting livelihoods as well as the country's economy and agricultural sector. Based on past measurements, the mean annual temperature has risen by 0.9°C (1960–2006), and the country also experienced considerable inter-annual variations in rainfall across the country with a decreasing trend in mean seasonal rainfall (GoM, 2021). Specifically, there are significant differences in weather and climate change variability between the northern and southern parts of the country (Box 1). There are also differences in areas around Lake Malawi, where more rainfall is received due to the lake's contributions (Libanda et al., 2017). While rainfall changes are inconclusive, a decrease in the overall number of rainfall events is expected. Finally, it is projected for the next decades that the mean temperature will increase (Box 1).

Box 1. Summary of historical and projected climate change impacts in Malawi

Historic Weather and Climate

- Annual increase in temperature by 0.9°C since 1960; for each decade, the rate of the average increase was 0.21°C (United States Agency for International Development [USAID], 2012, cited in Irish Aid, 2018).

- Participation trends are variable across the country and throughout the year, so establishing trends is challenging (USAID, 2012, cited in Irish Aid, 2018).

- An increase in floods and droughts was documented (USAID, 2012, cited in Irish Aid, 2018).

- The northern parts of the country experienced increasing precipitation during El Niño years, while in the south, extremely little precipitation was reported (Ngongondo et al., 2006).

- During La Niña years, the northern part of the country sees dry weather and the southern part extreme wetness (Ngongondo et al., 2006).

- Increases in temperature and reduction in rainfall remain the main drivers for the evolution of droughts (Mtilatila et al., 2019).

Projected Weather and Climate (USAID, 2012, cited in Irish Aid, 2018)

- An average increase of 1.1°C–3.0°C by the 2060s compared to the average rate during the period of 1970–1999: by 2090 the projected change is an increase of 1.5°C–5.0°C.

- Precipitation projections vary from a 13% reduction to a 32% increase by 2030 compared to the 1970–1999 average.

- It is projected there will be fewer rainfall events, and thus rain will fall in shorter, but more intense, periods.

- Number of floods and droughts is expected to grow.

There have been several extreme weather and related events. Approximately 40 weather-related disasters occurred from 1970 to 2008, with 16 of these occurring between 1990 and 2008 (GoM, 2016). Between 2015 and 2017, Malawi faced four successive climate-related shocks, including severe floods, erratic rains, prolonged dry periods, and one of the worst droughts in three decades. The drought led to a delayed start of the agricultural season and crop failure, resulting in a drop of 12.4% in agricultural production compared to the previous season, which was already down by 30% due to the flooding of 2015 (GoM, 2016). Similarly, Cyclone Idai in 2019 led to the flooding of nearly 85,000 hectares of cropland, affecting over 57,800 farmers (OCHA, 2019). According to the National Agriculture Policy, the crop production sector is underperforming as a result of factors such as low adoption of agricultural technologies, pests, and climate change impacts (GoM, 2016).

The most recent floods and drought have contributed to food and nutrition insecurity (GoM, 2018). Climate change will mostly affect the poorest and most socially excluded groups in society, whose capacity to deal with climatic shocks is severely hampered. According to the Malawi National Resilience Strategy (2018), the levels of risk and vulnerability for children under 5 and people living with HIV increased during the most recent drought (in 2016). The impact of these events on already malnourished population groups contributes to increasing annual humanitarian needs. For example, from 2015 to 2016 there were significant climate impacts on agriculture, and a total of 6.5 million people received humanitarian aid. The number was later revised upwards to 6.7 million (an estimated 40% of Malawi's total population) (Malawi Vulnerability Assessment Committee, as cited in GoM, 2018).

Malawi has taken steps to address climate change in the country. The National Adaptation Programme of Action (developed in 2006), the National Climate Change Management Policy (developed in 2016), and the NDC (applicable from 2015 to 2040) have articulated the climate change impacts and possible interventions to ensure a coordinated and harmonized approach to managing climate hazards. The NDC of the country does not include specific new findings on the challenges of climate change and nutrition but refers to the findings from the country's National Adaptation Programme of Action developed in 2006.

With a specific focus on climate change, nutrition, and food security linkages, Malawi has developed an enabling environment to guide the integration of climate change into food security and nutrition policy while at the same time fostering economic development. Examples include the National Resilience Strategy, which aims to promote food security by strengthening development interventions that build resilience to shocks and accelerating access to economic opportunities from agricultural growth (GoM, 2018). The link between climate change and nutrition has been made at a very abstract level in the national climate change documents. In order to quantify this link, Malawi conducted a vulnerability assessment of the health sector in four districts. Malnutrition showed strong seasonal variation with high numbers of malnutrition cases found to occur during hot and drier seasons (Bai et al., 2020). Seasonal price variation is strongest for nutrient-dense foods (fruit and vegetables) that are challenging to store (Bai et al., 2020). Rural households therefore face a constrained supply of these foods in other periods, as they are largely only available from domestic producers. In addition, the average incidence of malnutrition has increased since 2006, and the rates are expected to rise up to 2050 due to climate change (GoM, 2021).

The government has highlighted some adaptation measures to address the existing and projected high levels of malnutrition. These measures include diversifying crops, promoting winter cropping, and fostering technologies, especially related to irrigation (GoM, 2021). Other adaptation options to address nutrition challenges and promote access to food in communities include fish farming, the raising of small animals, and nutritional supplements for children and the sick. In addition, even though it is not explicitly labelled as a link between adaptation and mitigation, the National Agriculture Policy has highlighted the need to address both types of responses through climate-smart agriculture and improved water- and land-use practices, which include measures such as integrated soil fertility management and conservation and utilization of agrobiodiversity. Malawi is one of the few African countries that has developed a National Climate Change Investment Plan. Developed in 2013, the plan details the country's investment priorities in climate change

adaptation and identifies both local and foreign investors that can engage in climate change, either privately or through public–private partnerships. Among the key investment areas for Malawi are resilience building, improved and resilient agricultural production, infrastructure development, and disaster risk-management efforts (GoM, 2013). Lastly, the Government of Malawi is undertaking efforts to shape a new generation of inclusive social protection policies and implementing strategy with a focus on nutrition and shock sensitivity as a reaction to malnutrition and recurrent (food) crises.

2.4 Understanding the Dynamics of the Local Food System

2.4.1 Data Sources

The principal source of primary data used in the estimation will be the most recent round of household survey data from the World Bank's Living Standard Measurement Survey (LSMS) dataset for Malawi. Table 2 presents a summary of the key features of the dataset.

Table 2. Summary of LSMS data for Malawi

Country	Malawi
Years covered	2019–2020 (Wave 5)
Coverage	Nationally representative; Regionally representative
Regions	North/Central/South, split by urban/rural
Number of enumeration areas	717
Number of households interviewed	11,434
Key modules of interest	Food consumption (7-day recall); Household roster; Non-food expenditures; Agricultural production

Source: Authors' summary.

A key feature of the LSMS dataset for the purposes of demand system information is that it provides high-quality and nationally representative data on household food consumption decisions reported directly by respondents. A designated respondent is asked to recall their household's consumption of a uniform list of food items, adapted to be contextually appropriate to Malawi, and to report how much the household consumed, the source of the food item (whether it was purchased, produced by the household, or obtained from other sources such as gifts or non-monetary transfers), and how much was spent to acquire the item if it was purchased. This information allows us to estimate the value of all food items consumed by each household in the sample, which in turn forms the basis of the estimation of the demand system.

2.4.2 Stages of Data Processing

In order to use the information from the primary data in the LSMS data set as an input into the modelling exercise, we undertake several processing steps: conversion of quantities from local into metric units; imputation of prices and estimation of the value of food items produced or otherwise not commercially acquired by households; outlier detection; and econometric estimation of the demand system. Figure 4 summarizes these steps.

Figure 4. Data processing flow diagram
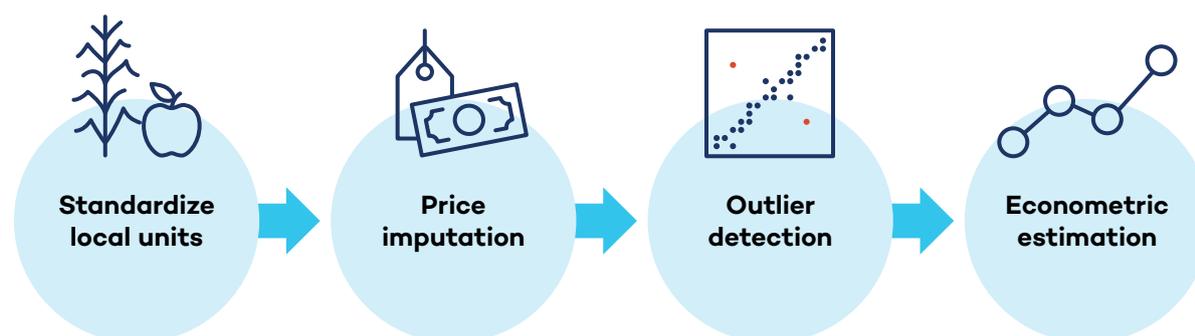
Source: Authors' summary.

A key challenge in estimating quantities of food items consumed by individuals is that people typically do not think about the foods they consume in terms of standard scientific units; for example, it is natural to report having a bowl of cereal for breakfast, rather than an amount in grams. Rather than asking respondents to provide conversions, which is likely to be challenging, particularly for individuals who have had limited access to formal education, they instead report in familiar units, which are often locally specific. The first stage of data processing is, therefore, to convert these quantities from non-standard units into metric units, using auxiliary data on conversion factors, which is collected as part of the LSMS data collection process.

After converting the quantities reported in the consumption module to metric units, we next estimate prices for those units. To do so, we first calculate the implied price reported by each individual for purchased items (which is simply dividing the total expenditure on a given item by the reported quantity purchased). For households who report purchasing an item, we can use this price to estimate the value of the amount of that item, on a per unit basis, that the household produced itself or it obtained from other sources. This procedure implicitly assumes that the per unit value of a food item that the household produced or obtained from other sources is equal to the value of the same quantity of that item purchased on the market; e.g., that there are no quality differences. By making this assumption, the overall value of the total amount of the item consumed by the households can be calculated. For households that consumed an item but did not purchase it, we calculate the median price of that item reported by other households within the same geographic area (at various administrative levels) and use this to impute the value of that item that the household produced or obtained from other sources.

The last stage of processing to prepare the data for use in the econometric model is outlier detection. This is an important consideration when using primary data since a reporting error by a small number of individual respondents (or indeed even one respondent) could bias our estimate of the quantity and/or value of a given food item for the whole sample. To deal with the issue of outlier values, we adopt a simple procedure to identify responses that have values to the extreme left- or right-hand side of both the quantity and price distributions of a given food item. We calculate the mean and standard deviation of the quantity of each food item and identify any responses for which the reported (or imputed) value is greater than the mean plus or minus three times the standard deviation. Under a normal distribution, we should, on average, observe 99.7% of responses within this range. Truncating the distribution in this manner thus entails a very small loss in terms of information if all values are accurate representations of actual consumption. This data-driven approach allows us to straightforwardly exclude erroneous extreme values without ourselves having to define numeric values for an appropriate range for food items.

1.4.3 Summary Statistics

To provide a summary of quality issues relating to these data processing steps, Table 3 provides a summary of the share of quantities, which we are able to convert into metric units, along with the rate of outlier detection for reported quantities and prices for all food items, and disaggregates these shares by food category.

Table 3. Overview of consumption data processing issues in Malawi

Food category	Conversion available	Quantity outliers	Price outliers
All	**93.9%**	**1.4%**	**1.5%**
Cereals, grains, and cereal products	98.9%	1.3%	0.9%
Roots, tubers, and plantains	97.3%	1.5%	1.3%
Nuts and pulses	90.3%	1.4%	2.3%
Vegetables	98.0%	1.6%	1.7%
Meat, fish, and animal products	98.4%	1.3%	1.5%
Fruits	95.4%	1.3%	1.4%
Milk and milk products	89.1%	1.6%	1.9%
Sugar, fats, and oils	84.4%	1.7%	1.4%
Cooked foods from vendors	92.5%	2.0%	2.5%
Beverages	88.3%	0.5%	0.9%

Source: Authors' calculations.

For 93.9% of reported consumption items, we are able to convert the respondent's information to a metric quantity, though there is some variation in response shares, with the highest for cereals and grains (98.9% of reports) and the lowest for sugar, fats, and oils (84.4%). In terms of both reported quantities and prices, we find a small share of outlier values: 1.4% of estimated quantities and 1.5% of prices fall outside of three standard deviations from the sample mean (relative to an expected share of approximately 0.3% assuming a normal distribution with no errors). The outlier rate is lowest in both categories for beverages (0.5% and 0.9% of responses respectively) and highest for external foods prepared by vendors (2.0% and 2.5%), potentially reflecting greater difficulty in estimating the mass (or volume) consumed in the latter category.

Figure 5. Share of households reporting food category, by source (Malawi)
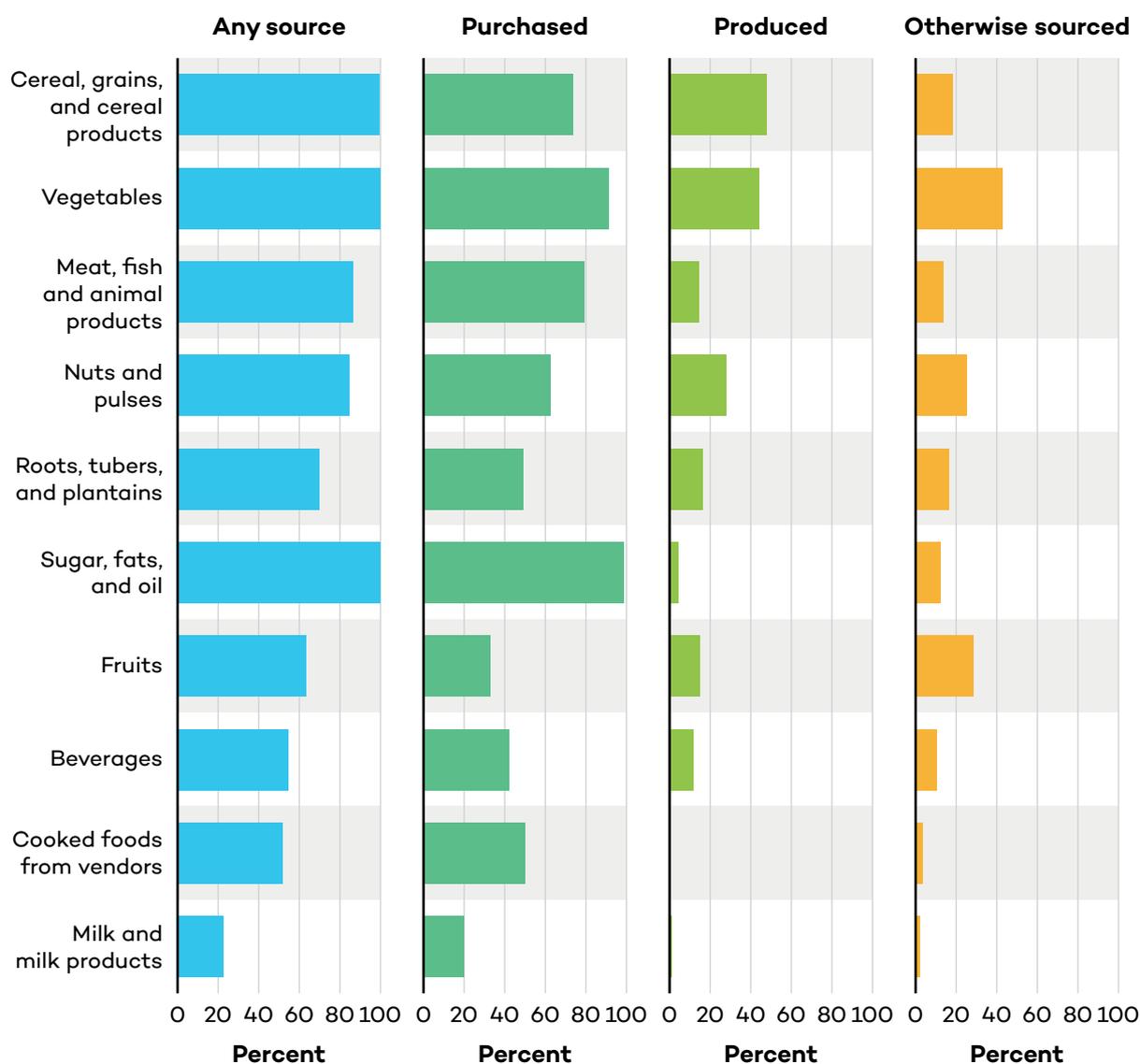
Source: LSMS-IHS Malawi, Wave 5.

Among these categories, cereals and grains, vegetables, and sugar, fats, and oils are almost universally reported, while some other categories, notably fruits, milk products, and foods prepared by outside vendors, are reported by a smaller share of the sample. Figure 6 presents an overview of the share of total estimated value of each food group, for the fraction of the sample with lowest and highest income (proxied by household expenditures on non-food items).

Figure 6. Share of value by food category, by non-food expenditure level (Malawi)
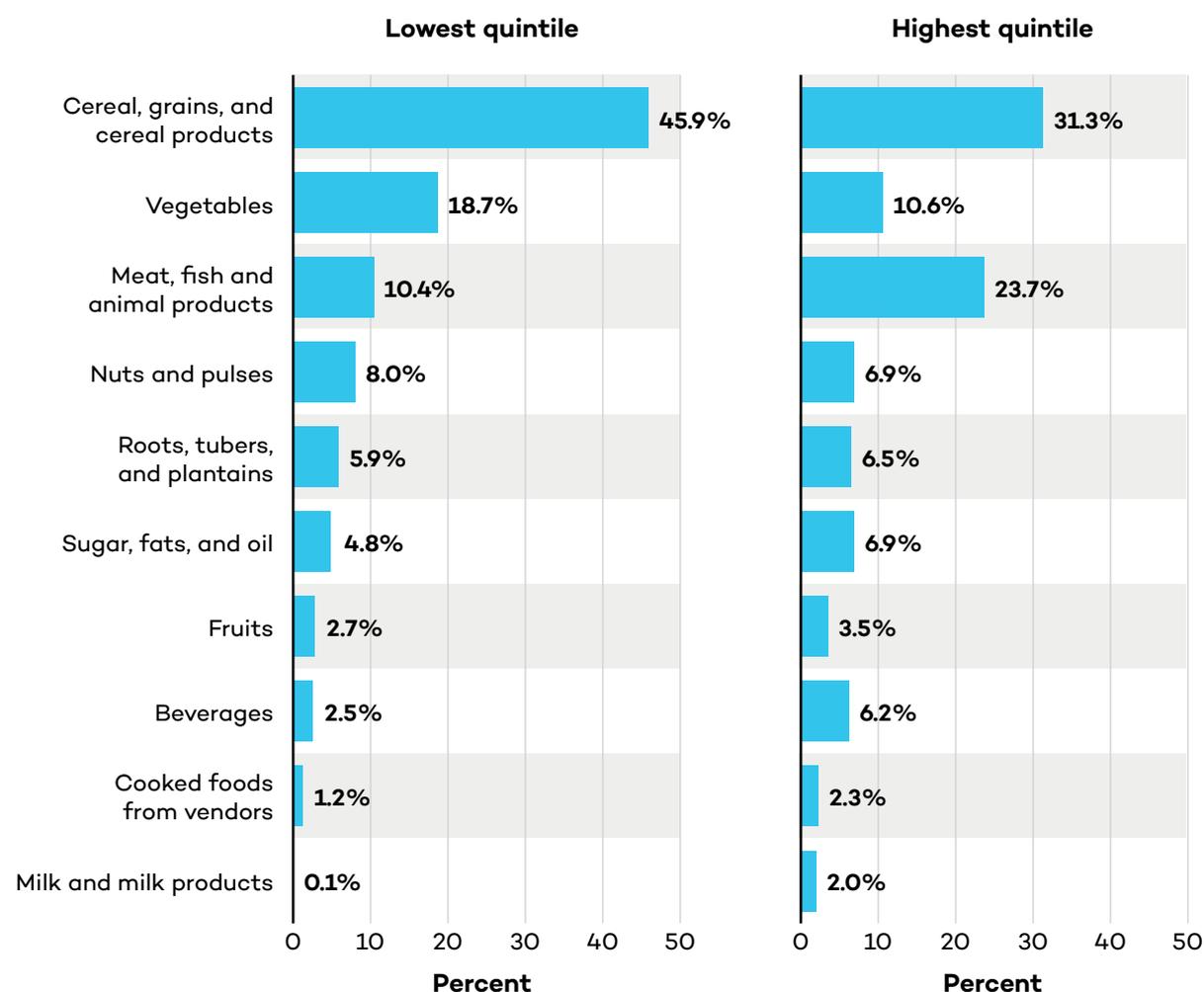
Source: LSMS-IHS Malawi, Wave 5.

As Figure 6 shows, for both low- and high-income households, cereals, grains, and cereal products occupy the largest share of diets in terms of value, particularly due to consumption of maize flour used to make *nsima*. Both sets of households spend a similar share of value on roots, tubers, and plantains, and nuts and pulses. Vegetables take up a much larger share for poor households (18.7%) relative to wealthy households (10.6%), while meat and animal products take up a much larger share for high-income households (23.7%) compared to those in the lowest quintile of the income distribution (10.4%).

3.0 Existing Action Framework for Healthier and Sustainable Food Systems

3.1 Existing Nutrition Guidelines for Healthier Diets

Over the past 25 years, the themes of hunger and malnutrition have been integrated into the country's development strategies. In the early years of this century, Malawi developed a number of policies and strategies, such as the Infant and Young Child Nutrition Policy and Guidelines (2003), Nutrition Policy, Strategy or Plan Focusing on Specific Nutrition Areas (2003), Comprehensive National Nutrition Policy (2005), and the revised Infant and Young Child Nutrition Policy and Guidelines (2007). However, most of these policies lacked detailed implementation strategies and so had limited impact (World Health Organization, 2021).

In 2007, the first National Nutrition Policy and Strategic Plan was developed. The policy was closely linked to the Millennium Development Goals. To follow up, the country developed The National Multi-Sector Nutrition Policy (GoM, 2018), which serves to guide nutrition programming and realign nutrition priorities with the national development agenda. There is also a recent strategy promoting a community-based approach to addressing malnutrition (Ministry of Health, 2016). These recent strategies promote a number of measures, including promoting access to healthy foods and addressing nutrition challenges of specific groups, such as women and children. In addition to the direct emphasis on undernourishment, some of these strategies also promote agricultural interventions focused on the production of diversified foods, dietary diversification, and promoting animal production. But even these recent policies do not make links to climate change impacts or adaptation.

> **Box 2. The Challenge of Defining "Healthy Diets" in Malawi**
>
> Early consultations (See Appendix A) generated responses from interviewees pointing to the absence of any specific definition of "healthy diets" in Malawi. Respondents from specific projects considered that a healthy diet should, for example "have a minimum of four of the six Malawi Food Groups (vegetable, fruits, animal-sourced foods, fats and oils, pulses and legumes, and energy giving foods)." Further consultations may be able to provide additional information and create an opportunity to build consensus on a definition of "healthy diets" and what they should entail.

Malawi does not have a set of national food-based dietary guidelines. Currently, there are "working definitions" of healthy diets as identified during consultations conducted for this project (Box 2). Malawi addresses one type of micronutrient deficiency (iodine) through mandatory salt iodization. The national government has made broad commitments to improving nutrition, particularly from the perspective of undernutrition. In all of Malawi's districts, acute malnutrition is addressed through community health services, which have substantially reduced severe acute malnutrition. These efforts are clearly borne out in statistics related to vitamin A deficiency; according to the Demographic Health Survey

(DHS), vitamin A deficiency among children under 5 had dropped from 59% in 2001 to 4% in 2016 (GoM, 2017; Williams et al., 2021). Finally, because there is a very low incidence of overweight and obesity, Malawi makes reference to these issues in their strategies, but lacks implementation policies.

Table 4. Summary of measures in the two most relevant recent strategies and research articles on undernourishment

Policy	Key focus
Food Security Policy and Food Security Action Plan (2008)	Specific measures focused on agriculture: • Increase food availability (quantity and quality) that is accessible to households by promoting contract farming • Promote irrigation by supporting private sector investment and local community participation • Ensure stability of fertilizer supply (e.g., maintain buffer stocks) • Promote the development of improved varieties based on domestic production and set up seed banks • Promote animal power and farm mechanization • Promote the uptake of financial instruments, including access to credit and micro-credit for women and men and setting up cooperatives and farmers' groups • Promote environmental and land management and the use of sustainable practices
National Multi-Sector Nutrition Policy (2018–2022)	The policy has identified eight priority areas which include (p. 13; selected) the following: • Prevention of undernutrition • Gender equality, equity, protection, participation, and empowerment for improved nutrition • Treatment and control of acute malnutrition • Prevention and management of overweight and nutrition-related non-communicable diseases (NCDs) • Nutrition education, social mobilization, and positive behavioural change • Creating an enabling environment for nutrition • Nutrition monitoring, evaluation, research, and surveillance. The policy also contains an implementation plan, and a monitoring and evaluation framework.

Policy	Key focus
Research articles	Addressing the supply constraints (low productivity, seasonality) and demand constraints (low income, preference for maize) will require sequenced interventions within and across value chains, including stronger collaborations between non-governmental organizations, government, and the private sector (Donovan & Gelli, 2019).
	• Households' proximity to markets contributes to their dietary diversity, which is lowest during the planting season, and thus seasonal fluctuations would need to be addressed as well (Luckett et al., 2015). In addition, the higher the engagement of farmers in selling their produce, the higher their dietary diversity (Koppmair et al., 2016).
	• Other assets of farmers that build resilience as well as contributing to dietary diversity include access to storage, production technology, and education (Snapp & Fisher, 2015).
	• Addressing nutrient deficits in the foods together with lack of sufficient calories. Increasing the consumption of fruits and vegetables is particularly important, so promoting the production, storage, and market access of these food items is also important (Gelli et al., 2020).
	• The study showed that farming approaches like agroecology, which emphasizes the cultivation of diverse crops, may be promising for improving household nutrition. In this paper, the agroecology approaches include participatory and knowledge sharing to improve planting skills with a focus on local crops such as pigeon peas and groundnuts, as well as open pollination of yellow maize, sweet potato, and cassava (Kansanga et al., 2021).
	• Policies and interventions that improve access to basic services, encourage asset accumulation, and build adaptive capacities need to be promoted. Investments in road and telecommunication infrastructure, water and sanitation, productive assets, human capital, and crop and livestock diversification are crucial for resilience and improved nutrition in Malawi (Murendo et al., 2020).
	• In 2019, the country's government, with support from USAID and Tufts University, developed a food composition database that describes the nutritive value of locally produced and imported foods that are available in Malawi. Country-specific food composition databases and tables are essential tools for assessing and planning dietary nutrient intake for individuals and populations (MAFOODS, 2019).

As part of the UN FSS, the scientific group has tabled a draft paper to move toward a global definition of a "healthy diet" (Neufeld et al., 2020). This paper will help provide additional elements that can be discussed at the country level.

3.2 Ongoing Policies and Investments Toward Healthier and Sustainable Food Systems

Sustainable food systems are not the central objective of the country's policy documents targeting agriculture: the closest to this focus is the National Resilience Strategy (2018–2030). This strategy provides a vision for the country's future with emphasis on rural areas by providing a framework to guide all sectors in working together to address chronic food insecurity and pathways to reduce poverty (GoM, 2018).

In terms of specific actions, the National Resilience Strategy identifies priorities at the macroeconomic level as well as specific efforts to promote sustainable growth in the agricultural sector. At the macroeconomic level, the focus should be on addressing price fluctuations, promoting the engagement of the private sector in agriculture, and supporting the development of agricultural markets (GoM, 2018). In terms of support for rural areas and the agricultural sector, the strategy proposes expanding financial markets by providing access to financial instruments, risk-management practices, and farm and non-farm diversification. It also recognizes that private sector investments are needed in value chain development, marketing, rural transport, and building rural–urban linkages. Out-migration of surplus labour from agricultural and rural areas will also be necessary to other sectors such as mining, construction, and services.

The country's strategy to promote resilience and sustainability also recognizes the important role of ODA.[6] In total, USD 360 million (constant 2018 USD) was disbursed annually from 2014 to 2018 to projects directly affecting the food system in Malawi, accounting for one quarter of ODA grants and philanthropic donations (OECD, 2021). The United States accounted for USD 100 million of this disbursement, making it by far the top donor to projects in the food system in Malawi. The next nine donors account for a further USD 139 million constant 2018 USD (Table 5). In this context, the country's resilience strategy (GoM, 2018) stresses the importance of foreign assistance through, for example, agreements such as the Grand Bargain reached at the World Humanitarian Summit, the New Alliance for Food and Nutrition Security, the Scaling Up Nutrition movement, the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change, and the United Convention to Combat Desertification. The strategy also recognizes the responsibility of the country to implement effective measures to address climate change impacts and hazards.

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[6] Figures in this paragraph and Table 5 are preliminary estimates, to be refined as the project progresses.

Table 5. Top 10 donors by average annual disbursement, 2014–2018

Donor	USD million (constant 2018 USD)
United States	100
United Kingdom	40
EU Institutions	32
Norway	23
Ireland	12
Germany	7
African Development Fund	7
Belgium	6
International Development Association	6
Bill & Melinda Gates Foundation	6

Note: This table shows a total of USD 239 million out of the USD 360 million constant 2018 USD disbursed to food system projects in Malawi.
Source: Authors' analysis of OECD's Creditor Reporting System (OECD, 2021).

Finally, an extensive list of programs and initiatives funded or implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the European Union, and USAID that are relevant to the nexus on climate change, food security, and nutrition is presented in Appendix B. This list demonstrates that there are projects that link agriculture and food systems with climate change resilience and adaptation, as well as projects that link agriculture and food systems to nutrition diversification, but very few that link all three components of the nexus in one project. Additional projects were identified during the ongoing consultations with key stakeholders in the country.

4.0 Next Steps

4.1 Summary of Key Messages

This report provides an overview of recent data on undernourishment, current and projected economic development, climate change, and ODA in Malawi. It also includes current strategies and policies addressing climate change, agriculture, and undernourishment. In addition, it summarizes the team's efforts to include nutrition in the economic modelling developed in the Ceres2030 project. These indicators and policy documents reveal specific findings relevant to the next steps of this project.

The key messages are as follows:

- **Poverty and hunger today.** The high prevalence of extreme poverty (69%) and undernourishment (19%) in Malawi is mostly due to a high proportion of poor farmers who have insufficient income or food reserves to protect them during the growing season, or from crop failure.

- **Poverty and hunger by 2030.** In the next decade, the agricultural sector will continue to develop to respond to the increase in national food demand, in particular for animal products. The economic growth will assist in the reduction of chronic undernourishment, but without additional measures, the poverty level will remain extremely high even by 2030, according to our projections (see Table 1).

- **GHG emissions and deforestation till 2030.** According to our projections, GHG emissions from agriculture, particularly livestock, will increase by 4.4% per year compared to the 0.2% on average for the world, and 1.2% for the rest of Africa, South of the Sahara (Ceres2030 estimates). Land-use change from forestry to agriculture will continue to grow, leading to a reduction in forested area by about 10% over the next decade. Both trends show the need to take important measures, particularly in terms of increased productivity and sustainable intensification of the livestock sector, to allow the country to achieve its economic and environmental objectives (see Table 1).

- **Vulnerability to climate change and extreme events.** Currently, climate change and variability and extreme events including droughts and floods have considerably affected agricultural production, food security, and nutrition. The country's National Adaptation Programme of Action (2006), National Climate Change Management Policy (2016), and National Resilience Strategy (2018) have articulated the climate change impacts anticipated, as well as possible interventions to ensure a coordinated and harmonized approach to climate change mitigation and adaptation.

- **Poor diet diversity, especially for low-income households.** For both low- and high-income households, cereals, grains and cereal products occupy the largest share of diets in terms of value, particularly due to the consumption of maize flour used to make *nsima*. Both low- and high-income households spend a similar share of value on roots, tubers, and plantains, and nuts and pulses. Vegetables take up a much larger share for poor households (18.7%) relative to wealthy households (10.6%), while meat and animal products take up a much larger share for these latter households (23.7%)

compared to those in the lowest quintile of the income distribution (10.4%) (see Figure 6).

- **No definition of "healthy diets."** Currently, there is no definition of "healthy diets" in Malawi. However, a number of national strategies and plans focus on addressing undernourishment, food security, and nutrition challenges, and the UN FSS has tabled a draft report to advance a global definition. Since food-based dietary guidelines are not available for Malawi, we plan to examine how locally available foods can be combined to constitute a diet that meets micronutrient needs and explore its implications for sustainability under different policy scenarios. For example, as Malawi's diet is largely maize based, we would look at how other foods can fit into a largely maize-based diet rather than considering complete substitutions for maize. The diets developed will be on a regional basis (north, central, south) and will account for elasticities as estimated to modify current consumption patterns to be closer to adequate key nutrient levels for most people.

- **Role of ODA in the food system.** ODA plays an important role in Malawi, in particular for addressing problems in the food system. A small portion from these resources is allocated to addressing climate change, especially promoting climate-resilient solutions to food system problems. USD 360 million per year was disbursed to projects directly affecting the food system (average, 2014–2018). This accounted for one quarter of total ODA grants and philanthropic donations (OECD, 2021) (see Table 5).

4.2 Implications for Next Steps and Potential Revision of the Proposed Methodologies

Setting up and Conducting Country Consultations

We have established a partnership with the Department of Nutrition, HIV, and AIDs, which is responsible for overseeing and coordinating the national nutrition response in Malawi. This department is located within the Ministry of Health, and partnering with them will enable us to ensure that the appropriate stakeholders are targeted and included in the consultations. Notably, there is a desire within the Department of Nutrition, HIV, and AIDS to build a platform that more closely links agriculture and nutrition, and therefore this project—in providing an opportunity to establish these linkages—is very timely. While the Ministry for Agriculture (national Convenor for the UN FSS) has created a task force for the summit, the details regarding its role or capacity are not clear, as it has yet to meet. As Malawi is still in the initial stages of the convening around the UN FSS, it will be challenging to plan for—and directly integrate into—UN FSS processes. However, because the Department of Nutrition, HIV, and AIDs has a presence and role on this taskforce, partnering with them for the second and third rounds of consultations should enable us to link our work as closely as possible to conversations regarding the UN FSS.

We have also established a connection with the Scaling Up Nutrition movement in Malawi, which will help us ensure that the relevant stakeholders within donor circles are included in the next round of consultations. Similarly, contact with the Civil Society Organisation

Nutrition Alliance has been established to ensure the participation of the relevant civil society organizations in the next consultations, as well as with Akademiya2063 to co-organize the national consultations.

Estimating the Characteristics of Healthy Diets

Since food-based dietary guidelines are not available for Malawi, we plan to instead examine how locally available foods can be combined to constitute a diet that meets micronutrient needs. For example, as Malawi's diet is largely maize based, we would look at how other foods can fit into a largely maize-based diet rather than considering complete substitutions for maize. Maize consumption would decrease to fit in more nutrient-rich foods. The diets we will develop will be on a regional basis (north, central, south) and will account for elasticities as estimated to modify current consumption patterns to be more adequate in providing key nutrient levels for most people.

Adapting the Economic Modelling

Initial Data Sets

The review of existing data on the value of agricultural production in Malawi shows a number of discrepancies between different sources. We plan to readjust our valuation of domestic production in a way consistent with the information included in the household surveys (production and consumption data).

Elements of Baseline

The current baseline appears to be highly consistent with recent trends: while the growth of agricultural production will continue, it will not allow Malawi to achieve Sustainable Development Goal 2 targets without strong additional public investments to address poverty, promote dietary diversification, and mitigate environmental pressures (e.g., deforestation) from agricultural production.

Model Structure

The household-level analysis regarding food expenditures has also helped us to re-examine the need to change the product and commodity aggregation in the MIRAGRODEP modelling framework. In particular, the current structure includes a "fruits, vegetables, and nuts" group. While this group presents some similarities (high-value products, nutrient-dense elements), it is sometimes criticized since starchy vegetables, in particular roots and tubers, are also included in this group. While we were exploring the possibility of providing more disaggregation, the small expenditure share of this subcategory (about 6% stable across income groups) does not help focus our efforts to fine-tune the model disaggregation in this direction.

Modelling Policy and Interventions

A set of potential interventions will be developed based on measures prioritized in national policy documents to address undernourishment as well as those measures that could be

integrated into the economic model. Based on the preliminary findings, such interventions could include promoting crop diversification to address undernutrition while building resilience to climate change. Other measures could include improved safety nets, income support, promoting access to markets, and improving agricultural productivity. Finally, there are growing concerns about the high contribution of agriculture to environmental degradation. Thus, environmental impacts of production, such as GHG emissions and water use, and related mitigation efforts will be considered.

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Appendix A. Country-Level Consultations

Approach and Method

To help determine to what extent the three dimensions of climate, nutrition, and agriculture are integrated into ongoing projects in Malawi, we undertook a consultation and a desk review. The latter helped gather information on appropriate projects from the donors' websites. This round of consultation had two components: the first was an online survey that focused on gathering from specific donors the profile of their projects, trying to get specifications on their objectives and targeted groups (see below for the survey questionnaire). For the second, the team conducted a series of semi-structured interviews with the same objectives plus covered a direct validation of the methodology as we confirmed respondents to participate in rounds 2 and 3 of the project. Consultations were held with members of the Malawi Department of Nutrition, HIV, and AIDs, Scaling Up Nutrition in Malawi, GIZ Malawi, and the EU Delegation to Malawi.

The Survey Questionnaire

Ceres2030 Deep Dives Into the Nexus of Food Systems, Climate Change, and Nutrition

Country-Level Consultations, Round 1

Introduction

"How can we influence consumption patterns through policy interventions that will lead to better environmental and nutritional outcomes?" This is the central question that Ceres2030 is exploring through a study on the nexus of climate change, food systems, and nutrition. The project will identify food system transition pathways and their associated costs toward improving nutrition outcomes through healthy diets using a more climate-resilient production system with fewer greenhouse gas emissions in three countries: Ethiopia, Nigeria, and Malawi.

We would like to invite your participation in a first round of consultations aimed at establishing an accurate inventory of ongoing projects and policies in these three countries. The consultation aims to assess how the nexus between food security, environmental sustainability, and healthy diets is conceived and integrated into the national strategy and donor agencies' strategies and programs.

Your response will provide key elements to the research teams on how to connect the research conducted in the two other components, that is, the large-scale modelling exercise based on the Ceres2030 framework and the research into food demand behaviour at the household level, with respective countries' policies and institutional environments.

Online Survey

Section 1 – Profile

1. Contact

   Name
   Role
   Department
   Email address

2. Are you a

   Government official (Go to 2B and 3B)
   Donor Agency (Go to 2A and 3A)

Section 2A – Project and Policies Profiles (Donors)

3. Does your department have a project/program/strategy linking food systems, food security, climate change, and nutrition?

   Yes
   No

4. If you answered yes above, please provide information here to relevant material related to your projects and their status.

   Name of the project/strategy/program
   Links if available:
   Any other information or comments

5. If you answered no, could you please provide a little more information on your current or future plans?

6. Does your project/program/strategy use a definition of "healthy diet"?

   Yes
   No
   Please specify and briefly explain.

7. Does your project/program/strategy have a clear set of objectives related to supporting the nexus between food systems, food security, climate change, and nutrition?

   Yes
   No
   Please specify and briefly explain.

8. Who are the target recipients of your project/program/strategy?

   Children below three years of age
   School-aged children
   Pregnant and lactating women
   Women
   Small-scale producers
   Others (please specify)

Section 2B – Project and Policies Profiles (Government Officials)

9. Does your country have a strategy/policy/program linking food systems, food security, climate change, and nutrition?

   Yes
   No

10. If you answered yes above, please provide information here to relevant material related to strategy, policy, or program and their status.

Name of the strategy, policy or program

Links if available:

Any other information or comments

11. If you answered no, could you please provide a little more information on your current or future plans?

12. Does your strategy, policy or program use a definition of "healthy diets"?

   Yes
   No
   Please specify and briefly explain.

Section 3 – Objectives of Your Programs/ Projects? (Donor)

13. What are the objectives of your project/program/strategy?

	Very important	Important	Less important	Not important
Enhance understanding and awareness of healthy diets				
Promote the production of food with high nutritional values, aligned with national dietary or nutrition guidelines				
Improve access to fresh and nutrient-dense foods for consumers				
Support the development of technological innovations that increase productivity and nutritional content [of crops and food products]				
Promote environmentally sustainable agriculture				

	Very important	Important	Less important	Not important
Increase household production and consumption of micronutrient-rich foods				
Improve nutrition through behaviour change				
Invest in the implementation of good practices and technologies for resilience to climate variability and change				
Other objectives (please specify)	Yes		No	

14. What is the share of your project/program/strategy that contains quantifiable objectives?

> 75%
75%–50%
50%–25%
< 25%
Not sure
Not applicable

15. Please provide one or two examples of how these objectives are quantified.

16. Has the demand for aid from your partner countries changed to reflect a systems approach to food security, climate change, and healthy diets?

Yes
No
Not sure

17. If the demand increased, how is this reflected in the specific local projects and activities for which aid requests are made?

18. Are you harmonizing your strategy with other donors?

Always/usually
Sometimes
Rarely/never
Not sure
Not applicable

19. If you are harmonizing, how often do you use the following approaches?

	Always	Sometimes	Rarely/never	Not sure
Joint needs assessment				
Co-financing				
Sector-wide approaches				
Joint implementation				
Joint evaluation				
Other (please specify)				

20. Please rate the importance of the following challenges in evaluating your programs and projects:

	Very important	Important	Less important	Not important
Difficulty in identifying quantifiable objectives				
Absence of suitable indicators				
Budgetary constraints				
Ability of in-country staff to collect and report data				
Ability of project partners to collect and report data				
Difficulty of assigning changes to the program				
Other (please specify)				

Section 3B – Objectives of Your Policies? (Government Officials)

21. What are the objectives of your policies?

	Most important	Important	Less important	Not important
Improved nutrition and healthier diets				
Increasing production and consumption of nutritious foods				

	Most important	Important	Less important	Not important
Promoting changes in behaviour toward healthier diets through education, communication strategies, and school programs related to nutrition.				
Increasing capacity to measure and monitor weather or climate risk exposure to food systems				
Taking action to address weather or climate risk exposure to the food system				
Other (please specify)				

22. Which funding and financing sources do you primarily use?

    Public
    Donor Aid
    PPP arrangements
    Other (please specify)

23. Has your country benefited from donor-funded projects related to food systems, food security, climate change, and nutrition?

    No
    If yes, please specify.

Section 4 – Further comments or suggestions

Please feel free to share with us any additional information that might be of interest for our project.

Appendix B. Overview of Projects by International Agencies

This table is the result of the consultations and desk review. It offers a non-exhaustive overview of the projects funded or implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the EU, and United States Agency for International Development (USAID) in Malawi.

Table B1. Projects by international agencies

Agency	GIZ and EU
Project Title	Nutrition and Access to Primary Education (NAPE) (within the Afikepo Programme)
Objective	Supports the provision of school meals for primary school pupils in selected districts. As a result, regular school attendance also improves. (GIZ, n.d.).
Strategy	• Making more high-quality food available for school meals • Improving the understanding of primary school children and community members' regarding nutrition and hygiene practices, especially in relation to the preparation and consumption of school meals • Developing the capacity of the actors involved for example, financial and technical support (GIZ, n.d.-b).

Agency	GIZ
Project Title	Food and Nutrition Security Programme as part of the Global Programme Food and Nutrition Security, Enhanced Resilience to Food Crises from the Special Initiative ONEWORLD – No Hunger
Objective	Increasing people's food and nutrition resilience and security, especially women of child-bearing age, pregnant or nursing women, and small children (GIZ, n.d.).
Strategy	• Promotes nutrition education to support dietary diversification amongst women and young children • Develops the capacity of the two District Nutrition Coordination Committee to develop and deliver nutrition programs • Facilitates the sharing of lessons learned on nutrition-sensitive approaches to agriculture and social protection (GIZ, 2019c).

Agency	EU
Project Title	Afikepo – Let them Develop to Their Full Potential
Objective	Four pillars:
	"1) Agriculture for nutrition security and improved maternal, infant and young child feeding and care practices
	2) Primary health care, therapeutic care, support, and treatment
	3) Integration of behavioural change and communication for optimal maternal and young child feeding and care (knowledge, attitude and practices) among communities, learners, professional and frontline workers through nutrition education
	4) Governance, human capacity building, research, monitoring and evaluation and fortification" (Anon, 2019b).
	The specific objectives are
	• Diversify the diets of women and children to include more safe and nutritious foods
	• Increase the use of good nutrition and hygiene practices through education and awareness raising
	• Strengthen the integration of nutrition into a multi-sector approach at national and district levels, in development and monitoring, and policy-making (Anon, 2019b)
Strategy	Four main implementing components involving various partners:
	• A grant on Advocacy for Enhanced Nutrition Security and Community Empowerment in Malawi implemented by Save the Children
	• Component led by FAO, in partnership with UNICEF, covering specific objectives 1 and 3
	• GIZ component on Improved Nutrition Education and Hygiene practices (covering specific objective 2) (see NAPE project above)
	• Government of Malawi Multi-Annual Programme Estimate implemented by the Directorate for Nutrition, HIV, and AIDS under the Ministry of Health, and in collaboration with other ministries (Afikepo, 2019).

Agency	EU
Project Title	Strengthening community resilience to climate change in Blantyre, Zomba, Neno, and Phalombe Districts
Objective	Strengthening resilience to climate change and variability through the adoption of climate-smart agricultural practices and technologies. Developing district-level capacities to plan and implement climate-resilient development plans (Delegation of the European Union to the Republic of Malawi, 2018b).
Strategy	The project provides knowledge and technical skills on aspects such as "soil and water conservation, conservation agriculture, agroforestry, natural tree regeneration, gully reclamation, basin planting, post-harvest handling, bio-intensive backyard gardening, and food safety" (Delegation of the European Union to the Republic of Malawi, 2018b).

Agency	EU
Project Title	Global Climate Change Alliance in Malawi
Objective	The project seeks to improve the climate resilience of Malawi by mainstreaming climate change issues at regional and district levels and improving the resilience of vulnerable populations to climate change impacts (The Global Climate Change Alliance Plus Initiative, 2018).
Strategy	Component One—strengthening district-level capacities to design and implement climate-resilient development plans. This involves a needs assessment for a climate-sensitive sector, irrigation, and capacity development programs. Component Two—support vulnerable communities in their efforts to adapt to climate variability and change. For example, by promoting the sustainable use of natural resources and energy supplies or improved agricultural techniques (The Global Climate Change Alliance Plus Initiative, 2018).

Agency	EU
Project Title	Improving medium-scale rice farming and farmers' access to markets
Objective	"Rehabilitation and expansion of medium-scale rice irrigation scheme in Salima district and improvement of farmer access to markets" (Delegation of the European Union to the Republic of Malawi, 2018a).
Strategy	

Agency	EU
Project Title	Farm Income Diversification Programme (FIDP II) – SUN Component
Objective	The overall objective is to contribute to poverty reduction. More specifically, the project seeks to improve rural livelihoods by strengthening the conservation of natural resources, diversifying agricultural production, reducing post-harvest losses, and increasing agribusiness (Malawi National Authorizing Officer Support Unit, 2017b).
Strategy	The project is part of an integrated development project. Specifically, it targets 12 districts through grants awarded to selected organizations (Malawi National Authorizing Officer Support Unit, 2017b).

Agency	EU
Project Title	Agriculture Sector Wide Approach (ASWAp) and Green Belt Initiative
Objective	The overall aim is to contribute to poverty reduction in accordance with Malawi's Growth and Development Strategy. The project aims to improve rural communities' agricultural productivity and food security by improving systems, implementation capacities, and the delivery of inputs to beneficiaries (Malawi National Authorizing Officer Support Unit, 2017a).
Strategy	ASWAp has three pillars: "food security and risk management, agribusiness, agro-processing and market development and sustainable land and water management" (Malawi National Authorizing Officer Support Unit, 2017a).

Agency	EU
Project Title	Land Governance for Sustainable Agriculture Project
Objective	The general objective is to improve livelihoods, particularly of those in rural areas, through sustainable agricultural development (Malawi National Authorizing Officer Support Unit, 2017d).
Strategy	The first component aims to strengthen the capacity of all levels to implement land policies and laws effectively and efficiently, especially the Ministry of Lands, Housing and Urban Development. The second component focuses on the implementation of a pilot project at the local level and the improvement of land rights of smallholder farmers, especially women, through responsible land governance (Malawi National Authorizing Officer Support Unit, 2017d).

Agency	EU
Project Title	KULIMA (Promoting Farming in Malawi)
Objective	Increase incomes, employment, and food and nutrition security in the context of climate change and variability by promoting sustainable agricultural growth (Anon, 2019a).
Strategy	The program has three components: • Increasing agricultural productivity and diversification in a sustainable and resilient manner, especially through the use of climate-smart agriculture technologies • Establishing and developing agriculture value chains and businesses • Strengthening governance in the agriculture sector. GIZ contributes to executing these objectives in two projects: KULIMA Green Innovation Centres for the Agriculture and Food Sector and KULIMA MIERA (Malawi National Authorizing Officer Support Unit, 2017c; Anon, 2019a).

Agency	EU and GIZ
Project Title	KULIMA Green Innovation Centres for the Agriculture and Food Sector
Objective	
Strategy	"Provides guidance on the suitability of inputs in different agroecological zones of Malawi, successful agricultural practices and the application of relevant innovations and technologies in view of addressing in a holistic manner the issues affecting the production systems in Malawi" (GIZ, 2019a).

Agency	EU and GIZ
Project Title	KULIMA More Income and Employment in Rural Areas of Malawi
Objective	
Strategy	KULIMA MIERA focuses on processing, market linkages, and marketing. There are three main areas: • "Promotion of inclusive business models & stakeholder dialogue • Improving value chain services • Supporting the business capacity of farmers, Farmer Organisations (FOs) & MSMEs" (Anon, 2019c).

Agency	USAID
Project Title	Improving Nutrition With Improved Crops and Awareness
Objective	
Strategy	"Improves women's nutrition through nutrition-sensitive agriculture activities that increase the production of and access to nutritious crops; it complements these activities with nutrition education delivered through care groups and teen clubs to improve adolescent health, especially among girls. It also supports improved food processing for nutrition and income" (USAID, 2018b).

Agency	USAID
Project Title	Food for Peace Program
Objective	Two 5-year development initiatives—United in Building and Advancing Life Expectations and Pathways to Sustainable Food Security (Njira)—which focus on improving food and nutrition security and the resilience of vulnerable communities (USAID, 2021).
Strategy	"Both activities focus on: 1) Increasing access to and availability of diverse and nutritious foods 2) Improving the health and nutrition of pregnant and lactating women and children under 5 3) Building resilience of vulnerable households" (USAID, 2021).

| Agency	USAID
Project Title	
Objective	With Food For Peace's assistance, and in support of Malawi's National Resilience Strategy, CARE is instigating a multi-year food security development program (USAID, 2020).
Strategy	The aim is to improve incomes, women and children's nutrition and health, and the resilience of communities to climate crises. The project also seeks to strengthen the capacity of local, district, and national institutions to prevent and mitigate against the impacts of climate shocks (USAID, 2020).

Agency	USAID
Project Title	Feed the Future Malawi Improved Seed Systems and Technologies (MISST) Project
Objective	
Strategy	MISST seeks to increase the supply, accessibility, and use of improved, drought-resistant seeds (CIMMYT International Maize and Wheat Improvement Center, n.d.; USAID, 2018)

| Agency	USAID
Project Title	Feed the Future Strengthening Agricultural and Nutrition Extension in Malawi (SANE)
Objective	
Strategy	Strengthening the capacity of the Department of Agricultural Extension Services to work with service providers to deliver more effective agriculture food and nutrition extension and advisory services (Rivera & Moore, 2019; (USAID, 2018a).

Appendix C. Additional Figures

Figure C1. Composition of the diet in Malawi for 2018 and 2020 and projection for 2030

Malawi
Daily consumption, Percentage as a share of daily intake indicated for each category above 1 percent.
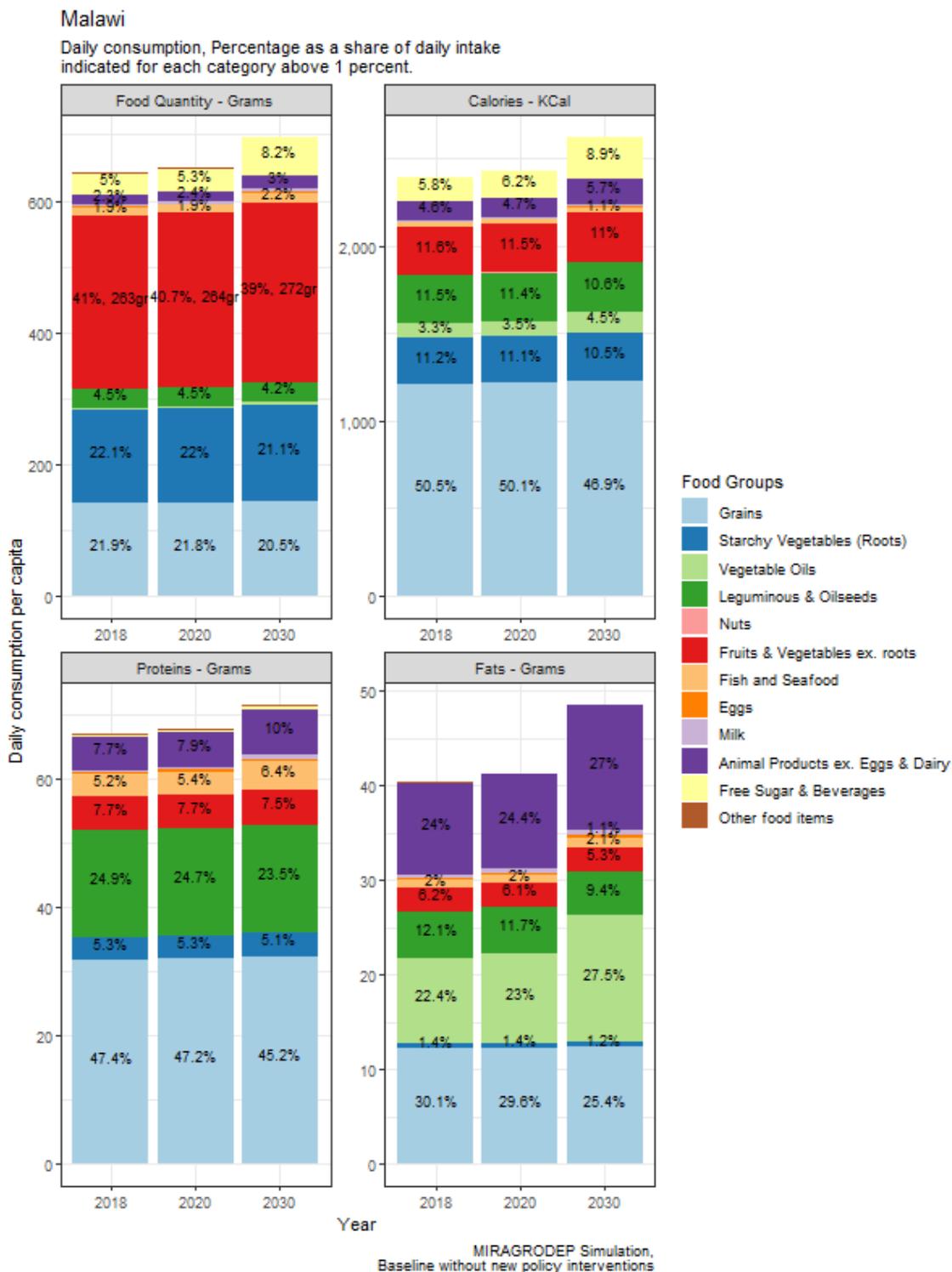
Source:

Figure C2. Relationship between malnutrition incidences and temperature, 2006
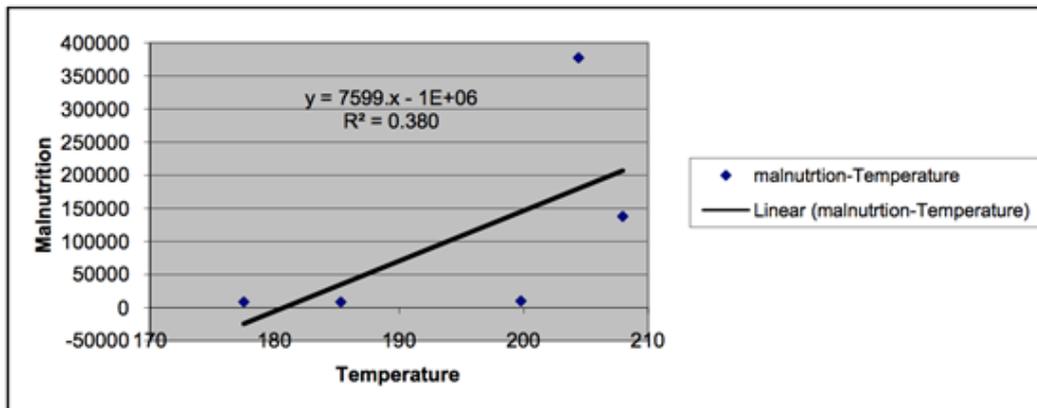
Source: Ministry of Natural Resources, Energy and Environment, 2011, p. 179.

Figure C3. Relationship between malnutrition incidences and rainfall (mm), 2006
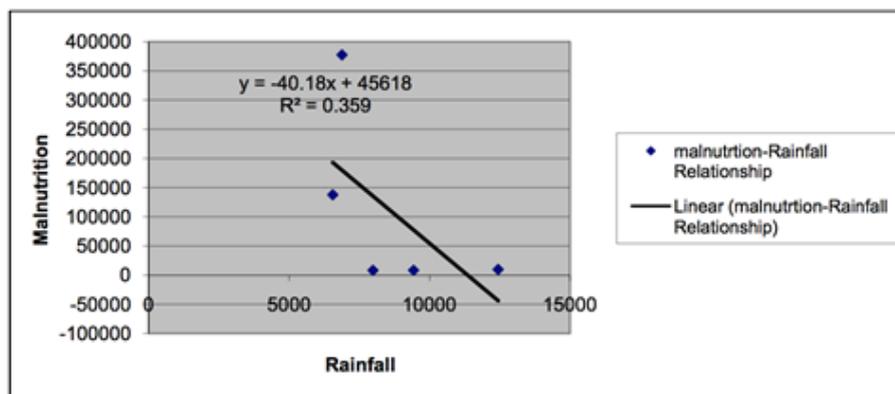
Source: Ministry of Natural Resources, Energy and Environment, 2011, p. 179.

Appendix D. List of Research Questions

The project will answer seven research questions by applying them to the three countries, Nigeria, Malawi, and Ethiopia, and is aimed at studying the food system transitions and supporting decisions to trigger transformative changes:

1. What are the expected trends in terms of diets for the three countries?

2. What is the definition of a healthy diet for a country, considering cultural and economic specificities and the nutritional value of different food items?

3. Based on micro-econometric evidence, how well do we understand consumer decisions regarding food, in particular in transitioning food systems (for example, with rising income, urbanization, food processing, and food consumed away from home)?

4. What are the policy instruments and the food system innovations required to achieve healthier diets?

5. What are the costs and benefits, both in economic and environmental terms (GHG focus), of these diets, and what is their mitigation value?

6. Considering the answers from questions 2–4, what is the most efficient set of actions to achieve this transformation? (Criteria to assess efficiency include these factors: feasibility, potential costs/benefits, gender-transformative or -sensitive aspects, if applicable.)

7. How do the different sets of actions in question 6 translate in terms of weather or climate risk exposure to the future food systems?

Ceres2030 is a partnership between academia, civil society, and economists, led by three institutions—Cornell University, the International Food Policy Research Institute, and the International Institute for Sustainable Development—who share a common vision: a world without hunger, where small-scale producers enjoy greater agricultural incomes and productivity, in a way that supports sustainable food systems.

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