The Dynamics of Deprivation in Malawi:

The multi-dimensional effects of the lean season on children

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Preface

The idea of assessing the dynamics of deprivation in a more structured, holistic way was developed by the UNICEF Malawi team working on shock-sensitive social protection, supported by Maxi Ussar. The intention was to look beyond seasonal food insecurity, to better understand and in consequence address the multiple and nuanced ways children are affected every year by immense risks that can have lasting consequences on child wellbeing, development and Malawi's human capital. Understanding the predictability of risks and nature of seasonal deprivations for children, was for the team a way to better inform and advocate for increased coverage, adequacy, and services under Malawi's National Social Support Programme, in line with seasonal, recurrent shocks.

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Executive Summary

This study is the first cross-sector evaluation of seasonal deprivations in Malawi. Cycles of vulnerability in Malawi have significant impacts on a range of child deprivations, including child mortality, child labour, malnutrition, poverty, food security and dietary diversity. Through examining the deprivations children face over the lean season, how these deprivations interact, and how socio-economic and climatic factors influence deprivation, this study aims to enhance the evidence base for policy and programming decisions in Malawi.

Malawi's socio-economic profile

Malawi is the third poorest country in the world and ranks in the bottom decile of the Human Development Index (World Bank, 2020a; UNDP, 2020). 20% of the country's population live in extreme poverty, defined as an inability to satisfy basic food needs, while 70.3% live below the international poverty line of $1.90 a day (IHS4, 2017; World Bank, 2020).

With the majority of Malawians dependent on rain-fed agriculture, which is characterised by a single, main harvest season and a long lean season, the lives and livelihoods of many Malawians are inextricably linked to the country's agricultural cycle. The lean season encompasses both the sowing and growing seasons, which run from October to December and January to March respectively and are characterised by low food availability. Widespread chronic poverty and high vulnerabilities mean that even predictable, recurrent lean seasons, which are characteristic of the country's agricultural cycle, can prolong and/or deepen poverty, effecting not only economic and food security but a host of other deprivations (FAO, 2017; Cherrier, 2019).

Malawi's agricultural cycle

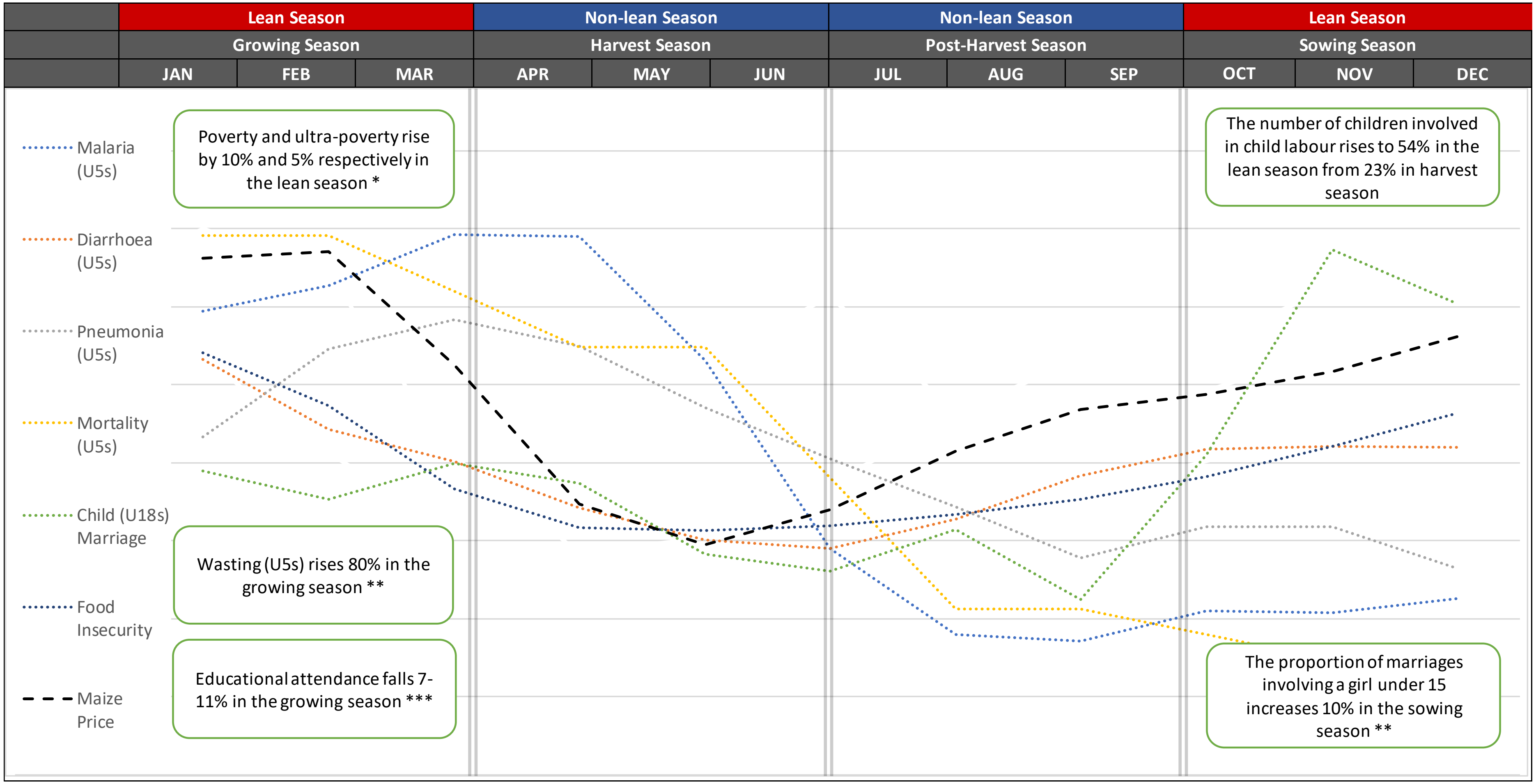
Every year, Malawi's agricultural cycle leads to seasonal social and environmental stressors, affecting millions of Malawians. These pressures are primarily the result of the concurrence of Malawi's rainy and lean seasons, with the former characterised by extreme weather events and the latter by low agricultural production and food insecurity. As environmental degradation and population growth rise, these seasonal crises and their consequences are expected to worsen, impacting children disproportionately due to their heightened vulnerability (Ofori-Kuma, 2019; World Bank, 2020b; Banda, 2007).

As shown in Figure 1, food prices in Malawi follow the agricultural cycle closely. While the impact of the lean season on food security is well documented, there are a number of deprivations that rise in the lean season but which have received less prominence in the discourse, despite having significant implications for child health, wellbeing and development.

Objectives of the study

Major development challenges are often multidimensional and addressing poverty in Malawi, and the various forms it takes, is no exception. This study intends to enhance the evidence base on how children are affected in the lean season through country specific research and analyses on a wide range of child deprivations and their potential causal factors. The nature of deprivations children face, the importance and impact of these deprivations, and the environmental, social and economic factors that influence them have been examined in an attempt to enhance available research and analysis on Malawi and improve the efficiency and effectiveness of programming in country.

Figure 1: Seasonal deprivations in Malawi



** In comparison to the non-lean season*

*** In comparison to the post-harvest season*

**** In comparison to the beginning of the sowing season, when the school year begins*

The trend lines shown above indicate the magnitude of fluctuation in each variable. They are placed on the same axis to demonstrate the similarities in their trends. For the specific magnitudes of these fluctuations, please see the main report.

Findings of the study

This study establishes a clear link between the country's agricultural cycle and a range of deprivations, with the following pages summarising how deprivations fluctuate between seasons and those most vulnerable to them. For many deprivations, seasonal surges can have permanent or semi-permanent effects on child development, making understanding the cyclical nature of deprivations, and those who are affected by them, crucial to improving long-term development outcomes.

Seasonal fluctuations in educational outcomes

An estimated 5.2 million Malawian children were in primary education as of 2017/18 – a net enrolment rate of approximately 90%[1] (EMIS, 2018). While these rates are high, low attendance rates, poor grade progression and low education expenditures are negatively affecting educational attainment and child development. The lean season, which encompasses two of Malawi's three school terms, affects educational outcomes in two distinct ways uncovered by this study: reduced education expenditure and reduced school enrolment/attendance, as discussed below[2].

1. **Educational expenditures reduce in the lean season among ultra-poor households**

The education expenditures of the poorest quintile in Malawi (bottom 20% of households) fail to increase in line with school fees, unlike in average and richer households. Education expenditures in Malawi typically peak at the commencement of the lean season, as it coincides with the beginning of the school year when the majority of school fees are due, but competition for resources is seemingly leading poor households to reduce their education expenditures at this critical time of year, when agricultural inputs and labour are also required.

2. **Educational enrolment and attendance vary seasonally among vulnerable groups**

The U-report surveys conducted for this study found that educational attendance rates fell between October 2019 (the beginning of the first term) and February 2020 (the beginning of the second term) by 11%, with this finding highly statistically significant (U-report, 2020). Analysis of the 2017/18 Malawi Longitudinal School Survey (MLSS) data found similar seasonal fluctuations, with primary school enrolment and attendance rates falling nationally by 8% and 7% between October and February respectively, although the findings in this data are less consistent.

Affected vulnerable groups

Among the poorest households (bottom 20% of income), child headed households and households with a high dependency ratio demonstrate the lowest expenditures at the beginning of the school year, when an estimated 70% of school costs are due, with inevitable implications for school enrolment and attendance. In fact, child headed households spend on average 85% less per child in September and October than non-child headed, ultra-poor households.

School attendance for boys in disabled headed households is noticeably affected, dropping in the sowing season (October-December) by 12%. This most likely reflects the increased burden faced by boys when the household head is incapacitated and when labour demand is high, such as in the planting season.

[1] Net enrolment rate translates to the percentage of relevant school age children enrolling in the relevant level of education, i.e. primary school age children enrolment in primary school.

[2] The effects of the lean season on other education indicators, such as grade progression, are also likely to be significant, but insufficient data prevents their analysis.

Girls in disabled headed households are also 12% less likely to attend school than girls in non-disabled headed households, however this finding is consistent across the school year. This is most likely because they are expected to do a range of chores and household activities in lieu of an incapacitated household head.

Children in elderly headed households are also 16% less likely to be enrolled in primary school at the commencement of the school year (the beginning of the lean season) than children in non-elderly headed households. Furthermore, for boys that are enrolled in primary education, they are 7.5% less likely to regularly attend school in the growing season if they reside in elderly-headed households, compared to boys in non-elderly headed households. There is no clear seasonal relationship among girls in elderly-headed households.

The findings above are based on partial data as statistically representative information on child enrolment, attendance and attainment is limited. However, this data shows a clear and strong relationship between the lean season and educational outcomes, as well as between certain socio-economic groups and educational expenditure, attendance, and enrolment, which is likely representative of a broader national trend.

Seasonal fluctuations in child labour

Child labour is pervasive in Malawi. 1.72 million (41%) of children aged 5-13 and 401,000 (29%) of children aged 14-17[3] were involved in child labour in 2015, with these figures no doubt underestimating the magnitude of the problem with more dangerous and illicit forms of employment going underreported (NCLS, 2015; ILO, 2018). The lean season itself has a number of implications for child labour, with peaks not only in the prevalence of child labour at this time of year, but also in hazardous and exploitative work, with certain segments of the population particularly vulnerable.

3. **Child labour is twice as prevalent in the lean months of October to March than in the non-lean months of April-June.**

Child labour peaks in the lean season, with 54% of children aged 5-17 working in the lean season compared to 23% in the harvest season[4]. The fact that child labour remains high in the growing season (when labour demand is low) and drops in the harvest season (when labour demands are high) shows that child labour is not correlated with labour demand. In fact, as soon as harvests are yielded (from April), child labour decreases even though agricultural labour peaks at this time of year (De Janvry, 2018). These findings imply that child labour in Malawi is most likely a result of necessity and survival rather than the high marginal utility of child labour.

4. **The probability of being involved in dangerous work and experiencing at least one form of physical, verbal or sexual abuse at work increases significantly in the lean season**

The probability of being involved in dangerous work[5] increases by 60%[6] if a child works regularly in the lean season (4 months or more) compared to if they work regularly (4 months or more) in the non-

[3] Child labour for 14-17 years olds refers to those involved in 'hazardous work'
[4] The post-harvest season encompasses the school holidays, given the low opportunity costs of working at this time of year (no school-work time allocation trade-off) this season is omitted from this comparison.
[5] Dangerous work is classified as such if a child experiences exposure to any of the following while working: dust, fumes; fire, gas, flames; loud noise or vibration; extreme cold or heat; dangerous tools (knives etc); work underground; work at heights; work in water/lake/pond/river; workplace too dark or confined; insufficient ventilation; chemicals (pesticides, glues, etc.) and/or explosives.
[6] Predicted probabilities of 19.3% and 12.1% for lean and non-lean season respectively.

lean season[7], with this finding highly statistically significant (NCLS, 2015). Unsurprisingly, given the hazardous nature of seasonal work, the probability of a child experiencing at least one form of physical, verbal or sexual violence at work increases nearly 3 fold if they work regularly (4 months or more) in the lean season compared to if they work regularly (4 months or more) in the non-lean season (NCLS, 2015)[8].

Affected vulnerable groups

The probability of a child working at least 3 months in the lean season increases by 7 percentage points if the child lives in an ultra-poor household and 8 percentage points if they are in a child headed household.

The number of children in a household also has a significant bearing on child labour levels, with the probability of a child working (and the probability of them working for more months) increasing with household size. For instance, if you are a child living in a households of 5 children you are 11.5 percentage points more likely to work 3 months or more of the lean season and 15 percentage points more likely to work 6 months in the lean season, compared to an only child household (statistically significant at 5%) (NCLS, 2015).

Orphan children are also more at risk of excessive child labour in the lean season. This study finds that in the sowing season of October to December, the probability of an orphan working excessive hours (15 hours or more a week) is 13 percentage points higher than a non-orphaned child[9]. This trend does not persist across the year, showing that orphan children are vulnerable to seasonal labour demand, which peaks in the sowing months of October to December.

Children are also more likely to work excessive hours (15 hours or more per week[10]) in the lean season if they reside in districts characterised by either high levels of ultra-poverty, seasonal food shortages[1], or large scale agricultural/tobacco farming.

This study's analysis shows that not only does child labour increase in the lean season, but that children are more likely to work in hazardous employment and be subjected to emotional, physical or sexual abuse. Given the dangerous nature and potentially serious consequences of seasonal work, utilising the information above to target and assist vulnerable children is essential.

Seasonal fluctuations in child marriage

Malawi has the 12th highest rate of child marriage in the world[11], with approximately 42% of girls marrying before the age of 18, and 9% before the age of 15, with these numbers rising even higher in the lean season. This compares to just 6.5% of boys marrying before the age of 18 and less than 1%

[7] The variable for 'dangerous work' was constructed so that the total number of months worked in lean season and worked in non-lean season were comparable. Work outside of the lean season can encompass 1 month in lean season only.
[8] The predicted probability of facing any of these abuses at work is 13.3% and 5.1% for the lean and non-lean season respectively. Sexual violence was experienced the least by children working regularly in and outside of the lean season, at 2.2% and 1% respectively.
[9] Predicted probabilities of 25.5% and 39.5% for non-orphaned and orphaned children, respectively.
[10] In this report, we refer to excessive child labour as children between the ages 6-17 working 15 hours or more a week. As we cannot determine whether children aged 14-17 are involved in 'hazardous work', which the Government uses to define child labour for 14-17 year olds, all children aged 6-17 working 15 hours or more a week are considered to work excessive hours.
[11] Child marriage prevalence calculated as the percentage of women 20-24 years old who were married or in union before they were 18 years old (UNICEF, 2017)

before the age of 15[12] (DHS, 2016). Many studies have shown that early marriage impairs educational, social and psychological development; yet the implications of child marriage for girls is even greater, with early marriage among girls acutely associated with early pregnancy, lower education attainment and lower economic freedom, thereby reinforcing the gendered nature of poverty (Ibrahim et al., 2019; UNICEF, 2014).

5. **Child marriage rates for under 15s and under 18s peak in Malawi's lean season**

Malawi's lean season has a clear and statistically significant impact on child marriage, with the proportion of marriages involving a person under 18 and under 15 rising significantly in the lean season, from lows of 38% and 7% in the post-harvest season to highs of 54% and 17% in the sowing season for under 18s and under 15s respectively. Pressures to relieve the economic 'burden' associated with an additional households member and improve the household's financial predicament (64% of child marriages elicit a bride price or dowry payment) may explain the high rates of child marriage experienced in the sowing season, when agricultural expenditures and competition for resources are at their highest (NSO, 2018; Hopper et al., 2020).

Affected vulnerable groups

An examination of the key determinants of child marriage among girls in Malawi shows a highly statistically significant relationship between education level and age at marriage, with girls 5 times more likely to be married before the age of 15 if they have no education compared to if they attended secondary school (UNICEF, 2014). These findings are consistent across the agricultural calendar.

Ethnicity significantly influences the probability of early marriage in Malawi. Specifically, girls from the Nkhonde, Lomwe and Yao tribes are more likely to be married before the age of 15 than any other ethnic group in Malawi. In fact, you are twice as likely to be married before the age of 15 if you are Nkhonde (predicted probability of 21%) than if you are Chewa (9% predicted probability).

Girls are also particularly vulnerable to child marriage if they reside in elderly headed households, with girls in elderly headed households 53% more likely to be married before 18 than those in households with non-elderly heads. Similarly, the education of household head impacts the probability of early marriage among girls, who are 53% less likely to be married before 18 if the head of household attended secondary school compared to if they had primary only or no education (Haenni and Lichand, 2020).

Furthermore, with child marriages 3.5 times more likely to be the result of 'poverty' than adult marriages in Malawi[13], economic necessity is a clear factor in early marriages in Malawi (NSO, 2018).

The socio economic and environmental relationships above are consistent across the year and between seasons in Malawi. The lean season itself, however, does demonstrate a rise in both the prevalence (proportion of children married under the age of 18) and severity (the proportion of children married under the age of 15) of child marriages in Malawi, particularly in the sowing season, when the vulnerable groups identified by this paper are even more susceptible to early marriage.

[12] The child marriages referred to here refers to the number of 20-24 year olds surveyed who reported being married before 18 and 15 years of age, and thus reflects current levels of child marriage. If one includes all marriage before the age of 18 and 15 in the dataset, the child marriage rates increase.
[13] This refers to the reasons reported for marriage in the Traditional Practices Dataset (NSO, 2018)

Seasonal fluctuations in child morbidity

Environmental and climatic factors increase the prevalence of diseases and reduce the availability of food and nutrition in Malawi's lean season, directly affecting child health (Ghani et al., 2017). With children particularly susceptible to disease and infection, the lean season has a significant impact on a range of child health outcomes.

6. Malaria and cholera infection rates exhibit strong seasonal trends in Malawi

The proportion of under 5s who contract malaria is 8.8% higher in the growing season compared to the post-harvest season, with peaks in infection rates typically lasting from January to May. With an annual average contraction rate of 8.5% for under 5s, a seasonal swing of 8.8% represents a significant, seasonal shift. Cholera contraction in Malawi also exhibits a strong seasonal trend, with 88% of registered cholera cases occurring between the months February and April[14] (DHIS2, 2020).

7. Both diarrhoea and pneumonia contraction rates vary seasonally

The proportion of under 5s with diarrhoea and pneumonia peaks in Malawi's sowing season, with official district health data showing increases in infection rates of 1.3 and 1.4 percentage points respectively among under 5s, compared to annual infection rates of 2% and 3.5% (DHIS, 2020). These rates of pneumonia and diarrhoea among under 5s are projected to be underestimates, with survey data showing that 18% of households had at least one child in their home having diarrhoea in November 2019, compared to 21% in January 2020 and 11% in May 2020 (U-report, 2020).

Affected vulnerable groups

Infection rates for malaria, pneumonia and diarrhoea differ by socio-economic groups and household characteristics. For instance, the income and education level of a household impacts the use of mosquito nets and the probability of contracting malaria among under 5s, with the probability of infection varying from 11% for the richest households to 41% for the poorest households[15], and from 6% for households with higher education to 32% for households with no education (Malaria Indicators Survey, 2017). However, income and education level have little impact on diarrhoea and pneumonia contraction rates.

Children are also more likely to contract malaria if they reside in elderly headed households**,** with the predicted probability of a child under 5 contracting malaria increasing from 26.5% for non-elderly headed households to 33% for elderly headed households, controlling for other determining factors (DHS, 2018). Poor data on malaria contraction among child headed households precluded this analysis; however, children under 5 in child headed households have a far higher probability of exhibiting symptoms of pneumonia (predicted probability of 19.5%) compared to adult headed households (predicted probability of 11%) (DHS, 2000, 2004, 2011, 2016).

A household's water and sanitation facilities are also significant determinants of a range of health outcomes. Households who use an open well or river for water consumption are 2.5 times more likely to have children under 5 contracting diarrhoea than those households that have a tap at home (predicted probabilities of 15% and 40% respectively) (U-report, 2020). Furthermore, children under 5 are over 3 times more likely to contract malaria if they live in households that collect water from an unprotected spring, compared to households whose main source of water is piped into their home or

[14] This analysis is based on data from January 2016 to December 2019. Data reported by district health offices.
[15] Poorest households refer to the poorest 20% in Malawi. Richest households refer to the wealthiest 20%.

plot (DHS, 2018). A household's water source has a seemingly small impact on annual pneumonia contraction rates; however, in the sowing season, a household's primary drinking source is an important determinant of pneumonia contraction among under 5s, with the predicted probability of a child under 5 contracting pneumonia 2.7 percentage points higher in households where the primary drinking water comes from surface water sources such as rainwater, rivers, lakes or damns (13.5%), compared to households where the primary drinking water source is piped into their home (10.8%) (DHS, 2000, 2004, 2011, 2016).

Household sanitation facilities impact infection rates for both pneumonia and diarrhoea, with these factors increasing in significance in the lean season. The predicted probability of contracting diarrhoea or pneumonia is 7.5% and 5.5% higher in the sowing season for under 5s who live in households without a toilet facility, compared to those with a flush toilet (DHS, 2000, 2004, 2011, 2016).

The transmission of many parasitic, viral, and bacterial diseases in Malawi is influenced by a range of environmental and climatic factors. While temperature and rainfall have been found to determine the spatial and seasonal distribution of many water and vector borne diseases; geographic, demographic and socio-economic factors clearly alter the magnitude and population of disease burdens in Malawi.

Seasonal fluctuations in child malnutrition and mortality

"Seasonal food scarcity and climate shocks (such as droughts) have long been shown to drive short-term malnutrition, morbidity, and, in Africa, mortality in vulnerable populations, especially women and girls" (Ghani et al., 2017). Malawi is no exception, with seasonal peaks in disease prevalence and food insecurity leading to increases in acute malnutrition and child mortality.

8. **Food security, dietary diversity and malnutrition are inextricably linked to Malawi's agricultural cycle**

Self-reported food insecurity patterns follow the harvest season closely, ranging from just under 10% of households in May 2016 (the middle of the harvest season) to around 57% in January 2017 (the middle of the lean season) in rural households, effecting dietary diversity and nutrition. Wasting increases by 3 percentage points in the growing season in Malawi compared to the post-harvest season (IHS4, 2017)[16], while the number of households consuming 4 or more food groups increases by 35% in the harvest season compared to the lean season (DHS, 1992-2015). While indicators of chronic malnutrition do not appear to demonstrate a clear and obvious cyclical pattern over the agricultural cycle, seasonal variations in weather and climate can clearly exacerbate chronic malnutrition and play a significant role in reducing the probability malnutrition in the wake of climate shocks.

9. **Child mortality shows strong seasonal trends in Malawi, in line with the agricultural calendar and fluctuations in food security, morbidity and malnutrition**

There is a clear and statistically significant excess of reported child deaths (+10% in under 5 mortality) in the growing season compared to the post-harvest season in Malawi, demonstrating the devastating and permanent impact of the lean season on children and their families[17] (DHS, 2000, 2004, 2011,

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[16] Wasting is a ratio of weight to height. The weight-for-height z-scores used to calculate this indicator were computed using the 2006 WHO growth standards, which define a child with a height-for-weight z score of less than -2 (2 standard deviations below the median) as 'wasted' (Bloem, 2007).

[17] Similarly, using child mortality from the DHS (2015) birth recode, we can see there is clear and statistically significant excess of reported child deaths (+9.8% in under 5 mortality) in the growing season compared to the post-harvest season. These changes are also supported by Hopper et al. (2020) analysis using DHS (1992-2015).

2016)[18]. These patterns are consistent for infant and neonatal deaths over this period, with infant and neonatal mortality increasing 9.7% and 6.9% respectively between the post-harvest and growing season.

Affected vulnerable groups

Income has a significant bearing on rates of malnutrition and mortality. The predicted probability of a child under 5 being wasted reduces as income increases, from 6.8% for the poorest quintile to 4.6% for the richest quintile, but has a far more substantial impact on child mortality, with a child 12% more likely to die before their 5th birthday if they reside in households in the lowest wealth quintile compared to households in the highest wealth quintile, controlling for other factors (DHS, 2016).

Furthermore, households with no education and households where the highest level of education is primary education, are 20% and 15% (respectively) more likely to lose a child under 5 than households with tertiary education[1], controlling for other determining factors (DHS, 2000, 2004, 2011, 2016).

Children under 5 years that reside in child headed households are almost 18% more likely to be wasted, with a predicted probability of 23.6%, compared to adult headed households, who have a probability of 5.4%, with this finding statistically significant at 5% (IHS4, 2017). Insufficient data was available on child-headed households to conduct mortality analysis. However, the relationships between child mortality and elderly headed households were significant and surprising.

Under 5, infant and neonatal mortality rates are higher in elderly headed households, with this relationship far stronger for girls than boys, with girls 37% more likely to die before their 5th birthday compared to 7% for boys if they reside in elderly headed households, compared to non-elderly headed households (DHS, 2000, 2004, 2011, 2016).

Poor sanitation also has a significant impact on under 5 mortality for girls only, who are 56% more likely to die before their 5th birthday if they live in a household with no sanitation facility, compared to one that has a flush toilet. This relationship is equally as strong for both infant and neonatal mortality rates for girls but does not exist for boys of any age group.

Despite the statistical significance of the effects of sanitation and elderly headed households on girls, this study recommends further examination of these relationships to determine to corroborate the validity of these findings.

Seasonal spikes in child malnutrition and mortality demonstrate clearly how seasonal fluctuations in deprivations can have potentially permanent consequences for child wellbeing and development.

Conclusion and Recommendations

Malawi's lean season is a result of the concurrence of the country's rainy season (characterised by extreme weather events) and its sowing/growing seasons (characterised by low agricultural production and food insecurity). These events lead to a range of adverse outcomes for children, which are precipitated by reduced seasonal consumption, increased prevalence in diseases, and rising mortality.

[18] Information collected on birth histories is presented by mothers in the birth recode dataset. The quality of these estimates thus depends on the mother's recall ability, which can lead to potential data quality issues. In order to avoid duplication and reduce the impact of recall bias, only data in the years between survey rounds and in the 5 years prior to the DHS survey were used.

Vulnerable socio-economic groups

While trends in deprivation are clear, they do not exist for all households and socio-economic groups equally. Analysis shows, however, that children living in ultra-poor households, child- and elderly-headed households, and disabled-headed households are disproportionally vulnerable to seasonal deprivations in Malawi.

Variable consumption paths are not uncommon in sub-Saharan Africa countries due to their single primary harvest seasons. In such environments, annual cycles exist for many economic variables, including labour, wages, migration patterns and prices, in line with food and cash crop production (Christian and Dillon, 2016). These economic influences impact children in a number of ways, from reduced food consumption and nutrition, to increased child labour, trafficking and marriage. While extreme climatic events at this time of year also increase the spread of disease and infection (DCCMS, 2020, Godfrey, et al., 2019; Okuni, 2019). Combined, these seasonal factors have a range of impacts on child deprivations, including rising child morbidity and malnutrition; reductions in education expenditure, attendance, and progression; increases in child labour and marriage; and rising child mortality. The types of households vulnerable to these deprivations have a number of consistent socio-economic characteristics, as shown in this study. However, due to a dearth of data on a range of deprivations and/or socio-economic characteristics, there are likely to be a number of relationships not fully explored or uncovered by this research. Furthermore, while this study examined how deprivations vary over Malawi's seasons and in different environmental, social and economic contexts, the relationships between these deprivations needs to be examined further if responses to seasonal deprivations are to be as effective and efficient as possible.

In light of the above, four recommendations are made with regards to potential policy, programming and future research in Malawi. These are as follows:

1. **Season sensitive programming.** As this study has shown, the lean season impacts on a range of child deprivations beyond food insecurity, most notably in the areas of education, health and child protection. At present, the majority of government or partner implemented programmes in Malawi remain consistent throughout the year, failing to account for seasonal changes. Yet adaptive programming that is responsive to seasonal needs is essential in Malawi: it is not only needed to mitigate the impacts of rising seasonal deprivations, but is integral for preserving long-term, developmental outcomes. Furthermore, with children effected in a multitude of ways, the impacts of the lean season can be better mitigated if the provision of services, and the linkages and referral mechanisms between programmes/services are improved, thereby helping children access all services they require.

2. **Seasonal emergency/lean season responses should target and respond based on more than food security.** Every year, Malawi's lean season sees huge spikes in food insecurity, which precipitate a humanitarian response. In fact, over the last ten years an average 1.8 million[19] people in Malawi (approximately 10% of the rural population) have been in receipt of emergency food assistance in the lean season (October – March), with these numbers expected to worsen as environmental degradation and population growth continue to increase[20] (Cherrier, 2019, Ofori-Kuma, 2019; World Bank, 2020b). At present, Malawi's seasonal

[19] This figure is 1.4million if one excludes the exceptional drought year of 2016/7 when 6.5 million Malawians were in need of assistance. These figures are calculated between 2010/11 and 2019/20.
[20] Malawi's population is projected to double between 2020 and 2040

emergency responses are based solely on food deficits. Yet with children vulnerable to a host of deprivations, seasonal emergency responses (or lean season responses) may be far more effective if a range of deprivations and specific groups vulnerable to multiple deprivations are targeted. The characteristics associated with a wide range of seasonal vulnerabilities, as identified in this report, can also help improve responses by guiding targeting to reach a broader range of vulnerabilities and vulnerable groups.

3. **Increased coordination and joint programming.** Major development challenges are often multidimensional and addressing poverty in Malawi, and the various forms it takes, is no exception. Programmes in Malawi frequently lack coordination and tend to focus on specific sector responses. Yet the importance of inter-sectoral coordination and programming cannot be understated. Integrated approaches can not only improve the cost effectiveness of programmes but their efficiency and effectiveness. In fact, many of the deprivations outlined in this report cannot be successfully addressed in isolation, with the relationship between child labour and education highly significant, as shown in this study. With many deprivations interdependent, tackling the adverse effects of the lean season would no doubt be substantially improved by coordinated programming/responses. While relationships between some deprivations have been reported in this study, with few datasets containing information on multiple deprivations, it is not possible to conduct comprehensive analyses on these relationships. Further data collection is required and recommended by this report.

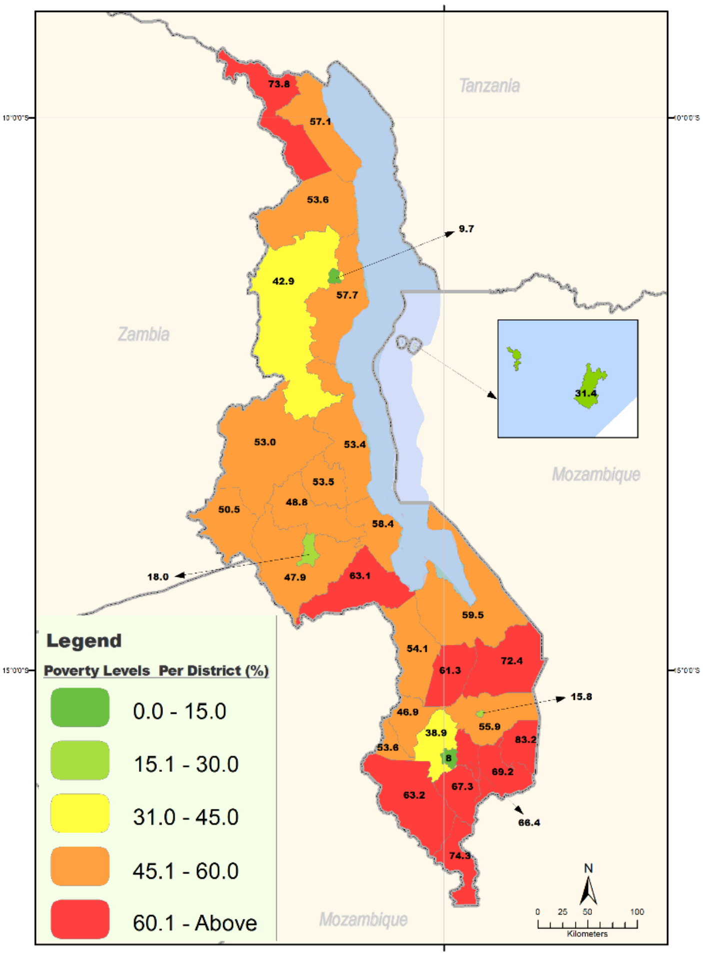
4. **Further data collection and research.** The limited availability and quality of data in Malawi prohibits comprehensive analysis of seasonal fluctuations in deprivations and their causal factors. The analysis conducted in this report is based almost exclusively on cross-sectional data. To undertake seasonal analysis on this data is challenging, but given the serious impact of the relationships uncovered in this report, with the lean season effecting on a range of deprivations in Malawi, collecting reliable deprivations data by tracking households and children over one or more agricultural cycles could prove invaluable in determining the impact of seasonal (as well as covariate and idiosyncratic) shocks on a range of deprivations. Furthermore, with many deprivations seemingly interlinked, and coordinated action to seasonal deprivations possible, further data collection is required and encouraged to determine the strength and nature of relationships between deprivations. This would not only improve the quality of analysis on socio-economic factors but enable analyses of the relationships between deprivations and their cumulative impacts, thereby expanding the scope and use of this data.

1. Introduction

Background and Country Context

Malawi's socio-economic profile

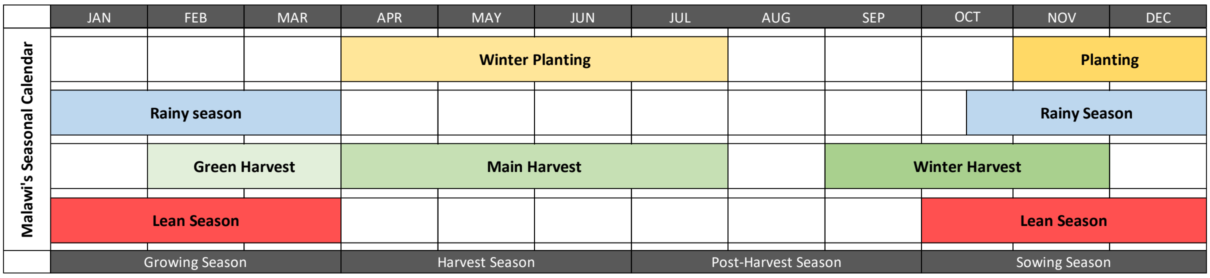
Malawi is the third poorest country in the world and ranks in the bottom decile of the Human Development Index (World Bank, 2020; UNDP, 2020). 20% of the country's population live in extreme poverty, defined as an inability to satisfy basic food needs, while 70.3% live below the international poverty line, set at $1.90 a day. The most rural and remote districts in the far north and south of the country are also the most impoverished, experiencing poverty levels above 70% and ultra-poverty rates over 50%[21] (NSO, 2016/17; World Bank, 2020).



Malawi's dependence on rain-fed agriculture means the country is beset by slow and volatile growth, which has precipitated low overall poverty reduction. Agriculture accounts for approximately 35% of Malawi's GDP, but supports nearly 85% of the population. Almost 2 million of the 2.7 million hectares of farmed land in Malawi are cultivated by smallholder farmers, who typically preside over small and fragmented plots of less than 1 hectare. These small land sizes are insufficient to meet household needs and mean that over 80% of smallholder farmers are net buyers of maize (Holmes, et al., 2017; FAO, 2017).

With the majority of Malawians dependent on rain-fed agriculture, which is characterised by a single, main harvest season and a long lean season, the lives and livelihoods of the Malawian people are inextricably linked to the country's agricultural cycle (see Figure 2). Widespread chronic poverty and high vulnerabilities mean that even predictable, recurrent lean seasons, which are characteristic of the country's agricultural cycle, can prolong and/or deepen household and child poverty, effecting not only economic and food security but a host of other deprivations (FAO, 2017; Cherrier, 2019).

Figure 2: Malawi's seasonal calendar and associated impacts on wellbeing



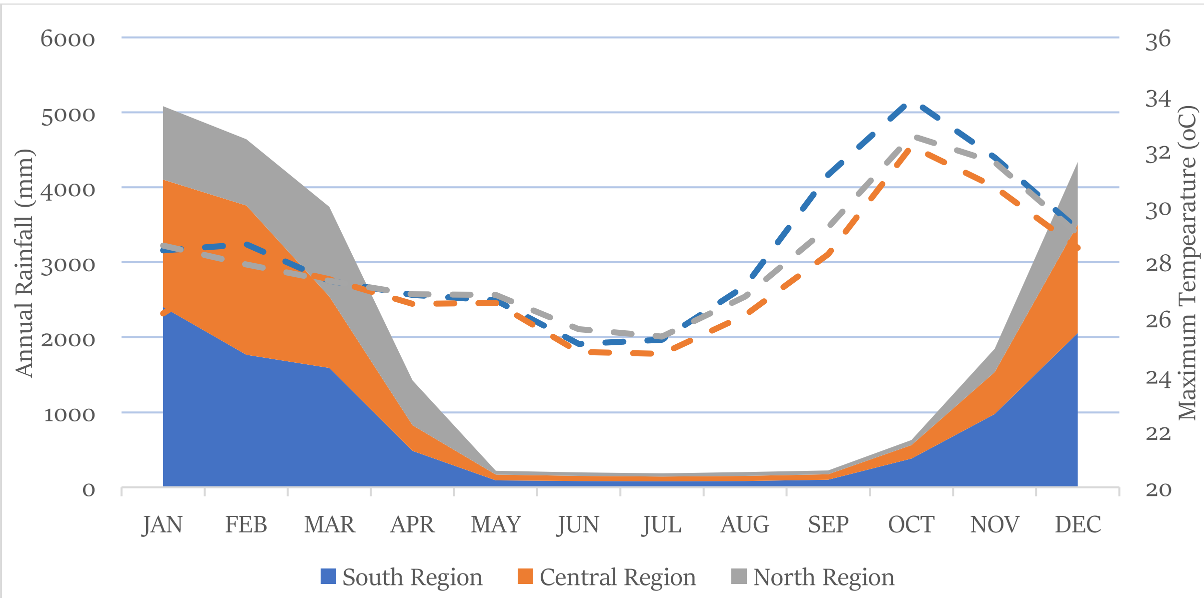
Source: Holmes et al (2017:14); FEWSN (2019)

Malawi's Agricultural and Weather Cycles

Every year, Malawi's agricultural and climate cycles lead to seasonal social and environmental stressors, which threaten the ecological system, affect livelihoods, and impair the wellbeing of many Malawians. These pressures are primarily the result of Malawi's rainy and sowing/growing seasons, with the former characterised by extreme weather events and the latter by low agricultural production and food insecurity.

Malawi's rainy season stretches from November to April, when around 90% of annual precipitation takes place, as shown in Figure 3. These excessive rains leave low-lying areas, such as Salima, Karonga and the Lower Shire Valley and river basin, particularly susceptible to flooding, which can not only damage crops, but destroy infrastructures, displace households and affect livelihoods. Malawi's rainy season coincides with its growing and sowing seasons, which are characterised by low agricultural output, high agricultural prices, and rising food security. It is the critical concurrence of Malawi's rainy and sowing/growing seasons that make the lean season so significant and devastating.

*Figure 3: Total monthly rainfall (mm) and max temperatures (oC), 2017**



Source: DCCMS (2020)

*Notes: *Likoma Island's data is for 2015, the latest period for which yearly data was available.*

Motivation for the Study

While the impact of the lean season on food security is well documented, there are a number of deprivations that rise in the lean season, but which are less prominent in the discourse, despite having equally important implications for child health, wellbeing and development.

Children are among the most susceptible to seasonal deprivations, not only due to their reliance on elders for the provision of essential goods and services, but because they experience a range of specific seasonal deprivations. In Malawi, an estimated 61% of children suffer multi-dimensional poverty, with children deprived in areas such as education, water, nutrition, housing, sanitation and health (NSO, 2018). The cyclical nature of vulnerability in Malawi means that many deprivations peak in the lean season, which can have potentially permanent implications for child development and wellbeing. As such, addressing the cyclical aspects of these deprivations is crucial to mitigating their long-term effects and improving developmental outcomes.

This study intends to enhance the evidence base on how children are affected over the lean season through country specific research and analyses on a wide range of child deprivations and their causal relationships. This study focuses on child deprivation in Malawi's lean season specifically, examining the nature of deprivations children face, the importance and intensity of these deprivations, and how deprivations are affected by environmental, social and economic factors.

Country-specific evidence is essential for effective programming and policy; yet information on seasonal deprivations and their determinants in Malawi scarce, with this study the first cross-sector evaluation of seasonal deprivations in Malawi.

Through examining a range of education, health, nutrition, WASH and child protection indicators, this study unveils the integrated and interdependent nature of child deprivations in Malawi, with the magnitude of these deprivations and the key socio-economic and environmental factors that influence these relationships forming the focus of this study.

2. Approach and Methods

Research Design

Experts from UNICEF Malawi's social protection, health, nutrition, education, child protection and WASH sections contributed to the design of this study. Specifically, the study's research questions were formulated through extensive consultation with section focal points, utilising the organisation's wealth of knowledge and expertise on child deprivations. These questions, listed below, frame the study's analysis, the results of which were then tested within UNICEF to confirm the validity and strength of these findings.

Research Questions

Education: *School Enrolment, Attendance and Expenditures on Education*

1. Are school enrolment and attendance rates effected over the lean season?
2. Are changes in attendance and enrolment rates concentrated in districts adversely affected by the lean season or among certain socio-economic groups?
3. Do household education expenditures change in the lean season? Do expenditure patterns vary by household type/income level?
4. What household socio-economic characteristics are most important in determining reduced education expenditure over the lean season?

Child Labour: *Labour, Trafficking and Child Time Allocation during School Terms*

1. Does child labour and trafficking differ seasonally? Is this increase consistent across the country or concentrated in certain districts and at certain periods of the lean season?
2. Is the prevalence of child labour and trafficking effected by environmental and/or social-economic conditions? Are these effects more pronounced in the lean season?
3. Given the evidence above, what are the potential causal pathways through which the lean season impacts child labour and trafficking in Malawi?
4. What evidence is there that child labour impacts on other deprivations in the lean season?

Child Marriage: *Early Marriage in Under 15s and Under 18s*

1. Does child marriage increase in the lean season in Malawi? Is this increase consistent across the country or concentrated in certain districts or among certain ethnic groups?
2. Is the prevalence of child marriage in the lean season effected by environmental, social or economic conditions? Are these effects more pronounced in the lean season than the rest of the year?
3. Given the evidence unveiled, what are the potential causal pathways through which the lean season impacts child marriage in Malawi?

WASH, Health and Nutrition: *Morbidity, Mortality and Malnutrition*

1. Do household expenditures on healthcare decrease in the lean season? Are socio-economic groups affected differently?
2. Are child morbidity, malnutrition and morbidity rates affected by the lean season? Are socio-economic groups affected differently?
3. Does combining socio-economic characteristics with information on access to WASH facilities influence deprivation outcomes?

Cross-Cutting Analysis: *Relationships between Multiple Deprivations and Socio-Economic Characteristics*

1. What types of households, disaggregated by socio-economic characteristics, are more vulnerable to increases in deprivation over the lean season? (This analysis identifies households that typically experience multiple deprivations over the lean season).
2. What types of households, disaggregated by socio-economic characteristics, are more vulnerable to key deprivations?
3. How do different deprivations interact and affect each other over the lean season? Are these interactions dependent on certain environmental characteristics?

Research Methods

A broad range of disciplines have been actively engaged in the research and understanding of poverty and deprivation. Due to the vast literature on this subject, this study does not provide a systematic review of the available literature, rather a heuristic review of the available evidence, based on existing meta-analyses, supplemented by expert interview and recent research.

Due to the multi-faceted nature of this study, and the limitations of the available data, a mixed methods research approach was pursued. Quantitative analyses were conducted where possible to confirm and identify new relationships, while a wide range of qualitative approaches, employed in isolation or in combination with quantitative methods, were used to supplement or triangulate findings. These methods are discussed in more detail below.

Quantitative Methods: Simple descriptive statistics are used in this study to uncover statistical regularities and find patterns in the data. Simple descriptive statistics do not control for confounding factors or allow for determination of causality. Inferential statistical exercises, such as confidence intervals, regression analyses, and hypothesis testing have been conducted where possible to isolate the specific contributions of variables of interest. Statistical models were tailored to the properties of the data and the nature of the outcome variable.

Qualitative Methods: Non-numeric information was used to complement and expand on the descriptive and inferential analyses outlined above. Due to data constraints, defining causality is not possible, but through qualitative research and triangulation, a rich analysis that can inform policy design and decision making has been produced. This qualitative analysis predominantly involves in-depth interviews with key experts within UNICEF and further afield to elicit the necessary narrative.

Interpretation of Quantitative analysis

The quantitative research in this study uses a range of descriptive and regression analyses. Statistical analysis was tailored to the properties of each model, depending, among other things, on the nature of the outcome variable. For dichotomous variables, logistic regressions were used; for polychotomous variables, ordered logistic regressions; and for normally distributed continuous variables, OLS regressions were used.

Predicted Probabilities

Predicted probabilities are used in this report to estimate the likelihood of events occurring. All likelihood estimates, unless stated otherwise, thus refer to predicted probabilities, which are calculated by taking the number of positive events in a sample and dividing by the total number of events in a sample. As the probability of an event occurring is based on sample rather than population data, it is a 'predicted' rather than 'actual' probability estimate.

Probability estimates are best demonstrated through example. The equation below shows the probability of 'a' occurring when 'a' represents the number of times an event occurred in the sample and 'b' represents the number of times the event did not occur in the sample. For example, in this equation, 'a' may represent the number of female-headed households in the dataset that were poor, and 'b' the number of female-headed household in the dataset that were not poor, with the equation below therefore producing an estimate of the probability of a household being poor if the head is female:

$$a/(a+b)$$

All predicted probabilities in this report use Average Adjusted Predictions unless stated otherwise. What this means is that the model predicts the probability of the outcome variable (in our example, household poverty) by assuming that all datapoints in the model have the tested value (in our example, that the household head is female) while keeping all other independent variables in the model as they.

Odds Ratios

In very few instances in this report, an odds ratio is used to estimate the relative likelihood of an event occurring. This is clearly stated where this is the case.

Odds ratios are similar and related to probability but produce very different results, as shown be the equations below where 'P' refers to the probability of an event. The odds ratio is the ratio of the event occurring in the test group (e.g. a household being poor, and female-headed) compared to it occurring in the control group (e.g. the household being poor, and male-headed)

The odds ratio represents the odds that an outcome will occur given a particular exposure, compared to the odds of the outcome occurring in the absence of that exposure. For instance, if O1 is the odds of an event in the test group (e.g. a households being poor and female headed) and O2 is the odds of event in the control group (e.g. a households being poor and male headed) then the odds ratio is O1/O2.

$$Odds = \frac{P1}{1 - P1}$$

$$Odds\ Ratio = \frac{P1/(1 - P1)}{P2/(1 - P2)}$$

Finally, it should be noted that all statistically significant findings are reported with their significance, measured at p-values of 10%, 5% or 1%. When this report refers to 'high statistical significance', this means a p value of less than or equal to 0.01 or 1%, representing a very strong statistical relationship.

Data Sources

This study relies on secondary data sources for most of its analysis. These datasets are listed in Annex 1. In several instances, analysis was conducted through appending survey rounds over several years to provide a larger dataset on vulnerabilities. Where this is done, potential differences across survey rounds were accounted for so that comparisons could be made without concerns for confounding effects due to the time of survey.

Primary data was collected for this study using UNICEF's surveying tool, the 'U-report'. The U-Report allows for text-based surveys to be sent to registered 'U-reporters', who totalled approximately 180,000 persons at time of this study's first survey.

Through this platform, a 10-point survey on how households were affected in the lean season was disseminated, with data collected in November 2019, January/February 2020, and April 2020 (please see Annex 2 for survey detail). Response rates approximated 18% for all three surveys, providing data points for over 30,000 households. Responses were naturally higher in more populous areas but were recorded in all districts with responses proportional to regional population size.

The data collected using the U-report is a non-random sample of the country's population and is heavily skewed toward households containing young people with mobile phone access, with 85% of respondent 30 years old or younger and 65% male. As such, no national or regionally representative inferences can be made using this data.

Limitations of Analysis

It is important to keep in mind there are a number of inherent limitations to undertaking this analysis, with specific causal relationships hard to discern given the limitations of the data available in Malawi. Dependence on incomplete secondary data sources for key control, test and outcome variables inhibits this study, as does the dearth of longitudinal data on household behaviour and wellbeing.

Since this study is based on cross-sectional data, it is not possible to establish causation between factors, rather one can only describe relationships between child deprivations and socio-economic, seasonal, and geographical influences. As such, this study identifies key trends and patterns in the data and draws on standard theories and expert interview to identify the potential nature/causality in these relationship, triangulating evidence where possible.

3. Findings of Research

This study is the first cross-sector evaluation of seasonal deprivations in Malawi. Building on the wealth of expertise across UNICEF Malawi, this research provides a multi-sectoral approach to understanding seasonal deprivations in Malawi. Experts from UNICEF Malawi's social protection, health, nutrition, education, child protection and WASH sections contributed to the design of this study and provided extensive feedback on the findings discussed below.

The information in this section presents a complex picture on deprivations and seasonal fluctuations in Malawi, and highlights the precarious situation of many households struggling with multidimensional poverty. Due to the inter-related nature of many of these deprivations, inferences across section areas are made where possible.

Seasonal Fluctuations in Education Outcomes

Seasonal fluctuation in school participation in Malawi illustrate both the "impact of the agricultural cycle on school attendance and the effects of food insecurity", with "the most significant decline in attendance rates tend to be found in rural areas during the lean season" (ILO, 2016)

An estimated 5.2 million Malawian children were in primary education as of 2017/18 – a net enrolment rate of approximately 90%[22] (EMIS, 2018). While these rates are high, grade progression and school completion rates are alarmingly low, with only 50% of learners completing primary school, 40%[23] passing the primary school leavers exam, and 16% entering secondary education (MoEST, 2019; EMIS, 2018). Grade repetition is also a major challenge in Malawi. Only 6.5% of children who started primary education in 2011 completed Malawi's 8-year primary education programme by 2019. In fact, on average it takes a child 13 years to graduate primary school in Malawi (MoEST, 2019), with repetition rates particularly high during standard 1 due to low preparedness from early childhood education (Barrington et al., 2019a)[24]. These delays naturally have significant financial implications for households and government alike.

Poor grade progression and high drop-out rates inevitably hinder child development. Low educational attainment not only limits the next generation's literacy, employability and wellbeing, but is associated with a marked rise in other deprivations, most notably poorer health outcomes (UNESCSO, 2013), reduced lifespan (IMF, 2017) and increased child marriage and labour (Makwemba et al., 2019). With low educational attainment significantly impairing wellbeing and development, determining the key factors that contribute to poor educational outcomes is essential.

[22] Net enrolment rate translates to the percentage of relevant school age children enrolling in the relevant level of education, i.e. primary school age children enrolment in primary school.
[23] 79% of those who complete primary school
[24] This study focused on only 3 districts in Malawi and on SCTP households only.

Seasonal education expenditure patterns

The lean season, which encompasses two of Malawi's three school terms, affects a range of education outcomes that impact grade progression and educational attainment. During this period, most notably the sowing season, regular household spending and agricultural investments are in competition with school expenditures, forcing some households with resource and credit constraints to reduce their education expenditures.

As of September 2018, both primary and secondary tuition fees were abolished in Malawi. However, indirect school and exam costs remain significant barriers to schooling in Malawi, particularly among poorer households. The estimated total value of school-related costs (including uniforms, school supplies, exam fees etc.) is MK106,627 for primary school students per year and MK152,125 for secondary school students per year respectively (Barrington et al., 2019a). These costs are substantial for many households, with yearly primary school fees constituting approximately 50% of the average Malawian household's annual consumption per capita (Barrington et al., 2019a; IHS4, 2016/17).

Figure 4: School fees over the school calendar

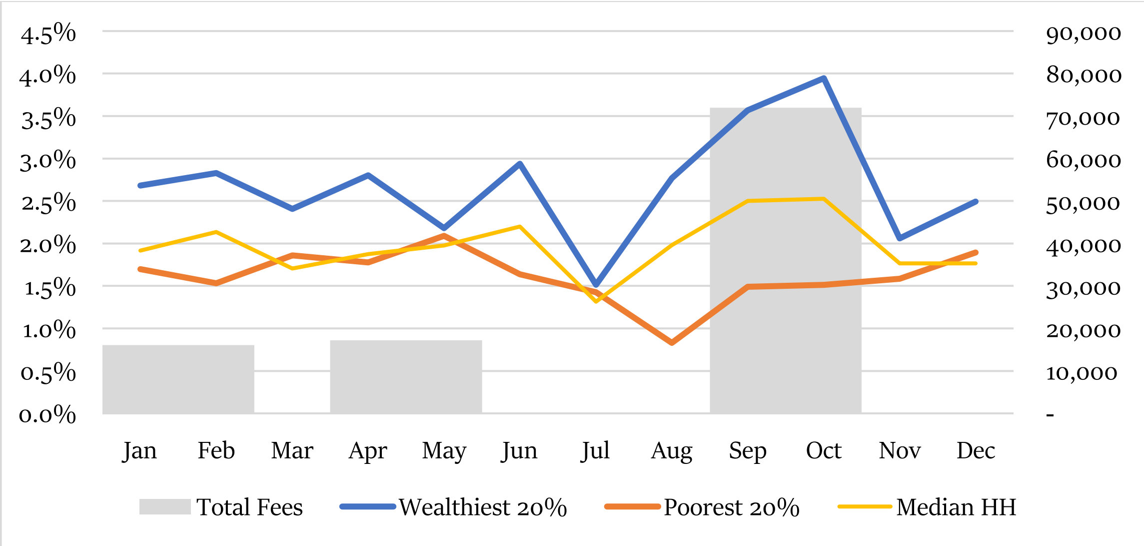
	Primary	Secondary
Books & stationery	47,320	47,320
Clothing & Uniform	55,900	55,900
Exam fees	1,177	29,204
School lunch and Canteen	967	4,292
Other	1,263	15,410
Total	106,627	152,125

Source: Barrington et al. (2019)

Education expenditures in Malawi typically peak at the commencement of the lean season, as it coincides with the beginning of the school year when the majority of school fees are due[25]. As can be seen in Figure 5, the education expenditures of the poorest quintile in Malawi (bottom 20% of households) fail to increase in line with school fees, unlike in average and richer households. The capacity of households to adjust their expenditures in line with fees varies significantly by income. In fact, education expenditures among the poorest 20% of households are 28% lower in September compared to May, which is the highest expenditure month for poorest households. This is a marked contrast to the education expenditures of average and wealthy households, whose education expenditures fall below their annual averages in May and peak in September and October, in line with fees. For the poorest 20% of households, this increase in expenditure is not realised, potentially as investments in agricultural inputs crowd out other expenditures during the planting season. Poor households are thus less likely to be able to raise their education expenditures at the beginning of the school year, when the majority of fees are due, but are able to increase their expenditures in the harvest season, when school expenditures and costs are typically low.

Figure 5: Education Expenditure (%) by income group and primary school fess (MKW)

[25] Education expenditures fall on average 9% in the growing season compared to the post-harvest season (IHS, 2010/13/16), ; however, this most likely reflects the school calendar, as school fees and costs are typically highest at the beginning of the school year (September and October) and peak again at the beginning of each school term (circa. January and April) (IHS4, 2017).

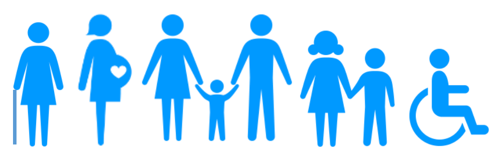


Source: IHS4 (2017); Silva (2020)

Socio-economic characteristics of low education expenditure households

Among the poorest 20% of households in Malawi, certain socio-economic groups are more likely to have lower education expenditures. The following analysis looks at education expenditures per child for the poorest quintile in Malawi. This analysis examines expenditure patterns at the commencement of the school year only (September and October) when the majority of school fees are due, and expenditure is required to peak. Thereby examining who among the poorest households are least likely to adjust their education expenditures when needed. This analysis found the following:

- **For the poorest 20% of households, education expenditure per child is 30% higher if the household head has completed primary school compared to if they have no education**, and increases by another 20% per child if the household head went to secondary school (IHS4, 2017). This finding highlights the intergenerational nature of human capital and poverty in Malawi.
- **This study finds that for every 0.1 increase in the dependency ratio, there is a 9% reduction in education expenditure per child among the poorest 20% of households**. This finding is highly statistically significant at 1%, controlling for other determining factors. What this means is that a poor household with two fit-to-work persons and 3 dependents will spend 31% less per child on education than a poor household with one fit-to-work person and 3 dependents. Again, this analysis relates to the beginning of the school year only when poorer households have markedly lower expenditures and the majority of school fees fall due (IHS3, 2011; IHS4, 2017). The dependency ratio is the ratio of fit-to-work persons in a household against non-fit-to-work persons, classified as children under 18, household members in the age bracket 19-25 years attending school, persons over 65 years, and persons 19-64 years who are unable to work due to illness or disability. While education expenditure per child falls as the dependency ratio increases, total education expenditure per household rises slightly. Thus, although the poorest



Households with larger dependency ratios spend less per child on education than households with lower dependency ratios households increase their spending on education as household size rises, the amount is insufficient and expenditure per child reduces.

- **Child headed households also demonstrate far lower education expenditures at this critical time of year. In fact, among the poorest households, child headed households spend on average 85% less per child than non-child headed households in September and October.** This finding is statistically significant at 10%, controlling for other determining factors. It has long been recognised that child heads of household sacrifice their own education (Gubwe et al., 2015; Masondo, 2006). However, the extremely low level of education expenditure among child headed households means that all children in the household, not just the head, are affected, with inevitable conseqeuences for school enrolment rates given the timing of when this analysis was conducted (the beginning of the school year).

Child headed households have by far the lowest education expenditures of any socio-economic group in Sep/Oct when the majority of school fees fall due.

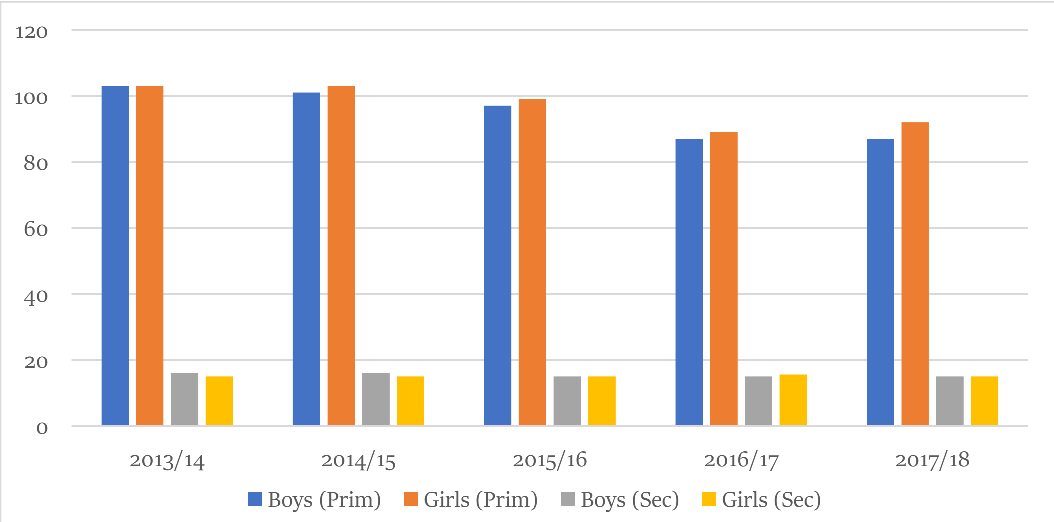
What this analysis shows is that expenditures on education for the poorest 20% in Malawi, particularly in child headed households and in households with many dependents, fail to increase at the commencement of the school year when the majority of school fees fall due. This will have inevitable implications not only for education spending but for school enrolment rates.

Analysis on education spending by child gender cannot be reliably conducted using the IHS4 (2017) as only household level expenditure is recorded, and as such no attempt is made to do so.

Seasonal school enrolment and attendance

Primary school net enrolment rates[26] have remained consistently high in recent years, while secondary school net enrolment rates have remained consistent from 2013/14 to 2017/18, fluctuating between 15% and 16% for both sexes, as shown in Figure 6.

Figure 6: Trend in Primary School Enrolment (Net Enrolment Rate, %)



[26] Net enrolment rate translates to the percentage of relevant school age children enrolling in the relevant level of education, i.e. primary school age children enrolment in primary school.

Source: EMIS (2018)

Despite enrolment rates remaining consistent between years, educational enrolment and attendance vary considerably within an academic year[27]. The U-report surveys conducted for this study found that educational attendance rates fell between October 2019 (the beginning of the first term) and February 2020 (the beginning of the second term) by 11%, with this finding highly statistically significant (U-report, 2020)[28]. Unfortunately, due to the covid-19 pandemic and subsequent school closures, no further questions on seasonal school attendance were asked in the April/May survey rounds[29].

Analysis of the 2017/18 Malawi Longitudinal School Survey (MLSS) data found similar seasonal fluctuations, with primary school enrolment and attendance rates falling nationally by 8% and 7% between October and February respectively[30]. However, disaggregation of this data presents a far from clear picture on seasonal enrolment and attendance rates, with no clear national or regional pattern. These inconsistent findings are because available data on school enrolment and attendance include a large amount of additional information that influence this data, but which cannot be accounted for. For instance, huge swings in attendance and enrolment in some schools are likely related to classroom openings/closure or other non-seasonal factors that are not recorded in the dataset, making fluctuations hard to discern and attribute solely to seasonal influences. As such, it is not possible to make reliable inferences about the geographical, environmental or household characteristics that may influence school attendance using the MLSS dataset. However, it should be noted that districts that show a significant drop in attendance do so across all schools for which data is provided and across all (or near all) standards in those districts, demonstrating some consistency and level of confidence in this finding. This is in stark contrast to those districts where no or a counter-intuitive pattern is presented. In fact, for those districts where sufficient school data is available[31] and where no relationship or an increase in attendance over the lean season is recorded – Balaka, Rumphi and Mulanje[32] – the change in attendance and enrolment rates between seasons were not consistent across schools or standards in these districts, with, for instance, 4 schools reporting significant seasonal drops in attendance in Mulanje, 5 reporting significant increases, and 8 reporting no change. The same

[27] Educational enrolment refers to registering a child with a school at the beginning of a school term or year, whereas attendance refers to whether a child attends school throughout the term or school year.

[28] This variable was computed by using the "How many children over 6 years in your household went to school last week?" question and combining it with "the number of children over 6 years old in each household" to produce a proportion of children in school of school age at the two dates recorded. Hypothesis testing (and regressions) were ran to produce these findings. As the questions on school attendance and household size were multiple choice, with the highest number of children recorded as '4 plus children', households with large numbers of school age children may have their attendance levels over reported. This may lead to skewed results.

[29] The variable used for this analysis was computed using the question "How many children over 6 years in your household went to school last week?" and combining it with data on "the number of children over 6 years old in each household" to produce a proportion of children in school and of school age at the dates recorded. Hypothesis testing (and regressions) were ran to produce statistically representative results. As the questions on school attendance and household size were multiple choice, with the highest number of children recorded as '4 plus children', households with large numbers of school age children may have their attendance levels over reported, which could lead to skewed results. As such, it is important to triangulate these findings with analysis of other data sources.

[30] These figures are average for October 2015 and February 2016 and October 2017 and February 2018 combined.

[31] At least 7 schools per district with demonstrably reliable data (data available for all standards at the beginning and end of the lean season)

[32] There was on average zero change or a slight increase in attendance from the beginning to the end of the lean season (October 2017 - February 2018).

inconsistency was also true for Rumphi and Balaka.[33] By comparison, those districts that showed consistent drops in primary school attendance between October 2017 and February 2018, showed consistent patterns across schools and standards in these districts. Overall attendance fell 14% in Dowa district[34] between October 2017 and February 2018, with drops in attendance reported for all standards of schooling. Similar patterns were also found for Lilongwe (-7%), Nkhotakota (-6%) and Mwanza (-5% seasonal drop in attendance).

Socio-economic characteristics of households with low seasonal attendance and enrolment

Using data collected by Barrington et al. (2019a) for the 2018-19 academic year, this study finds low attendance rates in the lean season to be highly correlated with certain socio-economic characteristics. Low attendance rates refer to attendance rates of 75% or less per term. These findings are summarised below, with the associated regression outputs shown in Annex 3. Due to the limited quality of nationally representative data, this analysis is based on a random sample dataset that is neither geographically nor demographically representative of Malawi[35] (Barrington et al., 2019a), meaning that inferences made on this data (UNICEF, 2020) are not nationally statistically representative and cannot be applied to the whole country. These findings are reported below:

Children in disabled headed and elderly headed households, and have far lower school enrolment and attendance rates

- **School attendance for boys in disabled headed households drops in the planting months of October - December when agricultural labour is required, while girls in disabled headed households are less likely to attend school all year round, most likely as they are expected to do a range of chores and household activities in lieu of an incapacitated household head.** Specifically, boys in disabled headed households are 12% less likely to regularly primary attend[36] school in the sowing season compared to the other seasons in the academic year, with this finding statistically significant at 10%. This most likely reflects the increased burden faced by boys when the household head is incapacitated and when labour demand is high, such as in the planting season. While girls in disabled headed households are also 12% less likely to regularly attend primary school compared to girls in non-disabled headed households, however this finding is consistent across the school year and statistically significant at 5%.
- **Children in elderly headed households are 16% less likely to be enrolled in primary school in Malawi than children in non-elderly headed households**, with this finding statistically significant at 5%. Due to the nature of enrolment data, this finding cannot be disaggregated by child gender.

[33] Rumphi, where 3 schools reported significant drops in attendance, while 4 present significant increases in attendance and 6 no change; and also in Balaka, where 2 schools report large drops in attendance across the lean season, while 3 report large increases, and 2 no change. All other districts had insufficient school data to make inferences on the impact of the lean season on attendance or enrolment. See Table 1 in Annex for further information

[34] Data is available on 8 schools in Dowa district

[35] This study collected schooling metrics for 1,500 households in the districts of Salima, Mangochi and Nkhata Bay from 2016-2019

[36] Regular attendance refers to children who attend at least 75% of classes.

- **Boys enrolled in primary education from elderly-headed households are 7.5% less likely to regularly attend school in the growing season than non-elderly headed households**. This finding is statistically significant at 10% and exists for the latter half of the lean season only, when food prices are at their highest and agricultural output is at its lowest, and when children from vulnerable households may be forced to abandon school for work or cultivation (ILO, 2018).

Child disability also has a significant impact on the probability a child enrolling and completing primary in school. Primary school completion rates of persons with disabilities are 64% of the primary school completion rates of persons without disabilities in Malawi. This is not surprising given that both poverty and extreme poverty are statistically significantly higher for households with disabilities than other households, while non-health expenditures are far lower (IHS4, 2017; Mitra et al., 2011). Furthermore, 4% of children surveyed by the National Child Labour Survey (2015) have never attended school, with the most common reason given 'disability'[37] at 17%[38]. Given that the prevalence of disability among children in Malawi stands at just 3% (Eide et al., 2018), that having a disability is the primary reason why school age children have never attended school is alarmingly, and shows the significant impediments to accessing education disabled children face.

The analysis conducted above shows that education expenditure among the poorest households, and educational attendance among vulnerable groups, falls in the lean season, with elderly and disabled headed households showing significant vulnerabilities. These findings are based on partial or random sample data, with nationally statistically representative information on child enrolment, attendance and attainment rates prohibiting more detailed analysis.

The limited availability and quality of data in Malawi prohibits comprehensive analysis of seasonal fluctuations in educational attendance and attainment. Given the low-grade progression and high dropout rates of primary and secondary children in Malawi, collecting reliable education data by tracking children over one or more academic years would prove invaluable. This data is especially important given that low attendance and drop-out rates are highly correlated with a range of other deprivations, including child marriage and child labour.

[37] The Malawi Disability Act (2012) defines "disability" …as a long-term physical, mental, intellectual or sensory impairment, which, in interaction with various barriers, may hinder the full and effective participation in society of a person on equal basis with other persons (UNICEF, 2019)

[38] This prevalence rate is calculated by omitting those that are too young for schooling, Once these children are omitted, the primary reason for their absence becomes disability. Other reasons for not attending included 'not interested in school' (15%) and 'school not considered valuable' (13%).

Key Learnings on Education:

- **Education expenditures in Malawi typically peak at the commencement of the lean season, as it coincides with the beginning of the school year when the majority of school fees are due. The education expenditures of the poorest quintile in Malawi (bottom 20% of households) fail to increase in line with school fees, unlike in average and richest households,** with competition for resources likely leading poor households in Malawi to reduce their expenditures on education at this critical time of year.

- **Among the poorest households (bottom 20% of income), child headed households and households with a high dependency ratio demonstrate the lowest expenditures at the beginning of the school year, when an estimated 70% of school costs are due, with implications for school enrolment and attendance**. In fact, child headed households spend on average 85% less per child in September and October than non-child headed ultra-poor households.

- **Despite enrolment rates remaining consistent between years, educational enrolment and attendance vary considerably within the academic year. Educational attendance among primary school children falls between 7-11% between October (beginning of term 1) and February (beginning of term 2) in Malawi**, with children in elderly headed and disabled headed households worst affected.

- **School attendance for boys in disabled headed households drops in the planting months of October-December by 12%.** This most likely reflects the increased burden faced by boys when the household head is incapacitated and when labour demand is high, such as in the planting season.

- **Girls in disabled headed households are also 12% less likely to attend school than girls in non-disabled headed households, however this finding is consistent across the school year.** This is most likely because they are expected to do a range of chores and household activities in lieu of an incapacitated household head.

- **Children in elderly headed households are 16% less likely to be enrolled in primary school compared to children in non-elderly headed households**. While boys that are enrolled in primary education are 7.5% less likely to regularly attend school in the growing season if they reside in elderly-headed households, compared to boys in non-elderly headed households. There is no clear seasonal relationship for girls in elderly-headed households

The analysis summarised above shows that education expenditure among the poorest households, and educational attendance among vulnerable groups, falls in the lean season, with ultra-poor, elderly and disabled headed households showing significant vulnerabilities. These findings are based on partial data, with statistically representative information on child enrolment, attendance and attainment prohibiting more detailed nationally representative analysis. However, this data does show a clear and strong relationship between the lean season and educational outcomes, as well as between certain socio-economic groups and educational attendance and enrolment, which is likely representative of a broader national trend.

Seasonal Fluctuations in Child Labour

"Children in Malawi engage in the worst forms of child labor" (USAID, 2018). Not only does child labour increase in the lean season, but children are more likely to work in hazardous employment and face an increased probability of being subject to emotional, physical or sexual abuse when they work in the lean season.

Malawi is a signatory of the UN Convention on the Rights of the Child and the African Charter on the Rights and Welfare of the Child, both of which define children as anyone below the age of 18. Malawi amended its constitution in 2017 to reflect this, with a child now classified as anyone under the age of 18. However, the country's Child Care, Protection and Justice Act still defines a child as anyone below 16 years of age, and the country's Employment Act (2000) still sets the minimum age of employment at 14 years, albeit prohibiting children between the ages of 14 and 17 from working in 'hazardous work'[39] (Odhiambo, 2016; Nakatani, 2020). The incongruence of this legislation leaves children at substantial risk of child labour and abuse.

Child labour in Malawi

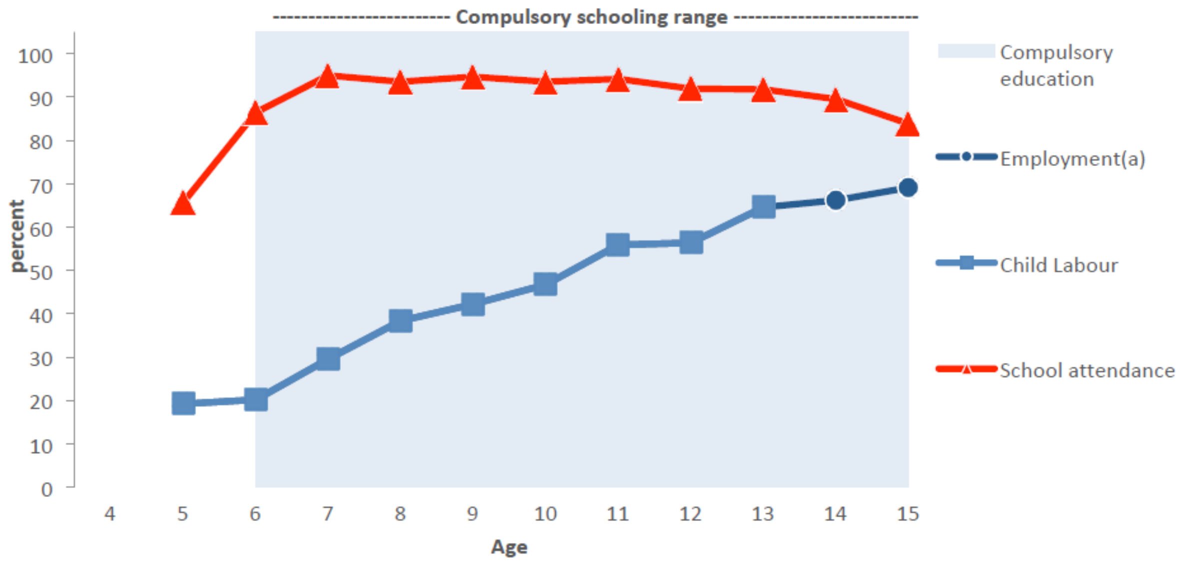
In line with current employment legislation in Malawi, child labour is defined herein as any work conducted by persons between the ages of 5-13 and any 'hazardous work'[40] conducted by 14-17-year olds (ILO, 2017). 'Work' encompasses all economic activity related to market production as well as any production consumed by the household. All forms of work – formal and informal; for cash, no pay or in-kind; and within and outside the family – are included in this definition.

As of December 2015, 1.72 million (41%) of children aged 5-13, and 401,000 (29%) of children aged 14-17, were involved in child labour in Malawi[41] (NCLS, 2015). While high, these figures no doubt underestimate the magnitude of underage employment in country, with more dangerous and illicit forms of employment, such as sexual exploitation and those associated with trafficking, underreported (ILO, 2018).

As Figure 7 shows, child labour levels increase with age and productivity in Malawi, as the opportunity cost of attending school rises as children develop. While children work more as they get older, with many children reporting themselves as 'attending school' and 'working' simultaneously, the reasons for labour are largely consistent between age groups. Overall, 52% of children stated they worked for financial reasons (either to supplement family income, help pay family debt, or because they could not afford school fees). Similarly, 48% of adults in these households gave financial incentives as a reason for their children working, showing that poverty, and specifically low cash income, is a key driver of child labour.

Figure 7: Child labour, employment and school attendance

[39] "The definition of "hazardous" fulfils at least one of the following work conditions: working in designated hazardous industries, namely tobacco, mining, quarrying and construction; working in designated hazardous occupations, namely those listed in the Employment act of 2012 (Prohibited hazardous work, CAP 55:02); working for more than 40 hours per week; working in other hazardous conditions, namely working at night, being exposed to hazardous working environment, carrying heavy loads, operating any dangerous machinery/equipment at work or begging" (ILO, 2018)
[40] Ibid
[41] Child labour for 14-17 year olds refers to those involved in 'hazardous work'

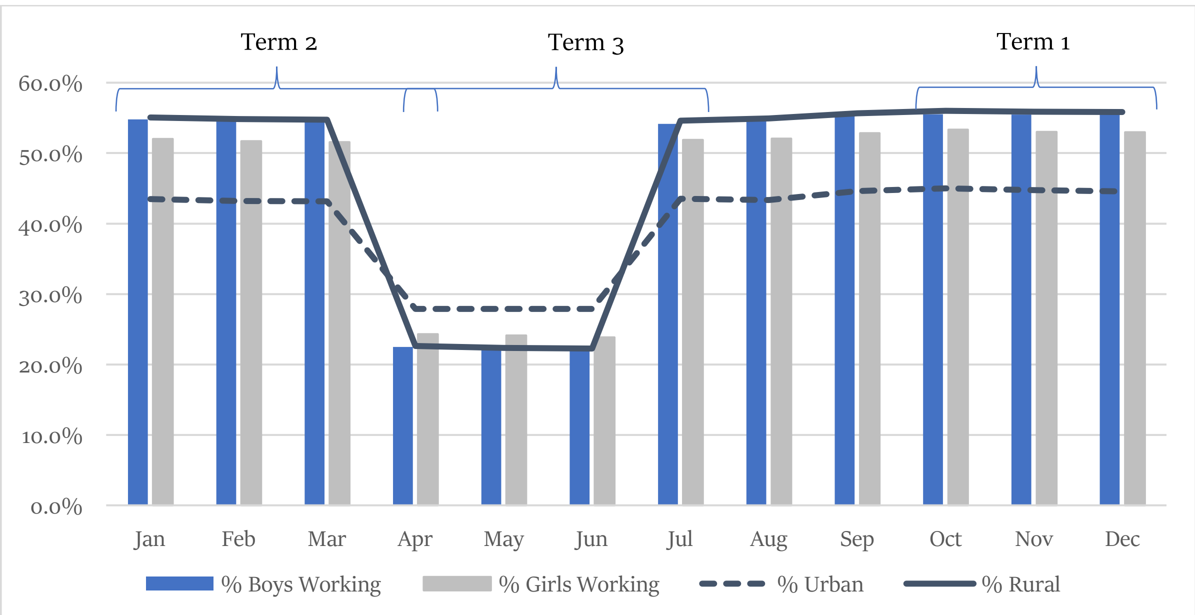


Source: ILO (2018); NCLS (2015)

Notes: School Attendance refers to those children who reported themselves as attending school. As the age of legalised employment begins at 14, this is can no longer be classified as child labour (unless hazardous work). This graph shows all forms of work for 14- and 15-year olds to show the correlation between work and schooling.

With financial reasons a major determinant of child labour, it is unsurprising that child labour drops in the harvest season when families typically have greater financial resources and economic and food security. Figure 8 below shows the proportion of children that said they worked or had a job in any given month in the year preceding the date they were surveyed. As the graph shows, over twice the number of boys and girls (aged 5-17) worked between the months of July to March than worked between April to June, with this trend driven by rural child labour.

Figure 8: Proportion of Children (age 5-17) that worked in each month



Source: Authors calculations using NCLS (2015)

Children are 15% more likely to be engaged in child labour during the lean season (October to March) than the harvest seasons (April to September), as shown in Figure 8 above, which is based on the NCLS (2015) dataset. Similar results are also found when analysing the IHS datasets from 2010/13/16[42]. However, one half of the 'non-lean' season (July-September) demonstrates similar levels of child labour prevalence as the lean season, perhaps implying a weak seasonal trend. This is, however, not the case. As the months of July-September encompass the school holidays, when children face no time allocation constraint related to schooling and/or labour, these months should be discounted.

What is more revealing about Figure 8 is that for the 9 months of the year that encompass school terms[43], child labour prevalence is over twice as high in the lean season (terms 1 and 2) than in the harvest season (term 3), demonstrating strong seasonal effects. The fact that child labour remains high in the growing season (when labour demand is low) and drops in the harvest season (when labour demands are high) shows that child labour is not correlated with labour demand in Malawi. In fact, as soon as harvests are yielded (from April), child labour decreases even though agricultural labour peaks at this time of year (De Janvry, 2018).

These findings imply that child labour in Malawi is most likely a result of necessity and survival rather than a consequence of the high marginal utility of child labour. In times of extreme poverty and low food availability, both of which peak in the growing season, the alternative to child labour may be acute hunger and malnutrition or even mortality. Primary data collected for this paper using UNICEF's U-report supports this finding. These surveys asked respondents "Have any children in your household worked rather than gone to school in the last week?". Controlling for the number of children of school age in each household, the data shows that the odds of a child working in February 2020 (when prices and food insecurity peak) compared to November 2019 were 10% higher, and that this finding is highly statistically significant.

With child labour peaking in the lean season, which coincides with the first and second terms in Malawi's school year, seasonal child labour will inevitably affect educational attainment. Even temporary, seasonal child work can have longer term impacts on grade progression and secondary school enrolment (Silva, 2020). In addition to the impact on education, seasonal child labour can have serious implications for child health and wellbeing.

The probability of being involved in dangerous work increases by 60%[44] if a child works regularly in the lean season (4 months or more) compared to if they work regularly (4 months or more) in the non-lean season[45], with this finding highly statistically significant (NCLS, 2015). Dangerous work is classified as such if a child experiences exposure to any of the following while working: dust, fumes; fire, gas, flames; loud noise or vibration; extreme cold or heat; dangerous tools (knives etc); work underground; work at heights; work in water/lake/pond/river; workplace too dark or confined; insufficient ventilation; chemicals (pesticides, glues, etc.) and/or explosives.

Unsurprisingly, given the hazardous nature of seasonal work, the probability of a child experiencing at least one form of physical, verbal or sexual violence at work increases nearly 3 fold if they work regularly (4 months or more) in the lean season compared to if they work

[42] Both findings are highly statistically significant. The IHS (2010/13/16) reported an increase in child labour of 10% in the lean season. The IHS asks household members whether they worked in the last week, whereas the NCLS asks children specifically about their work patterns over the previous year and is thus more detailed and its findings more reliable.
[43] Term 1: September-December; Term 2: January-April; Term3: April-July
[44] Predicted probabilities of 19.3% and 12.1% for lean and non-lean season respectively.
[45] The variable for 'dangerous work' was constructed so that the total number of months worked in lean season and worked in non-lean season were comparable. Work outside of the lean season can encompass 1 month in lean season only.

regularly (4 months or more) in the non-lean season[46] (NCLS, 2015). Agriculture is one of the three most dangerous sectors to work in at any age in Malawi (along with construction and mining) with these industries showing the highest rates of work-related fatalities, non-fatal accidents and occupational diseases. With the majority of child labour in agriculture (55%) and with this proportion increasing in the lean season, it is not surprising that more injuries and fatalities are experienced by children working at this time of year. Given the hazardous nature and serious consequences of this work, it is important to identify those children most at risk of exposure to employment in the lean season. Determining how to target these children is the focus of the remainder of this chapter.

Determining factors of child labour

Child labour is a consequence of a confluence of factors. Since our study is based on cross-sectional data, establishing causal determinants of child labour is not possible. However, by examining the differences in child labour between various environmental and household characteristics, one can identify key relationships and characteristics that demonstrate higher levels of seasonal child labour. The importance of a range of geographical, social and economic characteristics are examined below. As child labour is so pervasive in Malawi, with 57% of children reporting doing some kind of labour activity when surveyed[47] (NCLS, 2015), this section examines the defining characteristics of those working at least 15 hours a week, thereby targeting those most vulnerable to 'excessive' levels of labour.

In this report, we refer to excessive child labour as children between the ages 6-17 working 15 hours or more a week. As we cannot determine whether children aged 14-17 are involved in 'hazardous work', which the Government uses to define child labour for 14-17 year olds, all children aged 6-17 working 15 hours or more a week are considered to work excessive hours.

The geography of child labour in Malawi

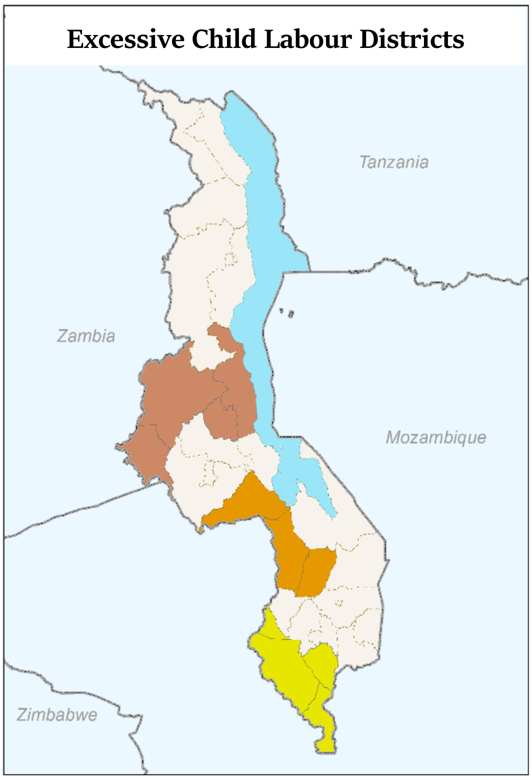
Examination of Malawi's third and fourth Integrated Household Surveys (IHS3, 2011; IHS4, 2017) shows that children residing in urban areas experience higher yearly levels of excessive child labour, but with much smaller seasonal differences, compared to rural households.

Malawi's major cities of Lilongwe, Blantyre, Mzuzu and Zomba have some of the highest levels of excessive child labour in the country, with children in these cities more likely to be involved in excessive labour than in almost any other area of the country. The predicted probability of a child working 15 hours or more a week in these four cities ranges from 0.28 to 0.32, i.e. 28%-32% of children in these cities will work on average 15 hours or more a week, compared to an average of 24% in rural areas, with all findings statistically significant at 5% (IHS3, 2011; IHS4, 2017). Although urban households are less dependent on agricultural production and the agriculture cycle for their livelihoods, excessive child labour does fluctuate seasonally in urban areas, rising on average 4.8% in the lean season compared to the non-lean season, compared an average seasonal swing of 8.5% in Malawi's rural areas, with all findings statistically significant at 1% (see Annex 4 for more information). This seasonal rise in urban child labour may be because children in urban areas work in industries related to the agricultural cycle, or because the rising cost of living at this time of year effects urban households forcing child labour levels to increase.

[46] Predicted probabilities of 13.3% and 5.1% for lean and non-lean season respectively. Sexual violence was the least experienced by children working in and outside of the lean season, at 2.2% and 1% respectively.

[47] 56.4% reported working at least 1 month of the preceding 12, while 57.5% of children surveyed reported working in the previous 7 days, showing consistency in findings that prevalence is approximately 57% (NCLS,2015)

Other areas with high levels of excessive child labour in the lean season include the Southern, neighbouring districts of Chikwawa, Thyolo, Mwanza and Nsanje. Mwanza and Nsanje show strong seasonal trends in child labour, with the predicted probability of a child in Mwanza working long hours (15 hours or more a week) increasing from 20% in the non-lean season to 29% in the lean season. In Nsanje, the difference is even greater, rising from 22% in the non-lean season to 33% in the lean season (IHS3, 2011; IHS4, 2017). Thyolo and Chikwawa exhibit similarly high levels of child labour in the lean and non-lean season, with the probabilities of a child working 15 hours a week or more 26% and 29% in Thyolo and Chikwawa respectively at any time of the year. These findings are highly statistically significant. The susceptibility of these districts to high levels of excessive child labour coincide with high ultra-poverty rates and food deficits typically experienced in these districts in the lean season (NSO, 2018; MVAC, 2020; MVAC, 2019; MVAC, 2018).



Nestled on the border of the south and central region, the neighbouring districts of Dedza, Balaka and Ntcheu experience similarly high levels of child labour in the lean season. Ntcheu district experiences a small seasonal variation in excessive child labour but has a high annual predicted probability of excessive child labour, which averages 32% over the year. Balaka and Dedza, on the other hand, exhibit very strong seasonal trends, with 38% of children predicted to work 15 hours or more a week in Balaka in the lean season, up from 28% in the non-lean season. The seasonal increase for Dedza is even more significant, with the predicted probability of a child working excessive hours increasing from 18% in the non-lean season to 33% in the lean season, with these findings highly statistically significant (IHS3, 2011; IHS4, 2017). These districts exhibit higher than average poverty and ultra-poverty rates and are known for their agricultural production, most likely a determining factor in their high rates of child labour.

Finally, the districts of Ntchisi (40%), Kasungu (31%), Nkhotakota (36%) and Salima (31%) in the central region exhibit excessive child labour levels in the lean season (shown in bracket above) (IHS3, 2011; IHS4, 2017). Ntchisi and Kasungu are two of the largest tobacco farming districts in the country (Makoka et al., 2016), while the neighbouring districts of Nkhotakota and Salima are typically used to recruit and traffic children for seasonal agricultural labour in the lean season (USAID, 2018; Kang'oma, 2018; Gondwe, 2016; UNICEF, 2005). "Most human trafficking of children for labor in Malawi is internal ... to work on tobacco farms in Malawi's northern and central regions" (USAID, 2018). Ntchisi, another large tobacco farming district, also shows high seasonal levels of excessive child labour in the sowing season (the first half of the lean season) when the majority of labour demand is required[48].

Children are more likely to work excessive hours in the lean season if they reside in districts characterised by either high levels of ultra-poverty, seasonal food shortages[49], or large scale agricultural/tobacco farming. It should be noted that excessive labour is pervasive across all of Malawi, with only two districts having predictive probabilities of excessive child labour in the lean season below 20%, showing the widespread nature of this problem.

Socio-economic characteristics of child labour

Analysis of available socio-economic datasets shows that there are clear household characteristics that are associated with excessive child labour (greater than 15 hours per week for anyone under the age of 18). By identifying those types of households and/or children who are more vulnerable, it becomes easier to target those most at risk of excessive labour and its associated health, education and wellbeing outcomes.

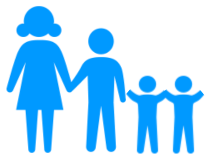
This section examines the socio-economic characteristics of those vulnerable to excessive child labour in the lean season. By controlling for a range of potential determining factors, such as location, one can ascribe importance to each socio-economic characteristic while accounting for the influence of others. Using data from the National Child Labour Survey (NCLS, 2015), the third and fourth Integrated Household Surveys (IHS3, 2011, IHS4, 2017), and the UNC Education Survey (Barrington et al., 2019), this study finds the following socio-economic characteristics to be acutely associated with excessive child labour (15 hours or more a week for) in Malawi's lean season:

- **The probability of a child working at least 3 months in the lean season increases by 7 percentage points if the child lives in an ultra-poor household[50]. However, the probability of a child working for 15 hours or more a week does not change if they live in an ultra-poor or non-ultra-poor household,** with these findings highly statistically significant at 1%. The difference is slightly smaller, 6.5 percentage points, for children who work 6 months in the lean season and live in ultra-poor vs non-ultra-poor households, again statistically significant at 1% (NCLS, 2015). Household income levels (beyond ultra-poverty) do not seem to have a substantial impact on child labour levels in the lean season, with children living in households in the wealthiest quartile (richest 25% of households) just as likely to work for at least 3 months of the lean season than not (IHS3, 2011; IHS4, 2017). Child labour is therefore not purely an outgrowth of poverty, meaning there is a clear case for policy attention beyond improving income generation opportunities for families or targeting those with low income levels.
- **The number of children in a household has a significant bearing on child labour levels, with the probability of a child working (and the probability of them working for more months) increasing with household size.** For instance, if you are a child living in a households of 5 children you are 11.5 percentage points more likely to work 3 months or more of the lean season and 15 percentage points more likely to work 6 months in the lean season, compared to an only child household (statistically significant at 5%) (NCLS, 2015). The positive correlation between family size and child labour suggests that resource and credit constraints

[48] Other large tobacco farming districts, such as Karonga, are underreported in the data and as such no inferences can be made regarding their levels of child labour (IHS3, 2011; IHS4, 2017).
[49] As reported by IPC data taken from MVAC (2018, 2019, 2020)
[50] Predicted probabilities of 59.8% and 52.8% for ultra-poor and non-ultra-poor households, respectively.

influence the probability a child will work (Edmonds, 2008; Knodel and Wongsith, 1991; Patrinos and Psacharopoulos, 1997). While children in larger households do work more months in the lean season, they are less likely to work excessive hours (15 hours or more a week). This is potentially not surprising as there are more children in the household to share the workload (IHS3, 2011; IHS4, 2017).

- **The probability of a child working 3 or more months in the lean season rises by 8 percentage points if they are in a child headed household**. This figure is 6.5 percentage points if one examines the predicted probability of a child working the whole 6 months of the lean season (NCLS, 2015)[51].
- **Children in a child headed households are also far more likely to beg than children in adult headed households, with this finding consistent across the lean and non-lean season**. Specifically, the predicted probability of a child begging is over 20 percentage points higher in a child headed household[52]. These findings are statistically significant at 1% (NCLS, 2015).



Child headed households are far more likely to beg and work in the lean season

- **Disabled headed Households have higher rates of excessive child labour than non-disabled household heads.** Having a head with a disability is associated with a 20 percentage point increase in domestic chores and a 25 percent increase in ganyu for young people all year round (Barrington et al., 2019b).
- **Orphan children are also more at risk of excessive child labour in the lean season. This study finds that in the sowing season of October to December, the probability of an orphan working excessive hours (15 hours or more a week) is 13 percentage points higher than a non-orphaned child[53].** This trend does not persist across the year, showing that orphan children are vulnerable to seasonal labour demand, which peaks in the sowing months of October to December. The volume of data available on orphan children is, however, low, and should be triangulated where possible, with this result statistically significant at 10% (IHS3, 2011; IHS4, 2017). Outputs for the above analysis can be found in Annex 4.

Orphan children are 1.5 times more likely to be involved in excessive child labour than non-orphaned children in the sowing season

"Children in Malawi engage in the worst forms of child labor" (USAID, 2018). These pernicious forms of labour peak in the lean season as income and food stocks diminish, households slip further into poverty, and as seasonal demands for labour increase. These resource constraints also lead to an increase in the number of girls and boys, particularly the former, entering into some of the most severe forms of exploitation, including being trafficked for work or married underage.

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[51] Predicted probabilities are 54.6% (3+ months) and 51.3% (all lean season) for children in adult-headed households, compared to 62.5% (3+ months) and 57.9% (all lean season) for child headed households.
[52] Predicted probabilities are 35% (all year) and 41% (lean season) for children in adult-headed households, compared to 55% (all year) and 61% (lean season) for child headed households.
[53] Predicted probabilities of 25.5% and 39.5% for non-orphaned and orphaned children, respectively.

Child Trafficking

Most child trafficking in Malawi is seasonal and internal[54], with children mostly trafficked to work on tobacco estates during the sowing and growing seasons, or trafficked for commercial sex during the crop market season, when bars and restaurants are busier (USAID, 2018; ILO, 2018; ILO, 2008). The Malawi Ministry of Gender, Community Development, and Social Welfare's Child Protection Integrated Information Management System (CPMIS, 2020) records child protection cases documented by district social welfare offices. This dataset shows child trafficking peaks at the beginning of the lean season (October) and bottoms out at the end of the harvest season (June). However, as this data is self-reported, and no doubt underreported, no profiling or analysis can be reliably conducted on it.

A lack of data on the worst forms of child labour, such as child trafficking and sexual exploitation, makes targeting children vulnerable to trafficking extremely difficult. Malawi's *Child Labour National Plan of Action* (2009–2016) recognised this deficiency and called upon District Labour Offices to improve their recording of child labour cases, which is still lacking (GoM, 2010).

Qualitative evidence on the profiling of trafficked children finds trafficked children to be overwhelmingly school dropouts, orphans or without parental care. **While the displacement that comes from seasonal and covariate shocks has also been reported to encourage the exploitation and trafficking of children** (ILO, et al., 2018; Makwemba, et al., 2019; ECPAT, 2016). However, as these insights are anecdotal and therefore partial, they do not help identify, in a systemic manner, children at risk of trafficking (MoHA, 2017; NCA, 2007; USAID, 2018).

While trafficking has long been recognised to peak in the lean season, with many children believed to be trafficked to work on agricultural estates and in the sex trade over these months, identifying specific vulnerable groups is not possible given a lack of reliable, data. If child trafficking is to be understood, targeted and reduced, further primary research and data collection is required, in addition to the previous requests for the improved recording of child labour cases by District Labour Offices (GoM, 2010).

[54] Trafficking to Mozambique, South Africa, Tanzania and Zambia has also been reported (USAID, 2018)

Key Learnings on Child Labour:

- **For the 9 months of the year that coincide with Malawi's school year[1], child labour is over twice as prevalent in the months that encompass the lean season (terms 1 and 2) than in the months that encompass the harvest season (term 3), demonstrating strong seasonal effects.** The fact that child labour remains high in the growing season (when labour demand is low) and drops in the harvest season (when labour demands are high) shows that child labour is not correlated with labour demand in Malawi, and is most likely a result of necessity and survival rather than a consequence of the high marginal utility of child labour.

- **The probability of being involved in dangerous work increases by 7 percentage points if a child works regularly in the lean season (4 months or more) compared to if they work regularly (4 months or more) in the non-lean season** (NCLS, 2015).

- **Unsurprisingly, given the hazardous nature of seasonal work, the probability of a child experiencing at least one form of physical, verbal or sexual violence at work increases nearly 3 fold if they work regularly (4 months or more) in the lean season compared to if they work regularly (4 months or more) in the non-lean season[1]** (NCLS, 2015). The predicted probability of facing any of these abuses at work is 13.3% and 5.1% for the lean and non-lean season respectively. Sexual violence was experienced the least by children working regularly in and outside of the lean season, at 2.2% and 1% respectively.

- **Children are more likely to work excessive hours in the lean season if they reside in districts characterised by either high levels of ultra-poverty, seasonal food shortages[1], or large scale agricultural/tobacco farming.** It should be noted that excessive labour is pervasive in Malawi, with only two districts having predictive probabilities of excessive child labour in the lean season below 20%, showing the widespread nature of this problem.

- **The probability of a child working at least 3 months in the lean season increases by 7 percentage points if the child lives in an ultra-poor household and 8 percentage points if they are in a child headed household**. The number of children in a household also has a significant bearing on child labour levels, with the probability of a child working (and the probability of them working for more months) increasing with household size.

- **Orphan children are also more at risk of excessive child labour in the lean season. This study finds that in the sowing season of October to December, the probability of an orphan working excessive hours is 13 percentage points higher than a non-orphaned child.** This trend does not persist across the year, showing that orphan children are vulnerable to seasonal labour demand, which peaks in the sowing months of October to December

This study's analysis shows that not only does child labour increase in the lean season, but that children are more likely to work in hazardous employment and be subjected to emotional, physical or sexual abuse. Given the dangerous nature and potentially serious consequences of seasonal work, utilising the information above to target and assist vulnerable children is needed.

Seasonal Fluctuations in Child Marriage

Child marriages for under 18 and under 15 year olds peak in Malawi's lean season. "A marriage between a child and an adult in Malawi marks the beginning of a personal tragedy for the child involved. Along with the "marriage" itself, the harmful traditional practice often includes sexualized violence and becoming a parent during childhood". (UNICEF,2018)

Malawi has the 12th highest prevalence rate of child marriage in the world[55], with approximately 42% of girls marrying before the age of 18 and 9% before the age of 15, compared to just 6.5% of boys marrying before the age of 18[56] and less than 1% before the age of 15, demonstrating a huge gender bias for child marriages among girls (DHS, 2016). The Survey on Traditional Practices in Malawi (NSO, 2018), Malawi's latest Demographic and Health Survey (DHS, 2016) and the country's latest Multi Indicator Cluster Survey (UNICEF, 2014) provide national data on child marriages. The child marriage rates reported by all three datasets are consistent for both under 18 and 15 marriages, strengthening the validity of these results[57].

In 2015, Malawi took a major step towards ending child marriage by banning marriage for persons under the age of 18, before removing an exemption permitting child marriage with parental consent two years later (Steinhaus, 2019). However, increasing the legal age of marriage in Malawi has not yet decreased the prevalence of child marriage, with marriage rates for under 18s the same in 2018 as they were in preceding years (Haenni & Lichand, 2020).

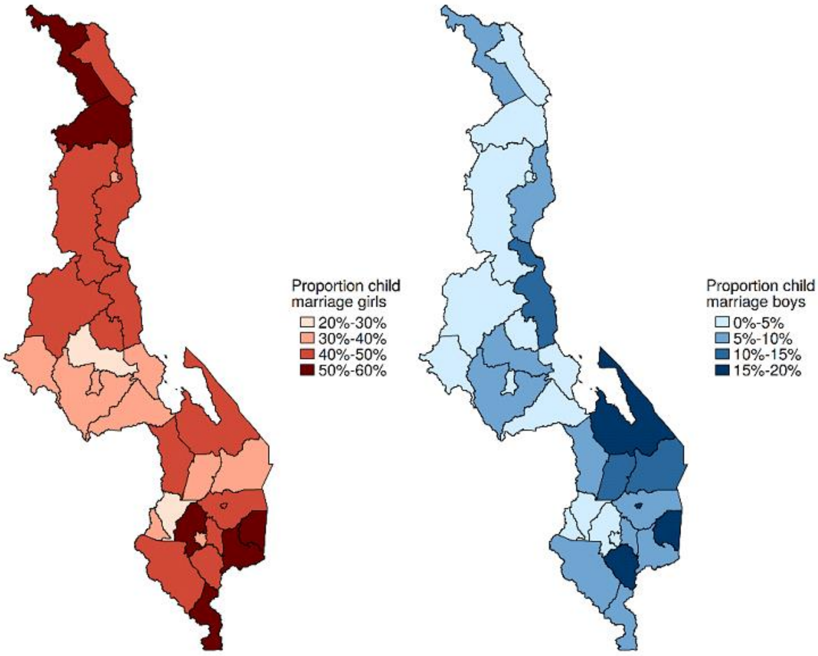
Figure 9 below shows the proportion of child marriages by district for both boys and girls. As this figure shows, child marriage is common across Malawi, but is more prevalent, particularly for girls, in the country's most northerly and southern districts, where rates rise above 50% in several districts.

Figure 9: Proportion of girls (left) and boys (right) married before the age of 18

[55] Child marriage prevalence calculated as the percentage of women 20-24 years old who were married or in union before they were 18 years old (UNICEF, 2017)

[56] The child marriages referred to here refers to the number of 20-24 year olds surveyed who reported being married before 18 and 15 years of age, and thus reflects current levels of child marriage. If one includes all marriage before the age of 18 and 15 in the dataset, the child marriage rates increase.

[57] 42% of women interviewed for the Tractional Practise Survey (NSO, 2018) were also married before the age of 18 and 9% before the age of 15, with Malawi's Southern region demonstrating the highest proportion of girls married under 15, at 14%. This compares to just 1% (under 15) and 6% (under 18) nationally for interviewed males.



Source: NSO (2018)

Despite persistently high rates of child marriage in Malawi[58], the majority of household heads in Malawi (over 90%) believe that girls should not be married before their 18th birthday (NSO, 2018). This finding is reported in other studies. Steinhaus (2019) surveyed over 1,500 adults in Thyolo and Phalombe who identified themselves as 'decision-makers' for at least one girl between the ages of 10 and 17. Over 90% of those surveyed[59] by Steinhaus (2019) thought it was 'wrong to marry a girl before the age of 18' and believed that 'a girl should have a say in who she marries' and 'in when she marries'. Yet the median age of marriage in these districts is among the lowest in the country, with over 50% of girls married before the age of 18 in both districts (NSO, 2018). These findings indicate either cognitive dissonance or that external factors are forcing families to marry off daughters at a young age.

Several studies find poverty to be a major determinant of child marriage among young girls in Malawi (Steinhaus, 2019; Ansell et al., 2018; Haenni and Lichand, 2020). With child marriage heavily influenced by economic factors, it is likely that the effects of the lean season (when poverty and food insecurity peak) influence the prevalence[60] and severity[61] of underage marriage. These hypotheses are explored in the analysis below, along with the consequences for and characteristics of those most effected.

The seasonal nature of child marriage in Malawi

As shown in Figure 10, child marriages peak in the lean season for both under 18s and under 15s. Pressures to relieve households from the economic 'burden' of an additional member as well as improve the household's financial predicament (64% of child marriages elicit a bride price or dowry

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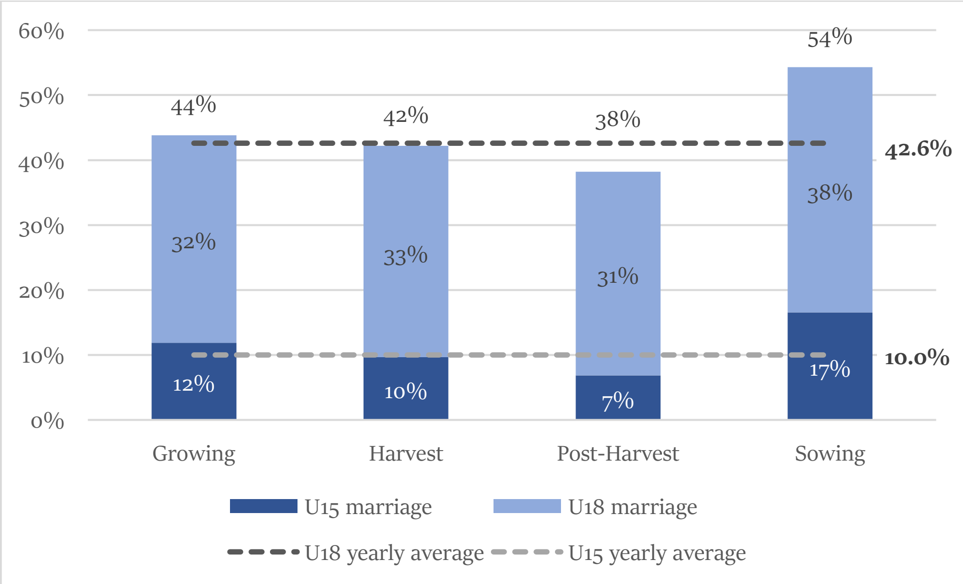
[58] As reported earlier in this paper, Haenni & Lichand (2020) find that marriage rates for under 18s were the same in 2018 as they were in 2016 and previous years, despite changes in legislation.
[59] Quantitative questionnaires were administered to a representative sample of 1,492 adults who self-identified as a decisionmaker for at least one girl between the ages of 10 and 17 years
[60] The proportion of children married under the age of 18
[61] the proportion of children married under the age of 15

payment) may explain the high rates of child marriage experienced in the sowing season (NSO, 2018). While child marriages are 3.5 times more likely to be the result of 'poverty' than adult marriages[62] (NSO, 2018), child marriages are still prominent among wealthy households (UNICEF, 2014). 29% of women in the richest quintile in Malawi were married under the age of 18 compared to 53% in the poorest quintile, while 5% of women in the richest quintile and 14% in the poorest were married before the age of 15.[63]

Figure 10: Under 18 and Under 15 female marriages as a proportion of total marriages per season



Source: MICS (UNICEF, 2014)

Socio-economic characteristics of child labour

As shown in Figure 10, child marriage is more prominent in Malawi's lean season, most notably the sowing season. By controlling for other potential determinants, including education level, ethnic group and pregnancy, one can isolate the significance of the lean season alone on child marriage as well as the significance of socio-economic factors on the probability of child marriage.

This study finds that the probability of being married in the sowing season increases by 5% for girls under 15 and 8% for girls under 18, controlling for other determining factors (UNICEF, 2014). The consequences of child marriage are severe. Early marriage has been shown to impair educational, social and psychological development, with the consequences of child marriage particularly severe for girls, who are not only disproportionately affected by child marriage but for whom early marriage is acutely associated with early pregnancy, lower education attainment and lower economic freedom, thereby reinforcing the gendered nature of poverty (Ibrahim et al., 2019; UNICEF, 2014).

[62] This refers to the reasons reported for marriage in the Traditional Practices Dataset (NSO, 2018)
[63] While the interviewee's economic circumstances may have changed since marriage, for this analysis we make the assumption that significant social mobility is unlikely and that wealth is by no means the only determinant of early marriage, with factors such as education, ethnic group/social norms, and other socio-economic characteristics impacting marriage age.

Despite poor data on a range of socio-economic characteristics[64], analysis on the causal factors related to child marriage was possible for a limited number of socio-economic characteristics. This analysis, presented below, is conducted for girls only as the quality of data, in addition to the probability of child marriage, is far greater for girls than boys in Malawi.

Before examining the socio-economic characteristics associated with early marriage in Malawi, it should be noted that the odds of being married before the ages of 18 and 15 years old are 2 and 3 times greater respectively for girls that are pregnant[65]. Pregnancy before marriage is calculated as positive if a woman falls pregnant 3 or more months prior to date of marriage. This finding is, unsurprisingly, consistent across the lean and non-lean season and is not particularly useful for targeting purposes but is reported here to show the relationship between family planning, early pregnancy and child marriage. Furthermore, pregnancy is accounted for in this paper's modelling so to ensure that no false attribution is given to other relationships related to child marriage and socio-economic variables (UNICEF, 2014).

With the consequences of child marriage so significant, it is important to understand the role the lean season plays in child marriage and utilise available data to identify those children most vulnerable to child marriage.

- **This study finds that girls are 5 times more likely to be married before the age of 15 if they have no education compared to if they attended secondary school**. The predicted probability of marriage before the age of 15 is 20% for girls with no education compared to 4% for girls that have a secondary school education[66], while the predicted probability of being married before 15 years of age is less than 1% for those who attended higher education (UNICEF, 2014). These findings are statistically significant at 1% and are consistent across the agricultural calendar, implying that encouraging and incentivising children to remain in school has a clear and significant impact on the reduced likelihood of child marriage.
- **Girls in Malawi are also over twice as likely to be married before 18 if they have no education or only attended primary school, compared to if they attended secondary school or higher.** The predicted probability of being married before 18 is 60% and 63% for girls with no education and primary education only, compared to 30% if they attended secondary school. The probability of being married before 18 if you attended higher education is only 8% (UNICEF, 2014).
- **Controlling for socio-economic factors, such as wealth and education, this study finds that household ethnicity significantly influences the probability of early child marriage (under 15) in Malawi.** Specifically, girls from the Nkhonde, Lomwe and Yao tribes are more likely to be married before the age of 15 than any other ethnic group in Malawi. In fact, you are twice as likely to be married before the age of 15 if you are from the Nkhonde tribe (predicted probability of 21%) than if you are from the Chewa ethnic group (9% predicted probability). The probability of a girl marrying before the age of 18 is similar for all ethnic groups, except for the Nkondwe and Chewa, who have higher than average and lower than average probabilities, respectively. The predicted probability of marriage before the age of 18 is 67% for Nkondwe

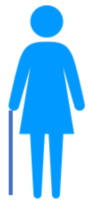
[64] For instance, the Malawi MICS dataset (UNICEF, 2014) includes a module on child marriage, yet the socio-economic status of the child when married is not recorded, preventing meaningful analysis. While the Traditional Practices dataset (NSO, 2018) did interview household heads on the marital status of their children, child marriages were significantly underreported, most likely due to the change in legal age of marriage that preceded the survey and a reluctance, given recent legislative changes, that the household is breaking the law.

[65] Specifically, this refers to an odds ratio of 2.1 for under 18s and 3.3 for under 15s

[66] This refers to those that attended secondary school. They did not necessarily finish secondary school.

girls and 49% for Chewa girls. All findings reported above are highly statistically significant (UNICEF, 2014).

- **Girls are particularly vulnerable to child marriage in Malawi if they reside in elderly headed households.** Supplementary analyses conducted on data collected by Haenni and Lichand (2020) shows that girls in elderly headed households are far more likely to be married before 18 than households with non-elderly heads. Haenni and Lichand (2020)[67] surveyed girls aged 10-17 in 2018 and again 16 months later, and found that girls unmarried at the time of baseline were 53% more likely to be married before their 18th birthday by the time of the endline survey if they live in elderly headed household, with this finding highly statistically significant. Due to the limitations of the data collected, no seasonal analysis could be conducted, rather the results presented above refer to differences at the baseline and endline surveys only.



Girls are particularly vulnerable to child marriage if they reside in elderly headed households

- **Similarly, education of household head impacts the probability of child marriage among girls, with unmarried girls (aged 10-17) 53% less likely to be married before 18 if their household head attended secondary school compared to if the household head had attended primary school only or had no education** (NSO, 2019; Haenni and Lichand, 2020). This finding controls for other potential determining factors, such as household income, but does not account for seasonal effects, but rather presents differences in marriage rates for girls ages 10-17 between mid-2018 and end-2019. Given the strong relationship between education and child marriage, this relationship may reflect the importance educated household heads place on their child's education as marriage often precludes access to schooling for girls in Malawi. See Annex 4 for more information on the above.

Data on child headed households and other vulnerable groups was insufficient and therefore further analysis could not be conducted.

As shown above, geography, ethnicity, poverty and the age and education of household head all impact the probability of child marriage. These relationships are consistent across the year and between seasons. The lean season itself, however, does demonstrate a rise in both the prevalence (proportion of children married under the age of 18) and severity (the proportion of children married under the age of 15) of child marriage in Malawi, particularly in the sowing season, when the vulnerable groups identified by this paper are even more susceptible to early marriage.

As mentioned in other sections of this study, tracking households over the duration of at least one agricultural cycle would provide invaluable data on the impact of seasonal, covariate and idiosyncratic shocks on a childhood deprivations, including child marriage. This would not only improve the quality of the analysis that can be conducted on child marriage, but enable an analysis of the relationships between deprivations and their cumulative impacts, thereby expanding the scope of this study.

[67] Data collected through nationally representative survey of 7,388 households across 412 randomly selected villages between July and August 2018. Likelihood refers to probability. Analysis conducted using a linear probability model.

Key Learnings on Child Marriage:

- **Early marriage is a major development challenge for girls in Malawi.** Malawi has the 12th highest prevalence rate of child marriage in the world (UNICEF, 2017), with approximately 42% of girls marrying before the age of 18 and 9% before the age of 15, compared to just 6.5% of boys marrying before the age of 18 and less than 1% before the age of 15, demonstrating a huge gender bias (DHS, 2016).

- **The probability of being married increases in the sowing season increases by 5% for girls under 15 and 8% for girls under 18, controlling for other determining factors** (UNICEF, 2014). Many studies have shown early marriage to impair educational, social and psychological development, but the implications are even greater for girls, for whom early marriage is acutely associated with early pregnancy, lower education attainment and lower economic freedom, thereby reinforcing the gendered nature of poverty (Ibrahim et al., 2019; UNICEF, 2014).

- **An examination of the key determinants of child marriage among girls in Malawi shows a highly statistically significant relationship between education level and age at marriage**, with girls 5 times more likely to be married before the age of 15 if they have no education compared to if they attended secondary school, implying that encouraging and incentivising children to remain in school has a clear and significant impact on the reduced likelihood of child marriage. These findings are consistent across the agricultural calendar.

- **Household and environmental characteristics, such as geography, ethnicity, poverty and the age and education of household head all impact the probability of child marriage.** Specifically, girls from the Nkhonde, Lomwe and Yao tribes are more likely to be married before the age of 15 than any other ethnic group in Malawi. While child marriage is common across Malawi, it is far more prevalent, particularly for girls, in the country's most northerly and southern districts, as shown in Figure 9. Girls are also 53% more likely to be married before their 18th birthday if they reside in elderly headed households, and 53% less likely to be married before 18 if their household head attended secondary school compared to if they attended primary school or had no education.

The socio economic and environmental relationships above are consistent across the year and between seasons in Malawi. The lean season itself, however, does demonstrate a rise in both the prevalence (proportion of children married under the age of 18) and severity (the proportion of children married under the age of 15) of child marriages in Malawi, particularly in the sowing season, when the vulnerable groups identified by this paper are even more susceptible to early marriage.

Seasonal Fluctuations in WASH, Health and Nutrition

> "Children have distinct physiologies and exposure profiles that mean climate-sensitive diseases place an undue burden on the youngest members of society... children are more likely to develop severe infection and experience complications during recovery due to their small body size and their developing immune systems which provide little natural immunity or resistance" (Ghani et al., 2017).

This section reviews the impact of Malawi's agricultural cycle on indicators of child health, nutrition, and mortality, and examines the relationships between these indicators and various socio-economic variables.

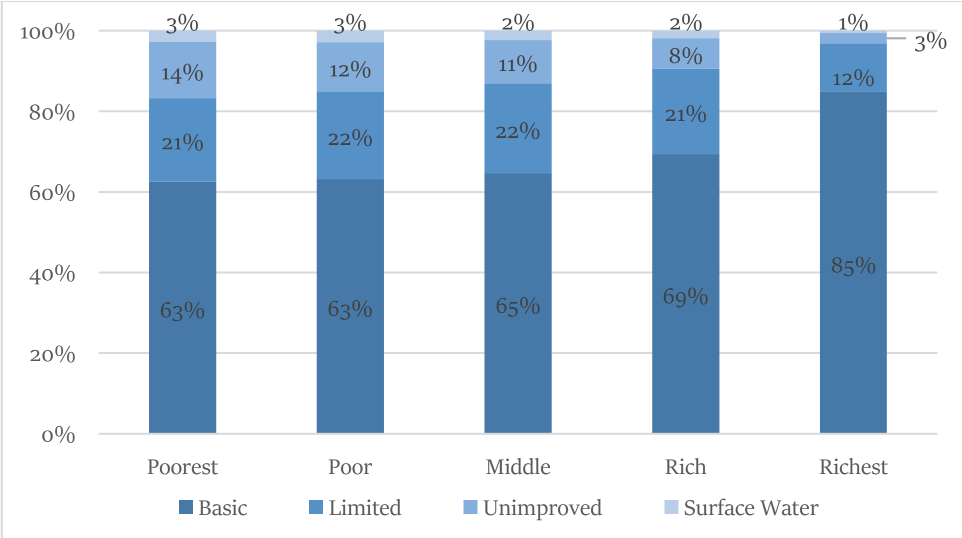
Safe WASH (water, sanitation, and hygiene) is an essential facility for good health (Mills et al., 2016). Yet access to improved water and sanitation facilities in Malawi remain low, particularly among poorer households, with approximately 1.5 million Malawians living without access to improved water and around 60% without access to improved sanitation, as can be seen in Figure 11 below (WHO & UNICEF, 2020)[68].

Malawi's rainy season, which runs from mid-October to March, is not only associated with crop seeding and germination, but a range of health and nutrition issues that manifest through several causal pathways. Most commonly, excessive rains in the lean season lead to the pollution and inundation of water and sanitation facilities, which can not only render these facilities inaccessible, but increase the sedimentation and turbidity of drinking water, increasing the spread of disease and infection. The proliferation of unsafe water management at this time of year can also encourage the breeding of mosquitoes leading to increases in the transmission of malaria and dengue (DCCMS, 2020, Godfrey, et al., 2019; Okuni, 2019).

Alternative water sources, such as seasonal streams, rivers and open wells, swell in the rainy season. These seasonal bodies of water, typically used for washing bodies, hands and clothes in Malawi, are associated with increases in the transmission of a range of water- and vector-borne diseases, such as diarrhoea, cholera, typhoid and bilharzia (Godfrey, et al., 2019; Okuni, 2019; Senbete, 2019; Mills et al., 2016).

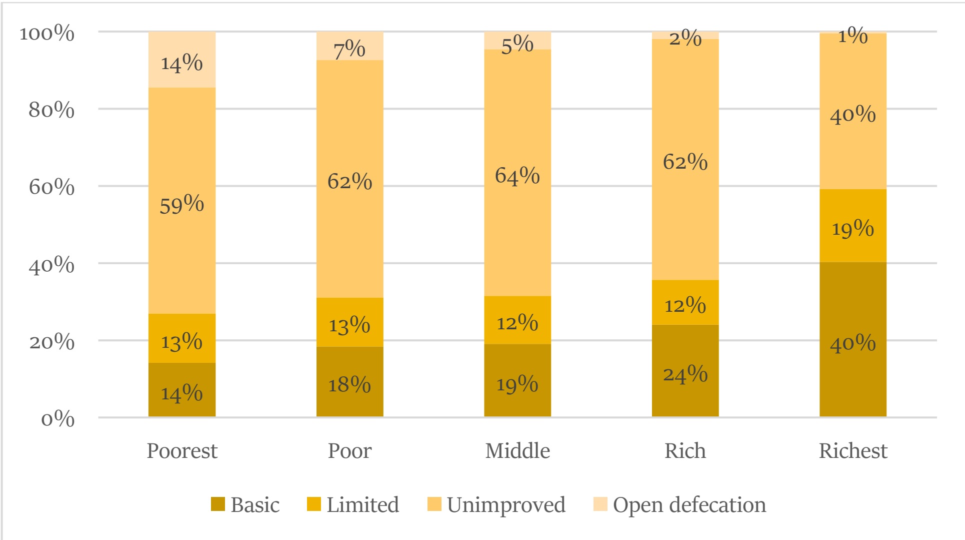
Figure 11: National Drinking Water Coverage by Wealth Quintile, 2017

[68] An improved sanitation facility is defined as one that hygienically separates human excreta from human contact, such as flush toilets and latrines, while an improved water facility is one that adequately protects the water from outside contamination, such as piped water, boreholes, tubewells and protected dug wells. Basic water access refers to drinking water from an improved source, provided collection time is not more than 30 minutes for a roundtrip including queuing, while limited access refers to using an improved sources but with a collection time that exceeds 30 minutes for a roundtrip, including queuing. Households using improved sanitation facilities shared with other households as a 'limited' service, whereas services in households are referred to as 'basic'.



Source: WHO, UNICEF (2019)

Figure 12: National Sanitation Coverage by Wealth Quintile, 2017



Source: WHO, UNICEF (2019)

The seasonal nature of vector and water borne diseases in Malawi

The transmission of many parasitic, viral, and bacterial diseases in Malawi is influenced by a range of environmental and climatic factors. Temperature and rainfall have been found to determine the spatial and seasonal distribution of many water and vector borne diseases; while geographic, demographic and socio-economic factors alter the magnitude and population of disease burdens (Ghani et al., 2017).

Children are particularly susceptible to disease and infection due to the immaturity of their immune systems and physical underdevelopment. Up to two-thirds of preventable illnesses and deaths due to environmental hazards are experienced by children, with those aged 5 years and under the most vulnerable (Xu et al., 2012; Ghani et al., 2017).

This vulnerability to disease and infection is exacerbated further by the lean season, when environmental and climatic factors increase the prevalence of diseases and reduce the availability of food and nutrition, directly affecting child health. Children are particularly adversely effected due to their reliance on other household members for survival and development, meaning the lean season impacts children directly (impairing their health and wellbeing) and indirectly (through impairing the health of their caregivers) (Ghani et al., 2017).

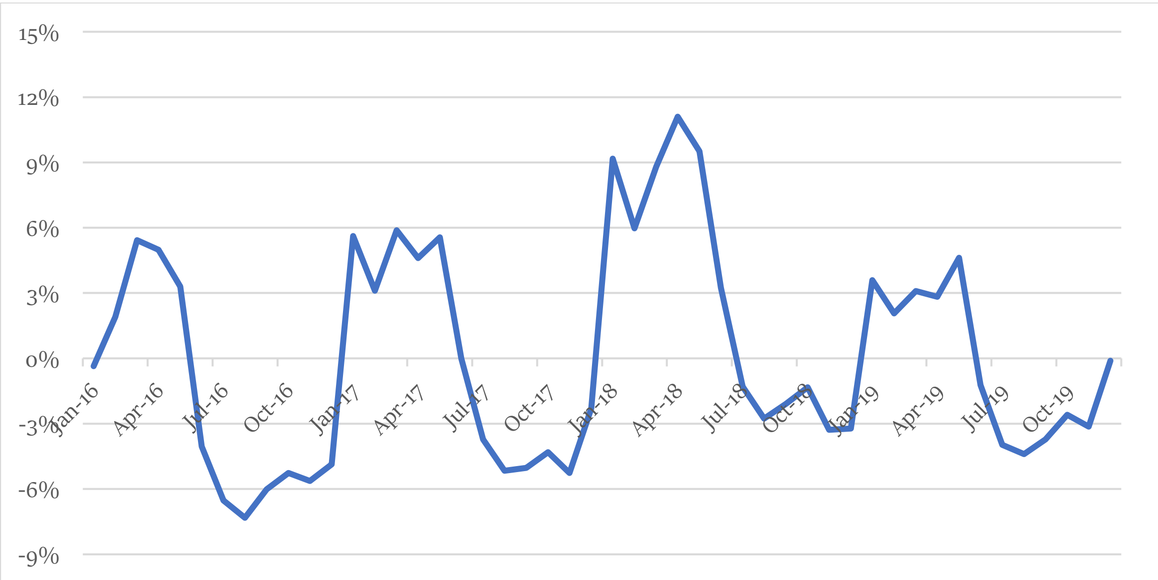
Seasonal fluctuations in Malaria

Using data from the Malawi District Health Management Information System (DHIS, 2020), new monthly cases of malaria, diarrhoea and pneumonia in under 5s were examined for seasonal fluctuations, along with indicators of acute and chronic malnutrition. This data has been 'de-trended' to remove annual changes from the data and show only the seasonal fluctuations in contraction rates.

As shown in Figure 13, malaria cases in children under the age of 5 demonstrate significant seasonal fluctuations in Malawi, with the proportion of under 5s who contract malaria 8.8% higher in the growing season compared to the post-harvest season. This higher rate of contraction typically then continues for the first two months of the harvest seasons, with peaks in infection rates typically lasting from January to May. With an annual average contraction rate of 8.5% for under 5s, a seasonal swing of 8.8% represents a significant, seasonal shift.

Strong peaks in malaria contraction at the beginning of the year coincide with heavier rains and an influx of disease vectors. Malaria contraction begins to increase at the end of the sowing season and peak at the beginning of the growing season, when the conditions for the multiplication and development of mosquito larvae are optimal. Anopheles mosquitoes, which are endemic to Malawi, depend not only on sufficient rainfall, but also require temperatures between 16 and 32°C to fully develop. These conditions are present only in the lean and beginning of the harvest season (see Figure 13) leading to peaks in mosquito population and malarial contraction over this period (Chirombo et al., 2020).

Figure 13: U5s malaria seasonal trend (data de-trended), cases as proportion of population (%)



Source: DHIS, 2020

Seasonal fluctuations in Cholera

Cholera contraction in Malawi also exhibits a strong seasonal trend, with 88% of registered cholera cases in Malawi occurring between the months February and April[69] (DHIS2, 2020). Cholera is endemic to Malawi. Outbreaks occur regularly around the rainy season, with the Lake Chilwa region in the South of the country among the worst affected areas (MOH Malawi, 2017; Grandesso et al. 2018). Although cholera affects people of all ages, children under five experience the highest burden and are at greatest risk in settings where cholera is endemic (Kohnje et al., 2012; Denn et al., 2008). This is also the case in Malawi, where under 5s are among the most effected by cholera outbreaks (Senbete, 2019).

Poor hygiene practices and a lack of access to safe water and sanitation services are the primary vectors of cholera contraction, **meaning that cholera is as much a consequence of poverty as it is of seasonality** (Allan, 2016; Baracchini et al. 2016; Denn et al., 2008; Kohnje et al., 2012). While insufficient data exists on cholera to identify specific socio-economic groups that are vulnerable to contraction in Malawi, children from poor socio-economic backgrounds, particularly in overcrowded urban areas, are believed to be the worst affected. This is largely due to overstretched or poor water and sanitation infrastructures, which previously analysed, are typically reduced in the lean season (Allan, 2016; Baracchini et al. 2016; Osei 2010; Saha et al., 2017). Improving water and sanitation access is therefore essential for the containment of cholera contraction and the propagation of this disease.

Given the seasonal and spatial synchrony[70] of cholera outbreaks in Malawi, targeting specific transmission hubs in hotspot areas, such as marketplaces, trading centres, waste dumping grounds and their immediate vicinities, can reduce transmission rates significantly during seasonal outbreaks (Luquero et al. 2011).

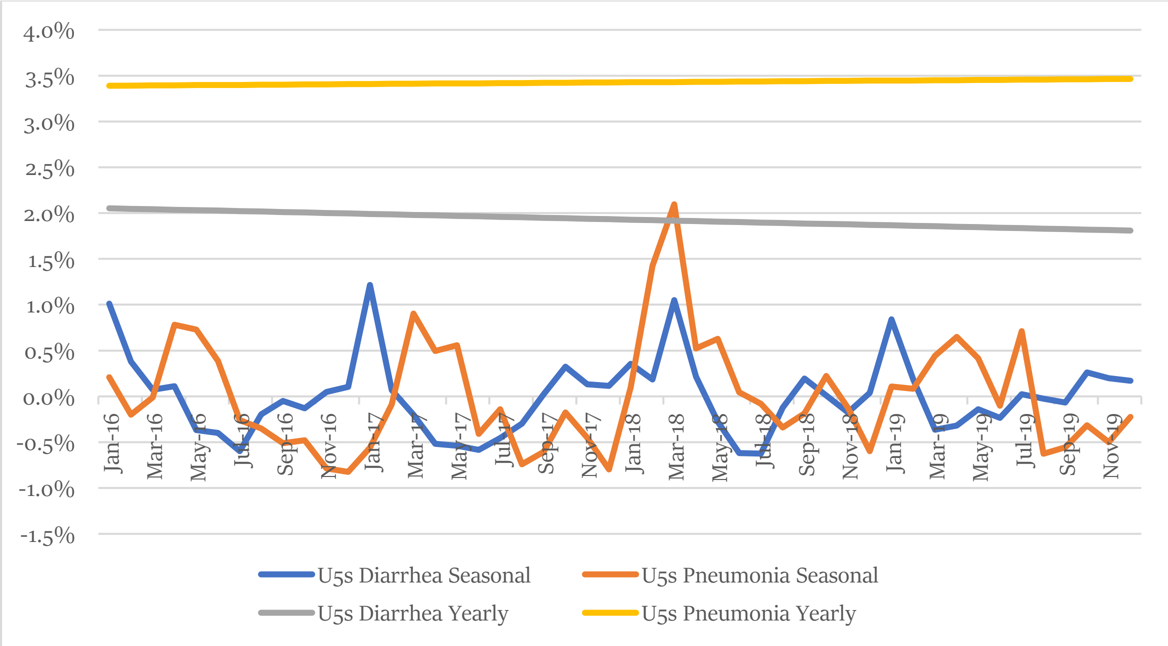
Seasonal fluctuations in Diarrhoea and pneumonia

Strong seasonal trends in infection are present for both diarrhoea and pneumonia among under 5s in Malawi. The *'yearly'* data in Figure 14 shows the 'de-trended' infection rates for both diarrhoea and pneumonia in Malawi – i.e. the average rates of infection once seasonal fluctuations are removed. As the graph shows, reported cases of diarrhoea among under 5s average around 2% across the year, albeit falling slightly from the beginning of 2019 to the end of 2019. In comparison, the cases of pneumonia in under 5s average around 3.5% over this period, over the same period.

Reported cases of diarrhoea peak on average in January and reach their lowest point in June, while pneumonia cases peak in either March or April before reaching their lowest point in December, with fluctuations in infection rates of 1.3 and 1.4 percentage points respectively (DHIS, 2020)[71]. These seasonal increases may sound small, but in comparison to average annual infection rates of 2% and 3.5% respectively, these swings are significant. However, as many households do not always seek medical assistance for these conditions (DHS, 2016), the infection rates shown in Figure 14 are likely to significantly underrepresent the prevalence of these conditions by only capturing those who sought treatment. In fact, primary data collected for this study shows that 18% of respondents recorded at least one child in their household having diarrhoea in November 2019, compared to 21% in January 2020 and 11% in May 2020 (U-report, 2020). This information indicates the magnitude under-reporting in the DHIS data presented in Figure 14.

[69] This analysis is based on data from January 2016 to December 2019 on data reported by district health offices.
[70] i.e. the same geographical areas and the same time of year
[71] These differences are statistically significant at 1%.

Figure 14: U5s Diarrhoea and Pneumonia Cases as a proportion of population (%)



Source: DHIS, 2020

Causal factors of disease prevalence in Malawi: An examination of malaria, diarrhoea and pneumonia

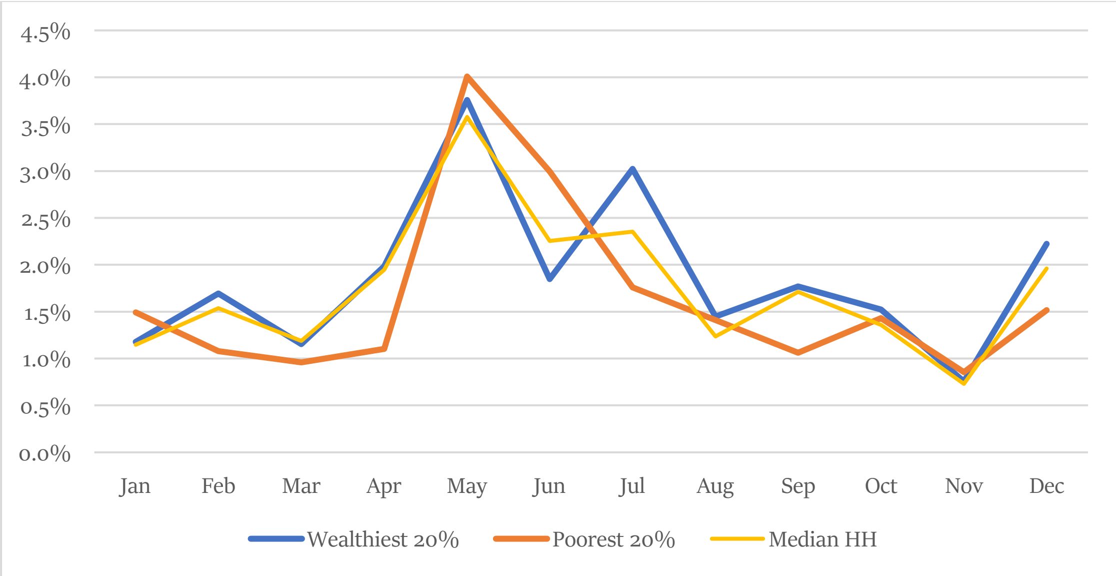
There are a number of socio-economic factors that influence disease prevalence in Malawi. These factors are the focus of the remainder of this section, which aims to unpack the seasonal nature of disease prevalence by examining the relationships behind these infections and those most susceptible to them.

Before examining the socio-economic characteristics that are associated with higher malaria, diarrhoea and pneumonia incidence, it is important to understand how health expenditures are affected by the lean season and whether this may impact contraction rates as well.

Seasonal health expenditures

As shown in Figure 15, health expenditure in Malawi fluctuates significantly throughout the year, with health expenditures on average 39% lower in the lean season compared to the non-lean season (the harvest and post-harvest seasons). This pattern is similar for the poorest, median and wealthier households.

Figure 15:Health Expenditure (% of overall household expenditure), median and poorest households



Source: IHS3 (2011), IHS4 (2017)

The cumulative impact of seasonal morbidity is most likely to be the cause of peaks in health expenditures at the end of this period (circa May). Rising incomes during the harvest seasons may also contribute to the timing of rising health expenditures. Given much of the primary health services are free of charge in Malawi, this analysis provides an indication of the gaps in public health services that are not covered by free public healthcare. With poverty and poor health clearly linked, the importance of income and other socio-economic factors on health outcomes are examined in more detail below.

Socio-economic characteristics of malaria prevention and contraction

National malaria prevalence in children under 5 has decreased by 19 percentage points from 43% in 2010 to 24% in 2017. Yet malaria is still one of the leading causes of morbidity and mortality among children in Malawi (DHS, 2018). In Malawi, children under age 5 are more likely to face severe illness or death as a result of malaria than any other population sub-group. For children, any immunity acquired in the womb is gradually lost after 6 months as they begin to develop their own resistance, with most children in malaria endemic areas reaching a high level of acquired immunity by age 5. Whilst acquired immunity cannot prevent against infection, it can help protect against severe malaria (DHS, 2018; Chirombo et al., 2020).

Malarial infection during pregnancy is a major public health problem in Malawi, with potentially severe consequences for both mother and child (UNICEF, 2018; DHS, 2018). Maternal immunity is greatly suppressed during pregnancy (most notably during a woman's first pregnancy), increasing the risk of severe malaria. Furthermore, malarial infection while pregnant is frequently associated with anaemia, which inhibits the transfer of oxygen and nutrients from mother to baby and which can lead to foetal anaemia, low birth weight, stillbirths, prematurity and foetal death (Ibanga et al., 2015; Shulman and Dorman 2003).

Due to the severity of malarial infections in under 5s and pregnant women, these 2 population sub-groups are the primary focus of this report's analysis on seasonal malaria infections.

As is well documented, malaria transmission is influenced by a range of climate, socio-economic and environmental factors and interventions. Nationally, malaria prevalence in under 5s has fallen from

43% in 2010 to 24% in 2017 in Malawi, in large part due to national net distribution campaigns and the scale up of effective therapies and rapid-diagnostic testing (DHS, 2018). Despite these efforts, contraction rates are still alarmingly high, and exhibit strong seasonal trends.

Climate is one of the leading drivers of interannual variation in malaria incidence in sub-Saharan Africa (Chirombo et al., 2020; Abeku, 2004; Ikeda, 2017). Mosquito larvae development is contingent on sufficient rainfall and temperature, as previously discussed. As shown in Figure 13, malaria contraction rates display strong seasonal patterns that align with Malawi's seasonal climatic conditions. This is not surprising, with temperature and lagged rainfall highly statistically significant drivers of malaria contraction in Malawi, with clinical malaria incidence peaking at a lagged rate of 3 months for both rainfall and temperature (DHIS, 2020; DCCMS, 2020; Chirombo et al., 2020; Abeku, 2004; Ikeda, 2017).

While patterns of seasonality in malaria infection exist across Malawi, transmission varies in accordance with the country's diverse geography. The low altitudes, high average temperatures and abundance of fresh water along the country's lakeshore and in its Shire Valley districts leads to higher malaria incidence in these areas. Yet within these districts - and across Malawi - malaria infection rates differ dramatically in relation to socio-economic characteristics. Socio-economic characteristics are key to understanding contraction rates and the adoption of health behaviours associated with malaria control. As such, knowledge of both climate (i.e. rainfall and temperature patterns) and non-climate (i.e. socio-economic factors) is essential for determining the characteristics of those who are less well prepared for seasonal spikes in malaria contraction (i.e. adopt poor behavioural control measures) as well as those whose contraction level is high.

The Malawi Malaria Indicator Survey (DHS, 2018) is a comprehensive, nationally representative survey of demographic and health indicators on malaria. 3,729 household heads were surveyed between April and June 2017, with an additional 2,377 women from 1,941 of these households interviewed simultaneously to understand their knowledge and behaviours with regards to malaria. Of the 2,377 women surveyed, 4% had never heard of malaria, while a further 9% were not aware that mosquito bites caused malaria. Of this 9%, the majority (over 90%) gave an incorrect cause for malaria, such as eating cold sima or drinking dirty water, while the rest were unaware of any cause (DHS, 2018). Furthermore, of the 13% of women who either had never heard of malaria or were not aware that mosquito bites caused malaria, 69% of them had never heard or seen any messaging about malaria and its causes (DHS, 2018).

It is important to understand the distinctions between those who do not use mosquito nets as they are unaware of malaria or how it is contracted, and those who are aware of malaria and its transmission vectors, but still do not use nets. The actions required to remedy both situations are naturally quite different, with the former most likely requiring education and improved dissemination of messaging, and the latter requiring improved access to nets or other potential actions that can encourage dissemination and/or adoption.

Low household education is unsurprisingly associated with poor knowledge of malaria and plays a key role in determining the use of mosquito nets. Women classed as functionally illiterate (i.e. either could not read any or only read part of a sentence) are twice as likely to be unaware of malaria and/or its causes[72] (DHS, 2018), while children under 5 are 30% more likely to sleep under a

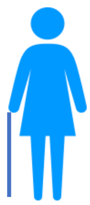
[72] With 21% of functionally illiterate women not aware of malaria or its causes, compared to 11% of literate women (DHS, 2018).

mosquito net if their mother attended higher education compared to if their mother has no education. This difference reduces to 21 percentage points and 15 percentage points respectively in households where the mother has only secondary education or where the mother has primary education respectively[73].

68% of children under 5 and 63% of pregnant women slept under an insecticide treated bed net the night before being surveyed (DHS, 2018). In those households where pregnant women and/or children did not sleep under a bed net, 56% had no net in the household, demonstrating a lack of access as the potential cause of low net use (DHS, 2018).

For those households that do have access to a bed net(s), various socio-economic factors are associated with their use:

- **Household size unsurprisingly impacts the use of mosquito nets among children under 5. 73% of children in households with one child under 5, compared to 31% of households with 4 or more children under 5, slept under a net the night before survey[74], with this finding highly statistically significant**. In addition, pregnant women are increasingly less likely to have slept under a net the night before survey as household size increases. These findings demonstrate the increased vulnerabilities faced by children and pregnant women in large households (DHS, 2018).
- **Elderly headed households are also less likely to have children under 5 sleeping under a mosquito net, with the probability of children under 5 sleeping under an insecticide treated bed net 8 percentage points lower in elderly headed households compared to non-elderly headed households[75]** (DHS, 2018; DHS, 2016). Furthermore, pregnant women are almost twice as likely to sleep under a net if they live in a non-elderly headed household, with a predicted probability of 61% for women in non-elderly headed households and 38% for women in elderly headed households. This perhaps indicates inertia among older people and an unwillingness to adapt health behaviours as what is deemed 'good practice' evolves. These findings are statistically significant at 1% and control for the number of children in the household as well as education of household head and various other socio-economic factors (DHS, 2018).



Children in elderly headed household are less likely to sleep under a net and more likely to contract malaria

The Malaria Indicator Survey (2017) is the only household survey that tests the interviewee for malaria, providing a wealth of new information on the socio-characteristics of malaria contraction. Unlike the DHS survey, which covered the lean season, the Malaria Indicator Survey was conducted from April to June and thus an assumption is made that those households vulnerable to infection from April to June are also similarly vulnerable from October to March.

- **In line with the findings on net use and preventative behaviours above, under 5 infection rates diminish significantly with the education level of household head and with**

[73] The predicted probabilities of children under 5 sleeping under a net the night before survey are 59% for mothers with no education, 65% for mothers with primary education, 71% for mothers with secondary education, 86.5% for mothers with higher education (DHS, 2018). The question used for this analysis is whether the child 'slept under a mosquito net the night before survey'.

[74] This analysis is done for children under 5 years old only.

[75] Predicted probabilities of 59% vs 67%.

household income, with both these findings statistically significant at 1% (Malaria Indicators Survey, 2017). The probability of infection varies from 11% for the richest households to 41% for the poorest households, and from 6% for households with higher education to 32% for households with no education.

- **Under 5 infection rates are also higher in elderly headed households than non-elderly headed households, with the predicted probability of infection increasing from 26.5% for non-elderly heads to 33% for elderly headed households respectively**, controlling for other determining factors such as education and wealth, with these differences highly statistically significant (DHS, 2018).
- **Children under 5 are over 3 times more likely to contract malaria if they live in households that collect water from an unprotected spring and 2.5 times (predicted probabilities) more likely to contract malaria if their main water source is borehole or protected well, compared to households whose main source of water is piped into their home or plot** (DHS, 2018). These findings were conducted controlling for household head education, age of household head and income of household. While the type of water source a household uses does have a significant on the probability of contracting malaria, this study finds no clear relationship between time from water source and contraction rates.

WASH facilities have a significant impact on child infection rates for malaria

Socio-economic characteristics of pneumonia vulnerable households

For children under 5, pneumonia is the single largest cause of death from infectious disease in Malawi, causing an estimated 13% of child deaths a year (WHO, 2019; UNICEF, 2018)[76]. Whilst healthy children can fight infection from pneumonia naturally, immuno-deficiency, which is significantly compromised by malnutrition or under-nourishment, leads to higher risk of contraction (WHO, 2019). With 37.4% of children under 5 stunted as in Malawi as of 2019, pneumonia infection can be fatal in Malawi (GNU, 2020).

The WHO specifies the following presenting features for diagnosing pneumonia in young children:

"In children under 5 years of age, who have cough and/or difficult breathing, with or without fever, pneumonia is diagnosed by the presence of either fast breathing or lower chest wall indrawing where their chest moves in or retracts during inhalation." (WHO, 2019).

In line with this definition, this study's analysis classifies children under 5 that 'demonstrate conditions of acute respiratory infection or pneumonia', as those who 'had a cough in last two weeks' which was accompanied by 'short, rapid breaths' and/or a 'problem in the chest or blocked or running nose' (categories in the DHS, 2000, 2004, 2011, 2016). **'**Fever' as a symptom was not included as pneumonia may be present with or without it. Analysis on pneumonia in this report is therefore not based on diagnosis, for which information is not available, but upon the presentation of symptoms of pneumonia. Under this classification, the percentage of under 5s exhibiting symptoms of pneumonia equates to 12.7% of the population (DHS, 2000 -2015).

76 https://data.unicef.org/resourcesu/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=MWI.CME_MRY0T4..&startPeriod=2016&endPeriod=2020

To analyse the household and environmental factors that influence infection rates, the last 4 survey rounds of Malawi's Demographic and Health Surveys were appended (DHS, 2000, 2004, 2011, 2016) to provide a large data source on vulnerabilities. Potential differences across survey rounds are accounted for so that comparisons can be made without concerns for confounding effects due to the time of survey. Despite combining 4 rounds of the DHS, not all months of the year are covered by the dataset, with no or poor data available for February, March, April and May. As such, no reliable estimates can be made for the months February-May and no inferences on the socio-economic characteristics of households vulnerable to pneumonia (or diarrhoea) can be made for the lean season in its entirety, rather this paper examines the risks of contraction in the sowing season only (the first half of the lean season), for which sufficient data is available.

- **Analysis conducted for this study shows that household wealth plays a small role in the probability of a child demonstrating symptoms of pneumonia, and only leads to a significant difference for the richest households in Malawi.** Pneumonia symptoms are largely consistent among the bottom 4 quintiles in Malawi, with the predicted probability of a child under 5 contracting pneumonia ranging from 11.4% for households in the poorest income quintile (the bottom 1-20% of households) to 10.4% for households in the richer income quintile (households in the 61-80% quintile). The predicted probability only falls noticeably - to 9% - for the richest quintile (81-100% in the income distribution), showing that wealth is not a determining factor in contraction (DHS, 2000, 2004, 2011, 2016).
- **The probability of a child under 5 exhibiting signs of pneumonia is also consistent across household education levels**[77]. The probability of a child exhibiting symptoms of pneumonia in households whose highest level of education is primary vs those whose highest education level is tertiary (e.g. a degree or other higher education), is 11.3% and 10.3% respectively, a difference of only 1%, with these findings highly statistically significant (DHS, 2000, 2004, 2011, 2016).
- **Children under 5 in child headed households have a far higher probability of exhibiting symptoms of pneumonia than children in adult headed households**, with the predicted probability of a child under 5 showing pneumonia symptoms 8.5% higher in child headed household (predicted probability of 19.5%) compared to adult headed households (predicted probability of 11%). This finding is highly statistically significant (DHS, 2000, 2004, 2011, 2016).

Female and elderly headed households show similar probabilities of children presenting features of pneumonia as male and non-elderly headed households, and as such these distinctions are not examined further.

The relationships discussed above between pneumonia contraction and income, household education level and age of household head remain consistent between seasons. As mentioned previously, data is not available for all months of the year, even after combining four survey rounds of the DHS, with gaps in datapoints from February-May. As such, comparisons between seasons is difficult and no analysis on the impact of the entire lean season can be made. However, sufficient data on the sowing season (the first half of the lean season) means that we are able to determine whether there are notable differences for this season compared to the rest of the year (DHS, 2000, 2004, 2011, 2016).

[77] As in the rest of this report, a household's education level refers to the highest level of schooling any households member has attended

- **Household water source has a seemingly small impact on contraction rates among under 5s across the year; however, in the sowing season, a household's primary drinking source is an important determinant of pneumonia contraction among children under 5.** In the sowing season, the predicted probability of a child under 5 contracting pneumonia is 2.7% higher in households where the primary drinking water comes from surface water sources such as rainwater, rivers, lakes or damns (13.5%), compared to households where the primary drinking water source is piped into their home (10.8%). These finding are highly statistically significant, with this analysis accounting for other determining factors, such as household wealth, education level, size and age of household head (DHS, 2000, 2004, 2011, 2016).
- **A household's sanitation facility also has a significant impact on the probability of contracting pneumonia among under 5s**. Households with flush toilets have a predicted probability of demonstrating features of pneumonia of 7.5% compared to 11.3% for households who have no facility and that practice open defecation. The probability of a child under 5 demonstrating symptoms of pneumonia is even higher in the sowing season if they reside in a household with no toilet facility, with this probability rising to 13.2% for households who have no toilet facility compared to 7.7% for those with flush toilets in the sowing season (DHS, 2000, 2004, 2011, 2016).

WASH facilities have a significant impact on pneumonia among under 5s, particularly in the sowing season

These findings are not surprising as "Handwashing with water and soap is the most cost effective health intervention to reduce both the incidence of diarrhoea and pneumonia in children under five" and is "most effective when done using water and soap after visiting a toilet or cleaning a child, before eating or handling food and, before feeding a child." (MICS, 2014)

The number of children under 1 years old exhibiting symptoms of pneumonia in the DHS datasets (2000, 2004, 2010, 2015) is insufficient to be able to make any inferences on infant or neonatal pneumonia symptoms. As such, the analysis was constrained to those children presenting features of pneumonia under the age of 5.

Socio-economic characteristics of diarrhea vulnerable households

According to the DHS (2000-2015), the under 5 infection rate for diarrhoea averages 14.7% a year in Malawi. Diarrhoea is commonly managed through oral rehydration salts (ORS), with the provision of zinc supplements also shown to reduce the duration and severity of diarrhoea and the probability of further episodes within the next two or three months (MICS, 2014). However, data collected in January 2020 from over 30,000 households across Malawi, showed that in households where children under 5 had diarrhoea, only 36% used ORS and 28% zinc for treatment (U-report, 2020).

These findings are concerning as chronic or severe diarrhoea can have particularly severe implications for children due to their small body size and their developing immune systems, including malnutrition and mortality. In fact, diarrhoea accounts for 7% of under 5 deaths (UNICEF, 2018)[78], with most diarrhoea-related deaths in children due to dehydration and the loss of water and electrolytes through

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78 https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=MWI.CME_MRY0T4..&startPeriod=2016&endPeriod=2020

loose stools, which can be combatted through ORS and zinc supplements. It is thus essential that those most susceptible to diarrhoea be targeted with appropriate interventions and at-risk socio-economic groups be identified.

- **Much like pneumonia, a household's wealth and education level have a small impact on infection rates.** The probability of a child under 5 having diarrhoea decreases marginally with wealth, from probabilities of 20.5% for households with primary education to 18.5% for households with higher education, and from 21.5% for households in the lowest income quintile to 18% for households in the richest quintile, with probabilities reducing incrementally as income increases and households move from one wealth quintile to the next (DHS, 2000, 2004, 2011, 2016). These patterns are consistent in the growing, harvest and post-harvest seasons (DHS, 2000, 2004, 2011, 2016).
- **Unsurprisingly, a households' main source of drinking water makes a large difference to diarrhoeal infection rates**, with those households who use an open well or river 2.5 times more likely to have children under 5 contracting diarrhoea than those households that have a tap at home (predicted probabilities of 15% and 40% respectively), with the importance if these factors in determining contraction rates similar between seasons (U-report, 2020).
- **A households' toilet facility also has a significant impact on diarrhoea infection rates for under 5s. Children under 5 in households that have no toilet facility are 6.5 percentage points more likely to contract diarrhoea than children residing in household with a flush toilet (21.7% and 14.2% predictive probabilities)**, with this finding highly statistically significant (DHS, 2000, 2004, 2011, 2015). These patterns are consistent in the growing season and non-growing season; however, the impact of having no toilet facilities increases marginally in the sowing season, with the predicted probability of contracting diarrhoea 7.5% higher for children under 5 in households without a toilet facility, compared to those with a flush toilet. This outcome also aligns with evidence from the U-report survey conducted for this study (UNICEF, 2020), which finds that child under-five are almost twice as likely to contract diarrhoea in the lean season if they live in a home without a functioning toilet or latrine (probabilities of 17% compared to 32%), with this finding highly statistically. While these data sources are different and so cannot be easily compared, toilet facilities seem to play a more significant role in the lean season most likely as diarrhoea contraction increases in the lean season, meaning the importance of poor sanitation is naturally heightened.
- **Age and gender of household head seem to have no impact on diarrhoea contraction in under 5s (DHS, 2000, 2004, 2011, 2016)**, with the predicted probabilities of infection remarkably similar across these groups. See Annex 5 for outputs from above analyses.

The significance of water and sanitation on diarrhoea is well recognised, with sanitation and hygiene promotion two of the most effective interventions for controlling endemic diarrhoea (Laxminarayan et al., 2006). In fact, it is estimated that piping uncontaminated, chlorinated water into households would reduce diarrhoea contraction by up to 95 percent (Fewtrell and Colford, 2004). Yet 1.7 million Malawians remain without access to a safe water facility, and 60% of the population have no access to improved sanitation, inhibiting the fight against diarrhoeal infection in Malawi (WHO, UNICEF, 2019). Due to the use of seasonal streams and infrastructure damage in the lean season, the use of safe water sources naturally diminishes at this time of year, increasing the risk to households in the lean season (Okuni, 2019).

The number of children under 1 year old with diarrhoea in the combined DHS datasets (2000, 2004, 2011, 2015) is insufficient to be able to make any inferences on infant or neonatal infection rates. As such, the analysis is constrained to under 5s.

Key Learnings on Child Morbidity 1/2:

- **Malaria, pneumonia and diarrhoea contraction rates exhibit strong seasonal trends in Malawi.** The proportion of under 5s who contract malaria is 8.8% higher in the growing season compared to the post-harvest season, while cases of diarrhoea and pneumonia peak in the sowing season, with official district health data showing increases in infection rates of 1.3 and 1.4 percentage points respectively, compared to annual infection rates of 2% and 3.5% respectively (DHIS, 2020). Pneumonia and diarrhoea among under 5s are however projected to be far higher than reported by district health official, with household survey data showing that 18% of households reported at least one child in their home having diarrhoea in November 2019, compared to 21% in January 2020 and 11% in May 2020 (U-report, 2020).

Infection rates for these malaria, pneumonia and diarrhoea differ among socio-economic groups and household characteristics, most notably:

- **The income and education level of a household impacts the use of mosquito nets and the probability of contracting malaria among under 5s,** with the probability of infection varying from 11% for the richest households to 41% for the poorest households, and from 6% for households with higher education to 32% for households with no education (Malaria Indicators Survey, 2017). The wealth and education level of a household has a small impact on diarrhoea and pneumonia contraction rates among under 5s in Malawi.

- **Children are more likely to contract malaria if they reside in elderly headed households,** with the predicted probability of a child under 5 contracting malaria increasing from 26.5% for non-elderly headed households to 33% for elderly headed households, controlling for other determining factors (DHS, 2018).

- **Whereas children under 5 in child headed households have a far higher probability of exhibiting symptoms of pneumonia**, with the predicted probability of a child under 5 showing pneumonia symptoms 8.5% higher in child headed household (predicted probability of 19.5%) compared to adult headed households (predicted probability of 11%). (DHS, 2000, 2004, 2011, 2016). Poor data on malaria contraction among child headed households precluded this analysis.

- **Age of household head seems to have no impact on diarrhoea contraction in under 5s (DHS, 2000, 2004, 2011, 2016)**, with the predicted probabilities of infection remarkably similar across these groups.

Key Learnings on Child Morbidity 2/2:

- **A household's water and sanitation facilities effect malaria, pneumonia and diarrhoea contraction. Unsurprisingly, a households' main source of drinking water makes a large difference to diarrhoeal infection rates**, with those households who use an open well or river for water consumption 2.5 times more likely to have children under 5 contracting diarrhoea than those households that have a tap at home (predicted probabilities of 15% and 40% respectively), with the importance of these factors in determining contraction rates similar between seasons (U-report, 2020).

- **Furthermore, children under 5 are over 3 times more likely to contract malaria if they live in households that collect water from an unprotected spring**, compared to households whose main source of water is piped into their home or plot (DHS, 2018). These findings were conducted controlling for household head education, age of household head and income of household.

- **A household's water source has a seemingly small impact on annual pneumonia contraction rates among under 5s; however, in the sowing season, a household's primary drinking source is an important determinant of pneumonia contraction among children under 5, along with the household's sanitation**. In the sowing season, the predicted probability of a child under 5 contracting pneumonia is 2.7 percentage points higher in households where the primary drinking water comes from surface water sources such as rainwater, rivers, lakes or damns (13.5%), compared to households where the primary drinking water source is piped into their home (10.8%) (DHS, 2000, 2004, 2011, 2016).

- **Children under 5 residing in households with flush toilets have a predicted probability of demonstrating features of pneumonia of 7.5% compared to 11.3% for households who have no facility.** The probability of a child under 5 demonstrating symptoms of pneumonia is even higher in the sowing season if they reside in a household with no toilet facility, with this probability rising to 13.2% for households who have no toilet facility compared to 7.7% for those with flush toilets in the sowing season (DHS, 2000, 2004, 2011, 2016).

- **A households' toilet facility also has a significant impact on diarrhoea infection rates for under 5s. Children under 5 in households that have no toilet facility are 6.5 percentage points more likely to contract diarrhoea than children residing in household with a flush toilet (21.7% and 14.2% predictive probabilities)**, with this finding highly statistically significant (DHS, 2000, 2004, 2011, 2015). These patterns are consistent in the growing season and non-growing season; however, the impact of having no toilet facilities increases marginally in the sowing season, with the predicted probability of contracting diarrhoea 7.5% higher for children under 5 in households without a toilet facility, compared to those with a flush toilet. This outcome also aligns with evidence from the U-report survey conducted for this study (UNICEF, 2020), which finds that child under-five are almost twice as likely to contract diarrhoea in the lean season if they live in a home without a functioning toilet or latrine (probabilities of 17% compared to 32%), with this finding highly statistically.

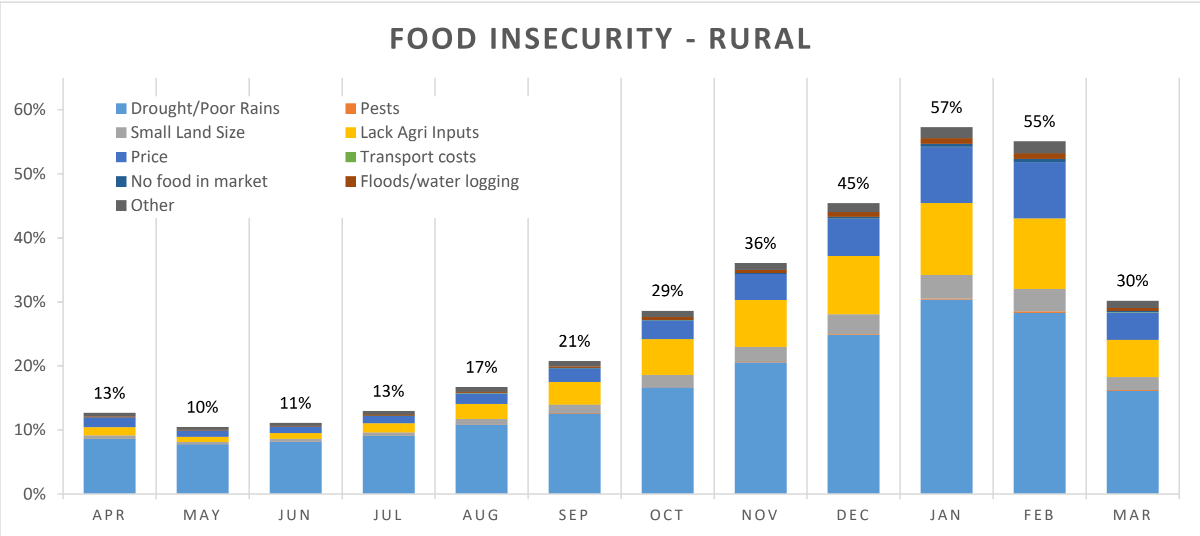
The seasonal nature of malnutrition and mortality in Malawi

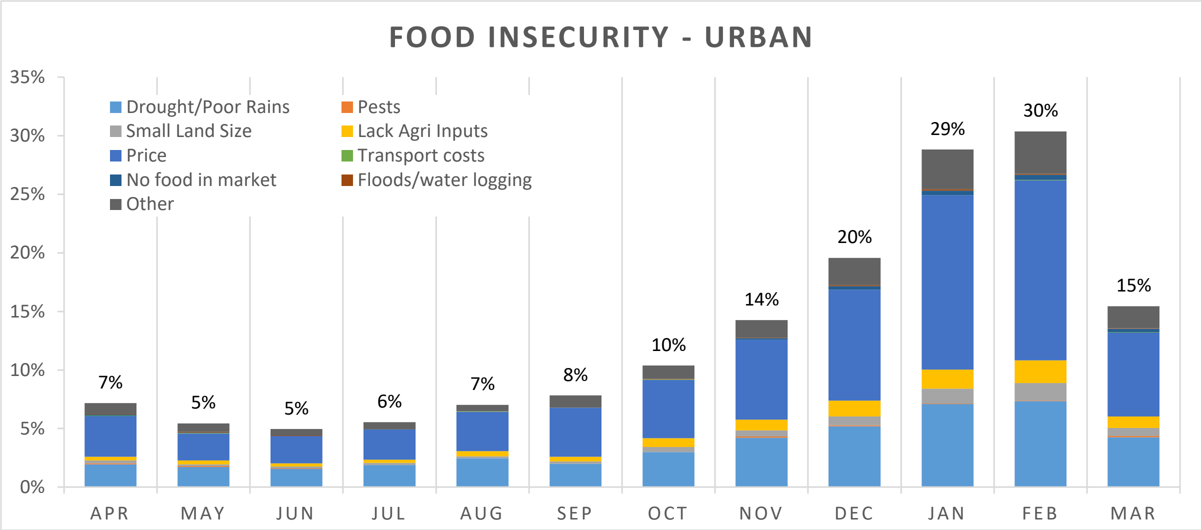
Malawi is heavily dependent on its own agricultural output, leading to patterns in food consumption dictated by the agricultural cycle. "Variable consumption paths are not uncommon in sub-Saharan Africa (SSA) where rural life follows a seasonal pattern rooted in the agricultural calendar" (Christina and Dillon, 2016). As can be seen in Figure 16, food consumption and security in Malawi varies in line with the country's agricultural cycle, with the country's harvest season showing low food insecurity while the cropping season experiences high food insecurity. In addition to low food intake, peaks in child morbidity in the lean season can also significantly increase child malnutrition by reducing the absorption and uptake of nutrients through illness and/or loss of appetite (Chikunga et al. 2014).

Acute malnutrition

As can be seen in Figure 16, self-reported food insecurity patterns follow the harvest season closely, ranging from just under 10% of households in May 2016 (the middle of the harvest season) to around 57% in January 2017 (the middle of the lean season) in rural areas. This compares to peaks of 30% and troughs of 5% in urban areas over these same periods (IHS4, 2017). Similar patterns were found in 2010/11 (IHS3, 2011) when self-reported food insecurity rose from just above 0% in April/May 2010 (same for both rural and urban areas) to almost 60% in rural areas and 40% in urban areas by February 2011.

Figure 16: Self-reported food insecurity, 2015-2016





Source, IHS4 (2017)

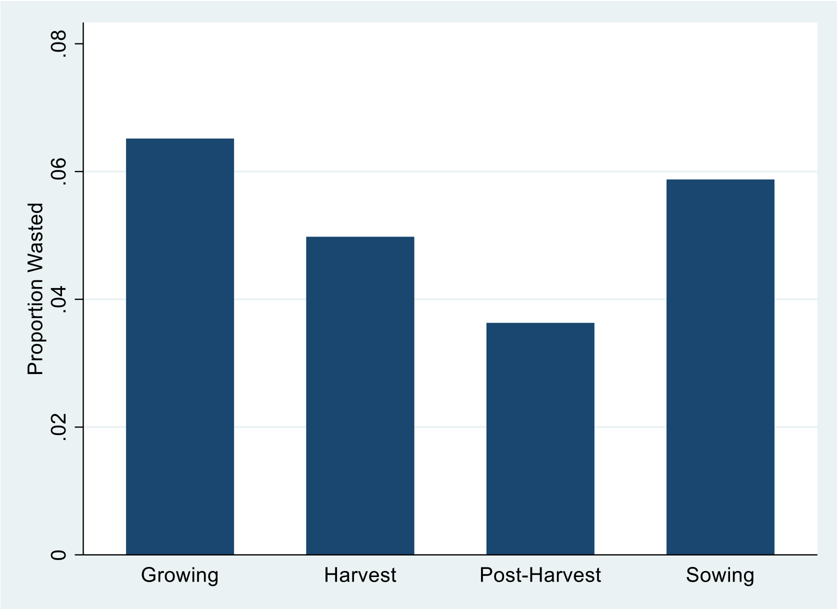
Seasonal food insecurity is closely related to low nutritional intake and low dietary diversity in Malawi, with the number of households consuming 4 or more food groups increasing by 35% in the harvest season compared to the lean season in Malawi (DHS, 1992-2015). Households are also 80% less likely to eat at least one meal a day with "fresh foods"[79] in January (the middle of the lean season) than they are in May (the middle of the harvest season) (U-report, 2020).

This study assesses the seasonal nature of acute malnutrition through examining wasting, a ratio of weight to height, which is a symptom of acute undernutrition (Bloem, 2007)[80].

As shown in Figure 17 below (IHS4, 2017), wasting increases by 80% in the growing season in Malawi compared to the post-harvest season (3.6% to 6.5%). This finding is consistent when replicated using DHS data (2000, 2004, 2011, 2015), and is coherent with similar analysis conducted by Maleta et al. (2003).

Figure 17: Wasting in children under 5

[79] Fresh foods were defined as 'meat, fish, eggs, chicken etc.' in the U-report questionnaire.
[80] The weight-for-height z-scores used to calculate this indicator were computed using the 2006 WHO growth standards, which define a child with a height-for-weight z score of less than -2 (2 standard deviations below the median) as 'wasted' (Bloem, 2007).



Source: IHS4 (2017)

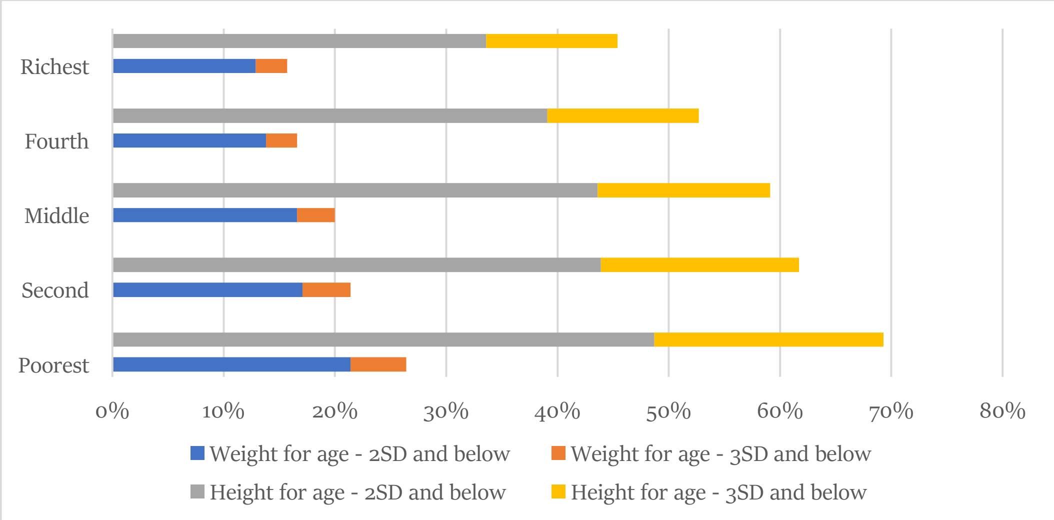
Socio-economic characteristics of children susceptible to acute malnutrition

Nutrition status is the result of a complex interaction of food consumption, health status and healthcare practices, which are affected by a range of environmental, socio-economic and cultural factors (WFP, 2015). Floods, excessive rains, droughts, dry spells and other environmental factors can affect child health and nutrition through infrastructure damage, disease prevalence and food availability. While socio cultural-economic factors such as poverty, inequality, education and cultural norms are closely associated with malnutrition (WFP, 2015). Together, these factors determine the quantity and quality of a child's dietary intake and their nutrient absorption capacity, which determine whether they are undernourished. These factors and their influence on malnutrition in Malawi are examined below.

Important in determining child nutrition levels is a households' access to land and/or ownership of livestock, which are significant determinants of both food and income. Data show that children living in households with no livestock, households with no land, households with no irrigation systems, and households with small plot size are much more vulnerable to seasonal variations in acute malnutrition (wasting or underweight) than children in households that do not present these vulnerabilities (IHS 2010/13/16).

The predicted probability of a child under 5 being wasted reduces as income increases, with this finding highly statistically significant (IHS 2010/13/16). Figure 18 below shows national acute and chronic malnutrition rates by income quintile. While the importance of income is clear, other key socio-economic characteristics beyond wealth are also highly associated with malnutrition.

Figure 18: National Acute (Weight-for-age – Underweight) and Chronic (Height-for-age – Stunting) Malnutrition rates by income group, Malawi



Source: UNICEF (2014)

Of far greater importance than wealth in determining acute malnutrition is the age of household head. Children under 5 years that reside in child headed households are almost 18% more likely to be wasted, with a predicted probability of 23.6%, compared to adult headed households, who have a probability of 5.4%, with this finding statistically significant at 5% (IHS4, 2017).

Also significant in determining vulnerability to wasting is a household's water and sanitation facility. WASH can affect childhood nutrition through various channels, including repeated bouts of diarrhoea[81], environmental enteric dysfunction, and intestinal worms, all of which can be prevented with safe WASH (Mills and Cummings, 2016).

Children under 5 in households without a piped or protected water source are 3.5% less likely to be wasted than households with neither a piped nor protected water source[82], with this finding highly statistically significant (Chikungu et al., 2014), corroborating previous evidence on the impact of water sources on morbidity and malnutrition.

Examination of wasting by season is not possible due to insufficient data. However, given the nature of the factors above that are highly correlated with wasting (e.g. water source, sanitation facility, income, age of head), these factors are likely to be important across the whole agricultural cycle.

Chronic malnutrition

Children that are stunted in their first 1000 days (from conception to 2 years of age) are more vulnerable to poor health and low socio-economic attainment as the risks associated with infectious morbidity and mortality during childhood extend into adulthood. Stunted children typically have impaired behavioural development in early life, have worse educational outcomes and poorer cognitive ability than non-stunted children, which impact their long term economic and development potential (Prendergast, 2014).

[81] "An estimated 25% of stunting is attributable to five or more episodes of diarrhoea before 24 months of age" (Mills and Cummings, 2016)

[82] Protected *water* sources refer to surface water sources and groundwater sources that have been protected from contamination of any kind. These included improved water sources such as piped water, tube well or borehole, protected dug well, and public standpipe

Chronic malnutrition levels have remained high and persistent in Malawi for many years, with 37.4% of children under 5 stunted as of 2019, surpassing the developing country average of 25% (GNU, 2020). Chronic malnutrition is the single biggest contributor to under-five mortality globally. For those that survive, the effects of chronic malnutrition, which include "permanent physical, cognitive and psychological impairment" are irreversible if not addressed before the age of 2-3 years (Ghani et al., 2017; Mbuya and Humphrey, 2016).

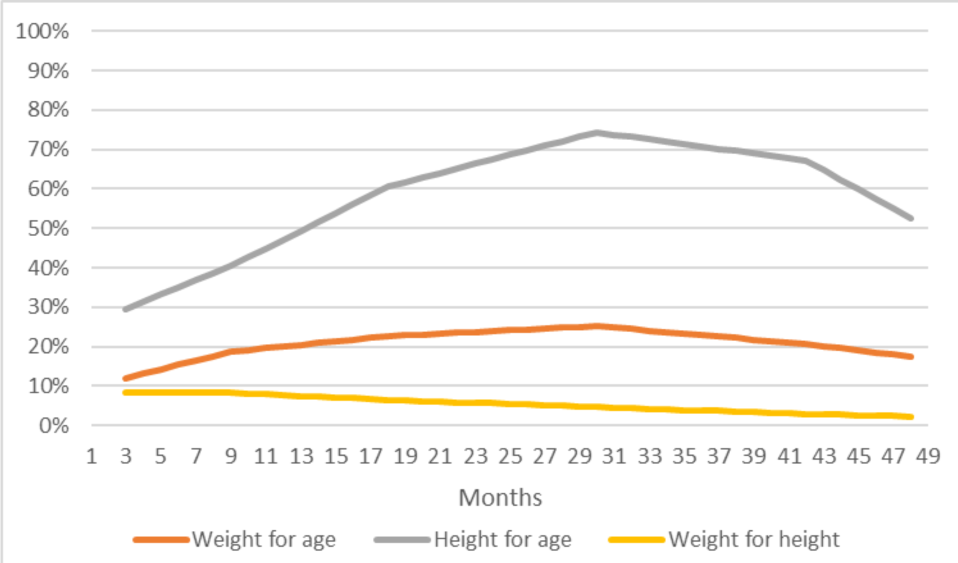
While indicators of acute malnutrition show seasonal variation in Malawi, see Figure 17, indicators of chronic malnutrition, such as stunting, do not appear to demonstrate a clear and obvious cyclical pattern over the agricultural cycle. Examining the IHS4 (2017) and DHS data (2000, 2004, 2011, 2015), it appears that stunting, measured using a child's HAZ score, increases marginally in the harvest season (IHS4, 2017; DHS, 2000, 2004, 2011, 2016); however, these findings are inconsistent across survey rounds making it difficult to make reliable inferences. This inconsistency is reported elsewhere. Maleta et al. (2003) research on rural Malawi reported a "rapid decline" in children's height for age z scores (i.e. stunting) in the rainy season compared to the dry season[83]; while Chikungu et al. (2014) research on Malawi finds the opposite, reporting higher levels of stunting among children in the harvest and post-harvest seasons compared to lean season. With chronic malnutrition a product of long-term nutritional intake, intra-year, seasonal fluctuations are liable to have muted impacts on chronic malnutrition.

In an attempt to unpack the inconsistency shown in this and other studies analysis on the impacts of the lean season on chronic malnutrition, this study looks at the potential exacerbating or mitigating effects of the lean season on chronic malnutrition when children have faced climatic shocks. Climatic shocks are known causes of chronic malnutrition. Through pooling data from the Malawian DHS (2004, 2010, 2015), and from Malawi's Multiply Indicators Cluster Surveys (UNICEF, 2006, 2014), a sample of 26,094 children under 5 years of age and their anthropomorphic scores is compiled. It is with this dataset that we aim to examine the impact of the lean season itself on chronic malnutrition scores and their relationship to climatic shocks, which are a known cause of undernourishment.

This study finds that even though chronic malnutrition is a product of long term imbalances or deficiencies in nutritional intake, seasonal variations in weather and climate clearly exacerbate chronic malnutrition and can also play a significant role in mitigating malnutrition in the wake of climate shocks. These impacts are significant for children at ages 1 and 2 only, when vulnerability is higher, and the impacts of malnutrition can be mitigated. While beyond the ages of 2-3 years the effects of chronic malnutrition are irreversible (Ghani et al., 2017), for all children under 5, as shown in Figure 19, the effects of malnutrition are observable and as such are examined in this study.

Figure 19: National Acute and Chronic Malnutrition and Wasting by age, Malawi

[83] For children aged 1 to 6 months and those aged 13 to 36 months.



Source: MICs (2014)

To measure chronic malnutrition, the anthropometric measure of height-for-age z-score (HAZ), which reflects a failure to reach linear growth potential (commonly known as stunting) is used. The HAZ, defined by the WHO, expresses a child's height in terms of the number of standard deviations above or below the median height of healthy children in the same age group. When a child falls below -2, the child is classified as stunted according to WHO growth standards. Low HAZ scores are associated with diminished "survival, childhood and adult health, learning capacity and productivity" (Dewey & Begum, 2011).

According to this study's analysis[84], a positive rainfall shock[85] (i.e. excessive rains) in the lean season (October to March) increases the probability of chronic malnutrition for those affected by 3.5% and 8.5% for 1- and 2-year olds respectively. A positive rainfall shock is associated with a -0.12 (reduction) in HAZ for 1 year olds[86] and a -0.24 (reduction) in HAZ for 2 year olds[87], and zero impact for children aged 3-5 years. This study was conducted controlling for a range of potential causal factors, such as age, household size and education level. This shows the significant and detrimental effects of excessive rains in the lean season on child nutrition and development. This rise in malnutrition from excessive rains is most likely due to increased morbidity from inundated and damaged water and sanitation infrastructures, as well as reduced crop yields from excessive rains causing direct physical damage to crops and reduced oxygen and nutrient uptake from waterlogged soil (DHS, 2004, 2010, 2016; MICS, 2006, 2014).

Furthermore, this study finds that a negative rainfall shock (i.e. a dry spell) at age 1 and 2 reduces the child's HAZ score by 0.47 and 0.38 lower HAZ respectively[88]. While negative rainfall shocks are not associated with the lean season per se, the analysis below shows that when negative rainfall shocks (i.e. dry spells) occur alongside increases in rains in the lean season, the negative impact

[84] This analysis was conducted in collaboration with Mirela Sabotic, University of Zurich.
[85] In this analysis, a positive rain shock (i.e. a flood) is defined as whether the regional annual rainfall increases above the eightieth percentile using the long-run rainfall distribution (1981–2016).
[86] This finding was found to just not be statistically significant.
[87] This finding is statistically significant at 10%.
[88] The reported reductions in HAZ scores above for 1 and 2 year olds are substantial and equate to an increase in the number of chronically malnourished 1 and 2 year olds by an estimated 14% and 13% respectively using HAZ data for 2014-16 (DHS, 2016; MICS, 2014)

on HAZ associated with a negative rainfall shock can be completely negated. In this analysis, a negative rainfall shock (i.e. a drought) is defined as when the average rainfall for a month falls below the twentieth percentile for the region using the long-run rainfall distribution (1981–2016)[89].

This study finds that a 1mm reduction in rainfall deviation in the rainy (lean) season correlates to a 0.011 improvement in HAZ[90], with these findings highly statistically significant[91]. The point of this analysis is to show that Malawi's population is vulnerable to intra-seasonal variability rather than inter-annual variability in rainfall, and that seasonal rainfall is a significant determinant of chronic malnutrition that can negate the impacts of a negative rainfall shock on a child's HAZ score. The millimetres of rainfall and their impacts on HAZ are estimates using a linear regression model, and a child's HAZ scores cannot be realistically inferred by evaluating rainfall, rather this analysis intends to show the significance of the lean season in determining chronic malnutrition through its impact of other environmental shocks (DHS, 2004, 2010, 2016; MICS, 2006, 2014).

Finally, this study finds[92] that the negative impacts of rainfall shocks can also be mediated by the quality of water source a child has access to. Access to an improved water source diminishes the impact of a negative rainfall shock by increasing HAZ scores by +0.27 and +0.29 on average for 1- and 2-year olds[93]. What this means is that for children in households with improved water sources[94], the impact of a negative rainfall shock on a child's HAZ score will be reduced by 57% and 76%[95] on average compared to those without improved water sources, showing that improved water sources can also mediate some of the negative impact of negative rainfall shocks on undernutrition. All regression outputs are shown in Annex 6.

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[89] The estimated effects in years 3, 4, and 5 are statistically insignificant, in line with UNICEF and broader research on the importance of the first 1,000 days for child development (Cusick & Georgieff, 2020; Martorell, 2017). Insufficient data means we cannot demonstrate the cumulative impact on HAZ of positive and/or negatives rainfall shock in children in repeated years (DHS, 2004, 2010, 2016; MICS, 2006, 2014).

[90] This means that if a child experienced a negative rainfall shock at age 1 or 2, a 40mm decrease in negative rainfall deviation from the mean – which implies a 40 mm increase in rainfall towards average yearly rainfall – would lead to an increase in HAZ of 0.44 on average.

[91] The annual rainfall data do not necessarily reflect the distribution and intensity of the rainfall, since large amounts of rain fell in only a few days, resulting in maize failure. However, what this data does show is that if a child experienced a negative rainfall shock at age 1 then their HAZ scores reduce by 0.47 on average, which would push 14% of children to be malnourished at current rates. However, an improvement in seasonal rainfall during the same year can negate this increase in stunting and reduction in HAZ score.

[92] Additional analysis conducted with UNICEF Malawi and Mirela Sabotic, University of Zurich.

[93] This analysis was conducted while controlling for other mediating factors, such as mothers education level, the size of household, location of household and income of household.

[94] Improved water sources refer to a household connection (piped), tube well or borehole, protected dug well, and public standpipe

[95] This is calculated by doing 0.27/0.47=57% and 0.29/0.38=76%

Key Learnings on Malnutrition:

- **Seasonal food insecurity is closely related to nutritional intake and dietary diversity in Malawi**, with wasting (acute malnutrition) increasing by 3 percentage points in the growing season compared to the post-harvest season, from approximately 3.5% to 6.5% (IHS4, 2017).
- **The predicted probability of a child under 5 being wasted reduces as income increases**, from 6.8% for the poorest quintile to 4.6% for the richest quintile.
- **Children under 5 years that reside in child headed households are almost 18 percentage points more likely to be wasted**, with a predicted probability of 23.6%, compared to adult headed households, who have a probability of 5.4%, with this finding statistically significant at 5% (IHS4, 2017).
- **Even though indicators of chronic malnutrition, such as stunting, do not appear to demonstrate a clear and obvious cyclical pattern over the agricultural cycle, this study finds that seasonal variations in weather and climate can exacerbate chronic malnutrition and can play a significant role in mitigating malnutrition in the wake of climate shocks**. These impacts are significant for children at ages 1 and 2 only, when vulnerability is higher, and the impacts of malnutrition can be mitigated.
- **According to this study's analysis, a positive rainfall shock (i.e. excessive rains) in the lean season (October to March) increases the probability of chronic malnutrition for those affected by 3.5% and 8.5% for 1- and 2-year olds respectively.** This is because a positive rainfall shock is associated with a -0.12 (reduction) in HAZ for 1 year olds1 and a -0.24 (reduction) in HAZ for 2 year olds1, and zero impact for children aged 3-5 years. This shows the significant and detrimental effects of excessive rains in the lean season on child nutrition and development.
- **This study also finds that a negative rainfall shock (i.e. a dry spell) at age 1 and 2 reduces the child's HAZ score by 0.47 and 0.38 lower HAZ respectively. While negative rainfall shocks are not associated with the lean season per se, this study shows that when negative rainfall shocks (i.e. dry spells) occur alongside rising rains in the lean season, the impact on HAZ associated with a negative rainfall shock can be completely negated**. Specifically, that a 1mm reduction in rainfall deviation in the rainy (lean) season correlates to a 0.011 improvement in HAZ, with these findings highly statistically significant. The point of this analysis is to show that Malawi's population is vulnerable to intra-seasonal variability rather than inter-annual variability in rainfall, and that seasonal rainfall can impact chronic malnutrition levels.
- **Finally, this study finds that the negative impacts of rainfall shocks can also be mediated by the quality of water source a child has access to.** Access to an improved water source diminishes the impact of a negative rainfall shock by increasing HAZ scores by +0.27 and +0.29 on average for 1- and 2-year olds. What this means is that for children in households with improved water sources, the impact of a negative rainfall shock on a child's HAZ score will be reduced by 57% and 76%.

Child mortality

“Seasonal food scarcity and climate shocks (such as droughts) have long been shown to drive short-term malnutrition, morbidity, and, in Africa, mortality in vulnerable populations, especially women and girls.” (Ghani et al., 2017).

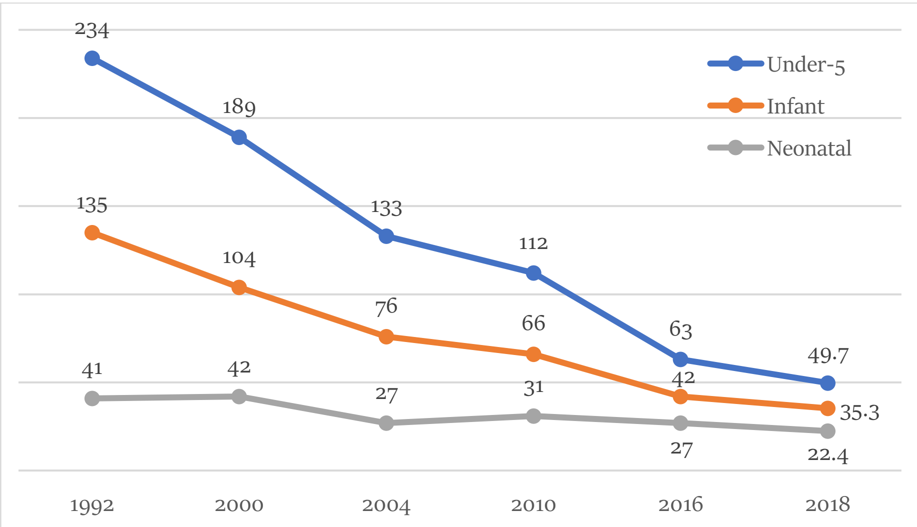
According to UNICEF (2018)[96], pneumonia, malaria and diarrhoea account for 13%, 8% and 7% of under 5 mortality respectively in Malawi, while approximately 23% of all child deaths in Malawi relate to under-nutrition. Child malnutrition leads to increased risk of infection and slow recovery from illness, leaving children more vulnerable to premature death (Prendergast, 2014). With Malawi’s growing season experiencing peaks in acute malnutrition (wasting), disease prevalence (diarrhoea, malaria and pneumonia) and food insecurity, children are particularly susceptible to mortality at this time of year.

In order to determine the impact of Malawi’s lean season on child mortality levels, this report examines the following mortality indicators, expressed as deaths per 1,000 live births, and their fluctuations between seasons:

- Neonatal mortality: probability of dying within the first month of life. As of 2018, Malawi’s under 5 mortality rate was 22.4 deaths per 1,000 live births, or 2.24%.
- Infant mortality: probability of dying between birth and the first birthday. As of 2018, Malawi’s under 5 mortality rate was 35.3 deaths per 1,000 live births, or 3.53%.
- Under 5 mortality: the probability of dying between birth and the fifth birthday. As of 2018, Malawi’s under 5 mortality rate was 49.7 deaths per 1,000 live births, or 4.97%.

As can be seen from Figure 20, two thirds of all under 5 mortalities occur between a child’s birth and first birthday, while approximately 43% of all under 5 deaths occur in the first month of a child’s life.

Figure 20: Trends in mortality rates in early childhood (deaths per 1,000 live births)

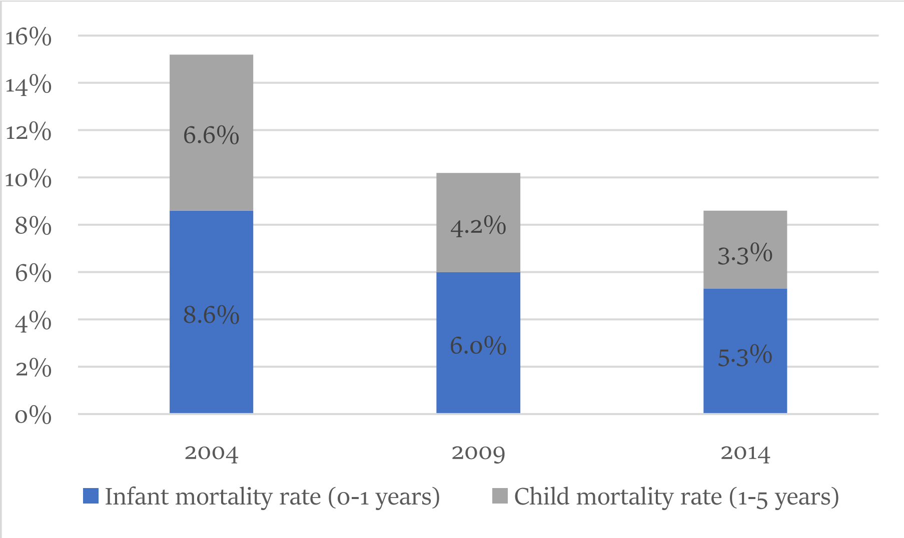


Source: DHS (2016), UNIGME (2019)

96 https://data.unicef.org/resources/data_explorer/unicef_f/?ag=UNICEF&df=GLOBAL_DATAFLOW&ver=1.0&dq=MWI.CME_MRY0T4..&startPeriod=2016&endPeriod=2020

Neonatal, infant, child and under-5 mortality rates in Malawi have improved dramatically in recent years, but this progress is not shared equally by both rich and poor alike. Income is a key determinant of child mortality, with under-five mortality rates far lower for children in the richest wealth quintile compared to the poorest wealth quintile, as shown in Figure 21 [97] (MICS, 2014).

Figure 21: Under 5 mortality rates, 2004-2014



Source: UNICEF (2014)

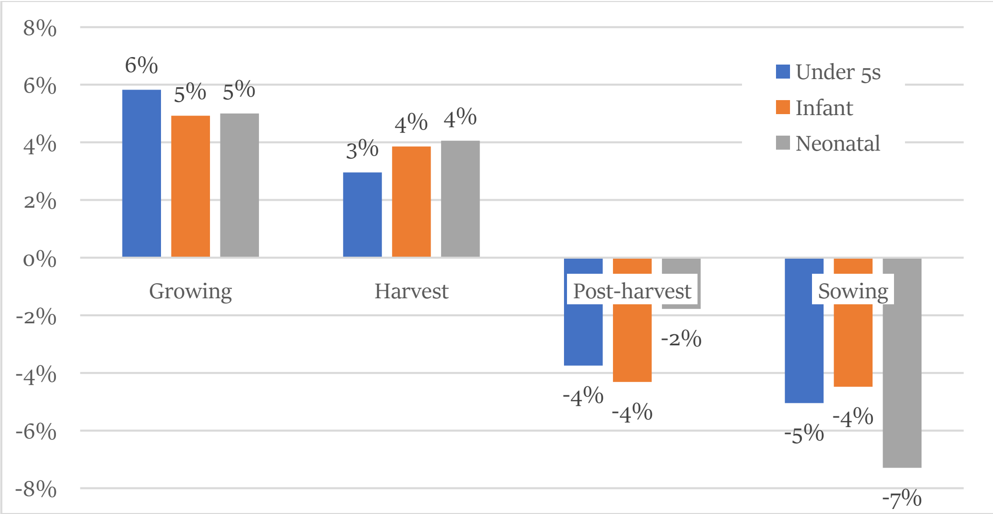
Unsurprisingly, child mortality shows strong seasonal trends in Malawi, in line with the agricultural calendar and fluctuations in food security, morbidity and malnutrition. Using mortality data from the DHS (2000, 2004, 2011, 2016)[98], we can see there is a clear and statistically significant excess of reported child deaths (+10% in under 5 mortality) in the growing season compared to the post-harvest season, demonstrating the devastating and permanent impact of the lean season on children and their families[99]. These patterns are consistent for infant and neonatal deaths over this period, with infant and neonatal mortality increasing 9.7% and 6.9% respectively between the post-harvest and growing season.

Figure 22: Seasonal fluctuations in Under5, Infant and Neonatal mortality rates, (1995-2014)

[97] Under-five mortality rates are lowest for children in the richest wealth quintile (70 deaths per 1,000 live births) and highest for children in the poorest wealth quintile (98 deaths per 1,000 live births).

[98] Information collected on birth histories is presented by mothers in the birth recode dataset. The quality of these estimates thus depends on the mother's recall ability, which can lead to potential data quality issues. In order to avoid duplication and reduce the impact of recall bias, only data in the years between survey rounds and in the 5 years prior to the DHS survey were used.

[99] Similarly, using child mortality from the DHS (2015) birth recode, we can see there is clear and statistically significant excess of reported child deaths (+9.8% in under 5 mortality) in the growing season compared to the post-harvest season. These changes are also supported by Hopper et al. (2020) analysis using DHS (1992-2015).



Source: DHS (2000, 2004, 2011, 2016)

Socio-economic characteristics of child mortality

Malawi's mortality data does not lend itself to comprehensive analysis of the socio-economic characteristics of child mortality. Poor information in the DHS on various factors of interest, such as disability, orphanhood, chronic illness and child headed households, limit the analysis that can be conducted. Despite these limitations, there is a clear and statistically significant relationship between certain socio-economic characteristics and under 5 and infant mortality, most notably wealth, education and age of household head, which are discussed in further detail below.

The analysis below appended the last 4 survey rounds of Malawi's Demographic and Health Surveys (DHS, 2000, 2004, 2011, 2016) to provide a large dataset with which to conduct socio-economic analysis (data from 1996-2016 was used). As child mortality rates were 3.5 times larger in 1996 than in 2016, predicted probabilities are not directly referenced in this text as they would not relate to current levels of child mortality and would therefore overstate the importance of current socio-economic factors. Rather this study compares the relative predicted probabilities of variables (e.g. the probability of mortality if a child is in and elderly headed household compared to if they are not) to understand the relative difference between them and thereby determine their importance. Where estimated are made on current rates of child mortality, predicted probabilities are given. This analysis yielded the following results:

- **A child is 12% more likely to die before their 5th birthday if they reside in households in the lowest wealth quintile compared to households in the highest wealth quintile, controlling for other potential determining factors (DHS, 2016)**. This finding is highly statistically significant and is the same for both boys and girls. Given that Malawi's under 5 mortality rate was 49.7 deaths per 1,000 live births in 2018, or 4.97% of the under 5 population, this translates to children residing in the poorest income quintile having an approximately 0.5% increase in probability that a child dies before their 5th birthday than those in the highest wealth quintile (DHS, 2000, 2004, 2011, 2016).
- **Child mortality rates are also affected by household education level, with under 5 mortality reducing significantly as household education rises[100].** Households with no

[100] Household education level refers to the highest education level of any individual in the household.

education and households where the highest level of education is primary education, are 20% and 15% (respectively) more likely to lose a child under 5 than households with tertiary education[101], controlling for other determining factors (DHS, 2000, 2004, 2011, 2016). This translates to a 1% and 0.75% increase in the predicted probability of a child dying before their 5th birthday if a household has higher education or primary education respectively compared to no education (DHS, 2000, 2004, 2011, 2016). There is no clear relationship between infant mortality and household wealth or education level.

- **Inadequate sanitation also has a significant impact on under 5 mortality; however, this finding is only significant for girls and not boys. Girls are 56% more likely to die before their 5th birthday if they live in a household with no sanitation facility, compared to one that has a flush toilet**, controlling for other determining factors such as wealth, education level and age of head. This relationship is equally as strong for both infant and neonatal mortality rates for girls but does not exist for boys of any age group[102]. All findings are highly statistically significant. Despite the statistical significance of the effects of sanitation and elderly headed households on girls, this study recommends further examination of these relationships to determine to corroborate the validity of these findings, given their significance.
- **Under 5, infant and neonatal mortality rates are higher in elderly headed households compared to non-elderly headed households, with this relationship far stronger for girls than boys, with girls 37% more likely to die before their 5th birthday compared to 7% for boys if they reside in elderly headed households, compared to non-elderly headed households** (DHS, 2000, 2004, 2011, 2016). Similar magnitudes exist for infant and neonatal mortality for girls and boys as well[103]. These relationships are highly statically significant and hold for all survey rounds individually and combined, controlling for other determining factors. As with the previous bullet's findings, to understand the nature of the patterns in the data, this study recommends further studies to look for confounding factors and clarify these findings.

WASH can affect maternal and child health through multiple direct and indirect mechanisms, such as increased infection rates, reduced performance of oral vaccines and medicines, poor food hygiene and lower nutrition, among others. As shown in Figure 11 and Figure 12, improved WASH coverage in Malawi is low, particularly among poorer households, and as shown in the evidence presented above, the distribution of WASH-related mortality and morbidity is also inequitable, falling disproportionately on the poorest, on women and on children (Mills and Cumming, 2016). However, as mentioned previously, while all findings are highly statistically significant, the disproportionate effects on girls reported above is not consistent with evidence from other studies. To understand the true relationships of the patterns in the data uncovered by this study, it is recommended that further studies look for potential confounding factors and clarify these findings.

Finally, the relationship between neonatal mortality and household socio-economic characteristics, including education level and wealth, is weak. This perhaps reflects the reduced impact of household

[101] Calculated by comparing the predicted probabilities of all 3 education levels and equating the difference in percentage.
[102] For girls, infant and neonatal mortality rates are 68% and 53% higher if they reside in a household without a toiler facility compared to one with a flush toilet.
[103] Girls are 34% more likely to die before this 1st birthday and boys 9% if they reside in elderly headed households. Girls are 48% more likely to die in their first month of like and boys 3% if they reside in elderly headed households. Controlling for other determining factors.

characteristics on neonatal mortality, perhaps implying that the determining factors around mortality during a child's first month are more systemic and environmental.

Key Learnings on Mortality:

- **Pneumonia, malaria and diarrhoea account for 13%, 8% and 7% of under 5 mortality respectively in Malawi, while approximately 23% of all child deaths in Malawi are related to under-nutrition (UNICEF, 2018).** Child malnutrition leads to increased risk of infection and slow recovery from illness, leaving children more vulnerable to premature death (Prendergast, 2014). With Malawi's growing season experiencing peaks in acute malnutrition (wasting), disease prevalence (diarrhoea, malaria and pneumonia) and food insecurity, children are particularly susceptible to mortality at this time of year.
- **Unsurprisingly, child mortality shows strong seasonal trends in Malawi, in line with the agricultural calendar and fluctuations in food security, morbidity and malnutrition.** Using mortality data from the DHS (2000, 2004, 2011, 2016)[1], we can see there is a clear and statistically significant excess of reported child deaths (+10% in under 5 mortality) in the growing season compared to the post-harvest season, demonstrating the devastating and permanent impact of the lean season on children and their families[1]. These patterns are consistent for infant and neonatal deaths over this period, with infant and neonatal mortality increasing 9.7% and 6.9% respectively between the post-harvest and growing season (*DHS, 2000, 2004, 2011, 2016)*.
- **Income is a key determinant of child mortality**, with a child 12% more likely to die before their 5th birthday if they reside in households in the lowest wealth quintile compared to households in the highest wealth quintile, controlling for other potential determining factors (DHS, 2016).
- **Households with no education and households where the highest level of education is primary education, are 20% and 15% (respectively) more likely to lose a child under 5 than households with tertiary education[1], controlling for other determining factors** (DHS, 2000, 2004, 2011, 2016).
- **Inadequate sanitation also has a significant impact on under 5 mortality; however, this finding is only significant for girls, who are 56% more likely to die before their 5th birthday if they live in a household with no sanitation facility, compared to one that has a flush toilet.** This relationship is equally as strong for both infant and neonatal mortality rates for girls but does not exist for boys of any age group. Despite the significance of this findings, it is not consistent with current available evidence. To understand the nature of the pattern in the data, this study recommends further studies to look for confounding factors and clarify these findings
- **Under 5, infant and neonatal mortality rates are also higher in elderly headed households,** with this relationship far stronger for girls than boys, with girls 37% more likely to die before their 5th birthday compared to 7% for boys if they reside in elderly headed households, compared to non-elderly headed households (DHS, 2000, 2004, 2011, 2016).

4. Conclusion and Recommendations

Malawi's lean season is a result of the concurrence of the country's rainy season (characterised by extreme weather events) and its sowing/growing seasons (characterised by low agricultural production and food insecurity). These events lead to a range of adverse outcomes for children, which are precipitated by reduced seasonal consumption, increased prevalence in diseases, and rising mortality.

Variable consumption paths are not uncommon in sub-Saharan Africa countries due to their single primary harvest seasons. In such environments, annual cycles exist for many economic variables, including labour, wages, migration patterns and prices, in line with food and cash crop production (Christian and Dillon, 2016). These economic influences impact children in a number of ways, from reduced food consumption and nutrition, to increased child labour, trafficking and marriage. While extreme climatic events at this time of year also increase the spread of disease and infection (DCCMS, 2020, Godfrey, et al., 2019; Okuni, 2019). Combined, these seasonal factors have a range of impacts on child deprivations, including rising child morbidity and malnutrition; reductions in education expenditure, attendance, and progression; increases in child labour and marriage; and rising child mortality. The types of households vulnerable to these deprivations have a number of consistent socio-economic characteristics, as shown in this study. However, due to a dearth of data on a range of deprivations and/or socio-economic characteristics, there are likely to be a number of relationships not fully explored or uncovered by this research. Furthermore, while this study examined how deprivations vary over Malawi's seasons and in different environmental, social and economic contexts, the relationships between these deprivations needs to be examined further if responses to seasonal deprivations are to be as effective and efficient as possible.

In light of the analysis undertaken for this study, four recommendations are made with regards to potential policy, programming and future research in Malawi. These are as follows:

1. **Season sensitive programming.** As this study has shown, the lean season impacts on a range of child deprivations, most notably in the areas of education, health and child protection. At present, the majority of government and donor programmes in Malawi remain consistent throughout the year, failing to account for seasonal changes. Yet adaptive programming that is responsive to seasonal needs is essential in Malawi: it is not only essential to mitigate the impacts of rising seasonal deprivations, but to preserve long-term developmental objectives as well. With many deprivations having permanent or semi-permanent implications for child development, mitigating the consequences of seasonal fluctuations by targeting those most in need will have long term implications for child development and wellbeing. Furthermore, with children effected in a multitude of ways, the impacts of the lean season can be better mitigated if the provision of services, and the linkages and referral mechanisms between programmes/services are improved, thereby helping children access all services they require.

2. **Seasonal emergency/lean season responses should target and respond based on more than food security.** Every year, Malawi's lean season sees huge spikes in food insecurity, which precipitate a humanitarian response. In fact, over the last ten years an average 1.8 million[104] people in Malawi (approximately 10% of the rural population) have been in receipt of emergency food assistance in the lean season (October – March), with these numbers expected

[104] This figure is 1.4million if one excludes the exceptional drought year of 2016/7 when 6.5 million Malawians were in need of assistance. These figures are calculated between 2010/11 and 2019/20.

to worsen as environmental degradation and population growth continue to increase[105] (Cherrier, 2019, Ofori-Kuma, 2019; World Bank, 2020b). At present, Malawi's seasonal emergency responses are based solely on food deficits. Yet with children vulnerable to a host of deprivations, seasonal emergency responses (or lean season responses) may be far more effective if a range of deprivations are targeted. The characteristics associated with a wide range of seasonal vulnerabilities, as identified in this report, can also help improve responses by guiding targeting to reach a broader range of vulnerabilities and vulnerable groups.

3. **Increased coordination and joint programming.** Major development challenges are often multidimensional and addressing poverty in Malawi, and the various forms it takes, is no exception. Programmes in Malawi frequently lack coordination and tend to focus on specific sector responses. Yet the importance of inter-sectoral coordination and programming cannot be understated. Integrated approaches can not only improve the cost effectiveness of programmes but their efficiency and effectiveness. In fact, many of the deprivations outlined in this report cannot be successfully addressed in isolation, with the relationship between child labour and education highly significant, as shown in this study. With many deprivations interdependent, tackling the adverse effects of the lean season would no doubt be substantially improved by coordinated programming/responses. While relationships between some deprivations have been reported in this study, with few datasets containing information on multiple deprivations, it is not possible to conduct comprehensive analyses on these relationships. Further data collection is required and recommended by this report.

4. **Further data collection and research.** The limited availability and quality of data in Malawi prohibits comprehensive analysis of seasonal fluctuations in deprivations and their causal factors. The analysis conducted in this report is based almost exclusively on cross-sectional data. To undertake seasonal analysis on this data is challenging, but given the serious impact of the relationships uncovered in this report, with the lean season effecting on a range of deprivations in Malawi, collecting reliable deprivations data by tracking households and children over one or more agricultural cycles could prove invaluable in determining the impact of seasonal (as well as covariate and idiosyncratic) shocks on a range of deprivations. Furthermore, with many deprivations seemingly interlinked, and coordinated action to seasonal deprivations possible, further data collection is required and encouraged to determine the strength and nature of relationships between deprivations. This would not only improve the quality of analysis on socio-economic factors, but enable analyses of the relationships between deprivations and their cumulative impacts, thereby expanding the scope and use of this data.

[105] Malawi's population is projected to double between 2020 and 2040

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Annex 1: Secondary data sources

- CPMIS (2019): Child Protection Management Information System, Ministry of Gender, Children, Disability and Social Welfare, Malawi
- DCCMS (2020): Department of Climate Change and Meteorological Services rainfall and temperature data, Malawi
- DHIS2 (2020): Health Management Information System, Department of Health, Malawi
- DHS (2010-2016): Demographic Household Surveys, Malawi National statistics Office
- EMIS (2018): Education Management Information System, Ministry of Education, Malawi
- IHS (2010-2017): Integrated Household Surveys, Malawi National statistics Office
- Malaria Indicators Survey (2017): Malawi Malaria Indicators Survey, DHS Program
- MICS (2018) Multiple Indicator Cluster Survey, UNICEF
- MLSS (2020): The Malawi Longitudinal School Survey, Ministry of Education, Malawi
- MODA (2018): Multiple and Overlapping Deprivation Analysis, Malawi National statistics Office
- MVAC (2015-2019): Annual Vulnerability Assessment and Analysis Reports, Malawi Vulnerable Assessment Committee
- NCLS (2015): Malawi: 2015 National child labour survey
- NSO (2018): Traditional Practices Survey, University of Zurich, Centre for Social Research at the University of Malawi, and UNICEF Malawi
- WFP ALPS (2019): Alert for Price Spikes Indicator, World Food Programme
- WFP VAM (2019): Vulnerability Analysis and Mapping Tool, World Food Programme

Annex 2: U-report Survey Example

The U-report specific survey questions varied slightly be round. The example questionnaire shown below was the first U-report survey disseminated in November 2019.

U-REPORT SOCIAL PROTECTION VULNERABILITIES POLL

November 2019

Hello U-reporter, we would like to know more about how you cope during the lean season. 1. How many people are in your household? 2. Does anyone in your household benefit from the Social Cash Transfer Programme (Mtukula Pakhomo)? (a) Yes (b) No	*Wawa U-Reporter, tikufuna tidziwe za moyo wanu spa nyengo ya chakudya chochepa.* *1. Kodi pakhomo panu pali anthu angati?* *2. Kodi m'banja mwanu alipo amene amalandira thandizo kuchokera ku pologalamu ya mtukula pakhomo?* *(a) Eya* *(b) Ayi* *3. Muli ndi ana angati a zaka zisanu kapena kuchepelapo.*

3. How many children are **under 5 years** in your household? (a) None (b) 1 (c) 2 (d) 3 (e) More than 4	*(a) Palibe* *(b) 1* *(c) 2* *(d) 3* *(e) Opitilira 4*
4. How many children **under 5 years** in your household consumed fresh foods, such as meat, fish, eggs, chicken, etc. yesterday? (a) None (b) 1 (c) 2 (d) 3 (e) More than 4	*4. Kodi dzulo ndi ana angati am'banja lanu osapitilira zaka zisanu omwe adya zakudya monga nyama , nsomba, nkhuku, mazila ndi zina.* *(a) Palibe* *(b) 1* *(c) 2* *(d) 3* *(e) Opitilira 4*
5. Did any child **under 5 years** in your household have diarrhea in the past week? (a) Yes (b) No	*5. Sabata yathayi pali mwana ochepera zaka zisanu pakhomo pano amene anadwala matenda otsekula mmimba?* (a) Eya (b) Ayi
6. How many children **over 6 years** are in your household? (a) 0 (b) 1 (c) 2 (d) 3 (e) More than 4	*6. Kodi muli ndi ana angati omwe ali ndi zaka zisanu (5) kapena kuposera apa?* *(a) 0* *(b) 1* *(c) 2* *(d) 3* *(e) More than 4*
7. How many children **over 6 years** in your household went to school last week? *(a) 0* *(b) 1* *(c) 2* *(d) 3* *(e) More than 4*	*7. Mwa ana anuwa ndi angati anapita ku kusulu sabata yangothayi?* *(a) 0* *(b) 1* *(c) 2* *(d) 3* *(e) More than 4*
8. Have **any children** in your household worked rather than gone to school in the last week? (a) Yes	*8. Kodi alipo ana m'nyumba mwanu amene anapita kogwira ntchito mmalo mopita ku sukulu sabata yatha?* *(a) Eya* *(b) Ayi*

(b) No

9. What is your **CURRENT** main source of drinking water?

(a) Tap at home
(b) Water kiosk
(c) Borehole with handpump
(d) Open well
(e) River
(d) Other

9. *Kodi madzi akumwa pakhomo panu mumatunga kutiko?*

(a) Mpopi wa pakhomo pompano
(b) Madzi a pampopi ogulitsa
(c) Mjigo
(d) Chitsime chosawaka
(e) Mtsinje
(d) Malo ena

Annex 3: Education Analysis

Table 1: Percentage change in school attendance rates (October 2017-February 2018)

District	Total (all standards)	Standard 1	Standard 2	Standard 3	Standard 4	Standard 5	Standard 6	Standard 7	Standard 8
Balaka	14%	3%	4%	-10%	1%	-10%	-8%	-6%	0%
Blantyre Rural	-20%	10%	-7%	-4%	10%	9%	14%	1%	-2%
Chiradzulu	7%	1%	19%	-1%	18%	6%	-3%	-2%	7%
Chitipa	1%	1%	1%	4%	6%	4%	2%	-1%	2%
Dowa	-14%	-13%	-10%	-5%	-8%	-11%	-13%	-8%	-11%
Karonga	-3%	7%	-6%	6%	-1%	10%	-1%	8%	2%
Kasungu	0%	1%	0%	1%	0%	3%	5%	0%	1%
Lilongwe	-7%	-8%	-7%	-12%	-7%	-3%	-3%	3%	-4%
Machinga	-39%	-52%	-56%	-3%	-34%	-25%	-24%	34%	-41%
Mangochi	-25%	-8%	-12%	14%	-12%	-15%	41%	-4%	-14%
Mchinji	1%	1%	-1%	-9%	0%	10%	-4%	-13%	-1%
Mulanje	6%	7%	5%	-1%	3%	2%	-1%	2%	2%
Mwanza	-4%	-6%	-6%	-6%	-8%	-1%	4%	-7%	-5%
Mzimba North	15%	16%	-12%	-8%	0%	6%	-8%	-25%	-2%
Neno	1%	5%	-27%	-2%	-14%	-5%	20%	3%	-6%
Nkhata Bay	-13%	-2%	0%	-11%	17%	3%	0%	-17%	-3%
Nkhotakota	-13%	3%	-12%	1%	-2%	1%	-5%	4%	-6%
Ntcheu	0%	9%	9%	1%	9%	3%	-5%	-5%	3%
Ntchisi	-12%	-1%	6%	9%	10%	0%	13%	12%	0%
Phalombe	15%	-3%	4%	9%	13%	16%	5%	-9%	7%
Rumphi	3%	11%	5%	1%	13%	-2%	6%	6%	3%
Salima	-3%	29%	34%	7%	14%	-10%	-20%	5%	11%
Thyolo	17%	-4%	49%	21%	-7%	15%	6%	5%	14%
Zomba Rural	-19%	53%	-7%	11%	-14%	-14%	-9%	4%	-2%

Data Source: Malawi Longitudinal School Survey (2017-2018), World Bank (2019)

Table 2: Regression of enrolment and regular attendance v household characteristics for all genders and school age children (primary and secondary), 2018

VARIABLES	(1) Enrolment 2018/2019	(2) Regular Attendance Term 1 18/19	(3) Regular Attendance Term 2 18/19	(4) Regular Attendance Term 3 18/19	(6) Effective Enrolment 2018/2019
Log per capita monthly expenditure	0.102*	0.00818	0.00306	-0.0256	0.0206
	(0.0551)	(0.107)	(0.106)	(0.109)	(0.0930)
Number of school going children 6-23 years	0.0517	0.0428	0.0529	0.0624	0.0745**
	(0.0326)	(0.0424)	(0.0432)	(0.0379)	(0.0366)
Household size	-0.0306	-0.0566	-0.0563	-0.0657**	-0.0643**
	(0.0239)	(0.0342)	(0.0339)	(0.0301)	(0.0267)
HH head aged 65+	-0.161**	-0.121	-0.155*	-0.103	-0.161**
	(0.0600)	(0.0809)	(0.0870)	(0.0906)	(0.0724)
HH Head Female	-0.0656	-0.162	-0.135	-0.154	-0.157
	(0.0601)	(0.117)	(0.107)	(0.116)	(0.103)
HH head Married	-0.0615	0.00796	0.0427	0.00344	-0.000627
	(0.0923)	(0.138)	(0.136)	(0.135)	(0.120)
HH head Widowed	-0.0523	0.0742	0.0829	0.0413	0.0355
	(0.0843)	(0.104)	(0.106)	(0.107)	(0.0948)
HH head ever Attended School	0.0515	0.0660	0.0635	0.0327	0.0245
	(0.0585)	(0.0812)	(0.0730)	(0.0724)	(0.0671)
HH head has a Chronic Condition	-0.0212	0.0724	0.0170	0.0518	0.0158
	(0.0502)	(0.0639)	(0.0598)	(0.0601)	(0.0518)
HH head has a Disability	-0.0240	-0.272**	-0.258**	-0.220*	-0.220*
	(0.0836)	(0.132)	(0.125)	(0.123)	(0.119)
Constant	0.117	0.475	0.444	0.760	0.00403
	(0.517)	(1.081)	(1.076)	(1.091)	(0.913)
Observations	4,814	3,933	3,932	3,930	4,685
Standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Source: UNICEF (2020)

Table 2: Regression of regular attendance v household characteristics (primary school girls), 2018

	(1)	(2)	(3)	(4)
	Regular Attendance first term 2018/2019	Regular Attendance second term 2018/2019	Regular Attendance third term 2018/2019	Regular Attendance 2018/2019
VARIABLES	y1	y1	y1	y1
Log Per capita monthly expenditure	-0.0133	-0.0174	-0.0303	-0.0162
	(0.0409)	(0.0407)	(0.0417)	(0.0408)
Household size	-0.00944	-0.00272	-0.00728	-0.00423
	(0.00897)	(0.00922)	(0.00927)	(0.00936)
HH head aged 65+	-0.0511	-0.0449	-0.0392	-0.0577
	(0.0440)	(0.0456)	(0.0452)	(0.0424)
HH Head Female	-0.0529	-0.0440	-0.0376	-0.0501
	(0.0515)	(0.0512)	(0.0553)	(0.0544)
HH Head Married	-0.0353	-0.0191	-0.0113	-0.0255
	(0.0544)	(0.0521)	(0.0558)	(0.0522)
HH Head Widowed	-0.00144	0.00491	-0.00127	0.0115
	(0.0459)	(0.0462)	(0.0463)	(0.0453)
HH Head Ever attended school	-0.0119	-0.00214	-0.0256	-0.0214
	(0.0373)	(0.0354)	(0.0328)	(0.0339)
HH Head Has a chronic condition	0.0307	0.0257	0.0363	0.0213
	(0.0348)	(0.0368)	(0.0337)	(0.0353)
HH Head Has a disability	-0.113**	-0.114**	-0.0963*	-0.121*
	(0.0525)	(0.0527)	(0.0533)	(0.0600)
Observations	1,709	1,708	1,707	1,707
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Source: UNICEF (2020)

Table 3: Regression of regular attendance v household characteristics (primary school boys), 2018

	(1)	(2)	(3)	(4)
	Regular Attendance first term 2018/2019	Regular Attendance second term 2018/2019	Regular Attendance third term 2018/2019	Regular Attendance 2018/2019
VARIABLES	y1	y1	y1	y1
Log Per capita monthly expenditure	0.0160	0.0173	0.00862	0.00785
	(0.0430)	(0.0431)	(0.0436)	(0.0417)
Household size	-0.0156*	-0.0152*	-0.0107	-0.0143*
	(0.00834)	(0.00806)	(0.00832)	(0.00768)
HH head aged 65+	-0.0423	-0.0759*	-0.0439	-0.0533
	(0.0338)	(0.0380)	(0.0395)	(0.0370)
HH Head Female	-0.0873	-0.0832	-0.0811	-0.0912
	(0.0565)	(0.0554)	(0.0516)	(0.0555)
HH Head Married	0.00688	0.000427	-0.0133	0.0146
	(0.0624)	(0.0619)	(0.0592)	(0.0607)
HH Head Widowed	0.0390	0.0325	0.0262	0.0489
	(0.0537)	(0.0520)	(0.0496)	(0.0532)
HH Head Ever attended school	0.0460	0.0450	0.0454	0.0375
	(0.0314)	(0.0321)	(0.0316)	(0.0335)
HH Head Has a chronic condition	0.0464	0.0165	0.0427	0.0320
	(0.0332)	(0.0315)	(0.0336)	(0.0327)
HH Head Has a disability	-0.118*	-0.0993	-0.0870	-0.0867
	(0.0625)	(0.0635)	(0.0619)	(0.0667)
Observations	1,779	1,779	1,778	1,778
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Source: UNICEF (2020)

Annex 4: Child Labour and Marriage Analysis

Figure 23: Probability of Excessive Child Labour if Reside in Rural Area and by lean/non-lean Season

```
Expression   : Pr(child_lab_last7days_15plushours), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
rural						
0	.3001976	.0035368	84.88	0.000	.2932655	.3071296
1	.2387843	.0015317	155.89	0.000	.2357823	.2417864
lean_season						
0	.2097548	.0019085	109.90	0.000	.2060142	.2134955
1	.2876824	.0020659	139.26	0.000	.2836333	.2917314
rural#lean_season						
0 0	.2756315	.0046402	59.40	0.000	.2665369	.284726
0 1	.3232512	.0052987	61.01	0.000	.3128659	.3336365
1 0	.1950582	.0020919	93.25	0.000	.1909582	.1991582
1 1	.2797468	.0022327	125.29	0.000	.2753707	.2841229

Source: (IHS3, 2011; IHS4, 2017)

Figure 24: District level predicted probabilities of excessive child labour

```
. margins i.district##lean_season

Predictive margins                              Number of obs     =     93,274
Model VCE    : OIM

Expression   : Pr(child_lab_last7days_15plushours), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
district						
Chitipa	.2135259	.007585	28.15	0.000	.1986595	.2283923
Karonga	.2069375	.0073834	28.03	0.000	.1924664	.2214086
Nkhatabay	.1640073	.0063406	25.87	0.000	.1515799	.1764347
Rumphi	.1740134	.0069093	25.19	0.000	.1604714	.1875555
Mzimba	.2856164	.0083455	34.22	0.000	.2692596	.3019732
106	.1590085	.0131576	12.08	0.000	.1332201	.1847969
Mzuzu City	.2862563	.0083028	34.48	0.000	.2699831	.3025294
Kasungu	.2552988	.0077193	33.07	0.000	.2401693	.2704284
Nkhota kota	.3192902	.0083638	38.18	0.000	.3028975	.335683
Ntchisi	.3271198	.0084617	38.66	0.000	.3105352	.3437045
Dowa	.2339757	.007666	30.52	0.000	.2189505	.2490008
Salima	.2584483	.0080843	31.97	0.000	.2426034	.2742932
Lilongwe	.156649	.0054048	28.98	0.000	.1460558	.1672422
Mchinji	.2097473	.0073428	28.56	0.000	.1953556	.2241389
Dedza	.2572855	.0079103	32.53	0.000	.2417817	.2727893
Ntcheu	.3153033	.0087508	36.03	0.000	.2981521	.3324546
Lilongwe City	.3244618	.007006	46.31	0.000	.3107303	.3381933
Mangochi	.1781591	.0072618	24.53	0.000	.1639263	.192392
Machinga	.2274359	.007734	29.41	0.000	.2122774	.2425943
Zomba	.2841492	.0085005	33.43	0.000	.2674885	.30081
Chiradzulu	.2304711	.008206	28.09	0.000	.2143876	.2465547
Blanytyre	.2506938	.0083877	29.89	0.000	.2342541	.2671334
Mwanza	.248818	.0080775	30.80	0.000	.2329864	.2646496
Thyolo	.2884992	.0089762	32.14	0.000	.2709062	.3060922
Mulanje	.2059934	.0076157	27.05	0.000	.1910668	.22092
Phalombe	.1733591	.0071255	24.33	0.000	.1593934	.1873249
Chikwawa	.2574548	.0082495	31.21	0.000	.2412861	.2736235
Nsanje	.2763987	.0084601	32.67	0.000	.2598172	.2929801
Balaka	.3283931	.0088802	36.98	0.000	.3109882	.345798
Neno	.2464031	.0080264	30.70	0.000	.2306717	.2621345
Zomba City	.3094161	.0086913	35.60	0.000	.2923814	.3264507
Blantyre City	.3205997	.0089043	36.01	0.000	.3031476	.3380517
lean_season						
0	.2106312	.0019033	110.67	0.000	.2069009	.2143615
1	.2873254	.002051	140.09	0.000	.2833055	.2913454
district# lean_season						
Chitipa#0	.1572469	.0092629	16.98	0.000	.139092	.1754018
Chitipa#1	.2662127	.011869	22.43	0.000	.24295	.2894755
Karonga#0	.1538221	.009054	16.99	0.000	.1360766	.1715675
Karonga#1	.2566537	.0115238	22.27	0.000	.2340675	.2792399
Nkhatabay#0	.1314708	.0092362	14.23	0.000	.1133682	.1495733
Nkhatabay#1	.1944257	.0087255	22.28	0.000	.1773241	.2115274
Rumphi#0	.1486754	.0088096	16.88	0.000	.1314089	.165942
Rumphi#1	.1977087	.0105369	18.76	0.000	.1770568	.2183605
Mzimba#0	.2155269	.0113389	19.01	0.000	.193303	.2377507
Mzimba#1	.3513639	.0122066	28.78	0.000	.3274394	.3752885
106 0	.1061182	.0159592	6.65	0.000	.0748386	.1373977
106 1	.2084479	.0205965	10.12	0.000	.1680796	.2488162
Mzuzu City#0	.2591341	.0110772	23.39	0.000	.2374232	.2808451
Mzuzu City#1	.3116996	.0122944	25.35	0.000	.2876029	.3357962
Kasungu#0	.2000161	.0111216	17.98	0.000	.1782181	.2218141
Kasungu#1	.3071135	.0107436	28.59	0.000	.2860564	.3281706
Nkhota kota#0	.2766354	.0108073	25.60	0.000	.2554534	.2978173
Nkhota kota#1	.3593413	.0126625	28.38	0.000	.3345233	.3841594
Ntchisi#0	.2546599	.0118178	21.55	0.000	.2314974	.2778224
Ntchisi#1	.3951699	.0121076	32.64	0.000	.3714394	.4189004
Dowa#0	.1952855	.0106296	18.37	0.000	.1744518	.2161192
Dowa#1	.2702176	.0110237	24.51	0.000	.2486115	.2918237
Salima#0	.2043747	.0110978	18.42	0.000	.1826234	.226126
Salima#1	.3091342	.0117238	26.37	0.000	.286156	.3321124
Lilongwe#0	.1279321	.0071343	17.93	0.000	.1139492	.141915
Lilongwe#1	.183491	.0080598	22.77	0.000	.1676942	.1992878
Mchinji#0	.1524283	.0096693	15.76	0.000	.1334768	.1713798
Mchinji#1	.263402	.0109775	23.99	0.000	.2418866	.2849174
Dedza#0	.1789377	.0102334	17.49	0.000	.1588806	.1989947
Dedza#1	.330721	.0119729	27.62	0.000	.3072544	.3541875
Ntcheu#0	.2912831	.0127536	22.84	0.000	.2662866	.3162796
Ntcheu#1	.3378551	.0120283	28.09	0.000	.3142802	.3614301
Lilongwe City#0	.3177526	.0097774	32.50	0.000	.2985892	.3369159
Lilongwe City#1	.3307626	.0100142	33.03	0.000	.3111351	.3503902
Mangochi#0	.1340344	.009701	13.82	0.000	.1150207	.1530481
Mangochi#1	.2194272	.0107435	20.42	0.000	.1983703	.2404841
Machinga#0	.1727853	.0100388	17.21	0.000	.1531097	.1924609
Machinga#1	.2786182	.0116743	23.87	0.000	.255737	.3014994
Zomba#0	.2394529	.0117431	20.39	0.000	.2164369	.262469
Zomba#1	.3260758	.0122652	26.59	0.000	.3020365	.3501151
Chiradzulu#0	.2150383	.0118147	18.20	0.000	.1918819	.2381947
Chiradzulu#1	.2449263	.0114118	21.46	0.000	.2225596	.267293
Blanytyre#0	.2203401	.0116532	18.91	0.000	.1975002	.2431799
Blanytyre#1	.2791402	.01204	23.18	0.000	.2555422	.3027383
Mwanza#0	.2045589	.0110025	18.59	0.000	.1829945	.2261233
Mwanza#1	.2902935	.0117821	24.64	0.000	.2672009	.3133861
Thyolo#0	.2518232	.0118293	21.29	0.000	.2286381	.2750082
Thyolo#1	.322907	.0134112	24.08	0.000	.2966215	.3491924
Mulanje#0	.1888804	.0105133	17.97	0.000	.1682747	.2094861
Mulanje#1	.2220113	.0109883	20.20	0.000	.2004747	.2435479
Phalombe#0	.138388	.0094056	14.71	0.000	.1199534	.1568226
Phalombe#1	.2060621	.010628	19.39	0.000	.1852316	.2268925
Chikwawa#0	.2429337	.012397	19.60	0.000	.2186359	.2672314
Chikwawa#1	.2710662	.0109783	24.69	0.000	.2495492	.2925833
Nsanje#0	.2187764	.0110107	19.87	0.000	.1971957	.240357
Nsanje#1	.3304379	.0127503	25.92	0.000	.3054479	.355428
Balaka#0	.2754734	.012108	22.75	0.000	.2517422	.2992047
Balaka#1	.3780947	.0129498	29.20	0.000	.3527136	.4034758
Neno#0	.2168947	.010506	20.64	0.000	.1963033	.2374861
Neno#1	.2740541	.0120446	22.75	0.000	.2504472	.297661
Zomba City#0	.2865207	.0115394	24.83	0.000	.2639039	.3091375
Zomba City#1	.3309083	.0129138	25.62	0.000	.3055977	.3562189
Blantyre City#0	.3011925	.0125816	23.94	0.000	.276533	.3258521
Blantyre City#1	.3388232	.0125971	26.90	0.000	.3141333	.3635131

Source: (IHS3, 2011; IHS4, 2017)

Figure 25: Probability of child working 3 months or more in the lean season if in a child headed household

```
Expression   : Pr(lean_season_work3plus), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
child_head						
0	.5460818	.0047834	114.16	0.000	.5367066	.5554571
1	.6249963	.0618568	10.10	0.000	.5037592	.7462334

Source: NCLS (2015)

Figure 26: Probability of a child begging (lean and non-lean season) if in a child headed household

```
Expression   : Pr(begging), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
child_head						
0	.3530339	.0134158	26.31	0.000	.3267393	.3793285
1	.5789474	.113269	5.11	0.000	.3569443	.8009505

Source: NCLS (2015)

Figure 27: Probability of orphan working in the sowing season

```
Expression   : Pr(child_lab_last7days_15plushours), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
orphan						
0	.2533414	.0051547	49.15	0.000	.2432384	.2634444
1	.3816923	.2197978	1.74	0.082	-.0491036	.8124881

Source: IHS3 (2011); IHS4 (2017)

Figure 28: U15 and U18 marriages, predicted probabilities by ethnic group

```
Expression   : Pr(U15marriage), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
ethnicity						
Chewa	.0931515	.0038289	24.33	0.000	.0856471	.100656
Tumbuka	.1238295	.0081431	15.21	0.000	.1078693	.1397897
Lomwe	.1674098	.0062025	26.99	0.000	.1552531	.1795666
Tonga	.1341111	.0138183	9.71	0.000	.1070277	.1611944
Yao	.1706511	.0073622	23.18	0.000	.1562215	.1850808
Sena	.1435949	.0102825	13.96	0.000	.1234416	.1637483
Nkhonde	.2059006	.0235361	8.75	0.000	.1597706	.2520306
Ngoni	.1098173	.0062729	17.51	0.000	.0975226	.1221121
Other	.1474156	.0088888	16.58	0.000	.1299938	.1648374

Expression : Pr(U18marriage), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
ethnicity						
Chewa	.4895049	.0064836	75.50	0.000	.4767974	.5022124
Tumbuka	.5882294	.0107503	54.72	0.000	.5671593	.6092995
Lomwe	.6129502	.0078062	78.52	0.000	.5976503	.6282501
Tonga	.6013772	.0183964	32.69	0.000	.565321	.6374333
Yao	.5932613	.0095803	61.93	0.000	.5744843	.6120383
Sena	.5549958	.014733	37.67	0.000	.5261197	.5838719
Nkhonde	.6731098	.0248372	27.10	0.000	.6244298	.7217899
Ngoni	.5555433	.0096	57.87	0.000	.5367277	.574359
Other	.5888171	.0120034	49.05	0.000	.5652909	.6123432

Source: UNICEF (2014)

Figure 29: U15 and U18 marriages, predicted probabilities by education level

Expression : Pr(U18marriage), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
education_level						
none	.6031427	.0100318	60.12	0.000	.5834806	.6228047
primary	.625068	.0042363	147.55	0.000	.6167649	.6333711
secondary	.2957335	.0088636	33.36	0.000	.2783612	.3131058
higher	.0785425	.0182763	4.30	0.000	.0427216	.1143634

Expression : Pr(U15marriage), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
education_level						
none	.2014701	.0078965	25.51	0.000	.1859932	.2169469
primary	.1356858	.0029762	45.59	0.000	.1298526	.1415191
secondary	.0444433	.0041199	10.79	0.000	.0363684	.0525182
higher	.010766	.0075764	1.42	0.155	-.0040835	.0256156

Source: UNICEF (2014)

Figure 30: U15 and U18 marriages, predicted probabilities by income group

Expression : Pr(U18marriage), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
windex5						
Poorest	.5768362	.0076694	75.21	0.000	.5618045	.591868
Second	.5757291	.0075486	76.27	0.000	.560934	.5905241
Middle	.5696654	.0074457	76.51	0.000	.5550721	.5842586
Fourth	.5578583	.0077932	71.58	0.000	.5425838	.5731327
Richest	.5195355	.008868	58.59	0.000	.5021546	.5369164

Expression : Pr(U15marriage), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
windex5						
Poorest	.151447	.0054719	27.68	0.000	.1407222	.1621718
Second	.1298817	.0051105	25.41	0.000	.1198653	.1398982
Middle	.1354653	.0051657	26.22	0.000	.1253407	.1455898
Fourth	.1264063	.0053238	23.74	0.000	.1159718	.1368408
Richest	.1050136	.00602	17.44	0.000	.0932146	.1168125

Source: UNICEF (2014)

Annex 5: Malaria, Pneumonia and Diarrhoea Analysis

Figure 31: Socio-economic characteristics of malaria contraction

Expression : Pr(malaria_causes_COMBINED), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
illit_part_whole						
0	.1078756	.0079807	13.52	0.000	.0922337	.1235175
1	.2078522	.0137886	15.07	0.000	.180827	.2348774

```
Logistic regression                         Number of obs     =      1,833
                                            LR chi2(8)        =     108.07
                                            Prob > chi2       =     0.0000
Log likelihood = -1210.9201                 Pseudo R2         =     0.0427
```

pregnant_no_net	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
v136	1.14802	.0271403	5.84	0.000	1.09604	1.202466
head_child	1.442419	.6570536	0.80	0.421	.5906777	3.52235
head_elderly	2.079557	.5092878	2.99	0.003	1.286796	3.360716
v149						
incomplete primary	.855291	.1503809	-0.89	0.374	.6059712	1.207191
complete primary	.4870909	.1080439	-3.24	0.001	.3153559	.7523485
incomplete secon..	.5209489	.1060758	-3.20	0.001	.3495209	.7764563
complete secondary	.3273678	.0828599	-4.41	0.000	.1993374	.5376295
higher	.2608599	.0996709	-3.52	0.000	.1233603	.5516193
_cons	.6462053	.1301028	-2.17	0.030	.435507	.9588395

Note: _cons estimates baseline odds.

```
.
. margins v149

Predictive margins                          Number of obs     =      1,833
Model VCE    : OIM

Expression   : Pr(pregnant_no_net), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
v149						
no education	.5518251	.0393869	14.01	0.000	.4746282	.6290219
incomplete primary	.5139976	.0155825	32.99	0.000	.4834566	.5445387
complete primary	.3797569	.0343085	11.07	0.000	.3125136	.4470002
incomplete secon..	.3952293	.0280271	14.10	0.000	.3402971	.4501615
complete secondary	.2939715	.0389567	7.55	0.000	.2176178	.3703252
higher	.2503434	.0630523	3.97	0.000	.1267631	.3739236

```
. tab  pregnant_no_net v460
```

pregnant_no_net	children under 5 slept under mosquito bed net last night (household questionnair 0	1	2	Total
0	51	18	481	550
1	396	10	41	447
Total	447	28	522	997

```
Logistic regression                               Number of obs     =      2,004
                                                  LR chi2(14)       =     271.00
                                                  Prob > chi2       =     0.0000
Log likelihood = -1031.2773                       Pseudo R2         =     0.1161
```

malaria_test	Odds Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hc61						
primary	.655999	.1040851	-2.66	0.008	.4806688	.8952831
secondary	.2407181	.0509101	-6.73	0.000	.1590325	.3643609
higher	.0626852	.0652777	-2.66	0.008	.0081425	.4825811
hv201						
piped to yard/plot	1.021004	.6043554	0.04	0.972	.3200233	3.257414
piped to neighbor	.3798715	.3381438	-1.09	0.277	.0663647	2.174385
public tap/standpipe	4.515288	2.626836	2.59	0.010	1.443731	14.12162
tube well or borehole	8.938024	5.107455	3.83	0.000	2.916349	27.39325
protected well	9.767868	5.939553	3.75	0.000	2.96626	32.1655
unprotected well	5.675427	3.375839	2.92	0.004	1.768844	18.2099
protected spring	4.892222	4.284012	1.81	0.070	.8792804	27.2198
unprotected spring	15.98335	11.60447	3.82	0.000	3.851818	66.32385
river/dam/lake/ponds/stream/canal/irrigation channel	2.906258	1.841545	1.68	0.092	.839406	10.06228
cart with small tank	1	(empty)				
other	1	(empty)				
hv204	1.00037	.0002363	1.56	0.118	.9999067	1.000833
1.child_headed_HH	1	(empty)				
1.elderly_headed_HH	1.387836	.4104624	1.11	0.268	.7773009	2.477919
_cons	.1078099	.0639099	-3.76	0.000	.0337338	.3445503

```
Expression   : Pr(malaria_test), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
hv201						
piped into dwelling	.1316363	.0623365	2.11	0.035	.009459	.2538135
piped to yard/plot	.1200608	.0356563	3.37	0.001	.0501759	.1899458
piped to neighbor	.0443839	.0311865	1.42	0.155	-.0167405	.1055084
public tap/standpipe	.257243	.0248536	10.35	0.000	.2085308	.3059552
tube well or borehole	.3206789	.0160081	20.03	0.000	.2893036	.3520542
protected well	.3247174	.0466213	6.97	0.000	.2333414	.4160934
unprotected well	.2366357	.0322498	7.34	0.000	.1734272	.2998443
protected spring	.2323003	.1133676	2.05	0.040	.0101039	.4544967
unprotected spring	.4214649	.0982155	4.29	0.000	.2289659	.6139638
river/dam/lake/ponds/stream/canal/irrigation channel	.1333144	.0320461	4.16	0.000	.0705053	.1961236

Source: DHS (2018)

Figure 32: Socio-economic characteristics of pneumonia contraction

```
Expression   : Pr(pneumonia), predict()
```

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
v106						
no education	.0882512	.0027749	31.80	0.000	.0828125	.09369
primary	.1130459	.001608	70.30	0.000	.1098942	.1161975
secondary	.1208221	.0041044	29.44	0.000	.1127777	.1288665
higher	.1035408	.0180871	5.72	0.000	.0680907	.1389909

Expression : Pr(pneumonia), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
child_headed						
0	.1091876	.0012968	84.20	0.000	.1066459	.1117293
1	.1945559	.0651528	2.99	0.003	.0668587	.3222531

Expression : Pr(pneumonia), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
water_source						
piped	.1118253	.004328	25.84	0.000	.1033427	.120308
public tap/protected s..	.1074026	.0016291	65.93	0.000	.1042096	.1105956
unprotected well/spring	.1115497	.0031626	35.27	0.000	.1053512	.1177482
rainwater, river, lake..	.1161663	.0053311	21.79	0.000	.1057176	.1266151

Expression : Pr(pneumonia), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
toilet_type						
flush toilet	.0758293	.0099409	7.63	0.000	.0563456	.0953131
latrine	.109277	.0014047	77.79	0.000	.1065238	.1120303
no facility/bush/bucke..	.1129169	.0039905	28.30	0.000	.1050957	.1207382

Expression : Pr(sowing_pneu), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
water_source						
piped	.1080315	.0096044	11.25	0.000	.0892073	.1268557
public tap/protected s..	.1237714	.0027528	44.96	0.000	.118376	.1291667
unprotected well/spring	.1338693	.00539	24.84	0.000	.1233051	.1444335
rainwater, river, lake..	.1346935	.0077297	17.43	0.000	.1195436	.1498433

Expression : Pr(sowing_pneu), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
toilet_type						
flush toilet	.0773712	.0171852	4.50	0.000	.0436889	.1110534
latrine	.1254866	.0023845	52.63	0.000	.1208131	.13016
no facility/bush/bucke..	.1324966	.0069835	18.97	0.000	.1188092	.1461839

Source: DHS (2000, 2004, 2010, 2015)

Figure 33: Socio-economic characteristics of diarrhoea contraction

Expression : Pr(diarrhea), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
v101						
northern	.1475485	.0042374	34.82	0.000	.1392434	.1558536
central	.228028	.0034069	66.93	0.000	.2213506	.2347053
southern	.1931144	.0027496	70.23	0.000	.1877254	.1985035

Expression : Pr(diarrhea), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
v190						
poorest	.2141611	.0045135	47.45	0.000	.2053147	.2230075
poorer	.2020779	.0041137	49.12	0.000	.1940151	.2101407
middle	.1991415	.0041383	48.12	0.000	.1910305	.2072525
richer	.1869147	.0043875	42.60	0.000	.1783152	.1955141
richest	.1788682	.0055317	32.34	0.000	.1680262	.1897101

Expression : Pr(diarrhea), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
toilet_type						
flush toilet	.1417139	.014081	10.06	0.000	.1141156	.1693122
latrine	.1963779	.0020475	95.91	0.000	.1923648	.200391
no facility/bush/bucke..	.2174771	.0061825	35.18	0.000	.2053597	.2295946

Expression : Pr(sowing_diarr), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
toilet_type						
flush toilet	.1232701	.0203033	6.07	0.000	.0834763	.1630639
latrine	.1816512	.0027831	65.27	0.000	.1761964	.187106
no facility/bush/bucke..	.1996152	.0085427	23.37	0.000	.1828718	.2163586

Source: DHS (2000, 2004, 2010, 2015)

Figure 34: Socio-economic characteristics of diarrhoea contraction

Expression : Pr(diarrhea), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
waterdrinksource						
Tap at home	.1501036	.0027258	55.07	0.000	.1447613	.155446
Borehole	.2077472	.0025337	81.99	0.000	.2027812	.2127132
Water Kiosk	.2183007	.004214	51.80	0.000	.2100413	.2265601
Open Well	.3133275	.0054634	57.35	0.000	.3026194	.3240356
River	.3999363	.0102226	39.12	0.000	.3799004	.4199721
Other	.2518041	.015692	16.05	0.000	.2210483	.2825598

Expression : Pr(diarrhea), predict()

	Margin	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
toiletlatrine						
No	.3221053	.0214404	15.02	0.000	.2800828	.3641277
Yes	.1724706	.005795	29.76	0.000	.1611126	.1838286

Source: UNICEF (2020)

Annex 6: Analysis on malnutrition

Figure 35: Stunting vs Rainfall I

Rainfall and HAZ	
===	
Dependent variable:	

HAZ	
---	
shock_age11	-0.376***
shock_age21	-0.400***
shock_age31	-0.073
shock_age41	-0.103
shock_age51	-0.264*
Year_fac2006	0.162**
Year_fac2010	0.411***
Year_fac2013	0.378***
Year_fac2014	0.230***
Year_fac2015	0.530***
Year_fac2016	0.741***
regionnorth	0.135***
regionsouth	0.225***
shock_age11:regionnorth	0.023
shock_age11:regionsouth	-0.134***
shock_age21:regionnorth	0.206***
shock_age21:regionsouth	-0.110***
Constant	-1.871***
--	
Observations	26,094
R2	0.033
Adjusted R2	0.032
F Statistic	51.841

Source: Traditional Practices Dataset (2019)

Figure 36: Stunting vs Rainfall II

Positive rainfall shock at different ages and HAZ	
===	
Dependent variable:	

HAZ	
---	
shock_age_pos1	-0.119
shock_age_pos2	-0.236*
shock_age_pos3	0.11
shock_age_pos4	0.211*
shock_age_pos5	0.201***
HHmembers	-0.002
Numofchild	0.022
age	-0.018***
male1	-0.163***
Year_fac2006	0.084
Year_fac2010	0.333***
Year_fac2013	0.378***
Year_fac2014	0.292***
Year_fac2015	0.711***
Year_fac2016	0.974***
residence2rural	-0.053
wealth3poorer	0.038
wealth3middle	0.090***
wealth3richer	0.197**
wealth3richest	0.385***
educationno education	-0.058
educationprimary	-0.096**
educationsecondary	-0.071***
regionnorth	0.281***
regionsouth	0.119***
Constant	-1.522***

Observations	26,094
R2	0.058
Adjusted R2	0.057
F Statistic	63.73

Source: Traditional Practices Dataset (2019)