Malawi Floods

A Post-Event Report

Pascal Chisom Okechukwu | Maryam Omolara Fajobi

(Exploring the natural disaster that swept through Southern Malawi in 2015)

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Contents

* Cover page: Flood. Peeterv, Getty Images. #172361770

About the Team

Incorporated in February 2019, Information and Data Analytics Foundation (iDAF) is a nonprofit organization committed to training and empowering Nigerians with advanced data science and A.I skills to solve data-related socio-economic problems in the communities. Pascal Okechukwu and Maryam Fajobi made up the iDAF team that created this report.

INTRODUCTION

Population 16.7 million * Urban Pop. 17.1% *

Context

In recent years the African continent has disproportionately experienced the most severe water-related natural disasters since our modern understanding of climate and environmental sciences. Indeed over the past few decades extreme climate has been no stranger to the countries inhabiting this tropical region, where many are enduring water stress because of too much – or too little – water (Quartz Africa 2018).

Over the past five decades, Malawi has experienced more than 19 major floods and seven droughts, with these events increasing in frequency, magnitude, and scope. Following the events of 2015, the impact on the affected population had been cumulative. In the pre-disaster period, about 3.3 million people in the flood affected districts were already categorized as food insecure, and after 2015 the national poverty rate stood at 51.5% with most of the poor (59.5%) of this percentage living in the rural areas (Malawi Government Data 2019).

Risk Summary

Malawi is highly vulnerable to the impacts of extreme weather events given:

• **Climate change and environmental degradation:** Ongoing environmental degradation such as cultivation and tree cutting for firewood (97% of Malawians depend on wood/charcoal for cooking), increase the risk of floods and makes the country more vulnerable to climate change impacts (World Resources Institute 2017).

• **Rapid population growth:** The frequency and magnitude of drought and flood events have increased since the 1990s, negatively affecting the poverty and food security situation. In addition to climate change and urbanization this increased trend has also been attributed to population growth (WMO 2015). Malawi currently has a population growth rate of 2.7%, just very little below 2.8% in 2015.

• **Unsustainable urbanization:** While greater impact on livelihoods and loss of assets are expected in rural areas as they mostly depend on agriculture, there is also a big impact in flooded urban areas due to population density (GFDRR 2015) – 203 per Km^2 (526 people per mi^2) in 2015. Currently, 39.5% of the population in the Central region and 48.3% in the Southern region's population live in urban areas (CIA Factbook 2018). Many houses in rural areas are built with limited land use planning and little compliance with safer housing construction standards (GFDRR 2015). Many houses are also built with traditional, natural materials, leaving them more vulnerable to floods than concrete safe houses (CIA Factbook 2018; Floodlist 2019; Nyasa Times 2019).

- **Its location along the Great African Rift Valley**
- **But of the most importance is the significant reliance of Malawians on subsistence farming.**

INTRODUCTION

1.1 million affected *

230,000 displaced *

* 2015 estimates

Overview

Floods and droughts pose the most significant and recurring risk to Malawi, with the highest impacts occurring in the central and southern regions. Particularly flooding poses a threat to all low-lying regions around Lake Malawi, with over 100,000 people affected by floods each year (GFDRR 2019).

Beginning in December 2014, heavy seasonal rainfall in the southern part of the continent caused high river levels and soil saturation in Mozambique, the neighboring country that very much surrounds Malawi to the south. The Southern Region of Malawi itself received 400% higher rains than usual (compared to the Long-Term Mean), causing the Shire River to reach its highest level in 30 years (reliefweb 2015).

Flood Extent

From January to March 2015, 15 of the 28 districts in the country experienced significant flooding sustained by the above-normal rains, with Nsanje and Chikwawa in the south experiencing the largest impacts. The floods affected more than 1.1 million of the country's population, displaced some 230,000 people whose homes and means of livelihood were either severely damaged or destroyed. And while 276 people were reported dead or missing, approximately 2.8 million Malawians faced hunger in months in the resulting worst food crisis seen in a decade.

In this report, we present insights on the aftermath of the floods, particularly in the southern region of Malawi. The analysis was carried out using data provided primarily by the Humanitarian Data Exchange, and most of the visualizations were created using the Tableau software.

Background image: map symbology for the 2015 flood event – the areas in light red show all places affected by the flood during the period. Places in darker red show flooded areas at the current time of satellite imaging in January, 2015. Permanent water is represented as dark blue, while the very light blue areas show all flooded areas since the year 2000.

METHODOLOGY

In addition to the flood extent, this report focused also on agriculture, food and nutrition, health and health sites, and general basic amenities accessible to the people. It is important to note that though the flooding event of 2015 occurred from January to March in Malawi, the data time series employed here ranged from pre-2015 to at least 2016, to enable us compare the before and after scenarios.

Data Understanding

The data used for this analysis comprised health sites, demographic and health surveys (DHS), food prices, food security indicators, weather data, socio-economic indicators, and spatial data. Using literature reviews and situation reports gathered from reliable sources, the team applied preliminary statistical and exploratory data analysis to understand what would be relevant to the objective of this report, especially narrowing our focus to data having moderate to high informativeness than the others with respect to the southern region of Malawi.

Key Features

1. The food prices dataset contains collated prices of major food commodities exported, imported, and cultivated in Malawi. Featuring beans, cassava, cow-peas, groundnut, maize, maize white, pigeon peas, rice, and red sorghum.
2. Weather dataset covering precipitation records for Malawi from 1991 too 2016.
3. Health sites data sheet containing 284 records of healthcare services-rendering institutions.
4. Food security indicators with values on a 3-year average recorded from 1999 to 2018.
5. All available DHS data consisting of the historical and current observations relating to vital indicators.

Data Preparation

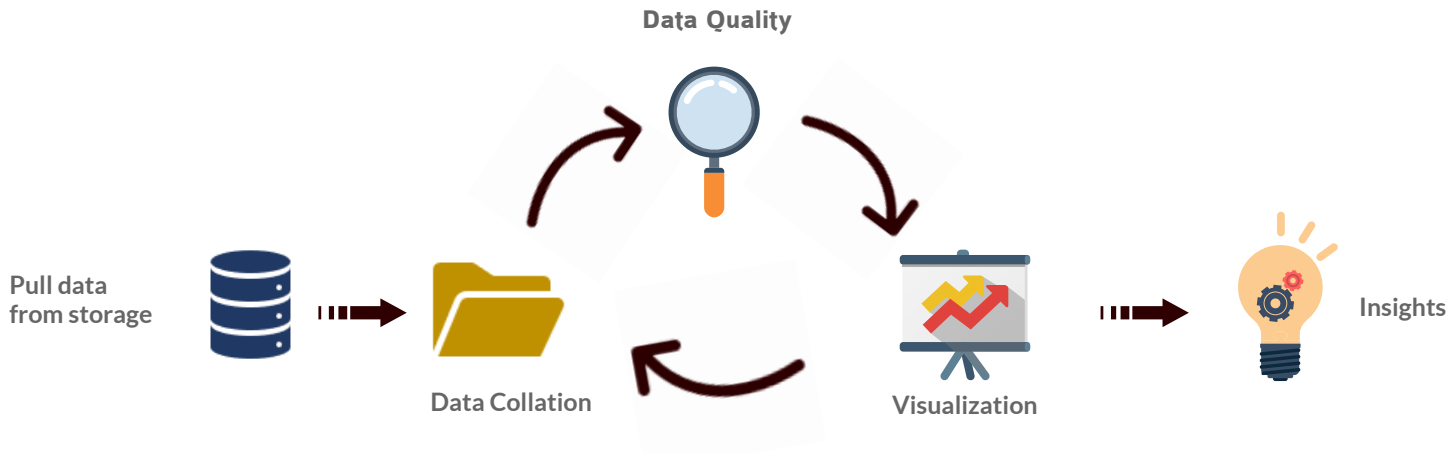
The team carried out series of exploratory analysis and pre-processing on most of the available data. For the food prices, the median value was calculated for each food item and the results grouped by country region and food category. This was achieved using the Python programming language on Azure Notebooks, and the mathematical approach was the most suitable, as median values are not affected by outliers.

For the rest of the datasets, ambiguous variables that offered little or no information to the purpose of generating insights were removed. These variables include table keys, IDs, DHS codes for indicators, etc. Redundant features and observations with sparse information were also removed.

Finally, data having very old survey years of collection and generally data that weren't informative enough for reporting on the flood disaster were dropped.

Visualization

Except where stated, the visualizations in the form of charts and graphs used in this report were created using Tableau.



Framework for the methodology. (Notice that the entire process is flexible, and we can cycle through steps, each time gaining a deeper understanding of the data).

AGRICULTURE, FOOD, and NUTRITION

Malawi is a small country with an estimated land area of 11.8 million hectares, of which Lake Malawi occupies one-fifth of the total. Out of 9.4 million hectares of land, approximately 5.3 million ha, or 56 percent, is cultivable. The Malawi economy is characterized by a high dependence on agriculture, a narrow industrial base, and weak inter-sectoral linkages. The agricultural sector currently accounts for about 42 percent of GDP and 81 percent of export earnings (FAO).

Climate and Agriculture

Agriculture in Malawi is composed of two main sub-sectors: small-scale farmers and estates. Smallholder farmers comprise an estimated 2 million farm families and cultivate about 4.5 million hectares of land. Smallholder production is highly subsistent. It is characterized by low levels of input and low output levels. Approximately 25 percent of smallholder farmers cultivate less than 0.5 ha on average; 55 percent cultivate less than 1.0 ha; 31 percent cultivate between 1.0 and 2.0 ha; and 14 percent cultivate more than 2.0 ha. But despite being resource-poor, smallholder farmers produce about 80 percent of Malawi's food and 20 percent of its agricultural exports.

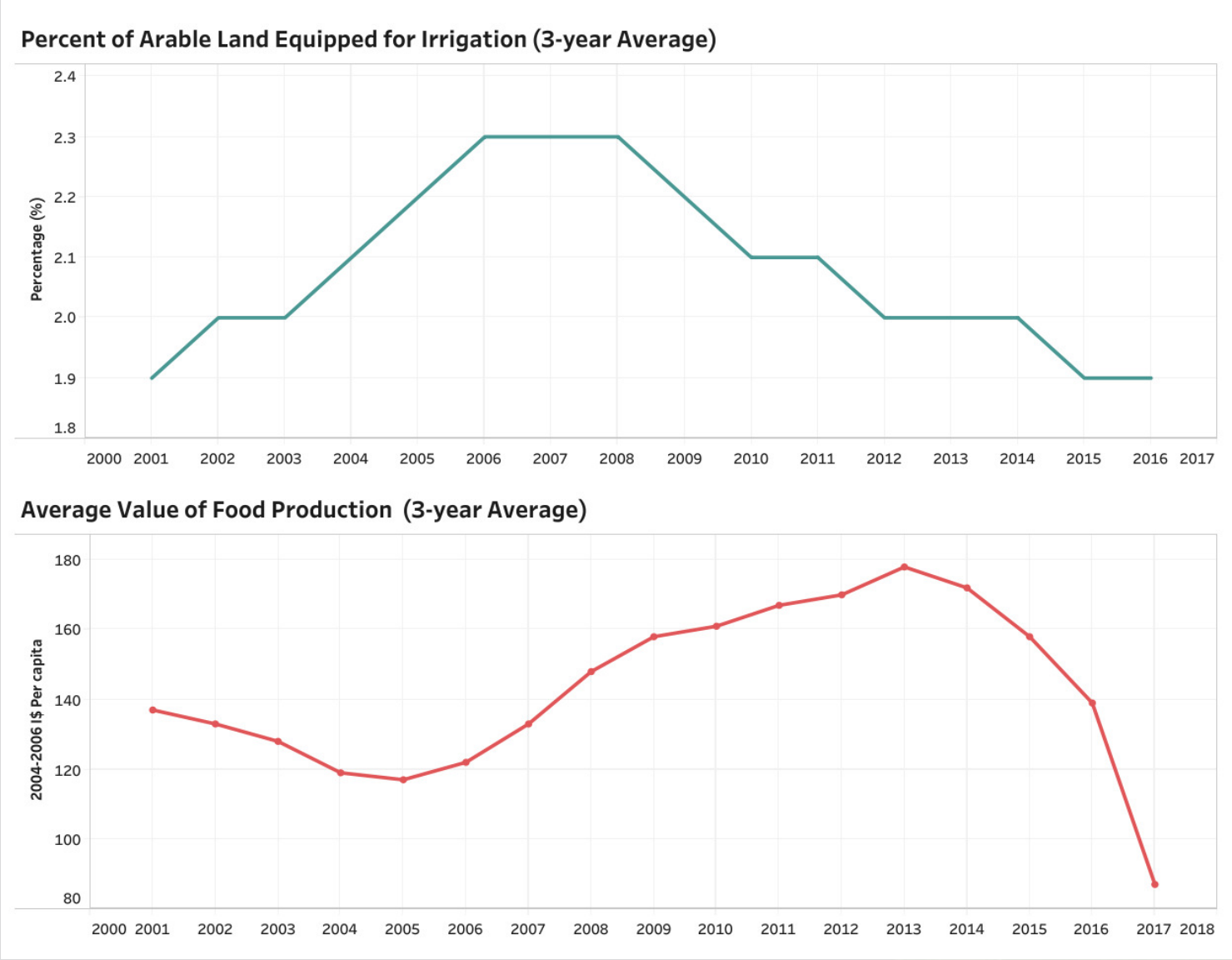
The most immediate impact of erratic rainfall on rural livelihoods is on crop production. Droughts and floods undermine farm yields and the national harvest, reducing household and national food availability, and agricultural income derived from crop sales. Poor harvests threaten food security and livelihoods from household to national level, to varying degrees according to the extent that the family or nation depends on agriculture for its food and income.

Households and economies that are more diversified are less vulnerable to these direct impacts of droughts and floods, provided that their alternative income sources are neither correlated with rainfall nor directly or indirectly dependent on agriculture (i.e, vulnerability falls to the extent that complementary sources of income and food are non-covariate). The figure below shows the trend for average rainfall in Malawi from 2005 to 2016.

From data, the rainy season in Malawi is from mid-November to April, with more of the wet weather occurring during the December - March window.

Arable Land and Food Production

The percent of arable land equipped for irrigation is a ratio between arable land equipped for irrigation to total arable land. Arable land is defined as the land under temporary agricultural crops (where multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is however not included in this category, it is important to note that data for arable land are not meant to indicate the amount of land that is potentially cultivable. Total arable land equipped for irrigation is defined as the area equipped to provide water via irrigation to crops. it includes area equipped for full and partial control irrigation, equipped lowland areas, pastures, and areas equipped for spate irrigation (knoema 2019). This chart follows for a period of 2001 to 2016 for this report.

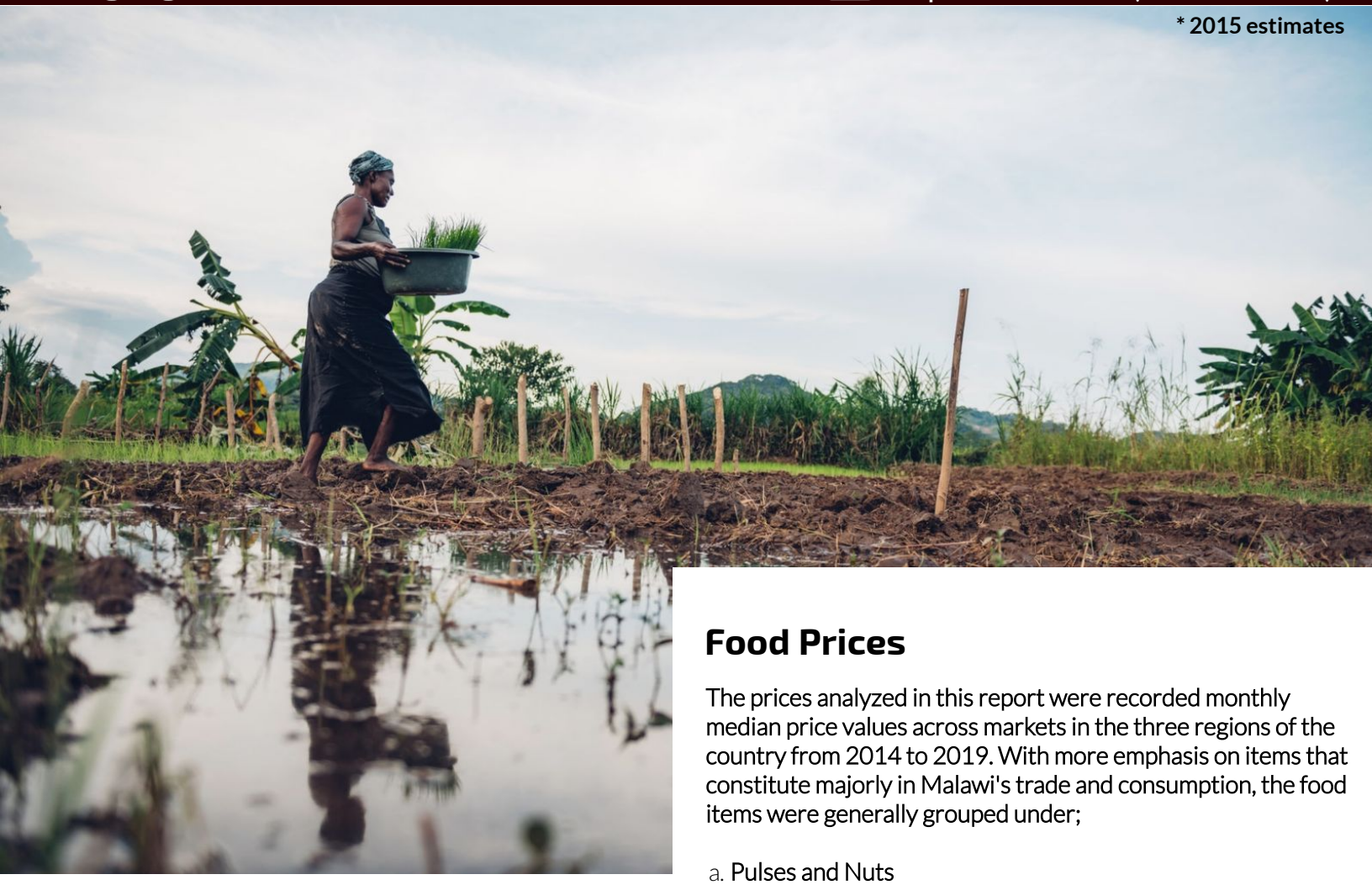


The percent of arable land equipped for irrigation was at level of 1.9% in 2016, unchanged from the previous year of the flood. But they followed a steep fall from 2% in 2014. We can see just how much the floods affected agriculture in Malawi. However, this becomes clearer in the line chart for the average value of food production.

FOOD

Cropland: 3.8 million ha (32.2% of land area) *

* 2015 estimates



Malawi's largely rural population depends heavily on crop production for its livelihood, most notably the production of maize, which accounts for three-fifths of daily calorie consumption (Ecker 2009). Agriculture and downstream agro-processing generate half of gross domestic product (GDP) and four-fifths of total export earnings and employment (Benin et al. 2008). Climate shocks therefore have a potentially profound direct affect on the agricultural sector and farm households while also indirectly affecting other economic sectors and non-farm households through price and production linkages.

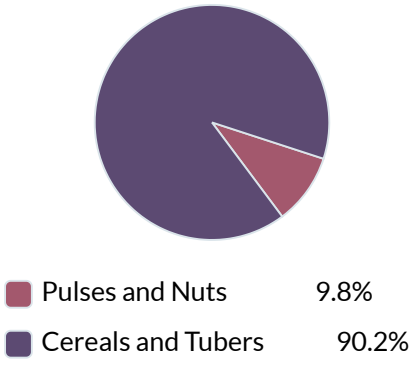
According to Recipes Wiki, the staple food in Malawi is Nsima, which is a thick maize porridge that is moulded into patties and served with either beans, meat, or, or vegetables collectively called Ndiwo. Other Malawian dishes are prepared with rice, cassava or potatoes. This, with other sources confirmed maize as the most important food crop, followed by cassava, sweet potatoes, and sorghum.

Food Prices

The prices analyzed in this report were recorded monthly median price values across markets in the three regions of the country from 2014 to 2019. With more emphasis on items that constitute majorly in Malawi's trade and consumption, the food items were generally grouped under;

a. Pulses and Nuts
b. Cereals and Tubers

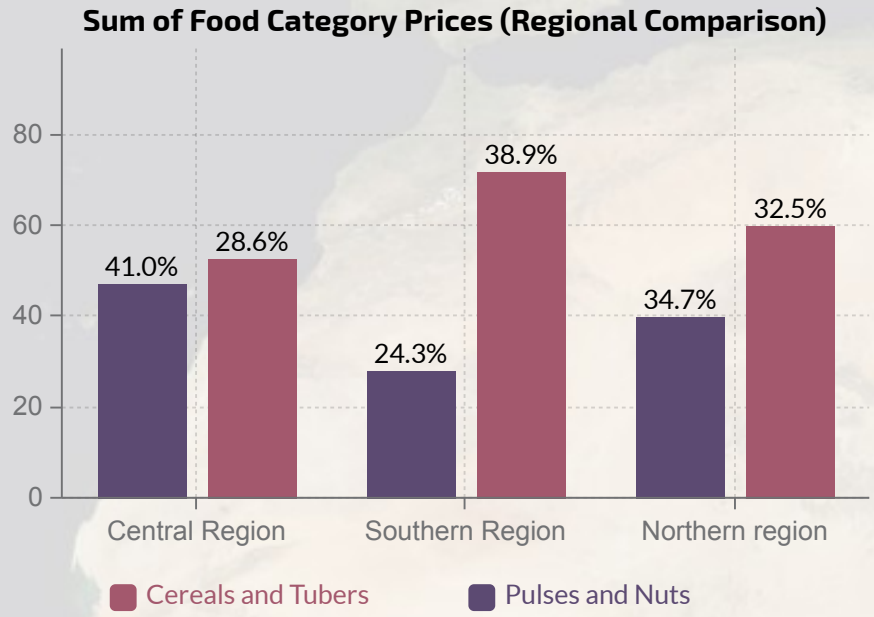
Sum of Food Category Prices (All Regions)



Drilling into the data for 2015 alone, there was a small change in the percentage share, with Pulses and Nuts accounting for only 8% at MWK34.13K, while Cereals and Tubers take up the rest at MWK391.22K for 92%.

FOOD

From the following figure, it is very evident that cereals and tubers constituted most of Malawi's food crop production, exports, and imports for the time frame considered. With the southern region contributing most of the overall 90.22% for cereals and tubers. The trend for this analysis is shown in the quarterly chart below.



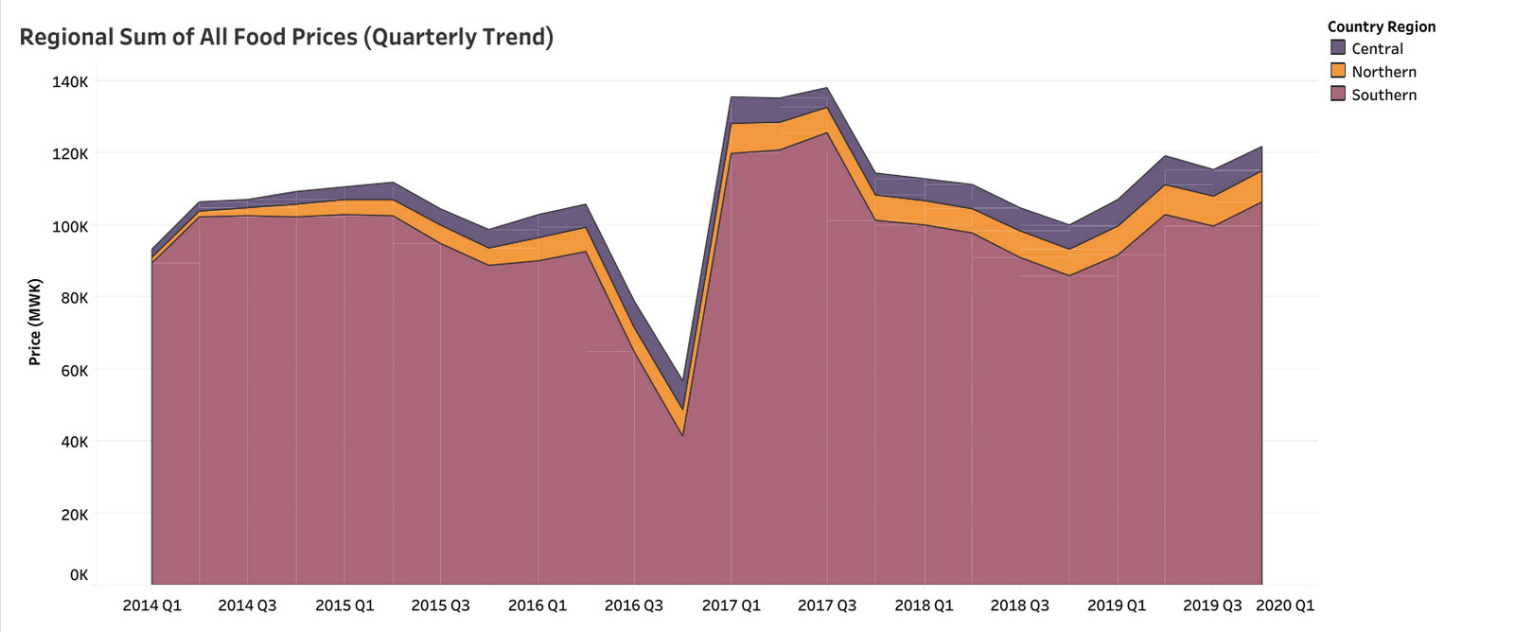
Cereals and Tubers comprise:

- Cassava
- Maize
- Maize (white)
- Rice (imported)
- Sorghum (red)

Pulses and Nuts:

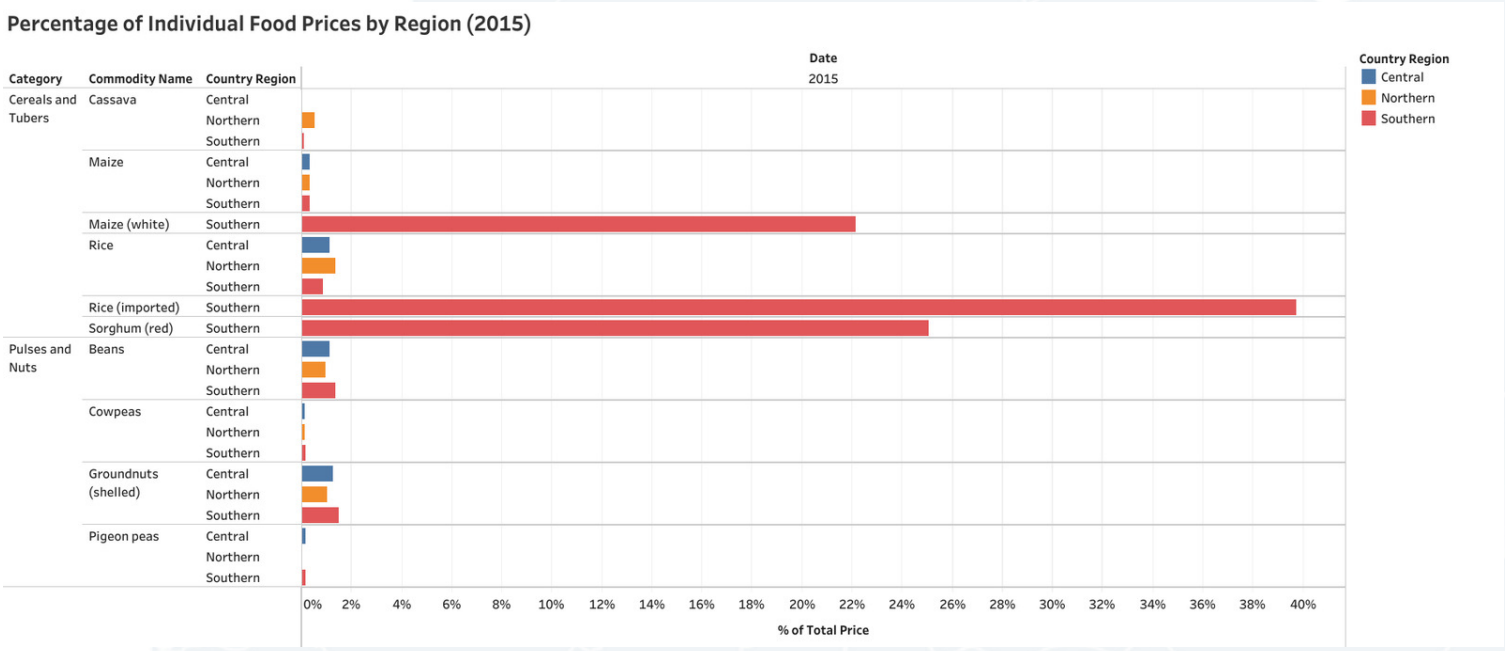
- Beans
- Cowpeas
- Groundnuts (shelled)
- Pigeon peas

Looking at the trend by the quarter of years, it is observed that there was no significant change in total prices for southern Malawi from the second quarter of 2014 to the second quarter of 2015, which covered the period of both the extreme rainfall and flooding of the southern region. There was however, a steep plunge from MWK 102,000 in the second quarter of the flood year to just below 90,000 in the fourth quarter of the same year.



FOOD

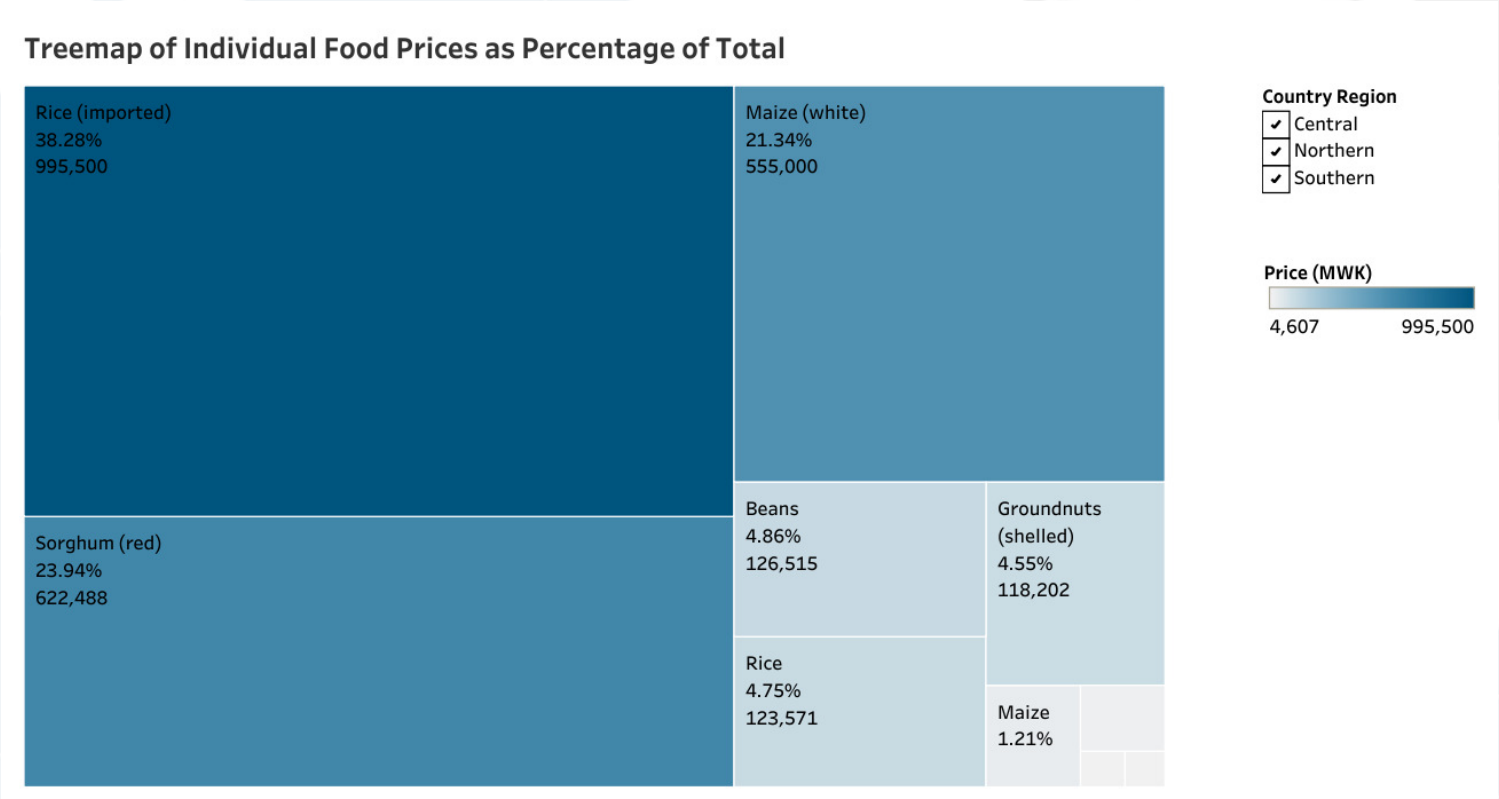
As we drill into the percentage of individual food prices for each region (see bar chart below), imported rice in the southern region accounted for approximately 40% of the total prices in 2015, followed by red sorghum and white maize at 25% and 22% respectively. These overshoots for the southern region could be understood due to the flood, and a couple of other reasons; owing to the fact that in times of crisis of this and similar nature, food scarcity (especially staple foods) leads to an inflation of prices because demand far outweighs the supply. And also owing to cases like the almost total lack of prices for cassava in 2015 - as flooded farmlands drastically affect the yield of tubers. Actually, from the available data, there were no price values for cassava starting from February, 2015.



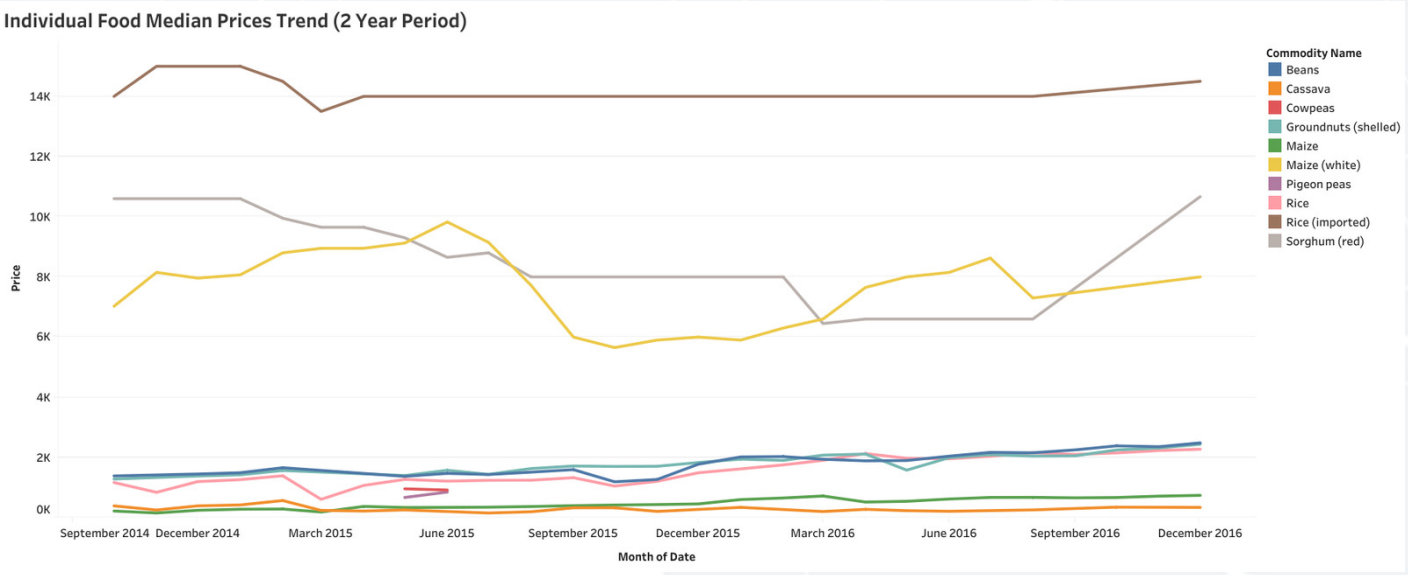
Comparing the sum of prices for the top three food items and cassava for the years 2014 through 2018 as shown in the table below. Note that for the period considered in the analysis (2014 - 2019), data for white maize, imported rice, and sorghum were recorded only for the southern region; in other words, the top three food items were possibly not available in the northern and central regions of Malawi from 2014 - 2019, according to the data used.

While the total for 2016 significantly dropped from that of the previous years for white maize, imported rice, and sorghum, there was a steady increase for the sum of prices for cassava up to 2017. The table also shows that the prices for the top three food items significantly spiked again in 2017, and this can be confirmed as the scarcity of those foods, following that Malawi declared a state of national food disaster in early 2016 over the drought that occurred after the 2015 floods.

Year	Maize (white)	Imported Rice	Sorghum (red)	Cassava
2014	MWK 104,192	MWK 168,500	MWK 114,506	MWK 950
2015	MWK 94,142	MWK 169,000	MWK 106600	MWK 2,174
2016	MWK 66, 525	MWK 126,500	MWK 66,116	MWK 2,434
2017	MWK 123,092	MWK 176,500	MWK 139,716	MWK 3,861
2018	MWK 78,325	MWK 178,750	MWK 91,225	MWK 3,521



This treemap of individual food prices sheds more light on the share of each food item in Malawi as a percent of total from 2014 to 2019. It is instantly recognized that maize and sorghum make the staple foods in Malawi, while the very high share of imported rice could be due to its ease of consumption as a basic food in times of crisis. From this data, cassava, cowpeas and pigeon peas were the least accounted for; making just 0.7%, 0.2%, and 0.18% of the total food prices respectively. The trend of each food crop is shown below from 2015 to 2016.



From the food prices trend above, the median price for maize in markets of the southern region significantly rose from October in 2014 (although this wasn't visualized here), up to the first quarter of 2016, while only dropping briefly once from April to May in 2015. The price for white maize, which was only available in Southern Malawi (according to the data) generally rose from the last quarter of 2014 to June 2015, and then took a steep plunge to October after the worst of the floods had been felt, before rising overall again.

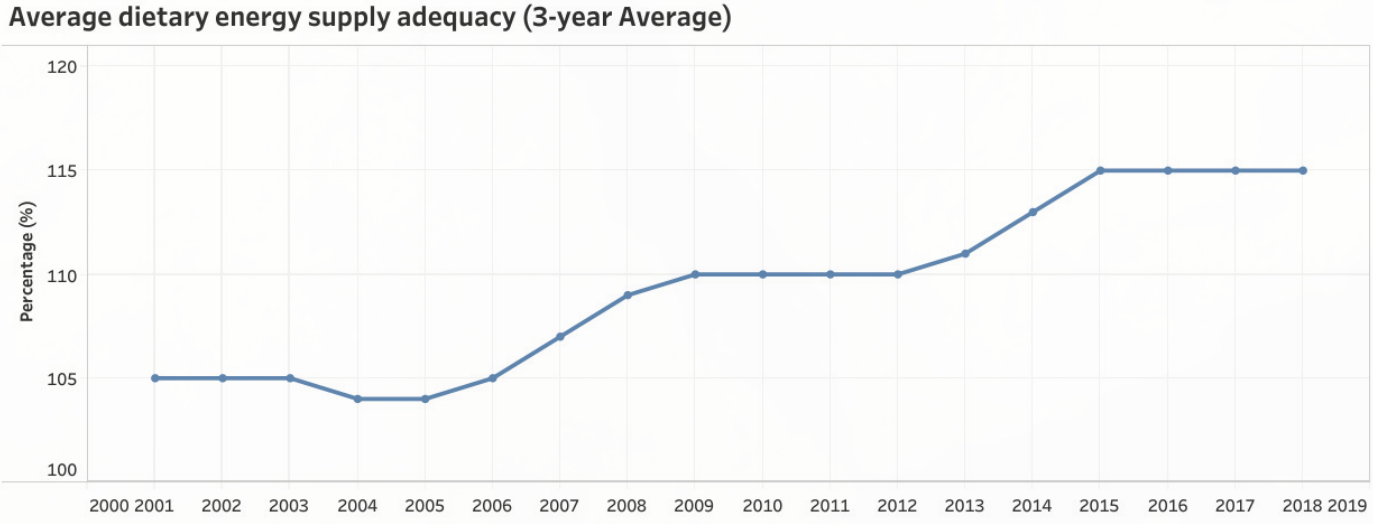
3.1 million people undernourished *

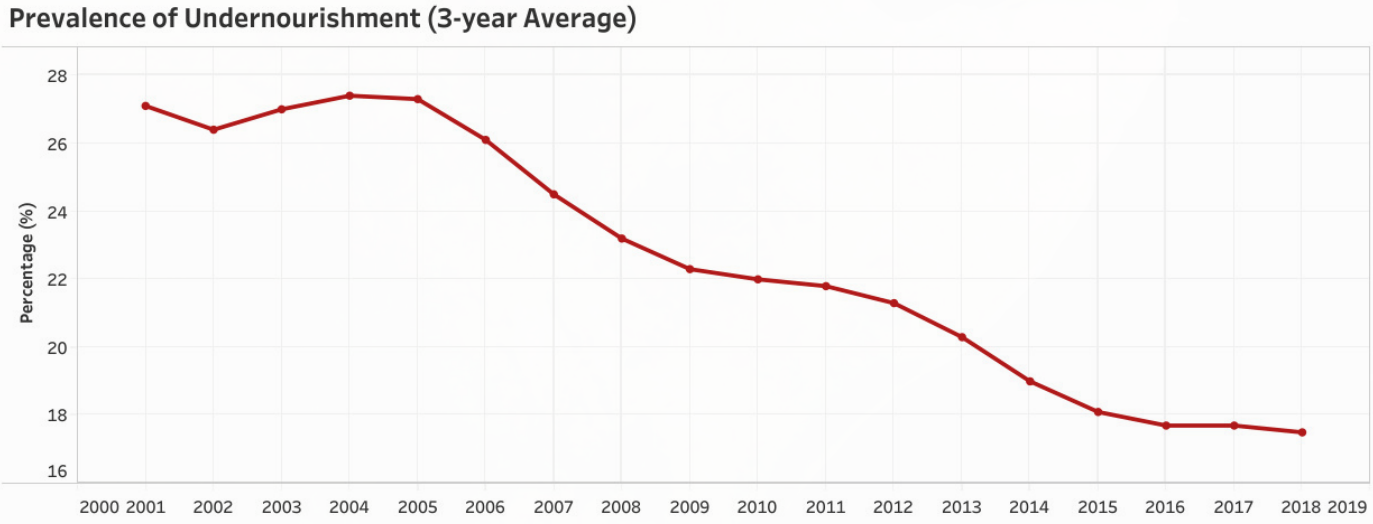
* 2015 estimates

Average Dietary Energy Supply Adequacy

This indicator expresses the dietary energy supply as a percentage of the average dietary energy requirement. Each region's average supply for food consumption is normalized by the average dietary requirement estimated for its population to provide an index of adequacy of the food supply in terms of calories. The figure below shows this trend for a period of 2001 - 2018.

Here, average dietary energy supply adequacy of Malawi increased from 104% in 2004 to 115% in 2018, growing at an average annual rate of 0.72%. There was however no positive change following the 2015 flooding events.





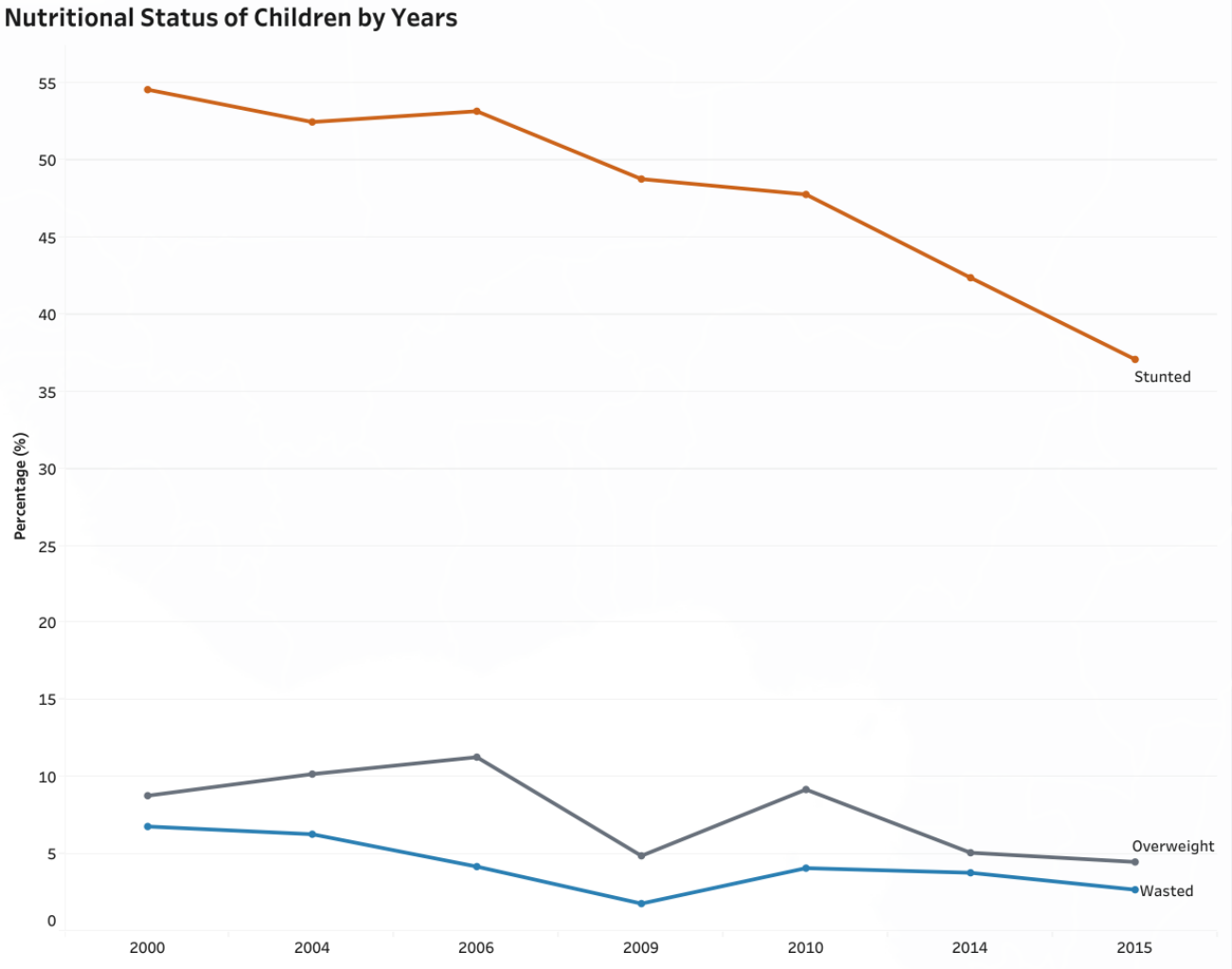
Prevalence of Undernourishment

The prevalence of undernourishment expresses the probability that a randomly selected individual from the population consumes a number of calories that is insufficient to cover her/his energy requirement for an active and healthy life. The indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with a threshold level called the minimum dietary energy requirement. Both are based on the notion of an average individual in the reference population (knoema 2019). It is observed that Between 2004 and 2018, prevalence of undernourishment, 3-year averages of Malawi was declining at a moderating rate to shrink from 27.4 % in 2004 to 17.5 % in 2018.

Nutritional Status of Children

Anthropometric indicators for young children were collected in the DHS to provide outcome measures of nutritional status. As recommended by WHO, evaluation of nutritional status in this report is based on a comparison of three indices for the children in this survey with indices reported for a reference population of well-nourished children (WHO Multicentre Growth Reference Study Group 2006). The three indices (height-for-age, weight-for-height, and weight-for-age) are expressed as standard deviation units from the median for the reference group. Children who fall below minus two standard deviations (-2 SD) from the median of the reference population are regarded as moderately malnourished, while those who fall below minus three standard deviations (-3 SD) from the reference population median are considered severely malnourished. Marked differences, especially with regard to height-for-age and weight-for-age, are often seen between different subgroups of children within a country.

The figure below shows the trend from the year 2000 to 2015 of the percentage of children under 5 years of age who are stunted, overweight, and affected by wasting. Note: Stunting reflects chronic malnutrition; wasting reflects acute malnutrition; underweight reflects chronic or acute malnutrition or a combination of both. While the percentage of children under 5 years of age affected by wasting was at level of 2.7 % in 2015, down from 3.8% previous year, the percentage who are stunted in growth fell gradually from 54.6 % in 2000 to 37.1 % in 2015. And though the percentage of children under 5 years of age who are overweight fluctuated substantially in recent years, it tended to decrease through 2000 - 2015 period ending at 4.5 % in 2015.



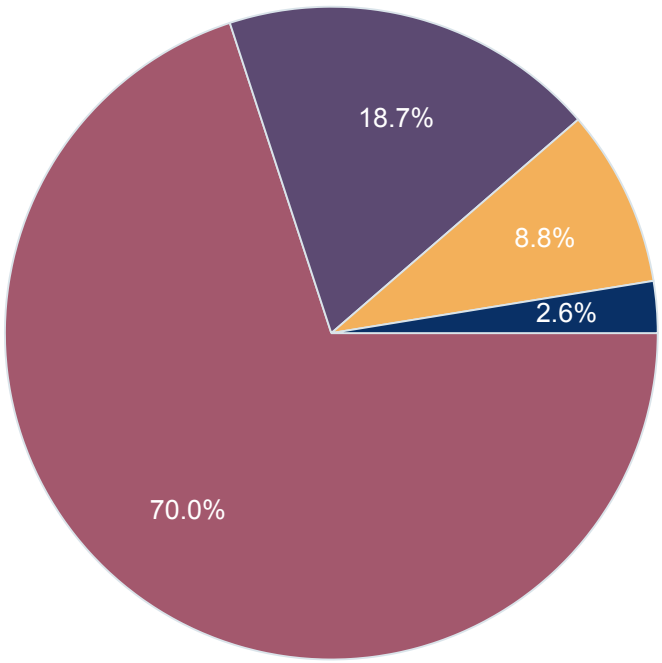
HEALTH and AMENITIES

Healthsites: 238 (healthsites.io)

The Ministry of Health is responsible for healthcare in Malawi. With 62% of health services provided by the government, the Christian Health Association of Malawi (CHAM) accounts for 37% while a small fraction of the population receive health services through the private sector. Also, private doctors and non-governmental organizations (NGOs) offer services and medicines for a nominal fee.

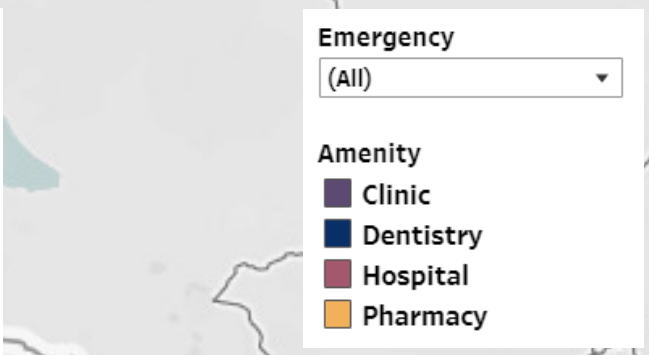
Although the public health system has three separate tiers (primary, secondary, and tertiary care) with a system of referrals linking them, they do not function properly. This is largely due to lack of manpower, lack of basic/expert skills set, overpopulation, lack of equipment/technology, corruption, lack of political commitment, lack of sufficient funds, poor prioritisation in budgeting and low motivation among personnel (Wikipedia).

Health Sites in Malawi (Percent of Total)



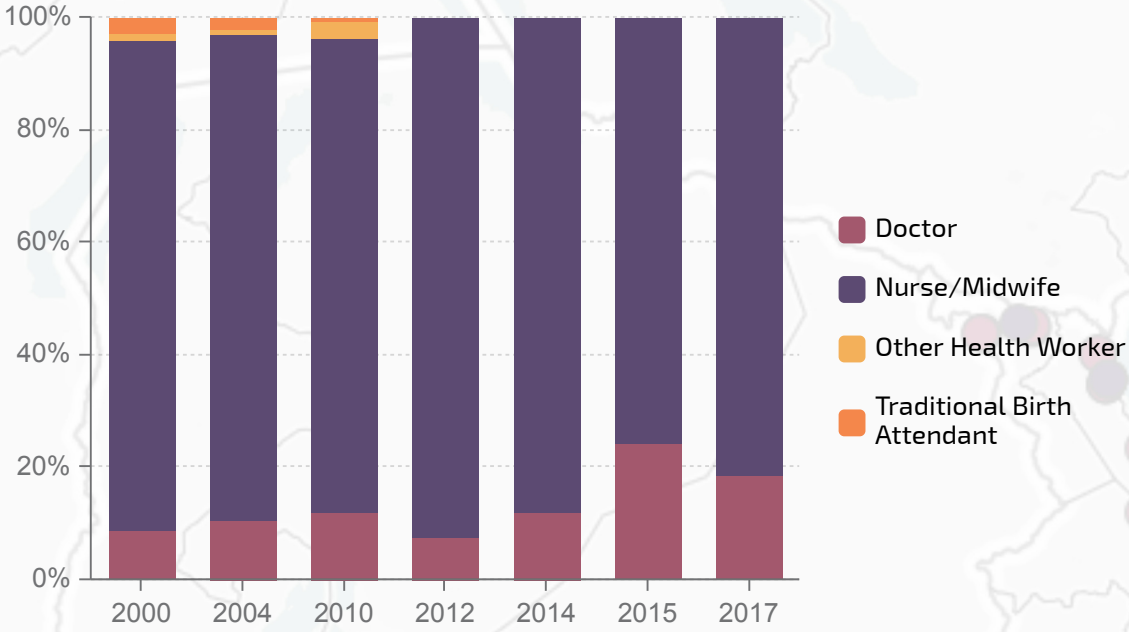
From data, hospitals in Malawi accounted for approximately 70% of all the health sites, while clinics and pharmacies (dispensaries) took up 27.5%.

Background image: geographical distribution of healthcare facilities in Malawi. (2019 up)

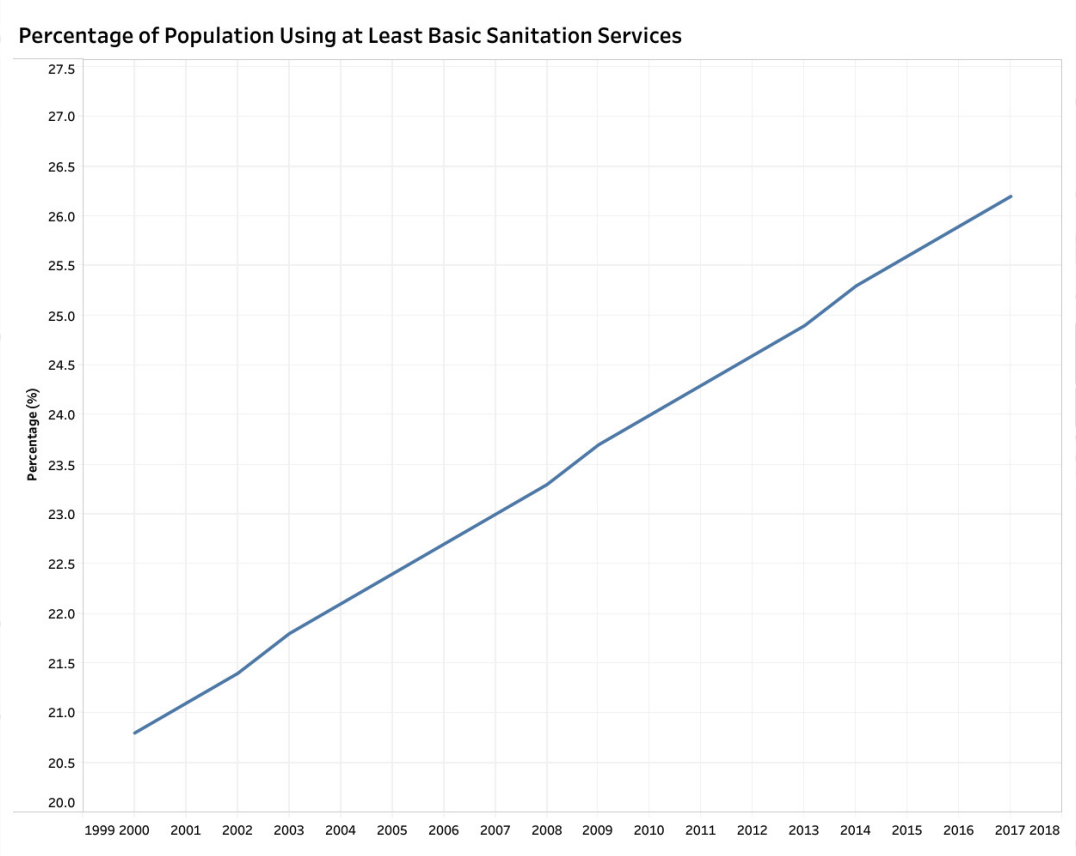


HEALTH AMENITIES

Antenatal Healthcare Providers



The above stacked bar chart compares how much part each healthcare provider in Malawi plays for the given year. Generally, nurses and midwives have provided most of the antenatal health care services over years, and this is to be expected given the poor structure and standards of the health sector in the country. However, 2015 saw a very significant increase in the antenatal health services provided by doctors, from the past years. This further clarifies the severity of the 2015 floods.



The trend for the Malawian population using sanitation services tells that there has been a steady increase since the year 2000. This suggests that Malawi has significantly improved on the provision of sanitary services to the people, even as the country is no stranger to extreme weather disasters every now and then.

LIMITATIONS and CONCLUSION

The primary challenge encountered in the course of the analysis for this report was the incompleteness of data in some of the categories of focus. The Demographic and Health Survey (DHS) data in many cases lacked sufficient information with respect to generating meaningful insights for the 2015 Malawi flood disaster. In addition, the DHS data were rarely representative of sub-national regions, which limited our ability to examine the flood extents within the specific region of interest in Malawi.

Also, we did not investigate factors that influenced the vulnerability of households to flooding such as building quality, or other determinants of flood impacts such as flood duration. and its impact on indirect losses such as loss in output, revenue, and economic disruption.

Conclusion

This work assessed the social and economic impacts of the 2015 flood disaster on Malawi. From the analysis of available data, it was discovered that the prices of food commodities in the southern region spiked greatly compared to the northern and central regions, and some foods weighed greater than others in need and demand. This potentially could further be attributed to the flood destroying farm crops and arable lands for agriculture leading to a decline in the average value of food production, and an increase in demand for commodities.

Furthermore, the prevalence of undernourishment and percentage of children with stunted growth decreased after the flood, and while this could be attributed to the availability of international aid in food and medicine via NGOs and the Malawian government, there was significant improvement in the provision of sanitary services to assist in catering to the public health of displaced majority.

Moving forward, it is evident that poor people in Malawi are disproportionally exposed to rural floods, and a particular concern is the fact that the southern region where these poor majority are overexposed will likely experience more frequent flooding in the future due to climate change. As this disaster risk is likely to get worse, resilience-building measures should become more important and urgent. The government should also strengthen risk-sensitive land-use policies that protect poor, such as flood zoning and land entitlement, to support the access of poor people to opportunities and not stifle them.

Finally, integrating local knowledge in developing localized and relevant climate change adaptation strategies is essential, and this can be achieved by creating a forum for interaction between scientists and indigenous knowledge holders.

Acknowledgements

Following a data visualization and reporting challenge hosted by Zindi Africa, and sponsored by UNICEF, ARM 2030 Vision, this work contributes to drawing a keen attention to the spot occupied by Malawi on the map of weather-related natural disasters and the often inevitable humanitarian crisis that follows. The team acknowledges the importance of actionable insights in this field and appreciates Information and Data Analytics Foundation (iDAF) for the scholarly support and opportunity to actualize this. The contribution of Zindi in recommending data from the Humanitarian Data Exchange is also appreciated. Finally, the team is grateful to NASA Earth Observatory for the free provision of the 2015 Malawi flood map on background in page 2.

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