EMERGING GLOBAL CHALLENGES

Climate-related hazards and urbanization: PROTECTING UGANDA'S CHILDREN

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THE REPUBLIC OF UGANDA

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EMERGING GLOBAL CHALLENGES

Climate-related hazards and urbanization:

PROTECTING UGANDA'S CHILDREN

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ADOLESCENT
young person between the ages of 15 and 19

CLIMATE CHANGE
significant time variation in long-term weather patterns

CLIMATE SHOCK
unexpected weather event that causes damage and welfare losses that society cannot cope with

EVAPOTRANSPIRATION
the process by which water is transferred to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants

STANDARDIZED PRECIPITATION EVAPOTRANSPIRATION INDEX (SPEI)
is designed to take into account both precipitation and potential evapotranspiration (PET) in determining drought. It captures the main impact of increased temperatures on water demand and can be calculated on a range of timescales from 1-48 months.

STUNTING
refers to children who are too short for their age and have suffered from a reduced rate of linear growth. Children are classified as being stunted when they have a height that is two standard deviations below the median height for children of the same sex and age in an internationally standardized index (WHO Child Growth Standards). Information on stunting is available for children below the age of 5. Since the climate impacts on stunting is likely to reflect cumulative malnutrition starting in utero, exposure to climate variation is measured from conception until the time of interview.

URBANIZATION
a process by which the population in cities and towns increases relative to that in rural areas. It also defines the ways societies adapt to this change.

WASTING
refers to children whose weight-for-height is two standard deviations below the median based on the WHO Child Growth Standards. Wasting indicates the failure to receive adequate nutrition in the period immediately preceding the survey. Information on wasting is available for children under age 5. Since the climate impacts on wasting are immediate, exposure to climate variation is measured 3 months before the interview.

YOUTH
young person between the ages of 15 and 24

Abbreviations

RCP	Representative Concentration Pathway
SD	Standard deviation score
SDG	Sustainable Development Goal
SPEI	Standardized Precipitation Evapotranspiration Index
IPPC	Intergovernmental Panel on Climate Change
UBOS	Uganda Bureau of Statistics
UDHS	Uganda Demographic Health Survey
UNHS	Uganda National Household Survey

Foreword

Uganda's vision to become a middle-income country by 2040 remains highly contingent on Government's ability to safeguard children's rights in the face of mounting global and regional challenges such as climate-related hazards and urbanization.

Despite the enormous progress we have made in reducing poverty and safeguarding children's rights, these challenges threaten to undermine our national potential and trap millions of children in poverty.

Climate change, environmental degradation and urbanization are increasingly responsible for creating new risks, and putting pressure on poverty reduction efforts while fostering and deepening socio-economic inequities. In this respect, this publication provides a significant contribution to guide emergency preparedness and inform the national response. As well as providing a detailed analysis of the potential impact of climate-related hazards on various aspects of children's well-being, it presents new insights into the issues affecting the growing number of children living in urban environments.

In thanking UNICEF for this important milestone, I urge all stakeholders to reflect upon the recommendations contained in this report. By taking action now, we can invest in child-centred, socially-inclusive national programmes aimed at preparing for and preventing climate related hazards and ensuring that children living in urban areas are protected and able to achieve their full potential. Only by meeting these challenges will we achieve inclusive growth and social cohesion.

Christine Guwatudde Kintu
Permanent Secretary, Office of the Prime Minister

Acknowledgements

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> Uganda's vision to become a middle-income country by 2040 remains highly contingent on Government's ability to safeguard children's rights in the face of mounting global and regional challenges such as climate-related hazards and urbanization.

Executive summary

Climate change and urbanization have been identified as major challenges that will have an increasingly significant impact on the well-being of children in coming decades, particularly on the poorest and most vulnerable children (UNICEF 2016). This is nowhere more so than in Uganda, which is already frequently affected by droughts and where the rate of urbanization is high.

Uganda has made great strides in reducing poverty in recent decades. However, child poverty remains high with more than 50 per cent of children aged under five living in poverty. Children represent more than half of the population and, as such, the country's vision of becoming a middle-income country by 2040 remains highly contingent on government's ability to safeguard the rights of its children.

Temperatures in Uganda are predicted to rise by an unprecedented **1.5ºC** in the next **20 years** and by up to **4.3ºC** by the **2080s.**

CLIMATE-RELATED HAZARDS

As well as having a rapid rate of urbanization, Uganda has one of the fastest changing climates. Temperatures are predicted to rise by an unprecedented 1.5ºC in the next 20 years and by up to 4.3ºC by the 2080s. This is likely to have an impact on a majority of the population, who live in rural areas and are dependent on rain-fed agriculture, as well as on the economy as a whole.

The possible impacts of climate change are complex and include an increase in childhood malnutrition. While droughts increase the likelihood of stunting, increased precipitation puts children at risk of being wasted. There appears to be no strong evidence that droughts affect stunting differentially by household wealth. However, rainfall reduction increases the likelihood of stunting for children whose mothers have lower than primary-level education. Although generally less prone to stunting and wasting, evidence suggests that girls are more vulnerable to climate-related hazards.

Malaria prevalence is associated with rainfall and can exacerbate the impact of climate variability on malnutrition. Although living in a malaria endemic area is not particularly threatening in times of drought, too much rainfall can facilitate breeding of mosquito vectors and consequently increase malaria incidence. This in turn increases the risk of wasting due to acute malaria infection.

Climate shocks also have an effect on school attendance. While there is no evidence of parents pulling their children out of school to buffer labour stocks for consumption smoothing during negative rainfall shocks, higher rainfall increases the likelihood of school drop-out for older children. The opposite is true for younger children, whereby higher rainfall enables them to stay on in school.

Household economic conditions are related to school attendance. Children from less wealthy households are less likely to attend school when precipitation is high, which implies that households may require extra labour during wetter years. Meanwhile, children living in urban areas and those from highly-educated households are also more likely to drop out in a good rainfall year. This possibly reflects the fact that older children in rural areas and in the less-educated households have already been out of school, in general. With a higher number of older children in school, households in urban areas and more educated households can still benefit from pulling their children out of school as extra labour supply in a good harvest year. Correspondingly, children from households in urban areas with agricultural land are less likely to attend school in a good rainfall year. It is possible that children who are not attending school are engaged in some kind of work as children who are not in school spend more hours doing work outside the home and/or household chores.

POLICY RECOMMENDATIONS

to mitigate the impact of climate-related hazards on children:

- Promote immediate interventions during or after drought episodes to improve food security and nutritional status and prioritise families with young children, as well as children whose mothers have lower than primary-level education to reduce the likelihood of stunting.

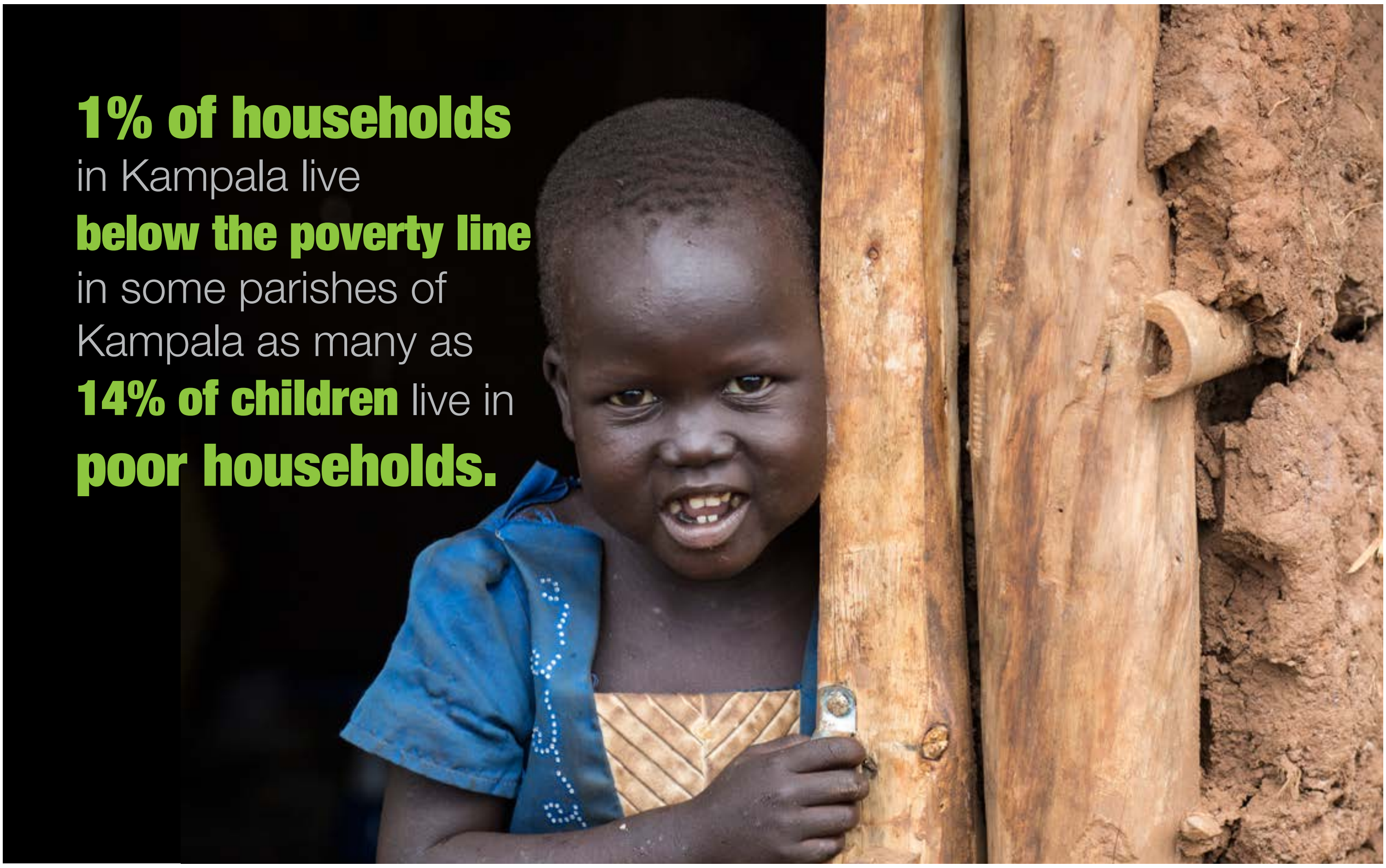
- Strengthen the capacity to forecast climate shocks. It is important to closely monitor weather variation to control disease outbreaks associated with extreme meteorological conditions (e.g. rainfall), as well as plan adequate measures.

- Control disease outbreaks associated with higher precipitation by prioritising and investing in preventive services (e.g. the promotion of good hygiene and sanitation, provision of anti-malaria nets) and provide malaria treatment and nutritional supplements to prevent and reduce the risk of wasting.

- Increase resilience and smooth consumption patterns by investing in child-sensitive social protection:
    - Focus on the girl child. In particular, attention should be paid to potential differentials in food allocations by gender as girls are more vulnerable to climate variability.
    - Particular attention should also be given to children in urban centres, especially in slum areas.

- Enforce implementation of laws and national policies on child labour and on children's right to education.

- Invest in girls' education to keep them in school, and prevent child marriage and teenage pregnancies.



URBANIZATION

Although urbanization is occurring at a rapid rate in Uganda, there has been little research into the particular vulnerabilities of children and adolescents living in the country's urban centres. While children living in urban areas are generally considered better off than their rural counterparts, average figures disguise the great disparity between the wealthiest and poorest urban dwellers. Recent analysis (UBOS, UNICEF and World Bank 2017) reveals that in some parishes of Kampala as many as 14 per cent of children live in poor households.

Urban children are more likely to live in overcrowded conditions, with 62.3 per cent of urban households using one room for sleeping compared to 42 per cent in rural areas. Their families are less likely to own assets than rural households and, although there is generally greater access to services in urban areas, sanitation is often poor, with families having to share a latrine with up to 20 other households.

Central Uganda, which has the greatest number of urban dwellers, has the largest proportion of children born with low birth weight, while 38 per cent of 0–5-year-olds living in the poorest urban households are stunted and 20 per cent are underweight. Although primary and secondary school completion rates are generally higher in urban areas compared to rural areas, only 2.2 per cent of urban children complete secondary education, and only 1.2 per cent of urban children living in female-headed households do so.

Although a majority of young people express a preference for living in a town or city, doing so exposes them to a number of risks. For urban male adolescents, drugs and alcohol account for half their biggest health risks, whereas urban female adolescents identify sexual violence and early pregnancy as the greatest threats.

POLICY RECOMMENDATIONS

to reduce the risks of rapid urbanization and provide urban children and youth, especially girls and young women, with hope and opportunities:

- Design urban-centred social protection policies to cater for the great inequalities and highly vulnerable members of society observed within urban centres.
- Improve the quality of education in poor urban areas to increase school retention and attainment.
- Provide training in the skills necessary to survive in and contribute to a modern, urban society.
- Work with marginalised young people to give every child and young person a reason to believe in the prospect of a better future.
- Address discriminatory social norms and cultural values that force girls to drop out of school and into early marriage, and provide training for girls and young women to enable them to engage in safe and profitable income-generating activities.
- Invest in and conduct research to:
  - Ascertain the current situation and discrepancies in the lives of urban children and young people.
  - Better inform urban planning and prevent the growth of unplanned urban settlements and slums.

20%
URBAN NOW

30%
URBAN BY 2035

80% of the country's population lives in **rural areas**, urbanization is occurring at a rapid rate **(5.2% per annum)**

1/Introduction

Uganda has made great strides in reducing poverty in recent decades. However, with more than half its population of 39 million below the age of 18, the country's vision of becoming a middle-income country by 2040 remains highly contingent on the Government's ability to safeguard the rights of its children. Today's children gradually transitioning into the labour force hold the potential to transform Uganda's economy, and remodel the socio-economic future of the nation.

Climate change and urbanization have been identified as major challenges that will have an increasingly significant impact on the well-being of children in coming decades, particularly on the poorest and most vulnerable children (UNICEF 2016). This is nowhere more so than in Uganda, which is already affected by frequent droughts and where the rate of urbanization is high. Investing in its young population will enable Uganda to reap unprecedented economic benefits.

CHILD POVERTY

Currently, however, child poverty remains high and widespread across the country. More than 50 per cent of children aged under five are living in poverty, and one in five in extreme poverty (UNICEF 2014a), with wide variations in levels of deprivation between regions, geographic locations, and the socioeconomic status of families.

According to the Uganda National Household Survey (UNHS), approximately 1 per cent of households in Kampala live below the poverty line. However, recent analysis by the Uganda Bureau of Statistics (UBOS), UNICEF and World Bank (2017) reveals that in certain parishes within Kampala as many as 14 per cent of children live in poor households (see Figure 1). Most slum-dwellers live in single-roomed, rented houses, many of which are also used for other activities such as the selling of alcohol or drugs, or commercial sex work (IOM 2017). Common health problems include waterborne diseases, such as cholera and dysentery, and HIV, and there are high rates of violence, including domestic violence and rape (IOM 2017).

FIGURE 1: CHILD POVERTY IN KAMPALA DISTRICT BY PARISH (2012/13)

Source: UBOS, UNICEF and World Bank, 2017

In addition, although Uganda has made substantial progress in achieving universal primary school enrolment, drop-out rates are high. It is estimated that in 2013, 477,468 children of official primary age had never attended school or dropped out before completing primary school (UIS.Stat 2016b). Achieving universal secondary education will be particularly challenging since less than a quarter of children are enrolled in secondary school (UNICEF 2015), and only 0.5 per cent of rural children and 2.2 per cent of urban children complete secondary education. Without investment in education, especially in preventing school drop-out, Government plans and aspirations cannot and will not be realised.

CLIMATE-RELATED HAZARDS

As well as having one of the fastest growing populations in the world (predicted to reach 68.4 million people by 2035 (UN-Habitat 2016)), Uganda has one of the fastest changing climates. Temperatures are predicted to rise by an unprecedented 1.5ºC in the next 20 years and by up to 4.3ºC by the 2080s. This is likely to have an impact on the majority of the population who live in rural areas and are dependent on rain-fed agriculture, as well as on the economy as a whole.

Between 1979 and 2010, the International Disaster Database, Emdat[1] recorded nine drought events affecting about 5 million people and causing 194 deaths. The 2008 drought alone affected about 1 million people. Severe drought conditions, probably related to an extreme El Niño event, also led to harvest failure in 2016. The country is also prone to serious riverine flooding. Between 1979 and 2010, 14 such events affected about 1 million people, causing 267 deaths.

With the predicted rise in temperatures, coupled with the erratic onset and cessation of rainfall seasons, the country is likely to experience increasingly frequent droughts (Majaliwa et al. 2012), affecting the quality and quantity of available water, agriculture production and food security. Heavy precipitation is also projected to rise, with consequent increased risk of floods and landslides, leading to the deaths of humans and livestock, water contamination, crop loss and damaged homes.

When coping with the aftermath of an extreme weather event or a weather shock, households may have to sell assets, reduce current consumption and even take children out of school (Helgeson et al. 2013). Some coping strategies can damage long-term prospects since disinvesting in human capital, for instance, undermines future returns to education. Crop failure and income loss can affect food supplies as well as cause reduced spending on food and other items. Consequently, changing weather conditions can jeopardize children's health and nutrition, among other things.

URBANIZATION

Although currently 80 per cent of the country's population lives in rural areas, urbanization is occurring at a rapid rate (5.2% per annum) and, indeed, moving towards an urban economy is an important element in the Government's 2040 vision and National Development Plan. By 2035, it is estimated that 30 per cent of the population will be urban dwellers (United Nations Urban Human Settlements Programme – UN-Habitat 2016), a high proportion of them children and youth. Table 1 provides a brief summary of the number of children living in Kampala and Uganda by age group.

TABLE 1: CHILDREN IN KAMPALA AND UGANDA BY AGE GROUP

AGE GROUPS	KAMPALA			UGANDA		
	Male	Female	Total	Male	Female	Total
0-2	70,059	62,968	133,027	1,874,743	1,734,135	3,608,878
3-5	61,007	56,397	117,404	1,878,606	1,766,166	3,644,772
0-8	181,255	167,935	349,190	5,480,860	5,169,897	10,650,757
9-14	91,248	107,069	198,317	2,931,726	2,907,828	5,839,554
15-24	163,909	227,156	391,065	3,249,054	3,694,926	6,943,980

Source: National Housing and Population Census, 2014

1 http://www.emdat.be/country_profile/index.html

While children living in urban areas are generally considered better off than their rural counterparts – with greater access to services and more diverse income-generating opportunities – they are also particularly vulnerable to homelessness, exploitation and abuse. Average figures disguise the great disparity between the lives of rich and poor children in towns and cities, which are home to the wealthiest and best-serviced sectors of society but also some of the poorest. Over the last two decades there has been a greater increase in income inequality in urban areas than in rural areas (UNICEF 2015; World Bank 2016b).

Urban environments and the effects of rapid urbanization exhibit a variety of characteristics that combine to put children at risk of abuse, exploitation and neglect. A survey by the African Network for the Prevention and Protection against Child Abuse and Neglect (Fallon, 2014) estimated that there are 10,000 street children in Uganda, a 70 per cent increase in the number of children on the streets since 1993, with approximately 16 new children coming to Kampala's streets every day (UNICEF 2015). Children in urban areas often have to share latrines or toilets, with upwards of 20 families. The *Adolescent Girls Vulnerability Index* (UNICEF 2013) shows that aside from Karamoja and West Nile, adolescent girls tend to be most exposed to social vulnerabilities in Central Uganda which represents the hub of rapid urbanization. In addition, urban populations are disproportionately more likely to be infected with HIV (8.7%) compared to rural residents (7%). Among 15–24-year-old females, the prevalence rate is 5.9 per cent, compared to 4.6 per cent in rural areas (UNICEF 2015).

PROTECTING UGANDA'S CHILDREN

In endorsing the UN Agenda for Sustainable Development in September 2015, Uganda committed to end poverty in all its forms by 2030 (Sustainable Development Goal (SDG) 1), to reduce inequality (SDG 10), eradicate hunger (SDG 2), take urgent action to combat climate change (SDG 10), make cities inclusive, safe, resilient and sustainable (SDG 11), and promote health and well-being (SDG 3). Given that children account for 57 per cent of the Ugandan population and are often most vulnerable to climate-related shocks and risks attached to rapid urbanization, identifying the extent of their vulnerability can inform better and more effective programming, as well as help design policy interventions.

Children living in the most difficult conditions, including rural and urban poverty and deprivation, are particularly vulnerable. This study, therefore, sets out to explore the impact of climatic shocks on different aspects of children's welfare in Uganda and provides unprecedented insight on the status of children in urban areas. The paper is structured in two parts, one focusing on climate- related hazards (Part 1) and the other on urbanization (Part 2). In Part 1, Chapter 2 describes the research methodology used to estimate the impact of climate related shocks on children, while Chapter 3 presents observations and projections about the effect of such shocks. Chapter 4 examines the impact of climate-related hazards on younger children's health, with a focus on malnutrition, while Chapter 5 assesses the impact on older children's education and training. Part 2 aims to provide a better understanding of the situation of children living in urban areas, again taking a life-cycle approach. Chapter 6 introduces the major issues, while Chapter 7 looks at the situation for younger children and Chapter 8 for older children and young people. Chapter 9 concludes by making policy recommendations. Models used to measure the impact of climate-related hazards on stunting, wasting and education are explained in the Appendix.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PART 1

CLIMATE-RELATED HAZARDS

POLICY RECOMMENDATIONS

to mitigate the impact of climate-related hazards on children:

- Promote immediate interventions during or after drought episodes to improve food security and nutritional status and prioritise families with young children, as well as children whose mothers have lower than primary-level education to reduce the likelihood of stunting.
- Strengthen the capacity to forecast climate shocks. It is important to closely monitor weather variation to control disease outbreaks associated with extreme meteorological conditions (e.g. rainfall), as well as plan adequate measures.
- Control disease outbreaks associated with higher precipitation by prioritising and investing in preventive services (e.g. the promotion of good hygiene and sanitation, provision of anti-malaria nets) and provide malaria treatment and nutritional supplements to prevent and reduce the risk of wasting.
- Increase resilience and smooth consumption patterns by investing in child-sensitive social protection:
  - Focus on the girl child. In particular, attention should be paid to potential differentials in food allocations by gender as girls are more vulnerable to climate variability.
  - Particular attention should also be given to children in urban centres, especially in slum areas.
- Enforce implementation of laws and national policies on child labour and on children's right to education.
- Invest in girls' education to keep them in school, and prevent child marriage and teenage pregnancies.

2/Introduction & methodology

As stated in the Introduction to this report, when coping with the aftermath of an extreme weather event or a weather shock, households may have to sell assets, reduce current consumption or sometimes even take children out of school (Helgeson et al. 2013). The aim of this and subsequent chapters in Part 1 is therefore to quantify the impact of climate related hazards on children's welfare.

This study combines micro data with climate-related data. The former is used to measure child welfare and investment in children while the latter is used to identify climate variability that can create income shocks. Climate variation is captured through deviation from normal climate patterns and long-term trends. The analysis is carried out in two steps:

1. Identifying the extent to which climatic shocks affect children's welfare by associating discrete climatic shocks (i.e. dry or wet conditions) with specific outcomes of interest (e.g. malnutrition, schooling).

2. Comparing child welfare in households with different socioeconomic characteristics (i.e. wealth, education) and geographic locations.

DATA

Demographic data and climate data used to measure child welfare

In order to assess the impacts of climate variability on child malnutrition the Uganda Demographic and Health Surveys (UDHS) collected by the Uganda Bureau of Statistics are used to provide large-scale, nationally representative data with relevant information on children's outcomes and geo-locate the place of residence to capture exposure to climate variability. The sample was designed to provide population and health indicator estimates for the country as a whole and for urban and rural areas separately. Sample size varied, with 7,885 households in 2000–01, 8,870 in 2006 and 9,033 in 2011.

Since malnutrition is closely related to agricultural productivity, and since there is evidence that cereal yields decline significantly with droughts and extreme heat (but not with floods and extreme cold) (Lesk et al. 2016) this study applies the Standardized Precipitation Evapotranspiration Index (SPEI) to monitor drought development. The SPEI is considered to be a reliable measure of droughts because it accounts for the effect of evapotranspiration due to temperature variability, not only precipitation (Vicente-Serrano et al. 2009). SPEI is calculated as an intensity scale containing both positive and negative values. SPEI classification is shown in Table 2.

TABLE 2: SPEI CLASSIFICATION

RANGE	CONDITION
SPEI ≤ -2	Extreme drought
-2 < SPEI ≤ -1.5	Severe drought
-2 < SPEI ≤ -1	Moderately drought
-1 < SPEI ≤ 1	Near normal
1 < SPEI ≤ 1.5	Moderately wet
1.5 < SPEI ≤ 2	Severely wet
SPEI ≥ 2	Extremely wet

Source: Adapted from Adnan et al. (2016)

A gridded 0.5 x 0.5 degree SPEI data set is calculated based on CRU TS3.23 input data (monthly mean temperature and monthly cumulative precipitation) supplied by the Climatic Research Unit of the University of East Anglia for the period 1901–2014. SPEI data calibrated for three months is used to capture drought at soil level, which is most relevant for agricultural production (Vicente-Serrano et al. 2009). Taking the yearly average of monthly SPEI levels in each location, the gridded SPEI data is then matched with the geographical location of each cluster of households in the UDHS data.

MEASUREMENT

In order to assess the potential effects of climate-related shocks on child welfare and what circumstances make certain children particularly vulnerable, data from three UDHSs (2000-2001, 2006 and 2011) are analyzed.

Outcomes: Child welfare

Child welfare refers to different dimensions of children's well-being but in view of the available data, and in line with the focus of *The State of the World's Children 2016* (UNICEF 2016)*,* this report focuses on health and education variables and on the need to reach the most disadvantaged children. With increasing risks associated with climate-related hazards, particular attention has to be paid to key quantifiable aspects of child welfare that can be jeopardized by climatic shocks. These include nutrition and education, two fundamental aspects of child development. An additional aim of this analysis is to unpack possible programmatic responses to protect children who are vulnerable to climate-related shocks from being deprived of a 'fair' start in life.

Key indicators include:

- ***Child malnutrition*** – Based on data on stunting and wasting from the three UDHS surveys covering 8,529 children aged under five years. Stunting captures the cumulative effects of undernutrition, while wasting indicates acute weight loss (see Glossary).

- ***Schooling*** – Based on data on primary and secondary school-aged children (aged 6–15 years) from the three UDHSs school attendance is divided into three processes: 1) dropout in the current school year of children who attended school in the previous year; 2) no progress from the previous year until the current school year due to dropout or grade repetition; and 3) new enrolment in the current school year of a student who was not enrolled in the previous school year. The dependent variable is a binary outcome indicating whether or not a child attended school in the current and the previous school year. Note that in the 2011 survey, only information about the current school year was available.

A notable implication of reduced school attendance is heightened participation in labour activities. By association, it may be possible that climate variability affects children's labour market participation since child labour can be a strategy households used to cope with external shocks. Note, however, that both good harvest and bad harvest can increase the demand for child labour because the child wage has both substitution and income effects.

Household characteristics

In order to identify what types of households are more vulnerable to climate variability as measured by child welfare, children's outcomes are analyzed according to household characteristics such as household wealth and the educational level of household members.

Geographic characteristics

To identify areas that are more vulnerable to climate variability as measured by child welfare, children's outcomes in different regional contexts and rural and urban locations are analyzed. Given an established link between malaria and poverty (Gallup and Sachs 2001), areas with high malaria risk may be particularly vulnerable to climate variation. The analysis is therefore carried out according to malaria prevalence in the areas based on malaria maps provided by the Malaria Atlas Project. Furthermore, region-specific analysis is performed (i.e. Northern, Central, Eastern, Western).

Methods

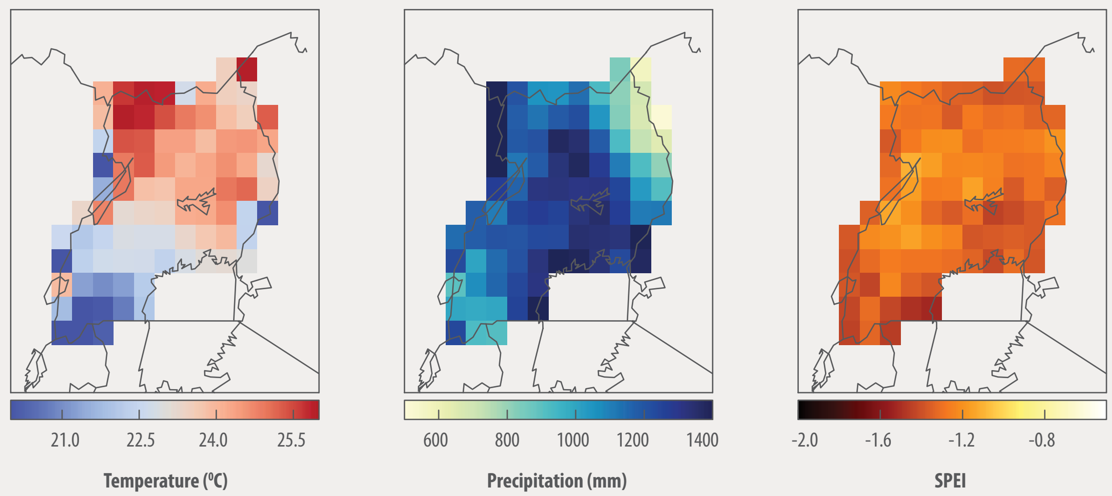
Regression techniques are used to quantify the impact of climate-related hazards on children's welfare. Each child is placed in a weather grid based on GPS coordinates. Regressions control for grid cell and/or household fixed effects as well as time controls, and standard errors are clustered at the grid level. A Moran's I test controls for spatial autocorrelation; the report only presents the results that pass this test.

3/Observations and projections

Uganda's climate classifies as tropical with humid equatorial climate prevalent in central Uganda and equatorial Savannah climate in North and South Uganda (GERICS 2016). The country is frequently affected by droughts. The signal of anthropogenic climate change is evident from the observational record in Uganda. This chapter provides an overview of the observed changes in temperature, precipitation and drought indices since 1900 based on the East Anglia Climate Research Unit´s dataset (CRU TS v. 3.23, (Harris et al. 2014)).

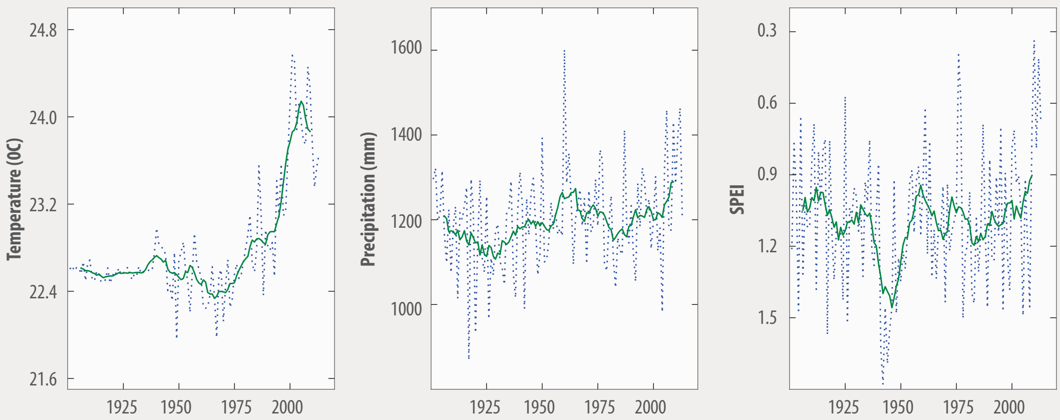
Figure 2 displays the climatological state between 1986 and 2005 for annual mean temperature, annual total precipitation and the drought indicator used.

FIGURE 2: ANNUAL MEAN TEMPERATURE (LEFT), ANNUAL TOTAL PRECIPITATION (CENTRE) AND ANNUAL MINIMUM SPEI (RIGHT) 1986–2005



The long-term temperature increase over the observational record of about 1.5°C exceeds the global mean of less than 1°C over the same period (see left panel). Most of the warming has occurred over the last 30 years, with a warming trend of about 0.5°C per decade (GERICS 2016)

FIGURE 3: COUNTRY AVERAGE OF ANNUAL MEAN TEMPERATURE (LEFT), ANNUAL TOTAL PRECIPITATION (CENTRE) AND ANNUAL MINIMUM SPEI (3 MONTHLY, RIGHT) 1901–2013



Notes: Based on CRU dataset. Dashed blue lines indicate yearly values; solid green line a two-year running mean. Note that regional information on climate trends cannot be meaningfully derived due to the limited spatial resolution of the underlying climate data..

Trends in precipitation changes are less robust then temperature changes across the country (see middle panel) and are affected by the multi-annual El Niño Southern Oscillation pattern. Over the last 30 years, annual total precipitation increased by about 20 per cent (Climate Service Center Germany 2016).

In this report, the three-monthly version of the SPEI over the dry season is used to assess the drought risk (Begueria and Vicente Serrano 2016). For each year, the month with the lowest three-monthly SPEI value was selected to analyse the drought risk profile and potential changes in drought risk. Trends in drought risk are not really apparent over the observational period (see left panel) and the occurrence of droughts in the recent past cannot be attributed to climate change with any confidence (GERICS 2016).

PROJECTED CLIMATE CHANGE FOR UGANDA

Projections for climate change in Uganda are based on the scenario layout used in the most recent Intergovernmental Panel on Climate Change (IPCC) fifth assessment report (Figure 4). The Representative Concentration RCP2.6 displays a stringent emission reduction scenario, which is in line with holding the global mean temperature increase below 2°C. This scenario, however, is still above the long-term temperature limit of 1.5°C above preindustrial levels expressed in the 2015 Paris Agreement of the United Nations Framework Convention on Climate Change. For cross-comparative purposes, a no-climate-action scenario that would lead to more than 4°C warming towards the end of the century (RCP8.5) is also included in the analysis.

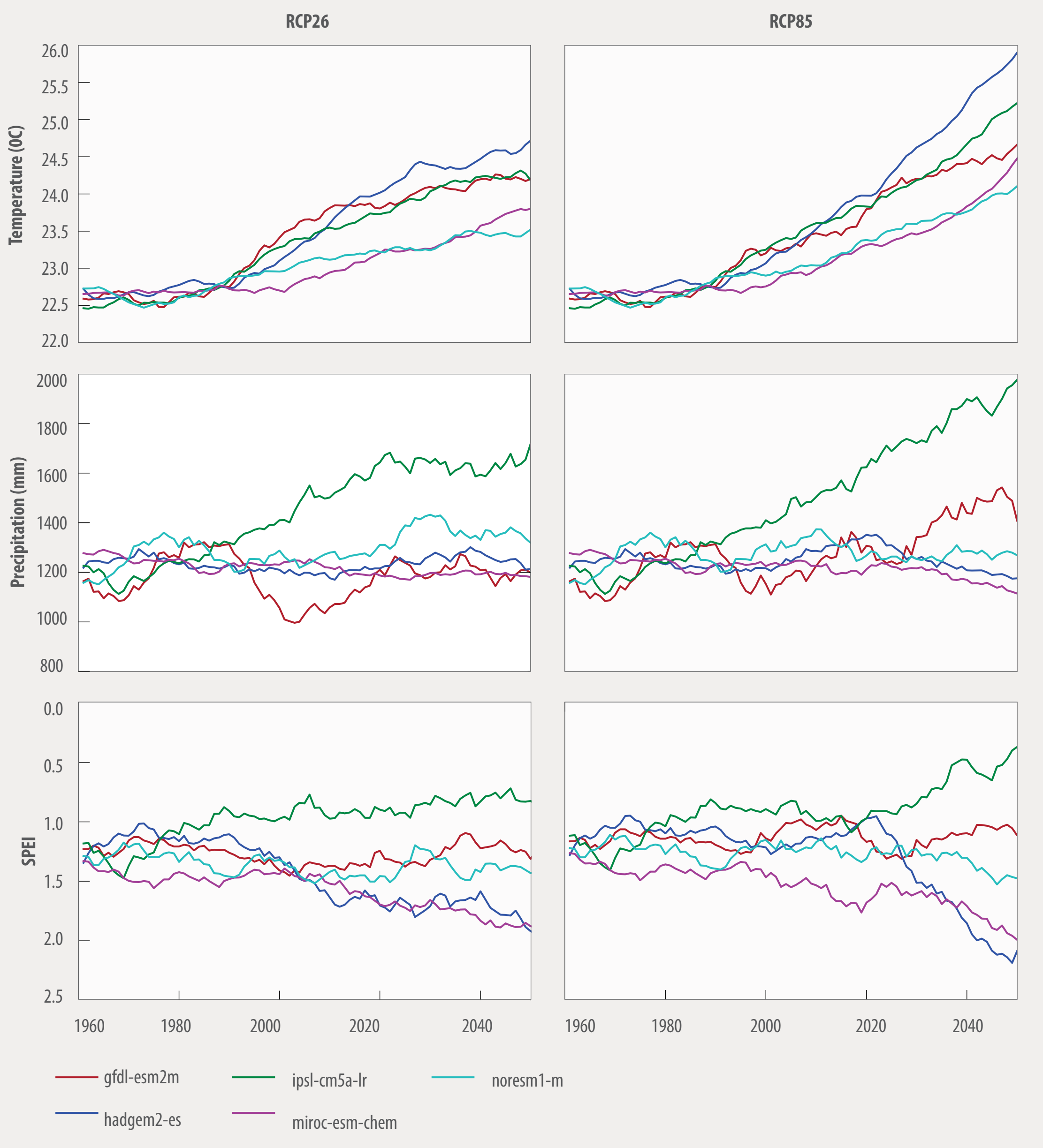
The analysis is based on five global General Circulation Models (GCMs) used in the Intersectoral Model Intercomparison Project (ISIMIP) (Hempel et al. 2013). The General Circulation Models or Global Climate Models are a class of computer-driven models that both identify possible causes of climate change and predict climate change into the future (see Table 3). For these models, the SPEI was derived using the SPEI-R-package (Begueria et al. 2003).

TABLE 3: GLOBAL CLIMATE MODELS USED FOR CLIMATE PROJECTIONS IN FIGURE 4

MODEL	DESCRIPTION	SOURCE
GFDL-ESM2M	Earth Systems Models based on atmospheric circulation model, oceaning circulation model with representations of land, sea ice and iceberg dynamics. The model considers how the Earth's biogeochemical cycles including human actions interact with the climate system. The ESM2M uses Modular Ocean Model version 4p1 with pressure-based vertical coordinates.	(Dunne et al. 2012)
HadGEM2-ES	Hadley Centre Global Environment Model version 1. The model includes a coupled atmosphere-ocean configuration with or without a vertical extension to include a well-resolved stratosphere and an Earth-System configuration which includes dynamic vegetation, ocean biology and atmospheric chemistry.	(The HadGEM2 Development Team et al. 2011)
IPSL-CM5A-LR	The IPSL-CM5A is an extension of IPSL-CM4 – a full Earth System Model developed by the Institut Pierre Simon Laplace (IPSL). The model includes a represen-tation of the carbon cycle, the stratospheric chemistry, the tropospheric chemistry with aerosols in addition to the physical atmosphere-land-ocean-sea ice model.	(Dufresne et al. 2013)
MIROC-ESM-CHEM	An atmospheric chemistry coupled version of an earth system model (MIROC-ESM) based on global climate model MIROC (Model for Interdisciplinary Research on Climate). MIROC-ESM includes an atmospheric chemistry component, a nutrient-phytoplankton-zoo-plankton-detritus type ocean ecosystem component and a terrestrial ecosystem component dealing with dynamic vegetation. Simulations of atmospheric chemistry in MIROC-ESM-CHEM are based on the chemistry model CHASER.	(Watanabe et al. 2011)
NorESM1-M	The Norwegian Climate Center's Earth System Model is largely based on the Community Climate System Model version 4 (CCSM4) but the main differences are the isopychic coordinate ocean module and the atmosphere module.	(Bentsen et al. 2013)

FIGURE 4: PROJECTED CHANGES IN ANNUAL MEAN TEMPERATURE (FIRST ROW), ANNUAL CUMULATIVE PRECIPITATION (SECOND ROW) AND ANNUAL MINIMAL SPEI (THIRD ROW) FOR THE FIVE DIFFERENT GLOBAL CLIMATE MODELS USED IN THE LATEST IPCC REPORT (TABLE 3)

Left: Projections for a low-emission scenario (RCP26). Right: Projections for a high-emission scenario (RCP85)



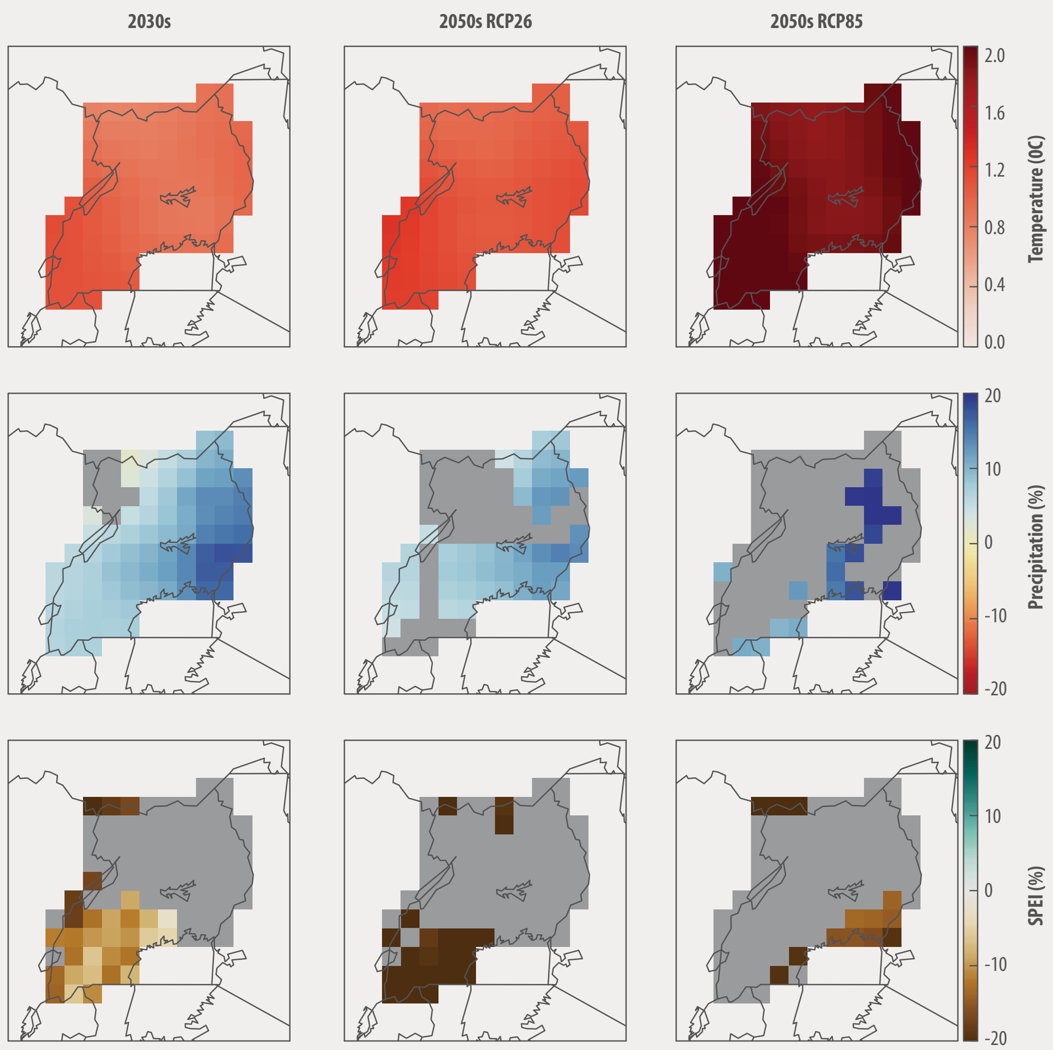
For each of the variables (annual mean temperature, annual total precipitation and annual minimum SPEI) scenario-dependent trends are displayed, resolving projections for individual climate models. Note that regional information on climate trends cannot be meaningfully derived due to the limited spatial resolution of the underlying climate data. As depicted in the upper panel, all models project increasing temperatures as a result of anthropogenic climate change. Precipitation-related changes, however, are less clear.

Annual mean temperatures are projected to increase robustly over the 21st century (see upper panel). In the 2030s, annual mean temperatures are projected to increase by about 0.5°C to 1°C across the country. In the 2050s, warming might reach about 1.5°C in a 2°C scenario, a value that is substantially exceeded in a non-mitigation scenario (see upper panel). Model deviations are the result of different model sensitivities to altered concentrations of global greenhouse gases in the scenarios used as well as differences in the regional temperature signals (Collins et al., 2013).

Unlike for annual mean temperature, the projected precipitation signal over Uganda is less clear. As apparent from Figure 4 (middle panel), most climate models do not project a substantial change in annual mean precipitation. Some models projections are indicating a tendency towards a wetter climate. As apparent from Figure 4, this wetting trend is most pronounced in eastern Uganda, where increases in annual mean precipitation of about 10 per cent are projected for the 2030s.

Figure 5 displays the spatially resolved changes over the country averaged over the 5 models included in the analysis for the 2030s (averaged over 2021–2040) and the 2050s (averaged over 2041–2060) compared to the reference period (averaged over 1986–2005, see Figure 2).

FIGURE 5: ENSEMBLE MEAN PROJECTIONS FOR CHANGES IN ANNUAL MEAN TEMPERATURE (FIRST ROW), ANNUAL CUMULATIVE PRECIPITATION (SECOND ROW) AND ANNUAL MINIMAL SPEI (THIRD ROW)



Future drought risk as expressed by the SPEI is sensitive to changes in both temperature and precipitation. Although the temperature increase points towards an increased drought risk, stable or increasing precipitation patterns largely counterbalance this effect. Out of the five models underlying the projections presented, two models project either an increased or decreased drought risk over Uganda (see Figure 4), whereas one projects limited to no change in drought risk. Spatially resolved projections point towards a slight increase in drought risk in southern Uganda (see Figure 5, lower panel). This is in line with other multi-model studies of future drought risk in Central and East Africa that also project decreasing trends (Dai 2013). However, these projections describe a mean state and do not fully account for extreme multi-decadal drought events, e.g. related to the El Niño Southern Oscillation that is projected to alternate more frequently between more extreme states under climate change (Cai et al. 2015). How such changes will affect future drought risk in Uganda is unclear. In addition, climate model projections do not fully account for local changes affecting drought risks, e.g. related to land use and land cover change or agricultural practices. Such ongoing changes may contribute substantially to land degradation and increased vulnerabilities to drought (Byenkya et al. 2014). At the same time, an increasing population will result in additional pressure on the water resources. It is therefore not warranted to draw conclusions about decreasing risks based on biophysical mean state projections alone.

4/The impact of climate variability on early childhood

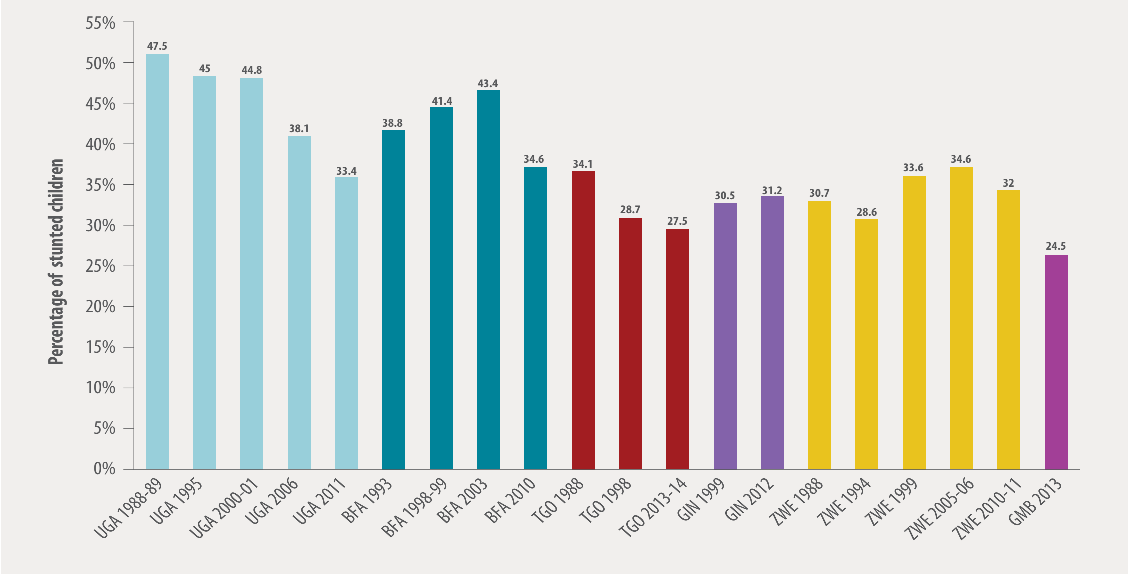
Among the top priorities of the Sustainable Development Goals (SDGs) are Goals 2 and 3 which emphasize eradication of hunger and promotion of health and well-being. The two goals are closely linked since food insecurity, which is a fundamental cause of malnutrition, has direct consequences on health and well-being. Scientific evidence on the negative impacts of malnutrition, usually measured by impairment in growth in weight and height (Onis et al. 2004), on children's well-being is abundant. Chronic malnutrition in preschool children – normally captured through stunting (low height for age) – increases the risk of mortality and morbidity including reduced cognitive ability (Gorman 1995; Liu et al. 2003). Poor cognitive ability hampers mental development, affects school performance and in turn results in reduced economic productivity as adults and lower offspring birthweight for women (Delpeuch et al. 2000; Rice et al. 2000; Victora et al. 2008). Similarly, acute undernutrition as measured by wasting – low weight for height – damages the functioning of the immune system making a child more susceptible to infectious diseases and consequently increased mortality risk. In developing countries, it was found that the mortality rate in children who were wasted is 2.3 times higher than children with no nutritional deficits (McDonald et al. 2013).

Although poverty has substantially declined in Uganda, the proportion of the country's 10.3 million population that is malnourished remains high – 25.5 per cent – and one-third of Ugandan children below the age of 5 are stunted. Figure 6 shows the trends in the proportion of children who are stunted in selected countries in sub-Saharan Africa with similar GDP per capita to Uganda.

FOOD INSECURITY AND CHILD MALNUTRITION

Since 1995, the proportion of stunted children declined from 45.0 per cent to 33.4 per cent in 2011. Based on the data for the most recent years, all countries (except Burkina Faso) have a lower proportion of stunted children than Uganda. This ranges from 32 per cent in Zimbabwe in 2010–11 to as low as 24.5 per cent in Gambia in 2013. In fact, compared to some sub-Saharan African countries with lower income, Figure 6 shows that Uganda displays higher prevalence of under-five stunting. In response, the Government of Uganda implemented the 2011–2016 Uganda Nutrition Action Plan (UNAP) aiming to ensure food and nutrition security for all Ugandans.

FIGURE 6: PERCENTAGES OF CHILDREN AGED ≤5 YEARS WHO ARE STUNTED BY COUNTRY AND YEAR



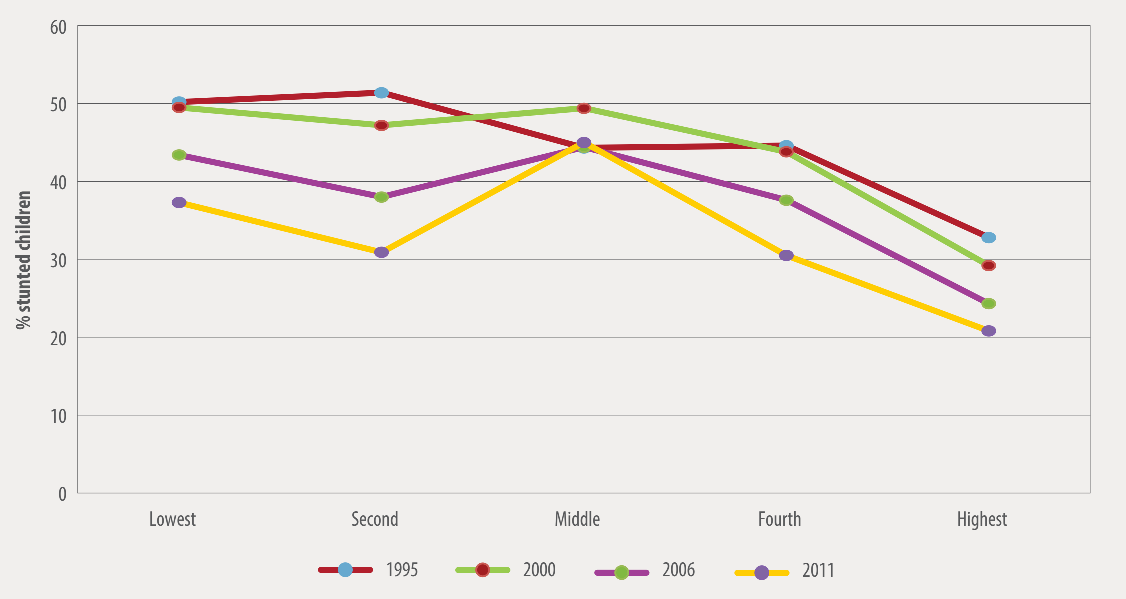
Source: Uganda Demographic and Health Surveys

The prevalence of malnutrition is closely linked to agricultural production, since the livelihoods and food security of many households rely predominantly on subsistence farming. Given that more than 99 per cent of agriculture in Uganda is rain-fed (with just 0.1% of production from irrigation), changes in precipitation patterns can have a considerable impact on crop yields and consequently food security. As shown in Chapter 2, Uganda is highly exposed to climate variability and particularly prone to the effects of drought and floods. In 1980, drought and cattle raiding caused famine in Karamoja leading to a 10-fold increase in the infant mortality rate when compared to the 1969 census data (Biellik and Henderson 1981). With a projected increase in temperatures and decline in rainfall, water demand will increase and food security strategies will become more complex. With the country's high level of dependency on rain-fed agriculture, agriculture production is highly vulnerable to climate variability (Cooper et al. 2008). Increased intensity and frequency of natural hazards due to climate change can thus have serious consequences for food security.

Possible impacts of climate variation on human populations have a complexity which researchers are only beginning to grasp. There are also several other ways than through agricultural production in which child health may be affected by temperature and rainfall. For instance, many disease vectors are more prevalent under relatively humid conditions (Stanke et al. 2013). Most relevant for Uganda are conditions conducive to mosquitoes, which increase the prevalence of malaria (Kudamatsu et al. 2012) and diseases in drinking water (Bandyopadhyay et al. 2012). These conditions suggest a positive relationship between rainfall and malnutrition in childhood if malnutrition is the result of malaria infection or other communicable child or maternal diseases. The causal relationship between malaria infection and malnutrition operates in two directions. On the one hand, malnutrition is found to be a key factor influencing susceptibility to and manifestation of malaria-associated morbidity (Deen et al. 2002; Ehrhardt et al. 2006). On the other hand, Plasmodium falciparum infection (protozoan parasite causing malaria in humans) can result in acute weight loss and malnutrition (Nyakeriga et al. 2004).

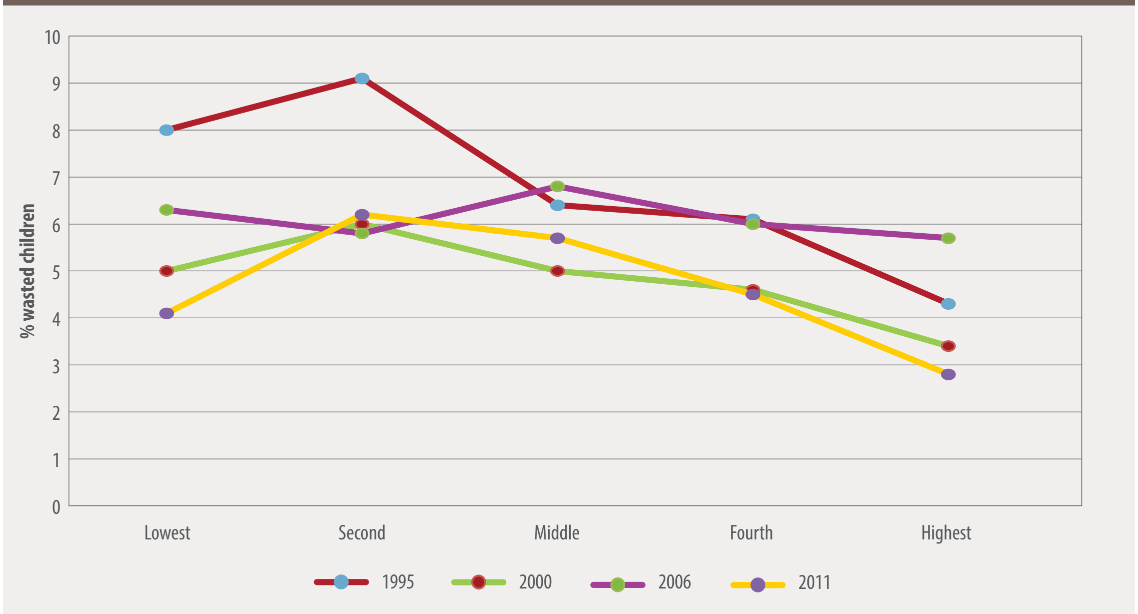
Because early childhood is a fundamental phase of physical and social-emotional development, food insecurity is particularly detrimental in the early years of life. Already, many households in sub-Saharan Africa are unable to access food because they are too poor, out of work or own no property, because food prices are too high or they cannot access markets. Empirical studies have consistently shown that childhood nutrition status varies with household wealth (Hong et al. 2006; Mushtaq et al. 2011; Ortiz et al. 2014), the mother's educational attainment (Burchi 2010; Wamani et al. 2004) and place of residence (i.e. rural vs. urban areas) (Jc 2007; Van de Poel et al. 2008). Similarly, in Uganda, stunting and wasting are strongly associated with wealth, education, place of residence and other relevant characteristics.

FIGURE 7: PERCENTAGES OF CHILDREN AGED ≤5 YEARS WHO ARE STUNTED BY HOUSEHOLD WEALTH QUINTILES



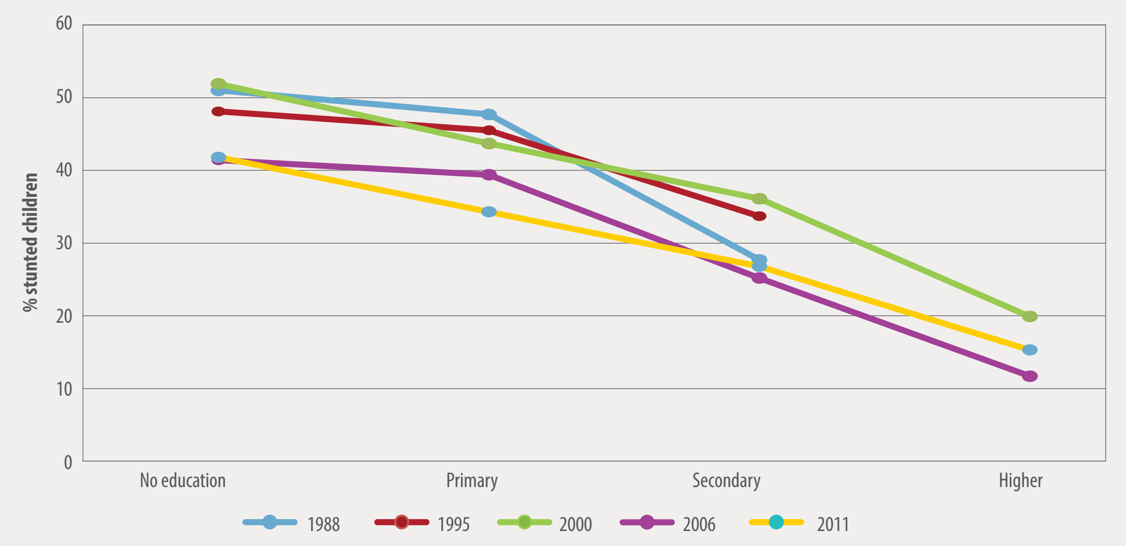
Source: Uganda Demographic and Health Surveys

FIGURE 8: PERCENTAGES OF CHILDREN AGED ≤5 YEARS WHO ARE WASTED BY HOUSEHOLD WEALTH QUINTILES



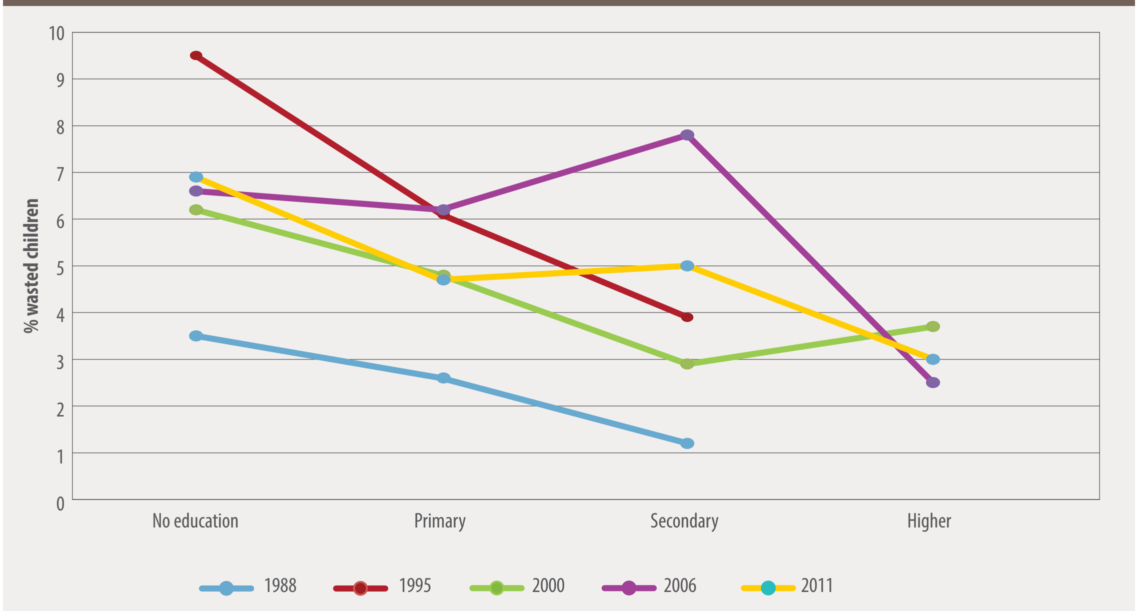
Source: Uganda Demographic and Health Surveys

FIGURE 9: PERCENTAGES OF CHILDREN AGED ≤5 YEARS WHO ARE STUNTED BY EDUCATION



Source: Uganda Demographic and Health Surveys

FIGURE 10: PERCENTAGES OF CHILDREN AGED ≤5 YEARS WHO ARE WASTED BY EDUCATION



Source: Uganda Demographic and Health Surveys

Figure 7 shows the percentages of children who are stunted and Figure 8 the percentages of those who are wasted by household wealth distribution. On average, the prevalence of stunting has declined over the UDHS survey period (1995 to 2011) used in this report. Children in the three lowest wealth quintiles present much higher prevalence of stunting from children in the two top quintiles. In 2011, for instance, the prevalence of stunting for children from the bottom wealth quintile is 37.3 per cent as compared to only 20.8 per cent for children from the top wealth quintile. The higher prevalence of stunting in the bottom wealth quintiles corresponds to the recent findings on economic inequalities in child undernutrition in 80 countries (Bredenkamp et al. 2014). Wealth differentials in the prevalence of wasting are also evident. For the 1995 and 2011 UDHS, the wasting prevalence was about twice as high in children in the poorest wealth quintile compared to children in the richest quintile.

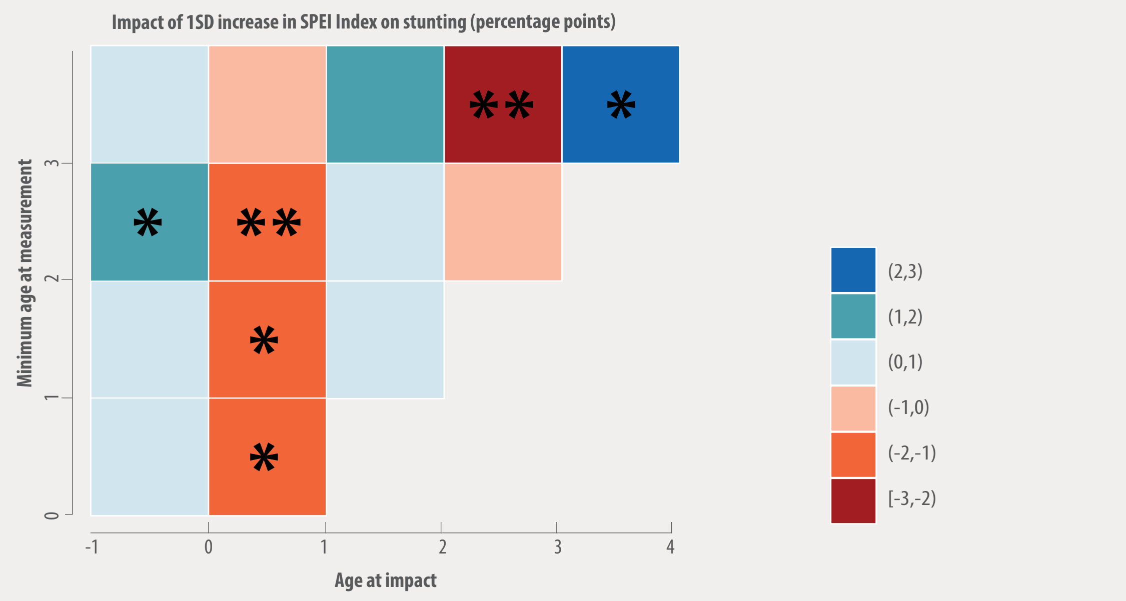
Figures 9 and 10 present the proportion of children who are stunted and wasted by household level of education, respectively. The relationship between stunting and education is linear, with children from households with higher levels of education clearly having a lower chance of being stunted. In fact, the proportion of stunted children in the household with no education in 2011 (41.8%) is even higher than that of children from the household with secondary education two decades earlier (27.7% in 1988). Although stunting has declined for all educational groups over the past few decades, children living in a household with at least a secondary level of education seem to benefit from nutritional improvement much more than children from a household with no formal schooling. Similarly, the relationship between education and wasting has also remained the same. However, there is no clear trend that wasting has declined over time.

Given socioeconomic differentials in malnutrition, this raises a question of how children from disadvantaged households fare under the context of climate variability, especially since these households are likely to have fewer resources and less capacity to cope with the changing climate. This question is of particular importance for children's well-being since nutritional status in early childhood is fundamental for both mental and physical development.

THE IMPACT OF CLIMATE VARIATION ON MALNUTRITION

Building on the analysis above, the following section sets out to quantify the impact of climate variation on malnutrition, as evidenced through the prevalence of stunting and wasting. Figure 11 shows the change in probability of being stunted given a 1 SD change in SPEI, with differential impacts represented by different colours. The X axis represents the age at impact which refers to the age when the child was exposed to the change in SPEI. The Y axis represents the minimum age at measurement which refers to the minimum age when stunting is measured until five years old. For instance, the minimum age at measurement 1 refers to children aged 1–5 years. This analysis is derived from the theoretical model outlined in the Appendix.

FIGURE 11: IMPACTS OF CHANGES IN SPEI INDEX ON STUNTING (PERCENTAGE POINTS)



Notes: *** p<0.01, ** p<0.05, * p<0.1

The first column shows the effects of SPEI the year before the child was born, partly while he or she was in utero. If anything, more rainfall in this period leads to more stunting, but these effects are not significant. The second column shows that an increase in SPEI when the child was in infancy leads to a decline in stunting on the whole sample of children, on children who were 1–5 years, and on children who were 2–5 years at the time of interview, with weakly significant results in the first two samples. A 1 SD increase in SPEI at this age leads to a 1.5 percentage point decline in stunting among children aged 2–5 years, which is statistically significant at the 5 per cent level. Similarly, a 1 SD increase when the child was two years old leads to a 3 percentage points decline in stunting among children who are 3–5 years old (statistical significance at the 5% level). The effect of a 1 SD change in SPEI can also be read in an opposite direction. For instance, a 1 SD decrease from the mean in SPEI when the child was in infancy increases the probability of being stunted by 1.5 percentage points for children who were 2 years or older at the time of measurement.

This finding suggests a persisting effect of unfavourable climate conditions on undernutrition. Exposure to drought in infancy (aged 0 year) or early childhood (aged 2 years) increases the risk of being stunted when the child gets older (2 years later) considerably. Given these lagged effects of droughts, an immediate intervention in improving food security and nutritional status during/after the drought event can change the course of stunting.

FIGURE 12: IMPACTS OF SPEI INDEX ON STUNTING (PERCENTAGE POINTS WITH 95% CONFIDENCE INTERVAL)

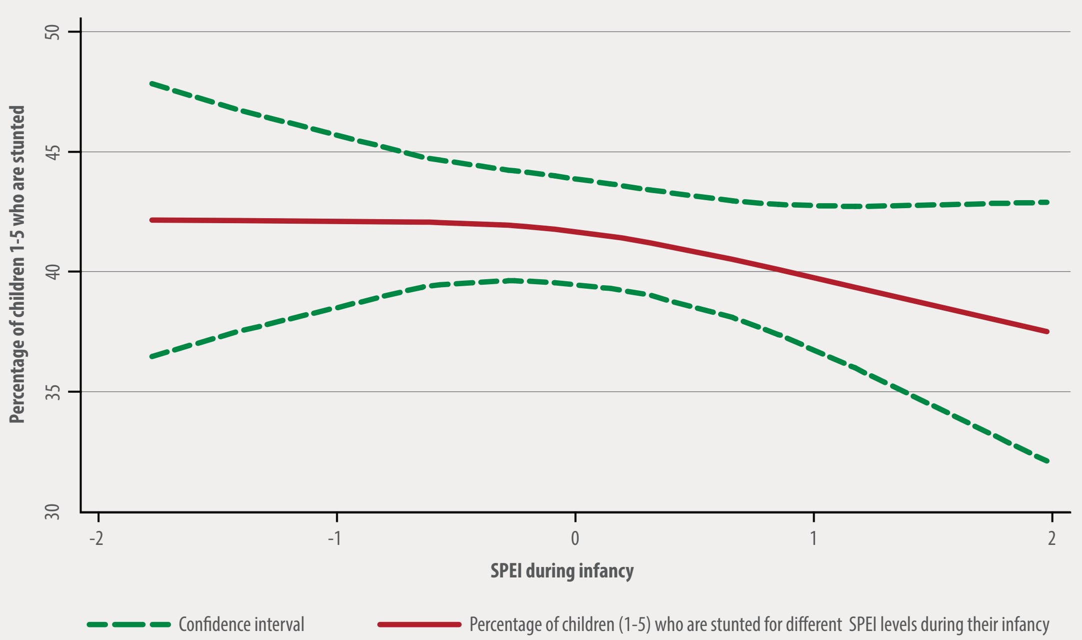


Figure 12 illustrates non-linear effects of SPEI on the percentages of children aged 1-5 years who are stunted given their SPEI during infancy, using a spline transformation of the SPEI index with knots[2] at -1, 0, and 1 standard deviation. When SPEI value is considered moderately wet to extremely wet (SPEI >1), the proportion of stunted children declines, from 42 per cent at SPEI 0 to 38 per cent when SPEI equals 2, holding other variables constant.

2 Knot is the point of separation in a cubic spline regression indicating the value at which separate regression lines or curves are fit between the knots.

Demographic and socioeconomic differentials in impacts of droughts on stunting

Extreme weather events and climate variability are not distributed evenly across population subgroups, household types and geographic regions (Flatø et al. 2017; Muttarak and Jiang 2016). Children living in a rural area have significantly higher likelihood of being stunted (13 per cent) as compared to children living in urban areas. However, there is a great difference between stunting rates between rich and poor urban children, with approximately 38 per cent of children aged 0–5 in the bottom welfare quintile being stunted compared to 11 per cent from the top quintile. With respect to the impact of climate variability on stunting, there is no significant difference between the two types of areas. A 1 SD increase in SPEI significantly reduces the chance of being stunted for young children living in urban areas, whereas there is no significant effect in rural areas.

TABLE 4: EFFECT OF SPEI IN INFANCY ON STUNTING BY GEOGRAPHIC CHARACTERISTICS

DV: STUNTING	(1)	(2)	(3)
SAMPLE	1-5 YEARS	1-5 YEARS	1-5 YEARS
SPEI in infancy			-0.030
			(0.021)
SPEI in infancy, urban	-0.022**		
	(0.011)		
SPEI in infancy, rural	-0.010		
	(0.008)		
SPEI in infancy, central region		0.001	
		(0.013)	
SPEI in infancy, eastern region		-0.005	
		(0.007)	
SPEI in infancy, northern region		-0.003	
		(0.015)	
SPEI in infancy, western region		-0.045**	
		(0.018)	
SPEI in infancy * $PfPR_{2-10}$ in infancy			0.021
			(0.047)
Rural	0.131***		
	(0.0195)		
$PfPR_{2-10}$ in infancy			-0.027
			(0.089)
Age splines	Yes	Yes	Yes
Survey controls	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes
R-squared	8,529	8,529	4,141
Sample size	0.076	0.070	0.080

Notes: SPEI is the yearly mean of the Standardised Precipitation and Evapotranspiration Index, calibrated for three months. $PfPR_{2-10}$ is the Plasmodium falciparum parasite rate in 2–10-year-olds during infancy. Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

The change in likelihood of stunting caused by climate variability also varies by region (see Table 4), with the Western region being particular susceptible to change in stunting rates. A 1 SD decrease in SPEI significantly increases stunting by 4.5 per cent in the Western region, and this impact is what seems to drive the whole nationwide relationship between SPEI and stunting. The Western region also stands out with respect to the level of stunting, which is 48 per cent in this region compared to between 36 and 38 per cent in the other regions.

Relationship between malaria and stunting

Using the geo-coded $PfPR_{2-10}$ data (Plasmodium falciparum parasite rate in 2–10-year-olds) from the Malaria Atlas Project (Bhatt et al. 2015), malaria prevalence in the area where the child lived at the time of interview was identified. The analysis shows no significant relationship between malaria prevalence and stunting. Likewise, there is no conclusive evidence of a malaria-endemic area being differentially susceptible to the effect of drought on malnutrition. However, the interaction effects are in the expected direction. In areas with higher malaria prevalence, there is a less negative relationship between SPEI and stunting, and a 10 per cent increase in the prevalence rate reduces the effect of SPEI on stunting by 0.2 percentage points. In the absence of malaria, the model predicts that a 1 SD decline in SPEI would lead to a 3 percentage point increase in stunting, more than double the rate currently observed.

TABLE 5: EFFECT OF SPEI IN INFANCY ON STUNTING BY BY GENDER AND WEALTH QUINTILE

DV: STUNTING	(1)	(2)
SAMPLE	**1-5 YEARS**	**1-5 YEARS**
SPEI in infancy, males	-0.006	
	(0.010)	
SPEI in infancy, females	-0.020**	
	(0.009)	
SPEI in infancy, bottom wealth quintile		-0.016
		(0.014)
SPEI in infancy, 2nd wealth quintile		-0.020**
		(0.010)
SPEI in infancy, 3rd wealth quintile		-0.021
		(0.018)
SPEI in infancy, 4th wealth quintile		0.001
		(0.012)
SPEI in infancy, top wealth quintile		-0.010
		(0.010)
Female	-0.067***	
	(0.012)	
2nd wealth quintile		-0.072***
		(0.021)
3rd wealth quintile		-0.024
		(0.023)
4th wealth quintile		-0.053***
		(0.020)
Top wealth quintile		-0.075***
		(0.024)
Age splines	Yes	Yes
Survey controls	Yes	Yes
Grid fixed effects	Yes	Yes
R-squared	8,529	8,529
Sample size	0.074	0.072

Notes: SPEI is the yearly mean of the Standardised Precipitation and Evapotranspiration Index, calibrated for three months. Wealth quintiles refer to quintiles of the DHS Wealth Index. Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Gender

As shown in Table 5, girls are less likely to be stunted than boys. This finding confirms what is commonly found in the literature on sub-Saharan Africa that male children are more likely to be stunted than female children, most probably due to higher energy usage as boys are allowed to play more freely (Wamani et al. 2007). However, during drier periods, the effect of the change in SPEI on stunting is significant only for girls. A 1 SD decrease in SPEI increases the probability of stunting for girls by 2 percentage points. Similar to the study of Behrman (1988) in India, it was found that the nutritional status of girls is poorer than that of boys in the lean agricultural season. This finding is also consistent with that of Flatø and Kotsadam (2014) who report that droughts affect female infant mortality more than the infant mortality of males in sub-Saharan Africa. This is possibly due to differential treatment of boys and girls in terms of intra-household food allocations. Hence, this suggests that nutritional interventions in drought-affected areas will need to ensure that girls benefit

Household wealth

Table 5 also shows that, similar to the findings of previous studies (Van de Poel et al. 2008), children from wealthier households are less likely to be stunted. No monotonic trend that children from households with lower wealth have higher probability of being stunted when experiencing a reduction in SPEI is found. However, there is a tendency for a larger impact in the lowest three wealth quintiles, although the differences are not significant.

Parental education

Parental education is also an important determinant of stunting (Table 6). Mothers and fathers who have a higher level of education are more likely to have protective caregiving behaviours such as using iodised salt, pursuing complete childhood immunisations and providing vitamin A supplements – activities that benefit child health and nutritional status (Semba et al. 2008). This is indeed the case in the Ugandan context. The higher the mother's level of education, the lower the chance of the child being stunted. Educational attainment of the mother's partner also plays a role. The likelihood of being stunted for children whose mother has completed primary education is 5 percentage points lower than their peers whose mother does not have formal education, and 29 percentage points lower for children whose mother has higher education as compared to the children whose mother has not completed any education.

The change in SPEI has a significant effect on the child being stunted only when the mother has less than primary education or when the mother's partner has only primary-level education. A 1 SD reduction in SPEI increases the probability of stunting for children of mothers with lower than primary level education by 3.1 percentage points and for children living with the mother's partner with primary education by 2.2 percentage points. This suggests that drought will have a significant effect on child malnutrition, especially a child whose mother does not have any education.

TABLE 6: EFFECT OF SPEI IN INFANCY ON STUNTING BY EDUCATION

DV: STUNTING	(1)	(2)
SAMPLE	1-5 YEARS	1-5 YEARS
SPEI in infancy, mother's education < primary	-0.031**	
	(0.015)	
SPEI in infancy, mother completed primary	-0.003	
	(0.008)	
SPEI in infancy, mother completed secondary	-0.024	
	(0.017)	
SPEI in infancy, mother higher education	-0.037*	
	(0.021)	
SPEI in infancy, partner's education < primary		-0.006
		(0.018)
SPEI in infancy, partner completed primary		-0.022**
		(0.010)
SPEI in infancy, partner completed secondary		0.005
		(0.012)
SPEI in infancy, partner higher education		-0.020
		(0.019)
Mother completed primary	-0.050***	
	(0.017)	
Mother completed secondary	-0.134***	
	(0.018)	
Mother higher education	-0.290***	
	(0.029)	
Partner completed primary		-0.036
		(0.024)
Partner completed secondary		-0.125***
		(0.024)
Partner higher education		-0.184***
		(0.030)
Age splines	Yes	Yes
Survey controls	Yes	Yes
Grid fixed effects	Yes	Yes
R-squared	8,529	8,058
Sample size	0.070	0.079

Notes: SPEI is the yearly mean of the Standardised Precipitation and Evapotranspiration Index, calibrated for three months. Wealth quintiles refer to quintiles of the DHS Wealth Index. Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Effects of droughts on wasting

Unlike stunting, which captures long-term nutritional status, wasting is useful in analysing the current health status in the short term. Typically, wasting is a result of a severe, acute malnutrition – short duration of nutritional deficit often complicated by concurrent infective disease (Collins 2007). Information on wasting is also available only for children below the age of 5. Since the climate impact on wasting is immediate, exposure to climate variation is measured as an average of the previous three months before the interview.

TABLE 7: EFFECT OF SPEI DURING LAST THREE MONTHS ON WASTING

DV: WASTING	(1)	(2)	(3)	(4)
SAMPLE	0-5 YEARS	0-5 YEARS	0-5 YEARS	0-5 YEARS
SPEI last 3 months	0.004		-0.017*	
	(0.004)		(0.009)	
SPEI last 3 months, male		-0.001		
		(0.006)		
SPEI last 3 months, female		0.008*		
		(0.005)		
SPEI in infancy * $PfPR_{2-10}$ in year of interview			0.050***	
			(0.018)	
SPEI in infancy, central region				-0.003
				(0.006)
SPEI in infancy, eastern region				0.013***
				(0.004)
SPEI in infancy, northern region				0.006
				(0.010)
SPEI in infancy, western region				0.005
				(0.012)
Female		-0.018***		
		(0.005)		
$PfPR_{2-10}$ in year of interview			-0.020	
			(0.030)	
Age splines	Yes	Yes	Yes	Yes
Survey controls	Yes	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes	Yes
R-squared	9,607	9,607	8,336	9,607
Sample size	0.042	0.043	0.046	0.042

Notes: SPEI is a three months average of the Standardised Precipitation and Evapotranspiration Index, calibrated for three months. $PfPR_{2-10}$ is the Plasmodium falciparum parasite rate in 2–10-year--olds in the year of interview. Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

In fact, wasting is quite a rare event, affecting only 6 per cent of the children in the sample (see Table 7). On average, we find no significant relationship between a 1 SD change in SPEI and the probability of the child being wasted. It appears that girls are significantly less likely to be wasted as compared to boys (1.8% less). Evidence from some other countries points towards a similar favourable outcome for girls (Phimmasone et al. 1996). With respect to the effect of a change in SPEI by gender, a 1 SD increase in SPEI weakly significantly increases the likelihood of wasting for girls by 0.8 per cent. A reduction in SPEI would thus reduce the probability of being wasted for girls. This finding is rather counterintuitive because drought or dry periods are generally associated with malnutrition (Chotard et al. 2010; Stanke et al. 2013). Since wasting is often caused by acute starvation, such as in time of famine or in the case of severe disease, too much rainfall may increase both diarrhoea prevalence and mosquitoes, which in turn increase illness among young children. In this case, the effect of SPEI change on wasting may indirectly operate via an increase in severe illness.

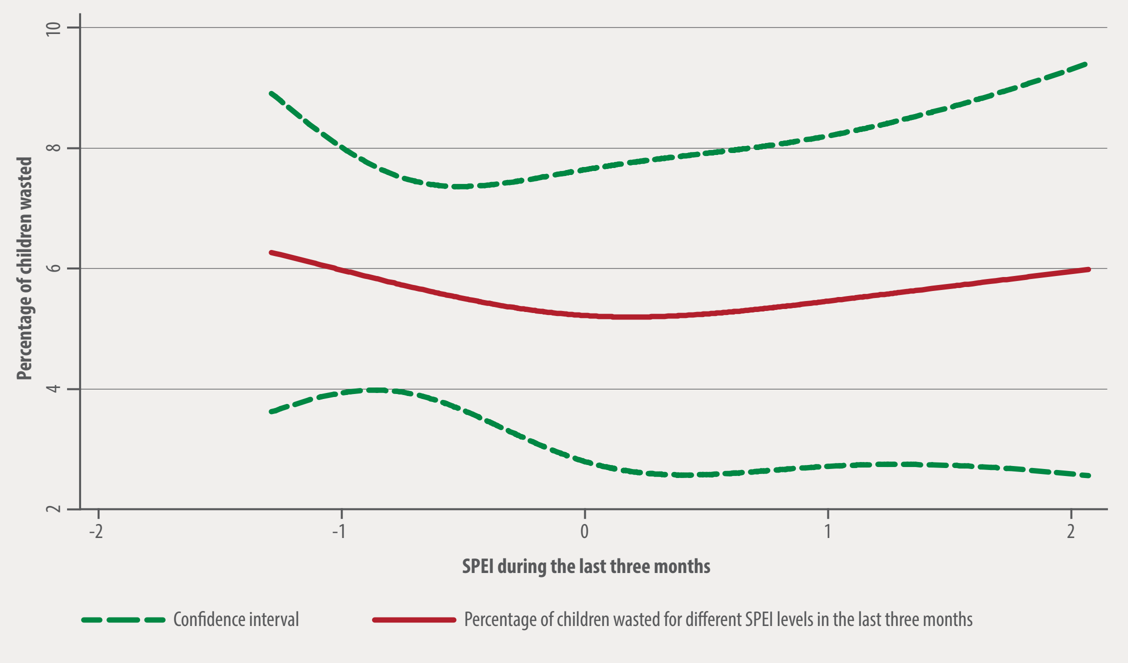
Similar to the previous analysis on stunting, malaria prevalence is measured by the Plasmodium falciparum parasite rate in children aged 2–10 years ($PfPR_{2-10}$) (see Table 6). An increase in $PfPR_{2-10}$ of 0.1 corresponds to a 10 percentage point increase in malaria prevalence rate. While living in malaria endemic areas has no significant relationship with the likelihood of wasting, the interaction between changes in SPEI and $PfPR_{2-10}$ on wasting has a significant effect. The probability of the child being wasted increases by as much as 0.5 percentage points with every 10 per cent increase in $PfPR_{2-10}$ and 1 SD increase in SPEI. Indeed, malaria transmission is positively associated with precipitation since growth of the vector population requires sufficient rainfall (Odongo-Aginya et al. 2005; Thomson et al. 2006). The incidence of infectious disease such as malaria can exacerbate malnutrition (Remans et al. 2011) and the interaction between SPEI change and $PfPR_{2-10}$ affects wasting more than stunting, possibly because wasting is an acute condition highly susceptible to disease incidence.

Interestingly, after controlling for malaria prevalence in the residential area as well as the interaction between SPEI change and $PfPR_{2-10}$ rate, it is found that a 1 SD increase in SPEI reduces wasting by 1.7 percentage points. This suggests that after controlling for malaria prevalence which influences wasting through acute illness causing rapid weight loss, in fact higher rainfall (i.e. increase in SPEI) implies better crop yields and consequently reduces the likelihood of wasting.

Analysis shows that 1 SD increase in SPEI raises the probability of wasting in the eastern region by 1.3 percentage point (see Table 6). It is, however, difficult to interpret the regional effect in the case of wasting. The DHS interviews typically start in one region in Uganda and then spread throughout the entire country in a different period. Since wasting is related to the short-term impact of malnutrition, given seasonal and geographical variation the true regional differences in how SPEI affects wasting may not be captured. Stunting, on the other hand, is a measure of chronic malnutrition which has been going on for some time.

Next, Figure 13 presents the percentages of wasted children at different SPEI levels based on estimates using a spline transformation of the SPEI index during the last three months with knots at -1, 0, and 1 standard deviation. The impact of SPEI index on wasting seems to be curvilinear whereby the proportion of children who are wasted are about the same (6%) in both dry months (SPEI <-1) and extremely wet months (SPEI >2). The share of wasted children is lower when SPEI is considered normal. However, note that the differences in the prevalence of wasting by the level of SPEI are not statistically significant.

FIGURE 13: IMPACT OF SPEI INDEX ON WASTING (PERCENTAGE POINTS)



CONCLUSION

As the analysis in this chapter has shown, although both stunting and wasting are commonly used as an indicator of malnutrition, vulnerability to climate variability differs between different measures. While exposure to droughts during infancy increases the likelihood of stunting, this might only become evident two years later. Immediate interventions during or after drought episodes can therefore reduce the likelihood of stunting.

Wasting, on the other hand, is associated with too much rainfall, in part because higher rainfall may increase the incidence of diseases such as malaria and diarrhoea, which young children are particularly vulnerable to. Controlling the disease outbreaks associated with higher precipitation is therefore a priority for public authorities.

Gender, socioeconomic and geographical factors also play a part in children's vulnerability. Although girls are generally less likely to be stunted and wasted as compared to boys, they seem to be more vulnerable to climate variability, as are children from poorer households and in certain geographic areas.

5/The impact of climate variability on childhood and adolescence

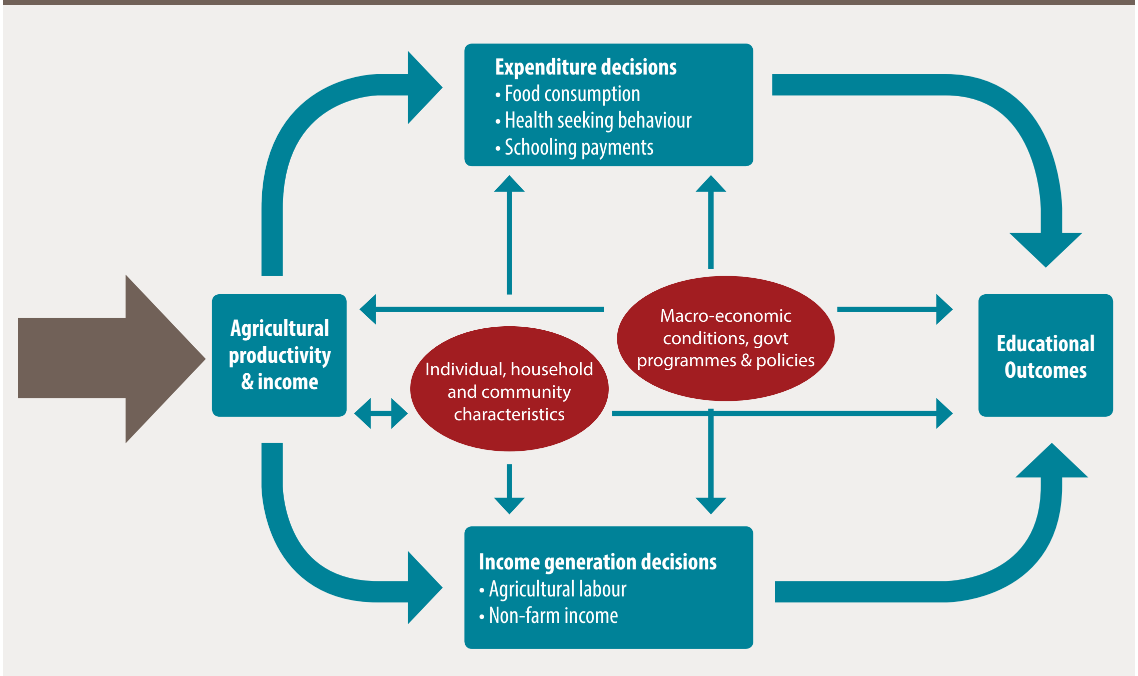
Sustainable Development Goal (SDG) 4 contains seven targets related to the promotion of high-quality education for all and an additional three targets concerning the provision of education facilities and qualified teachers and improvement of educational access. SDG 4 explicitly aspires for universal primary and secondary education for all girls and boys. Falling short of this goal will impede the achievement of sustainable development, since high-quality education for all is fundamental in realizing other goals such as poverty reduction, health, adaptive capacity and gender equality (Barakat et al. 2016).

Enrolling and keeping children in school is a costly process and households' decisions in investments in schooling primarily depend on households' economic conditions. When a household experiences an income shock due to e.g. death of a main earner, unemployment or rainfall variability, this could affect investment in children's schooling. Indeed, UNICEF has longed expressed concerns about the impact of economic shocks, e.g. due to structural adjustment programmes on health, education and nutrition, on children in developing countries (Jolly 1991). Climate variability presents a new threat to child welfare.

EDUCATION OUTCOMES

Figure 14 illustrates the processes through which an income shock (in this case due to changing environmental conditions, e.g. temperature and rainfall fluctuations affecting agricultural productivity) influences educational outcomes in a farming household context (Randell and Gray 2016, pp. 113–114). In order to cope with a reduction in income, households typically employ two strategies. First, they may reduce their current consumption such as food consumption and/or health and educational expenditures. This can affect both school enrolment and the ability to perform in school. Second, in periods of income shocks, households are obliged to seek additional income. As a consequence, children may be pulled out of school to participate in home production, agricultural labour or non-farm activities. On the other hand, higher rainfall means better agricultural productivity and increasing demand for child labour. In this case, children will be pulled out of school to help with farm activities. Another effect of climate variability on school attendance is related to a disease channel. There is evidence that rainfall is positively related to the development of water-borne disease pathogens and vectors such as mosquitos (Wu et al. 2016). Increase in disease outbreaks associated with higher rainfall may force children to drop out of school accordingly (Mudavanhu 2014). Climate variability can hence influence schooling through these mechanisms.

FIGURE 14: A CONCEPTUAL MODEL OF THE RELATIONSHIP BETWEEN ENVIRONMENTAL CHANGE AND EDUCATIONAL OUTCOMES AMONG CHILDREN FROM AGRICULTURAL HOUSEHOLDS



Source: Reproduced from Randell and Gray (2016)

Empirical studies on the relationship between climate conditions and educational outcomes are fairly scarce and the evidence is mixed (Randell and Gray 2016). On the one hand, there is evidence that adverse climate conditions affect school enrolment. For instance, Björkman-Nyqvist (2013) reported that negative rainfall shocks affect primary school enrolment of older girls in Uganda but this is not the case for boys and younger girls. Likewise, Bandara et al. (2015) find that experiencing crop shocks corresponds to increasing working hours and agriculture work hours, especially for boys and reducing school attendance for girls in Tanzania. Households increase the use of child labour during economic hardship to substitute adult labour in household activities such as gathering firewood or fetching water. On the other hand, children may be pulled out of school during positive rainfall periods to assist with farm labour. Evidence from Ethiopia and India supports this pattern, whereby boys in rural Ethiopia and children in India were more likely to drop out of school during the period of positive rainfall shocks (Mani et al. 2013; Shah and Steinberg 2016). Higher rainfall means higher agricultural productivity and farming households consequently require extra labour to assist in farming activities.

Household income

There is, however, substantial heterogeneity across households in school enrolment. Household income is one key determinant of the decision whether or not to send children to school (Deininger 2003; Grimm 2011). In particular, when households face liquidity constraints such as during the period of negative rainfall shocks, poorer households face greater difficulty in keeping their children in school due to the lack of insurance and limited abilities to smooth consumption through credit and savings (Beegle et al. 2006; Jacoby and Skoufias 1997). Without a buffer against the negative effects of income loss, children from less wealthy households experience lower educational attainment (Gitter and Barham 2007). Furthermore, children's education is determined by parental education during times of widespread economic hardship as well as during normal times. A study of children's educational achievement during the economic collapse in Zimbabwe between 2001 and 2011 reported a protective effect of parental education on school enrolment, grade and primary school completion (Pufall et al. 2016). Better educated households may have more diversified strategies to cope with income shocks and the effect of education on consumption smoothing is shown to be independent of income (Garbero and Muttarak 2013).

Place of residence

Place of residence is also highly relevant for school enrolment. UNHS results show that children living in rural areas are more likely to engage in child labour than those living in urban areas (22% vs. 7% among children aged 6–14 years, respectively) (Tamusuza 2011). Engagement in child labour constrains schooling, especially in the rural areas as evident that the hazard of dropping out of primary school is 60 per cent higher in these areas. Given that agriculture is the primary source of income for rural households (Burgess et al. 2013), climatic shocks are likely to affect rural households and consequently schooling outcomes more strongly than urban households. The understanding of the impacts of climate variability on schooling thus needs to consider the differential vulnerability by household characteristics and geographical locations.

In the quest to achieve SDG 4 on education, it is important to understand how external shocks such as climate-related hazards can affect schooling outcomes. To this end, this chapter aims to assess the impacts of climatic shocks on school enrolment of school age children and assess how demographic, household and geographical characteristics influence schooling outcomes. This will enable practitioners to pinpoint the disadvantaged groups and design appropriate policy interventions. For an explanation of the formula used to calculate outcomes, see Appendix.

TABLE 8: EFFECT OF SPEI ON CHANGES IN SCHOOLING OUTCOMES

	(1)	(2)	(3)
Dependent variable	**Dropout**	**No progress**	**New enrolment**
Sample	**Enrolled aged 6-15**	**Enrolled aged 6-15**	**Unenrolled aged 6-15**
SPEI previous year	0.009**	0.019	-0.067*
	(0.004)	(0.019)	(0.036)
Age splines	Yes	Yes	Yes
Survey control	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes
Sample size	18,621	18,995	4,036
R-squared	0.021	0.062	0.236

Notes: Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

In general, Table 8 shows that the effect of an increase in the SPEI index during the previous year seems to be less schooling. In the case of school dropout, a 1 SD increase in SPEI increases the likelihood of dropping out in the year of survey by 0.9 percentage points, which is statistically significant. Although not statistically significant, an increase in SPEI also affects schooling progression in a similar manner and to a larger extent than school dropout. Likewise, a 1 SD increase in SPEI reduces the probability of new enrolment by 6.7 percentage points (which is weakly significant at 10% level). This finding suggests that parents may have pulled their children out of school during good rainfall periods to assist with farm labour as found in other countries (Dumas 2015; Mani et al. 2013; Shah and Steinberg 2016) or that more rainfall increases disease prevalence which keeps children home from school.

TABLE 9: EFFECT OF SPEI ON SCHOOL ATTENDANCE BY YEAR OF SPEI MEASUREMENT AND A CHILD'S AGE

DV: Some attendance	**(1)**	**(2)**	**(3)**	**(4)**
Sample	**Children aged 6-15**	**Children aged 6-15**	**Children aged 6-15**	**Children aged 6-15**
SPEI year of attendance	0.003		0.005	
	(0.011)		(0.010)	
SPEI previous year		-0.012	-0.013*	0.053***
		(0.008)	(0.007)	(0.019)
SPEI previous year * age				-0.006***
				(0.001)
Age splines	Yes	Yes	Yes	Yes
School year controls	Yes	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes	Yes
Sample size	64,333	64,333	64,333	64,333
R-squared	0.195	0.195	0.195	0.196

Notes: Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Table 9 combines the three schooling outcomes in Table 7 to measure whether a child is in school in the year of interview and the year before (regardless of progression or new enrolment), and also includes the 2011 survey. While SPEI measured at the year of attendance does not have any significant relationship with school attendance, there is a lagged effect of SPEI change. There is also a negative effect of SPEI change on school attendance, i.e. a 1 SD increase in SPEI reduces the likelihood of attending school by 1.2 percentage points.

In fact, the increase in SPEI has a negative effect on school attendance only for older children. One year increase in age reduces the probability of attending school by 0.6 percentage points with each 1 SD increase in SPEI. For a child aged 15, this means that a 1 SD increase in SPEI reduces schooling by 3.7 percentage points. Meanwhile, younger children benefit from good rainfall year whereby a 1 SD increase in SPEI in the previous year leads to a 1.7 percentage point increase in the likelihood of attending school for a 6-year-old. This finding suggests that the impact of climate variability on school attendance varies with the age of a child. In a good rainfall year, parents may pull older children out to assist with farm and non-farm activities while, at the same time, good agricultural productivity associated with higher rainfall also enables households to send younger children to school.

FIGURE 15: IMPACTS OF SPEI INDEX ON SCHOOL ATTENDANCE (PERCENTAGE POINTS)

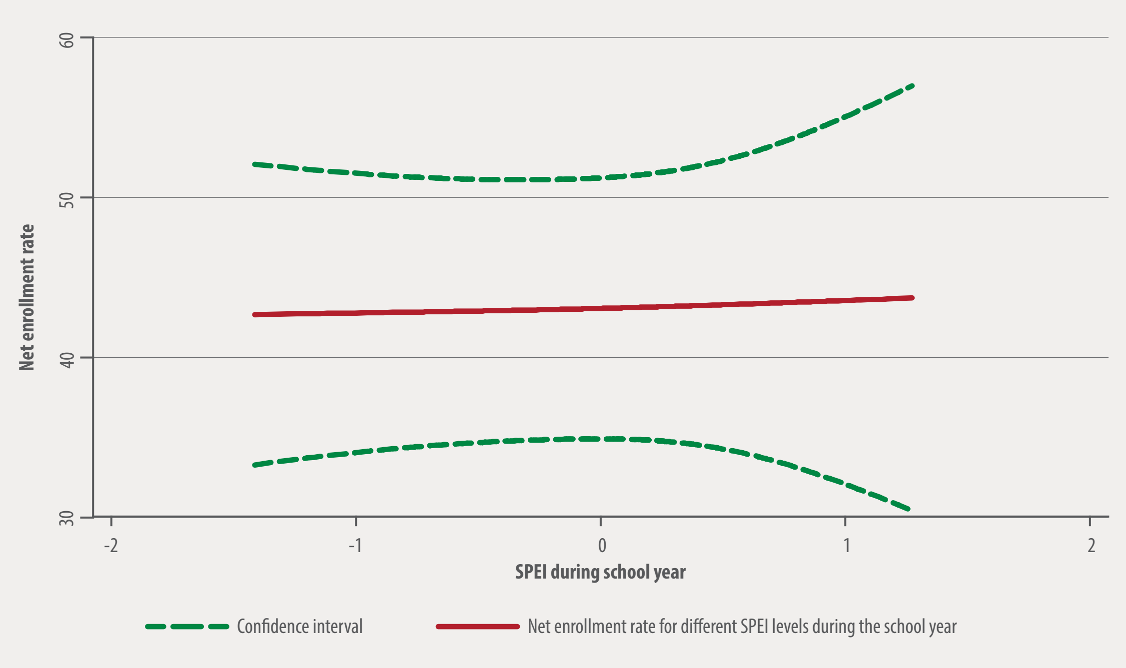
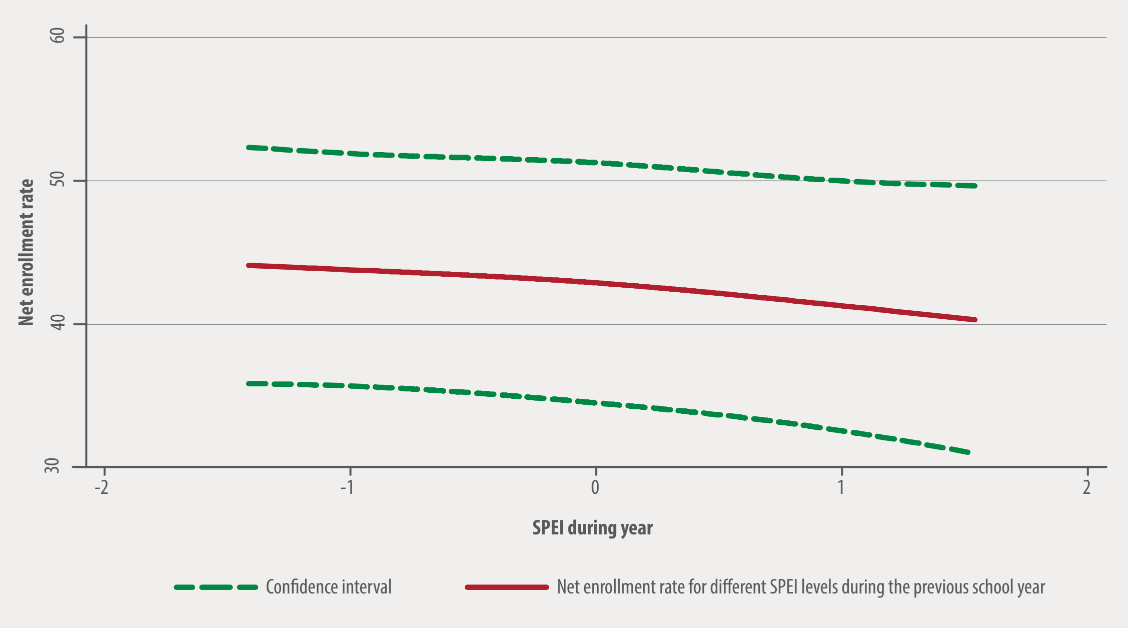


Figure 15 illustrates the estimated net enrolment rate by a restricted cubic spline transformation of the SPEI level with knots at -1, 0, and 1 standard deviations measured during the school year in question. The enrolment rate is slightly higher when the SPEI level during the school year is positive, but is not statistically significant. When investigating the net enrolment rate given a restricted cubic spline transformation of the SPEI level with knots at -1, 0, and 1 SD measured during the previous school year (Figure 16), there is a different pattern. The net enrolment rate declines slightly when SPEI level during the previous year is considered wet. When the SPEI value is considered moderately wet to extremely wet (SPEI >1), the net enrolment rate declines, from 43 per cent at SPEI 0 to 40 per cent when SPEI equals 2, holding other variables constant. The differences, however, are not statistically significant at the 5 per cent level.

FIGURE 16: IMPACTS OF SPEI INDEX DURING PREVIOUS YEAR ON SCHOOL ATTENDANCE (PERCENTAGE POINTS)



Geographic differentials

Table 10 explores geographic differentials in the relationship between SPEI change and schooling. Model 1 shows that in general the likelihood of attending school is significantly lower in the rural areas (i.e. 6.1 percentage points lower than the urban areas). In general, the likelihood of attending school is significantly lower in rural areas – i.e. 6.1 percentage points lower than in urban areas. However, a change in SPEI has a significant effect on schooling only in urban areas and the relationship is negative. A 1 SD decline in SPEI increases the probability of school attendance in the urban area by 2.8 percentage points. In other words, in the urban area, during wetter years children are more likely to drop out of school; and vice-versa. In a city like Kampala, for instance, where 54 per cent of inhabitants live in slums (UN-Habitat 2014), this is likely to be the direct result of poor, unhygienic living conditions resulting in heightened transmission of infectious diseases like malaria. The status of housing conditions among children living in urban areas is further elaborated upon in Part 2 of this report.

With respect to regional differences, a 1 SD increase in SPEI reduces the likelihood of attending school in the Central and Northern regions by about 2 percentage points. This finding confirms regional inequalities in school enrolment in Uganda. Based on the UNHS data, Tamusuza (2011) reported that compared to the children from the Central, Northern and Western regions, children in the Eastern region are less likely to drop out of school. The Eastern region is generally better-off than other regions.

Living in a malaria endemic area can also influence schooling outcomes. Investigations therefore included how the relationship between changes in the SPEI index interacts with malaria prevalence in determining school attendance. Malaria infection can discourage school attendance and an increase in water availability may further prosper breeding sites for mosquito vectors. The results are in an expected direction even if the relationships are not statistically significant. In the absence of malaria, there does not seem to be any correlation between the SPEI index and children's education, with a negative coefficient of -.3 percentage points.

TABLE 10: EFFECT OF SPEI ON SCHOOL ATTENDANCE BY GEOGRAPHIC CHARACTERISTICS

DV: Some attendance	(1)	(2)	(3)
Sample	Children aged 6-15	Children aged 6-15	Children aged 6-15
SPEI previous year			-0.003
			(0.029)
SPEI previous year , urban	-0.028***		
	(0.006)		
SPEI previous year, rural	-0.002		
	(0.009)		
SPEI previous year, central region		-0.021**	
		(0.010)	
SPEI previous year, eastern region		-0.009	
		(0.011)	
SPEI previous year, northern region		-0.022*	
		(0.013)	
SPEI previous year, western region		0.016	
		(0.013)	
SPEI previous year * $PfPR_{2-10}$ previous year			-0.019
			(0.036)
Rural	-0.061***		
	(0.014)		
$PfPR_{2-10}$ previous year			-0.006
			(0.042)
Age splines	Yes	Yes	Yes
School year controls	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes
Sample size	64,333	64,333	43,776
R-squared	0.198	0.195	0.230

Notes: *$PfPR_{2-10}$ is the Plasmodium falciparum parasite rate in 2–10-year-olds during previous year.* Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Land ownership

Table 11 explores whether agricultural land ownership can explain the rural-urban difference in school attendance given SPEI change. There is no difference between the effect of SPEI between households that own land and those that do not. When further breaking down into rural and urban areas,, it appears that compared to children from households with no agricultural land in urban areas, those living in urban areas whose household own agricultural land are significantly more likely to attend school, by 1.7 percentage point. On the other hand, children from households in rural areas (with or without agricultural land) are less likely to attend school. There is no significant difference between the groups in how they are affected by SPEI change. The negative coefficients for the interactions between SPEI previous year*rural/urban status and land ownership suggest that 1 SD increase in SPEI reduces the likelihood of school attendance for all groups. This reduction is however only statistically significant at the 5 per cent level for children living in the urban area whose households own agricultural land (4.9 percentage points less likely to attend school).

TABLE 11: EFFECT OF SPEI ON SCHOOL ATTENDANCE BY LAND OWNERSHIP CHARACTERISTICS

DV: Some attendance	(1)	(2)
Sample	Children aged 6-15	Children aged 6-15
SPEI previous year, no agric. land ownership	-0.037*	
	(0.021)	
SPEI previous year, owns agric. land	-0.032	
	(0.023)	
SPEI previous year, no agric. land ownership, urban		-0.037*
		(0.019)
SPEI previous year, no agric. land ownership, rural		-0.036
		(0.022)
SPEI previous year, owns agric. land, urban		-0.049**
		(0.023)
SPEI previous year, owns agric. land, rural		-0.031
		(0.023)
Owns agricultural land	-0.014	
	(0.008)	
No agric. land ownership, rural		-0.040*
		(0.024)
Owns agricultural land, urban		0.017**
		(0.008)
Owns agricultural land, rural		-0.053**
		(0.020)
Age splines	Yes	Yes
School year controls	Yes	Yes
Grid fixed effects	Yes	Yes
Sample size	42,092	42,092
R-squared	0.235	0.237

Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Table 12 investigates the relationship between a change in the SPEI index and school attendance by demographic and household characteristics. Model 1 presents the probability of school attendance by a child's gender. We find a small but significant female disadvantage with girls being 0.9 percentage point less likely to attend school as compared to boys. A 1 SD increase in SPEI reduces the likelihood of attending school by 1.4 and 1.1 percentage points for boys and girls respectively, but the effect is marginally significant at the 10 per cent level for boys and non-significant for girls. From these numbers, we conclude that there does not seem to be gender disparities regarding the effect of SPEI change on school attendance.

Model 2 presents the effect of wealth on school attendance. It is evident that school attendance in Uganda is determined by household wealth with children from a wealthier household being significantly more likely to attend school. Meanwhile, less wealthy households are also more susceptible to climatic shocks. A 1 SD increase in SPEI corresponds to 4.6 percentage points lower chance of attending school for children living in the household located in the bottom wealth quintile. Having ruled out the possibility that in wetter years children drop out of school as a result of the heightened transmission of infectious diseases like malaria, this finding also suggests that the less wealthy households may pull their children out of school in a good rainfall year to increase their labour supply.

Model 3 investigates the variation in school attendance by the level of education in a household. Household education is measured by the highest level of education of any adult member in a household. Compared to the households with lower than primary level of education, the probability of attending school for children living in a household with completed primary education is 52.6 percentage points higher. The magnitude of the effect is even larger when the household has completed secondary level or higher education i.e. approximately 60 percentage points higher chance of attending school as compared to children from a household with lower than primary level. No other indicator is a better predictor for children's education; for instance, the difference between wealth groups is much smaller than between educational groups. An increase in SPEI has a negative relationship (2.4 percentage points lower) with school attendance for children from a household with higher education. This finding could be due to the fact that lower educated households do not have many older children in school, and therefore they have less to gain from pulling them out during a year with a good harvest. Parents with higher education, on the other hand, benefit from pulling them out since many of their older children are attending school.

TABLE 12: EFFECT OF SPEI ON SCHOOL ATTENDANCE BY DEMOGRAPHIC AND HOUSEHOLD CHARACTERISTICS

DV: SOME ATTENDANCE	(1)	(2)	(3)
SAMPLE	CHILDREN AGED 6-15	CHILDREN AGED 6-15	CHILDREN AGED 6-15
SPEI previous year, males	-0.014*		
	(0.007)		
SPEI previous year, females	-0.011		
	(0.009)		
SPEI previous year, bottom wealth quintile		-0.046***	
		(0.015)	
SPEI previous year, 2nd wealth quintile		-0.019*	
		(0.011)	
SPEI previous year, 3rd wealth quintile		-0.006	
		(0.012)	
SPEI previous year, 4th wealth quintile		-0.007	
		(0.011)	
SPEI previous year, top wealth quintile		-0.008	
		(0.012)	
SPEI previous year, education < primary			0.021
			(0.023)
SPEI previous year, completed primary			0.0005
			(0.007)
SPEI previous year, completed secondary			-0.011
			(0.007)
SPEI previous year, higher education			-0.024***
			(0.007)
Female	-0.009**		
	(0.004)		
2nd wealth quintile		0.050***	
		(0.014)	
3rd wealth quintile		0.071***	
		(0.016)	
4th wealth quintile		0.090***	
		(0.017)	
Top wealth quintile		0.090***	
		(0.017)	
Completed primary			0.526***
			(0.026)
Completed secondary			0.595***
			(0.026)
Higher education			0.609***
			(0.027)
Age splines	Yes	Yes	Yes
School year controls	Yes	Yes	Yes
Grid fixed effects	Yes	Yes	Yes
Sample size	64,333	64,333	64,333
R-squared	0.195	0.201	0.236

Notes: Wealth quintiles refer to quintiles of the DHS Wealth Index. Standard errors clustered at the grid cell level. Stars indicate significance at 1 per cent level (***), 5 per cent level (**) and 10 per cent level (*). Standard errors in brackets.

Gender

There is a small but significant female disadvantage with girls being 0.9 percentage points less likely to attend school as compared to boys. A 1 SD increase in SPEI reduces the likelihood of attending school by 1.4 and 1.1 percentage points for boys and girls respectively, but the effect is marginally significant at the 10 per cent level for boy and non-significant for girls. From these numbers, there do not appear to be gender disparities regarding the effect of SPEI change on school attendance.

Wealth

School attendance in Uganda is determined by household wealth with children from wealthier households being significantly more likely to attend school. Less wealthy households are also more susceptible to climatic shocks. A 1 SD increase in SPEI corresponds to 4.6 percentage point lower chance of attending school for children living in the household located in the bottom wealth quintile. Having ruled out the possibility that in wetter years children drop out of school as a result of the heightened transmission of infectious diseases like malaria, this finding also suggests that less wealthy households may pull their children out of school in a good rainfall year to increase their labour supply.

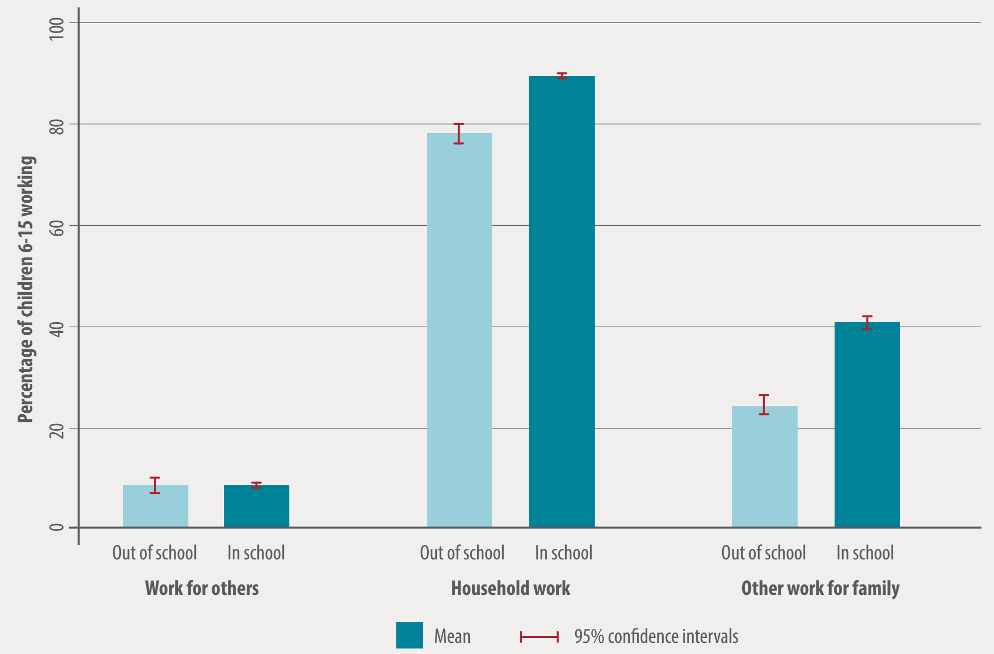
Level of education

Compared to the households with lower than primary level of education, the probability of attending school for children living in a household with completed primary education is 52.6 percentage points higher. The magnitude of the effect is even larger when the household has completed secondary level or higher education, i.e. there is approximately a 60 percentage point higher chance of attending school as compared to children from a household with lower than primary level education. No other indicator is a better predictor for children's education; for instance, the difference between wealth groups is much smaller than between educational groups. An increase in SPEI has a negative relationship (2.4 percentage points lower) with school attendance for children from a household with higher education. This finding could be due to the fact that lower educated households do not have many older children in school, and therefore they have less to gain from pulling them out during a year with a good harvest. Parents with higher education, on the other hand, benefit from pulling them out since many of their older children are attending school.

Engagement in labour

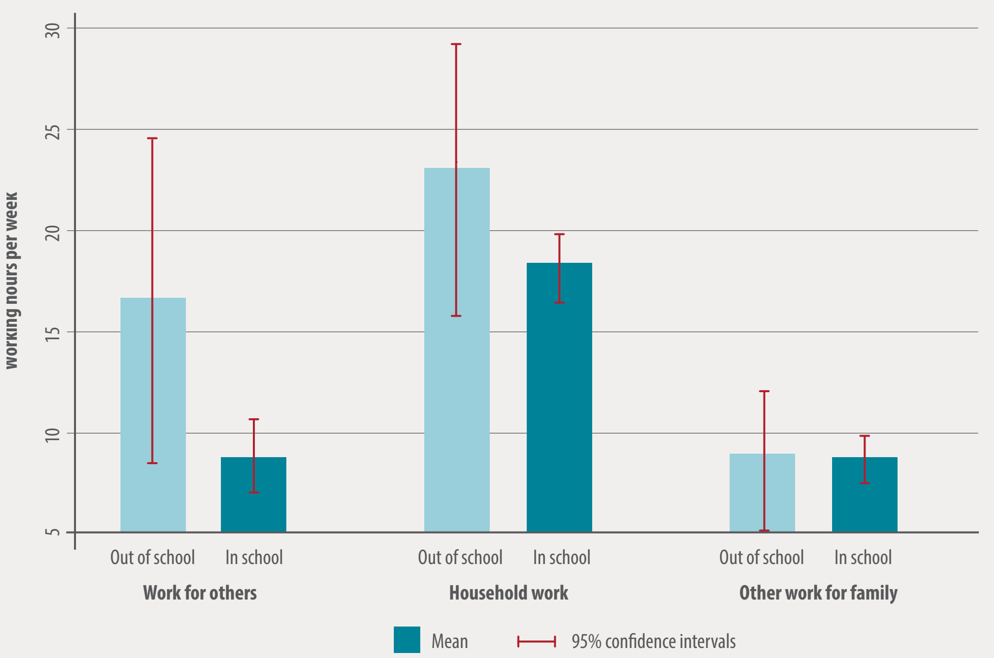
Figure 17 presents the proportion of children who are working by type of work engaged and school attendance. Figure 18 presents the number of working hours by type of work and school attendance. Note that there are three separate questions about the type of work the children are doing and, hence, a child can potentially be engaged in work both inside and outside their household.

FIGURE 17: PERCENTAGE OF CHILDREN AGED 6–15 WHO ARE WORKING, BY SCHOOL ATTENDANCE



Notes: Out of s. refers to children aged 6–15 who were not enrolled in school at the time of interview, in school refers to children aged 6–15 who were enrolled in school. Bars represent means, spikes represent 95 per cent confidence intervals.

FIGURE 18: NUMBER OF WORKING HOURS BY TYPE OF WORK AND SCHOOL ATTENDANCE



Notes: Out of s. refers to children aged 6–15 years who were not enrolled in school at the time of interview, in school refers to children aged 6–15 who were enrolled in school. Bars represent means, spikes represent 95 per cent confidence intervals.

Figure 17 shows that about 8 per cent of children aged 6–15 years are engaged in work outside their household regardless of their school attendance status. With respect to performing household chores and other work for the family, however, it is evident that children who are in school are much more likely than those out of school to help with household chores and other work. This may have to do with the age distribution of children enrolled in school in Uganda. In fact, delayed school entry is pervasive. In 2006, at age 6 only about 60 per cent of boys and girls were attending school and the proportion of children attending school rose to 90 per cent only at age 9 (Moyi 2011). Therefore, it is possible that the higher involvement in domestic work of children currently in school is partly explained by their older age. It may also be the case that children with disabilities are neither enrolled in school nor working.

Nevertheless, when considering the number of hours spent on doing different types of work in Figure 18, there is some evidence that children of school age who are out of school are more likely to engage in the labour market. The average number of hours worked per week in paid labour (work for others) is substantially but insignificantly higher for children who are not enrolled in school as compared to their counterparts who are currently enrolled in school. There is also a tendency of more working hours doing household chores for children who are not in school. The number of hours doing other work for the family does not seem to differ between children who are in or out of school.

CONCLUSION

As has been shown in this chapter there is an association between climate variability and school attendance. While there is no evidence of parents pulling their children out of school to buffer labour stocks for consumption smoothing during negative rainfall shocks, higher rainfall increases the likelihood of school drop-out for older children. The opposite is true for younger children, whereby higher rainfall enables them to stay on in school. School attendance is also affected by household economic conditions, with children from better-off households more likely to be pulled out of school in a good harvest year because children in poorer households are likely to be out of school anyway and already working outside and inside the home.

PART 2

URBANIZATION

POLICY RECOMMENDATIONS

to reduce the risks of rapid urbanization and provide urban children and youth, especially girls and young women, with hope and opportunities:

- Design urban-centred social protection policies to cater for the great inequalities and highly vulnerable members of society observed within urban centres.
- Improve the quality of education in poor urban areas to increase school retention and attainment.
- Provide training in the skills necessary to survive in and contribute to a modern, urban society.
- Work with marginalised young people to give every child and young person a reason to believe in the prospect of a better future.
- Address discriminatory social norms and cultural values that force girls to drop out of school and into early marriage, and provide training for girls and young women to enable them to engage in safe and profitable income-generating activities.
- Invest in and conduct research to:
  - Ascertain the current situation and discrepancies in the lives of urban children and young people.
  - Better inform urban planning and prevent the growth of unplanned urban settlements and slums.

6/Introduction and rationale

Although, as stated in the Introduction to this report, urbanization is occurring at a rapid rate in Uganda, there has been little research into the particular vulnerabilities of children and adolescents living in the country's urban centres. Consequently, this and subsequent chapters in Part 2 of this report aim to provide insight into the relationship between urbanization and child welfare in Uganda by investigating nuanced spatial disparities, and the question of how issues of urban deprivation can be identified and subsequently addressed to support more equitable access to services and livelihood options, particularly for the poorest, most marginalized and excluded urban children.

RATIONALE

With approximately 18.2 per cent of its population currently living in urban areas, Uganda is still a predominantly rural nation. However, the country is urbanizing at a rapid pace – an estimated 5.2 per cent per annum. In addition, the growth rates of urban populations are double those in rural areas (World Bank 2016b). Between 2002 and 2014, the share of Uganda's population living in urban areas increased by more than 50 per cent and it is estimated that 21 million people will be living in urban areas by 2040 (World Bank 2016b). Whereas most of the growth has been in small cities and secondary centres such as Hoima and Mukono (see Figure 19), the Greater Kampala Metropolitan Area remains home to more than 50 per cent of Uganda's urban dwellers (UN-Habitat 2016).

Central Uganda is the most urbanized region in the country, with 54 per cent of its population living in agglomerated areas in 2010. However, the level of urbanization is growing rapidly in the Eastern region (UN-Habitat 2016). Based on the data and analysis available, children in Karamoja and West Nile, closely followed by children residing in Central Uganda, are most affected by poverty (UNICEF 2015).

Such unprecedented population dynamics represent a number of challenges for local governments and municipalities, particularly in relation to service provision. This is especially the case in view of the fact that the secondary towns experiencing fast urbanization rates are currently still relatively small. With the expected population growth, there is a risk that they will grow into large unplanned settlements.

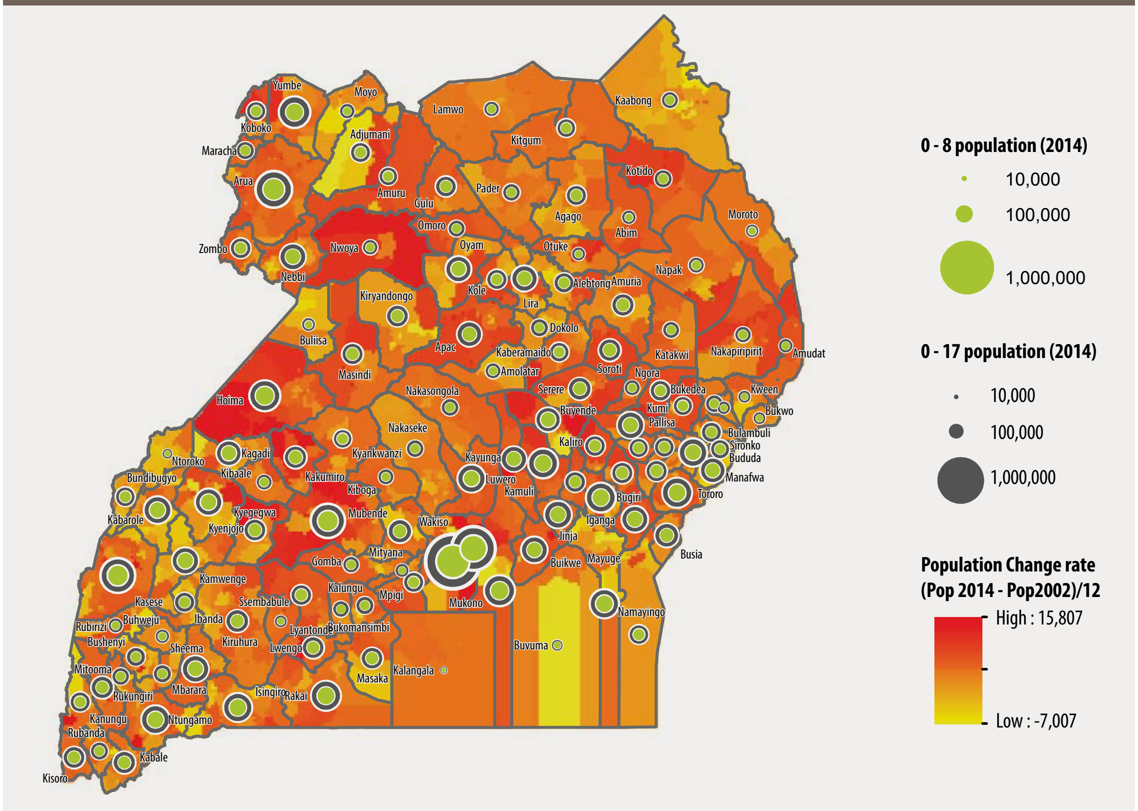
The Government's National Slum Upgrading Strategy (2008) aims to provide clear measures to improve living conditions as well as prevent the expansion of new unregulated settlements. This strategy moves away from regulation and control through rigid laws and by-laws towards flexible planning, which enables citizens to engage more actively in upgrading initiatives.

Children in urban areas are generally considered 'better off' than children in rural areas, with greater access to sanitation (13.2% of urban children vs. 2.4% of rural children), improved water sources (12.8% vs. 2.1%) and health care (17.3% vs. 3.4%) (UNICEF 2014a). However, because cities are often also home to the most affluent, well-educated and healthy segments of the population, official statistics that only depict averages tend to mask the actual living conditions of poor urban dwellers. The Situation Analysis of Children in Uganda (UNICEF 2015) reports persistent increases in the national Gini coefficient over the last two decades, with greater income inequality in urban areas than rural areas. Rising inequalities were also highlighted in the recently published World Bank Uganda Poverty Assessment (2016b). Research in the United States (Kearny & Levine 2015) shows how increasing inequality and lack of upward mobility becomes a self-perpetuating cycle. Poor children, especially boys, who live in a highly unequal environment are more likely to drop out of school than poor children in more equal areas because the possibility of achieving a higher standard of living feels increasingly out of reach.

Currently, 50 per cent of urban dwellers live in Kampala, more than half (54%) in slums (UN-Habitat 2014), with inadequate housing, poor sanitation and limited access to basic services, including education, and employment. It is not possible, at this stage, to provide statistical analysis that considers the determinants of child welfare in urban slums or refugee populations as there is no base line data. However, what is known, at least anecdotally, is that in high-density slum areas such as Kawempe, Kampala, residents tend to have fewer and riskier livelihood choices.

Figure 19 displays an alarmingly high correlation between rapid urban growth and child poverty. This is especially the case in secondary centres such as Hoima and Mukono, and the Greater Kampala Metropolitan Area.

FIGURE 19: URBANIZATION RATE/CHILD POVERTY POPULATION 2002–2014



Source: Author's own calculations based on UBOS Census 2002, 2014. Administrative boundaries: UBOS 2014

DATA AND DEFINITIONS

Countries differ in the way they classify populations as 'urban' or 'rural'. Typically, a community or settlement with a population of 2,000 or more is considered urban. In Uganda, the 1991 Population and Housing Census defined urban areas to include gazetted (designated as urban) centres and ungazetted Trading Centres with a population exceeding 1,000 persons. The 2002 and 2014 Censuses defined urban areas to include only the gazetted urban centres. Over time, official gazetting, may be affected (and possibly biased) by the creation of new districts. It is therefore important to distinguish between the actual movement of people to urban areas vs. change/movement of district borders leading to the mere reclassification of trading centre and municipal conglomerates.

The following chapters make substantive use of a combination of widely available, nationally representative data sets including the Uganda Demographic Health Survey (UDHS) series; the Uganda National Household Survey (UNHS) series; the Uganda National Panel Survey (UNPS) series; BRAC's Youth Watch Labour Survey (2012) and Uganda's Urban Labour Force Survey (2000). Unless otherwise stated, the figures and tables are all the author's own calculations based on these data sources.

Chapter 7 examines the health, education and living conditions of children in urban areas, particularly those living in lower-income households. Chapter 8 looks at the risks and opportunities of urban dwelling for adolescents and youth, particularly those relating to health, education and employment, and at young people's own worries and aspirations and how these differ from their counterparts in rural areas.

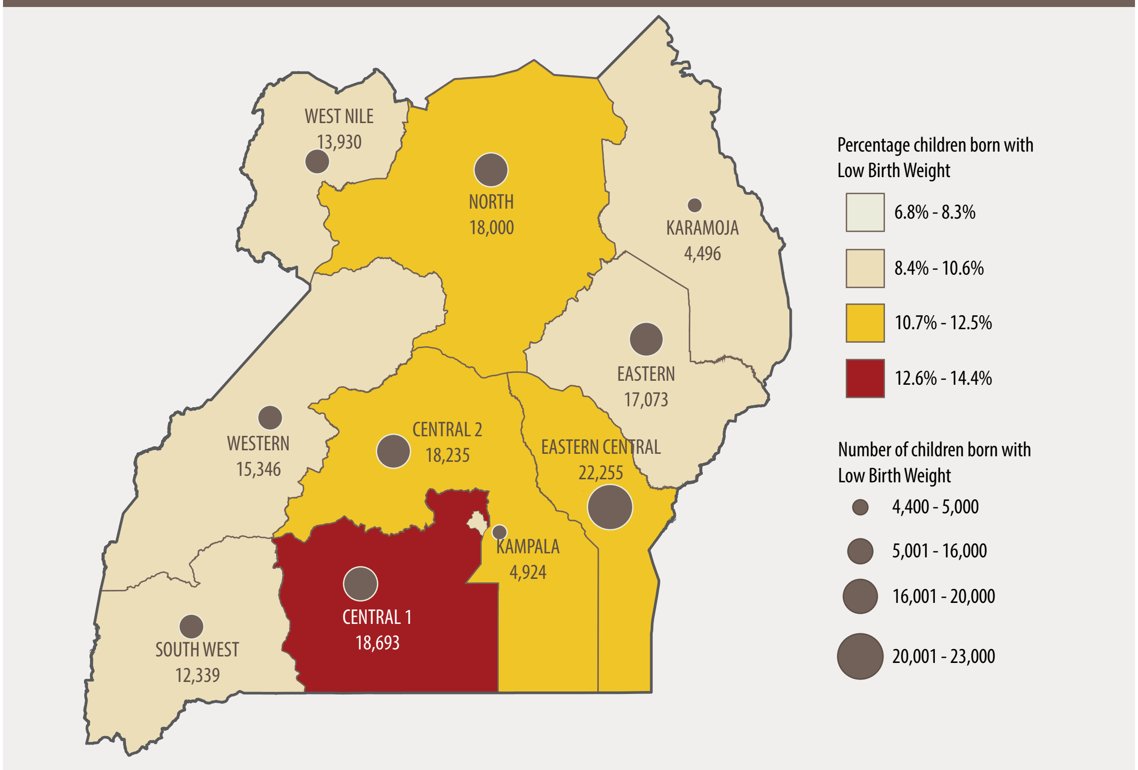
7/Urbanization: What it means for children

Making cities safe, resilient and sustainable (SDG 11) means ensuring access to safe and affordable housing, and upgrading slum settlements. It also involves planning and investment in infrastructure, health care, education, and livelihood opportunities. As stated previously, there has been little research into the lives and living conditions of the growing numbers of children living in urban areas in Uganda. This chapter aims to provide a better understanding of the situation of children living in urban areas, with a particular focus on health, living conditions and employment. Also taken into account are urban children's own concerns about the issues that affect them, and the implications that these have for future policies and planning.

HEALTH AND NUTRITION

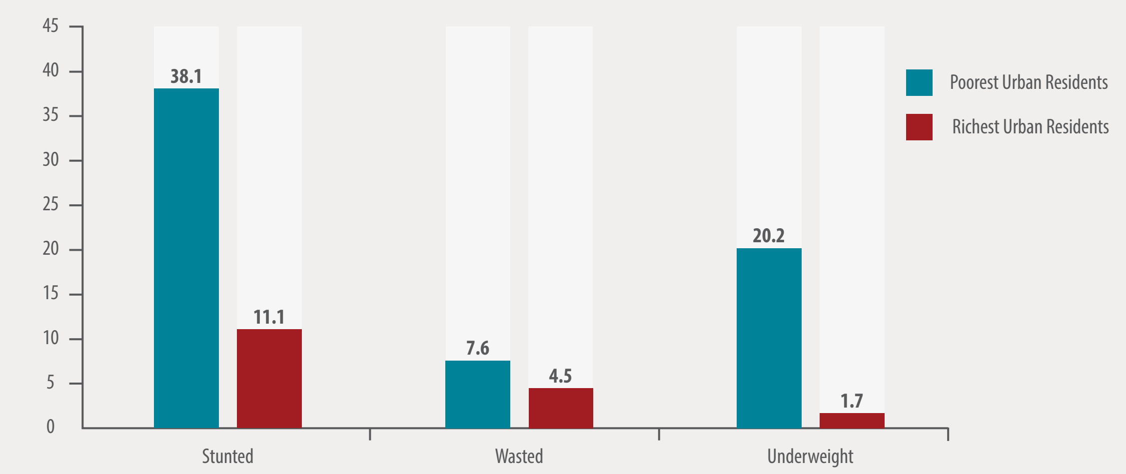
According to the Situation Analysis of Children in Uganda (2015), Central Uganda (which has the greatest number of urban dwellers) accounts for the largest proportion of children born with low birth weight (see Figure 20). The consequences of poor living conditions compounded with a disproportionately burdensome depth of poverty in urban areas are further elucidated in Figure 21 showing that approximately 38 per cent and 20 per cent of children aged 0–5 years living in urban households in the bottom welfare quintile are stunted and underweight, respectively. Notably, 11 per cent and fewer than 2 per cent of children from urban households in the top welfare quintile are stunted and underweight, respectively.

FIGURE 20: CHILDREN BORN WITH LOW BIRTH WEIGHT



Source: UNICEF 2015 Situation Analysis of Children in Uganda

FIGURE 21: URBAN CHILDREN 0–5 YEARS, NUTRITION BY WEALTH QUINTILES



Poorer urban households are typically less healthy, with approximately double the proportion of urban poor viewing themselves in poor health (1.7%) compared to their wealthier counterparts (0.8%) - see Table 13.

TABLE 13: HEALTH STATUS BY URBAN SOCIOECONOMIC STATUS (%)

	All Urban	Urban Poor	Urban Non-Poor
Very good	31	30.9	35
Good	42.5	44.4	39
Average	24.2	22.6	24.8
Poor	1.9	1.7	0.8
Very poor	0.3	0.3	0.4

LIVING CONDITIONS

Household characteristics provide an important marker of living conditions for children residing in urban areas. This is especially so for children living in households among the poorest wealth quintiles. The number of rooms used for sleeping in relation to the number of household members, for instance, represents an important indicator of the extent of crowding, which in turn (and among other things) increases the risk of contracting communicable diseases. Nationally, 46 per cent of households use one room for sleeping, 29 per cent use two rooms, and 25 per cent use three or more rooms (UDHS 2011). According to UNICEF's *Voices of Children* report (2014b), 62.3 per cent of urban households use one room for sleeping, compared to 42 per cent in rural areas. This finding is especially worrisome in view of the fact that poor urban households accommodate, on average, 1.3 people more than their wealthier counterparts – see Table 14.

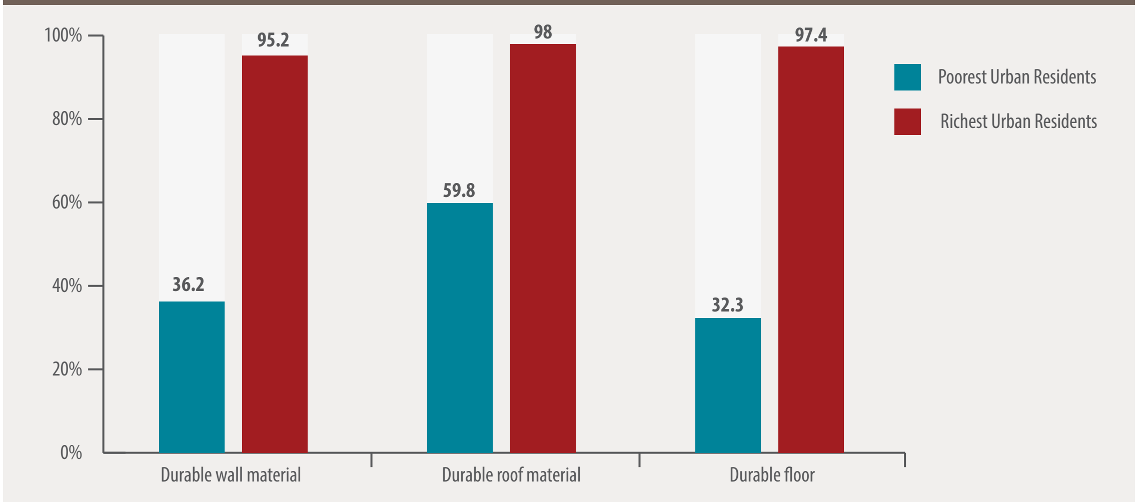
TABLE 14: MEMBERS IN HOUSEHOLD

All Urban	Urban Poor	Urban Non-Poor
5.4	5.8	4.5

In addition to lack of privacy in the home, children living in poor urban households are also extremely likely to reside in houses constructed with poor quality materials. Figure 22 shows significant discrepancies in the quality of houses between the poorest and wealthiest urban residents. While more than 90 per cent of urban households in the top welfare quintile live in houses with durable wall, roof and floor materials, fewer than 40 per cent in the bottom welfare quintile do so. The effect on children can be devastating on a number of counts.

And while children in urban areas may have greater access to a latrine, these are often shared between several households and are often unsanitary. In UNICEF's *Voices of Children* report (2014b), mothers in Kampala reported having to share latrines and toilets with up to 20 families.

FIGURE 22: LIVING CONDITIONS BY URBAN SOCIO-ECONOMIC STATUS (%)



NOISE AND POLLUTION

Noise and pollution appear to be a significant problem for urban dwellers, with air pollution disproportionately affecting non-poor urban residents and dirt and garbage (especially when in close proximity to their homes) being of greater concern to poor urban households (27.4% vs. 24.3%) – see Table 15. This was also reflected in the *Voices of Children* (UNICEF 2014b) report in which rubbish accumulation and waste on the streets in urban areas was a major concern for children: "Our children sometimes suffer from diarrhoea because some children pick dirty polythene bags and eat them." (Mother, 0– 5-year-olds, Bundibugyo).

TABLE 15: HOUSEHOLD PUBLIC GOOD AND ENVIRONMENT CHARACTERISTICS BY URBAN SOCIOECONOMIC STATUS (%)

	All Urban	Poor	Non-Poor
Do you Feel the Environment Around You is Polluted	63.3	61.8	66.9
Type of Pollution			
Air pollution	31.4	28.8	33.7
Water	8.9	9.4	10.7
Dirty streets/garbage	27.8	27.4	24.3
Noise	18.9	23.1	16.6
Sewage/sanitation	11.1	9	11.8
Fruits/vegetables (pesticides)	1.9	2.4	3

EDUCATION

As shown in Table 16, although primary and secondary school completion rates are generally higher in urban areas compared to rural areas, they are still alarmingly low (Primary – 16.7% rural, 20.8% urban; Secondary – 0.5% rural, 2.2% urban). Urban children living in female-headed households are particularly disadvantaged compared to urban children generally, with only 1.2 per cent completing secondary education.

TABLE 16: EDUCATION BY RURAL/URBAN AND GENDER OF HOUSEHOLD HEAD (%)

Variable	REGION/RURAL OR URBAN					
	Central	Western	Northern	Eastern	Rural	Urban
Male Household Head						
Missed					31.3	21.4
Some Primary					41.3	31.8
Primary Completed					16.7	20.8
Some Secondary					10.0	22.6
Secondary Completed					0.5	2.2
University					0.2	1.2
Female Household Head						
Missed					33.3	20.0
Some Primary					41.5	36.1
Primary Completed					15.0	19.9
Some Secondary					9.4	21.9
Secondary Completed					0.6	1.2
University					0.1	0.8

Source: UNHS 2012

WORK AND ASSETS

On average, only 12 per cent of poor urban households benefit from waged employment and evidence from the UDHS (2011) shows that urban households (36%) are less likely than their rural counterparts (68%) to own or have direct access to productive assets such as land and farm animals.

CHILDREN'S MAIN WORRIES

Children's main worries include (but are not limited to) the availability of work, getting an education, contracting HIV/AIDS and STDs. As Table 17 shows, concerns about HIV/AIDS (89.7%), STDs (80.1%), pressure to have sex (38.5%), and having children at a young age (59.7%) are visibly more pronounced among children living in poor urban households. Such sentiments are also emphatically reflected in the *Voices of Children* report (UNICEF 2014b), where HIV/AIDS was identified as a major cause for concern: *"In town children are exposed to many things. For example, some of them might be infected with HIV because there are many more girls in town than in the village. In the village, there are very few children infected with HIV."* (Boys, 15–17, out of school, Bundibugyo).

TABLE 17: CHILDREN'S WORRIES BY URBAN SOCIOECONOMIC STATUS (%)

Children main worries	Urban	Urban / Bottom welfare quintile	Urban / Top welfare quintile
Availability of work	82.3	84.3	80.2
Getting education	62.9	66.1	60.6
Pressure to have sex	33.7	38.5	24
STD	77	80.1	74
HIV/AIDS	88.7	89.7	87.8
Taking alcohol	44.7	43.3	49.4
Taking drugs	50.9	49.3	56.7
Having children at a young age	54.2	59.7	45.3
Access to medical treatment	55.9	58	57.1
Getting respect from community	35.6	42.2	29.1
Getting married	38.8	43.4	33.1
Welfare of children	48.7	49.3	48.4
Welfare of family	52.9	56.2	53.9

CONCLUSION

Although urban dwellers are considered to be better off than people who live in rural areas, this generalisation does not take into account the differences between the richest and poorest sectors of urban society. Children in poor households are disproportionately vulnerable to a variety of deprivations, including poor living conditions and lower educational attainment. Many live in informal settlements with poor infrastructure and sanitation. As urbanization increases – with more families relocating to urban centres and more children being born in them – careful planning will be required to ensure that the necessary investment and resources are available. More research needs to be carried out to inform this planning. This is especially so in view of the fact that urban households are less likely than their rural counterparts to own productive assets or for older household members to have access to informal income-generating activities that enable them to mitigate shocks, including climate-related hazards.

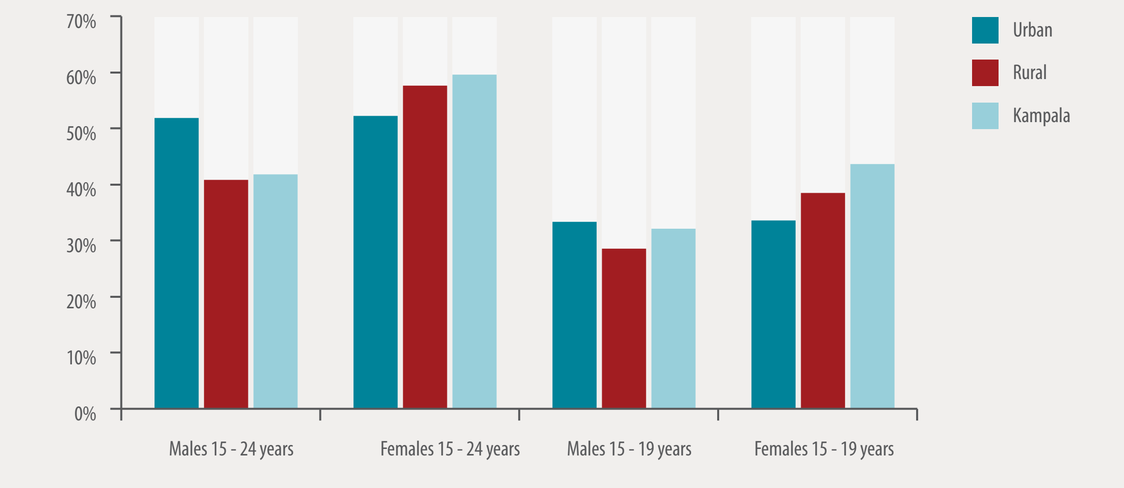
8/Urbanization: What it means for adolescents and youth

In Uganda, as elsewhere, many young people dream of moving to a town or city to escape poverty and enjoy educational and employment opportunities that are not available in rural areas. However, just as average statistics obscure the differences between the lives of rich and poor children living in urban centres, they also overlook the many risks attached to urban dwelling for adolescents and youth. This chapter explores the challenges facing young urban dwellers, with a particular focus on health, education, training and employment opportunities. It also highlights the particular vulnerabilities of young women and the major worries and concerns of young people themselves.

EDUCATION, HEALTH AND ENVIRONMENT

In terms of educational attainment, disproportionately high numbers of adolescent girls and young people living in urban areas are reported to have dropped out of school (Figure 23). Children in urban communities that have the highest drop-out rates also seem to come from households with larger families and, especially in Kampala, are significantly more likely to have been brought up solely by a single parent before the age of 15 (BRAC 2012).

FIGURE 23: DROP-OUT BY GENDER AND RURAL/URBAN (%), 15–19 AND 15–24

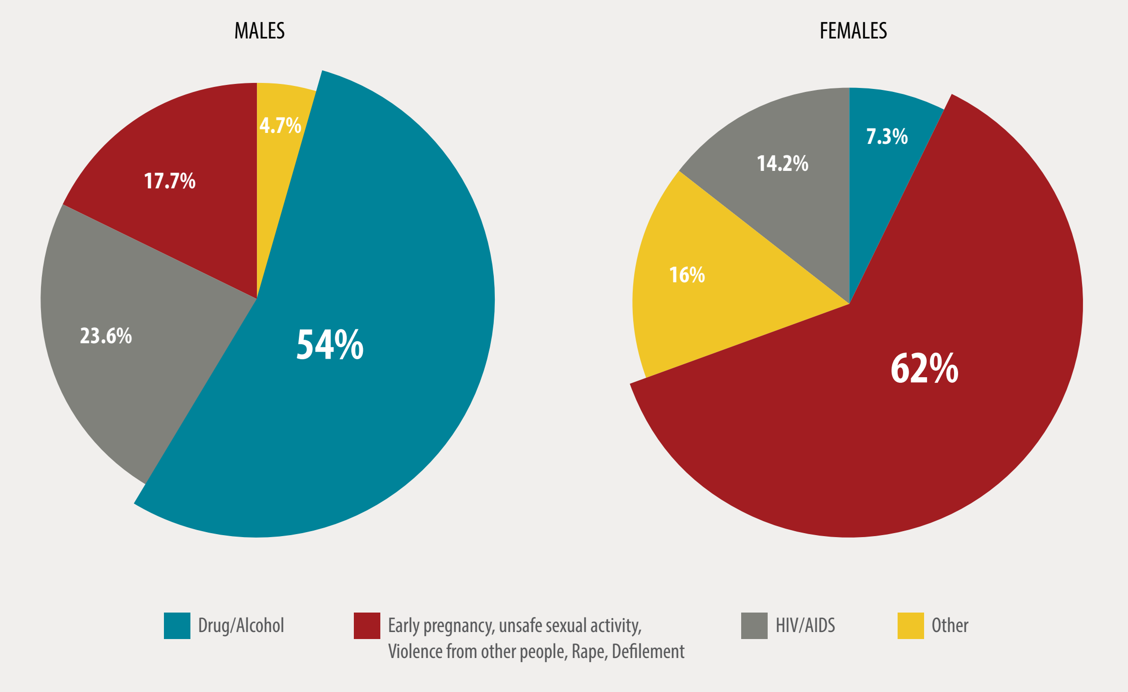


Poverty and heightened exposure to risk also represent key underlying factors at the heart of poor education outcomes. Table 18 shows a broad range of risky behaviours affecting adolescents and young men and women living in urban areas. These findings point to severe signs of gender imbalances demanding carefully crafted policy interventions to cater for gender-specific requirements. To illustrate, whereas drugs and alcohol account for approximately 50 per cent of male urban adolescents' biggest health risks, female urban adolescents identified lack of protection services (i.e. violence from other people, unsafe sexual activity, early pregnancy and rape and defilement) as their biggest cause for concern – see Figure 24.

TABLE 18: HEALTH RISKS BY GENDER AND RURAL/URBAN (%), 15–19 AND 15–24

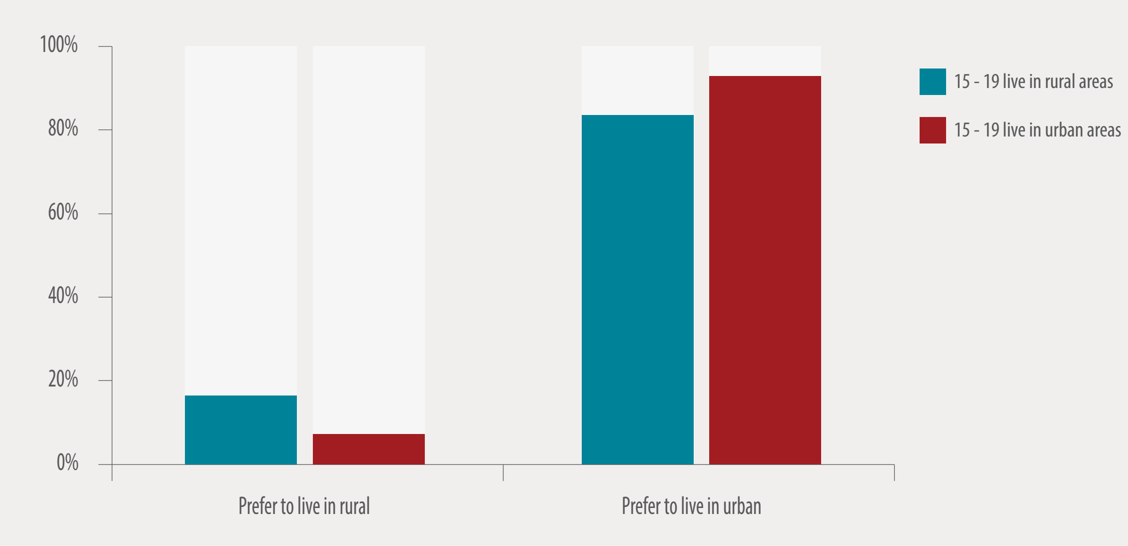
	Illness like diarrhoea, vomiting	Malaria	Drugs	Alcohol	Early pregnancy/ fatherhood	Unsafe sexual activity	HIV/ AIDS	Road accidents	Violence from other people	Rape / defilement
MALES										
Rural	.8 (0.8)	11.5 (12.5)	15.3 (15.4)	26.4 (25.7)	5.2 (5.6)	9.7 (8.9)	24.6 (24.7)	2.6 (2.7)	3.1 (2.7)	.8 (0.9)
Urban	1.3 (1.1)	10.6 (9.3)	34.8 (35.0)	14.4 (14.7)	3.5 (3.9)	6.9 (6.4)	22.1 (23.4)	1.5 (1.6)	2.9 (3.1)	1.9 (1.5)
Kampala	1.0 (.8)	2.7 (2.4)	40.0 (40.7)	13.7 (13.3)	3.7 (4.1)	6.7 (6.8)	23.0 (23.6)	1.7 (1.5)	5.3 (5.1)	2.3 (1.7)
All	0.9 (0.9)	11.3 (11.8)	20.0 (20.2)	23.5 (23.0)	4.8 (5.2)	9.0 (8.3)	24.0 (8.3)	2.3 (2.4)	3.1 (2.8)	1.1 (1.1)
FEMALES										
Rural	4.8 (5.2)	32.3 (32.7)	1.1 (1.0)	1.8 (2.1)	29.7 (29.5)	11.9 (11.0)	11.6 (11.7)	0.2 (0.1)	1.6 (1.4)	5.0 (5.3)
Urban	4.4 (4.1)	16.3 (16.8)	3.1 (3.0)	2.7 (2.8)	43.2 (40.3)	9.0 (9.4)	12.5 (13.7)	0.8 (0.6)	1.7 (2.2)	6.3 (7.1)
Kampala	1.3 (1.5)	5.7 (6.6)	5.7 (4.9)	2.7 (3.0)	51.3 (49.2)	11.0 (10.9)	13.3 (14.1)	.3 (.2)	2.0 (2.1)	6.7 (7.7)
All	4.7 (4.9)	28.4 (28.8)	1.6 (1.5)	2.0 (2.3)	33.0 (32.2)	11.2 (10.6)	11.8 (12.2)	0.3 (0.2)	1.6 (1.6)	5.3 (5.7)

FIGURE 24: BIGGEST HEALTH RISKS (15–24)



Challenges notwithstanding, Figure 25 shows a clear preference (nationally) among adolescents for living in urban areas. As noted by BRAC (2012:76) the preference to live in urban areas seems to be directly correlated with education. More specifically, 56 per cent of uneducated youth reported a preference for living in urban areas, in comparison with 76, 87, 89 and 86 per cent of those reaching P1–P7, S1–S4, S5–S6 and higher education, respectively.

FIGURE 25: LOCATION PREFERENCE (%), 15–19



Finally, Table 19 (and Figures 26 and 27) shows that in addition to some of the health risks indicated above, adolescents and youth share a real concern with regards to the availability of work.

TABLE 19: MAIN WORRIES BY RURAL/URBAN (%), 15–19 AND 15–24

	RURAL	URBAN	RURAL	URBAN
	No	No	Yes a lot	Yes a lot
Availability of work	10.7 (10.0)	6.8 (7.9)	69.8 (71.1)	82.2 (82.3)
Getting education	22.6 (26.3)	20.8 (21.3)	58.8 (54.2)	62.9 (62.9)
Pressure to have sexual intercourse	41.0 (43.4)	44.4 (48.2)	27.8 (25.9)	37.3 (33.7)
Sexually transmitted diseases	10.0 (9.7)	8.8 (8.8)	66.9 (66.2)	76.7 (77.0)
HIV/AIDS	3.9 (3.7)	6.7 (6.3)	86.2 (85.9)	87.9 (88.7)
Taking alcohol	41.1 (42.2)	38.5 (39.1)	31.3 (31.0)	44.4 (44.7)
Taking drugs	40.8 (42.1)	36.2 (36.3)	36.4 (36.7)	48.7 (50.9)
Having children at a young age	25.3 (30.6)	20.8 (25.2)	39.6 (35.2)	60.2 (54.2)
Access to medical treatment	21.0 (23.2)	24.0 (24.2)	52.8 (50.9)	55.6 (55.9)
Getting respect from the community	33.0 (34.8)	37.7 (37.7)	24.4 (23.6)	35.8 (35.6)
Getting married	35.2 (42.7)	33.3 (38.1)	25.4 (20.9)	43.2 (38.8)
Welfare of children	26.5 (25.6)	20.7 (20.2)	36.8 (38.7)	43.8 (48.7)
Welfare of family	19.3 (19.6)	16.0 (15.7)	39.8 (43.0)	48.1 (52.9)

FIGURE 26: MAIN WORRIES BY RURAL/URBAN (%), 15–19

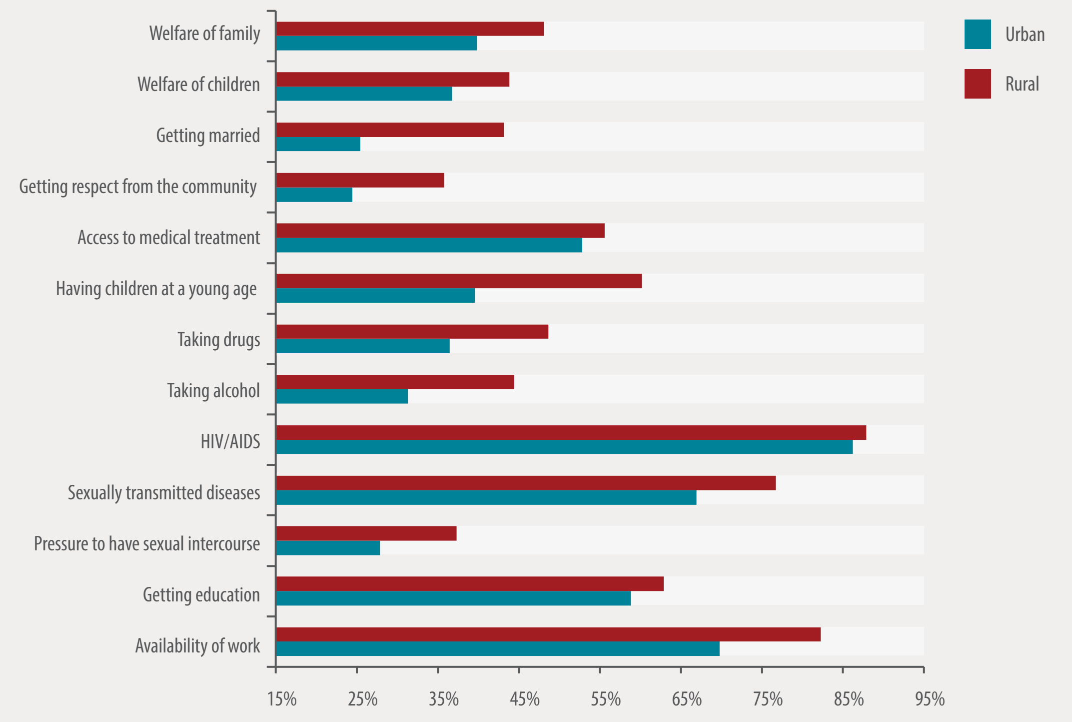
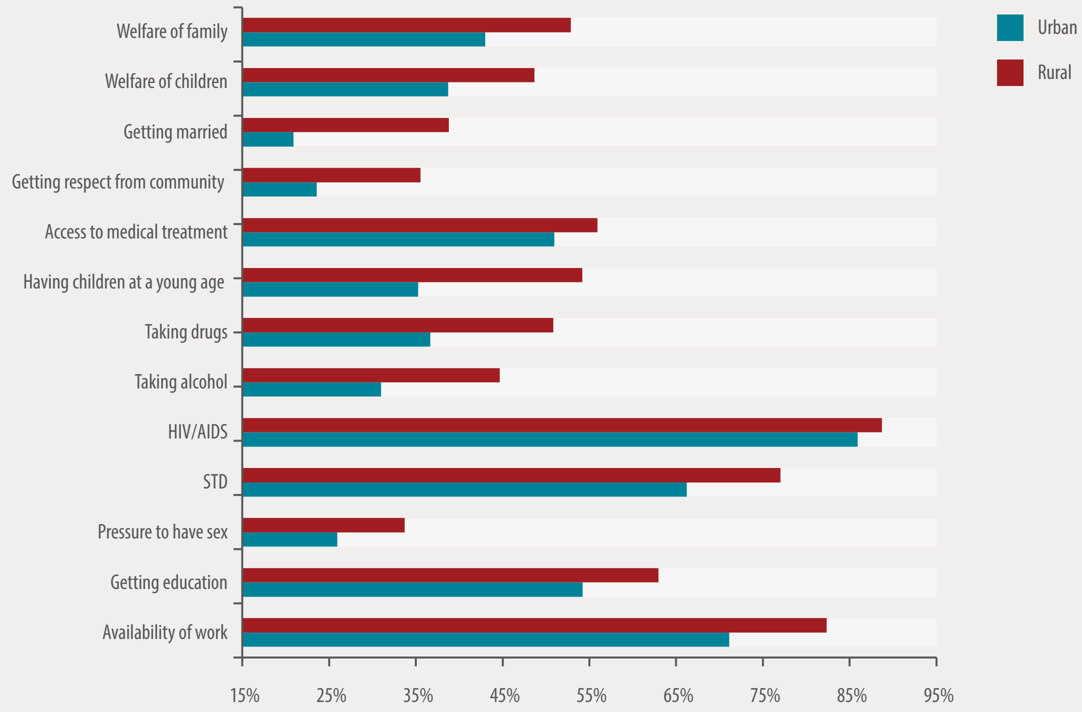


FIGURE 27: MAIN WORRIES BY RURAL/URBAN (%), 15-24



To elaborate, Table 20 shows that 18 per cent of 15–24-year-olds from urban households in the bottom welfare quintile who are out of school are involved in income-generating activities, and face an average of almost six months of unemployment or underemployment per year. This is in stark contrast with 83.5 per cent of young Ugandans from urban households in the top welfare quintile who are actively involved in income-generating activities.

TABLE 20: EMPLOYMENT BY URBAN SOCIOECONOMIC STATUS (%)

	All Urban	Urban / Bottom welfare quintile	Urban / Top welfare quintile
How Many Members Working in Household	2.1	1.9	2.2
Subsistence farming	8.1	9.4	7.1
Commercial farming	2.7	2.3	3.2
Waged employment	16.6	12	20.6
Non-farm self-employment	38.2	37.7	36.1
Salaried employment	31.9	35.4	30
Others	2.6	3.1	2.8
Involved in any Earning Activities in the Past Week? (15–24 years)	53.9	18	83.5
How Many Months Have You Been unemployed/underemployed (15–24 years)	4.4	5.9	3.4

JOB EXPECTATIONS, TRAINING AND EMPLOYMENT

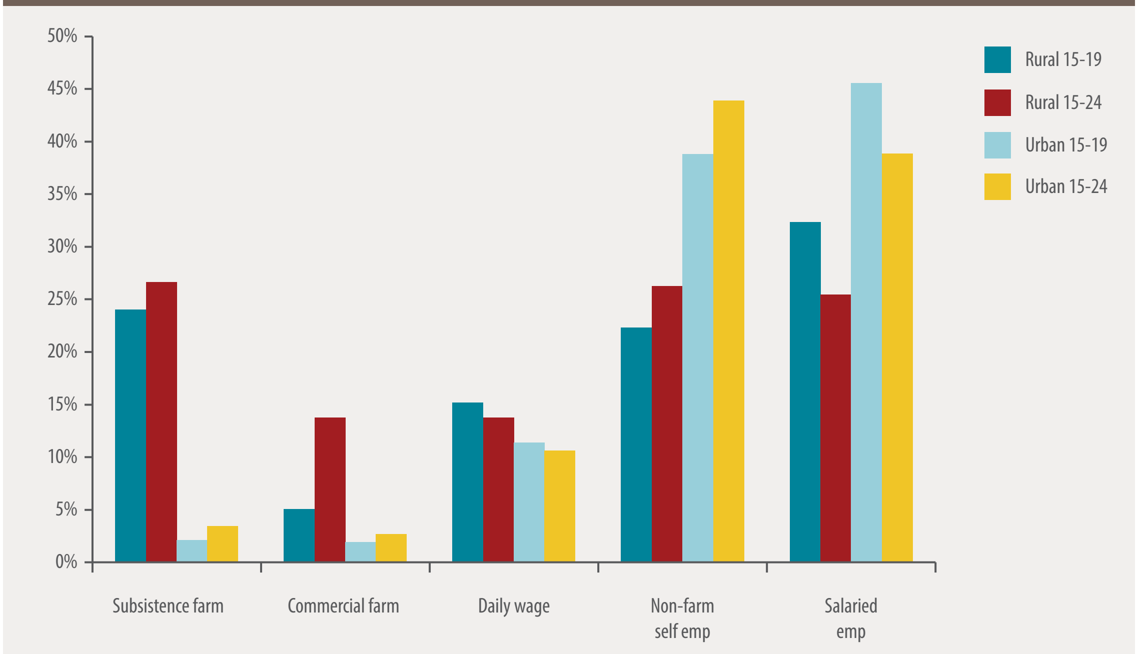
When considering rural/urban differences, adolescents living in urban areas in general have different employment aspirations than their rural counterparts. More specifically, urban residents are more likely to expect to be engaged in non-farm self-employment or salaried employment, rather than subsistence or commercial farming with daily wage compensation arrangements. The analysis in Table 21 (illustrated in Figure 28) also shows that for adolescents living in Kampala this effect is more pronounced. Notably, gender disaggregation of job expectation reveals minor differences among both age groups, i.e. 15–19 and 15–24-year-olds.

TABLE 21: JOB EXPECTATIONS BY RURAL/URBAN (%), 15–19 AND 15–24

	Subsistence farming	Commercial farming	Daily wage	Non-farm self-employment	Salaried employment
Rural	24.1 (26.6)	5.1 (6.7)	15.2 (13.8)	22.3 (26.3)	32.4 (25.4)
Urban	2.1 (3.4)	1.9 (2.7)	11.4 (10.7)	38.8 (43.9)	45.6 (38.9)
Kampala	1.0 (1.1)	1.3 (2.6)	8.4 (7.5)	42.1 (48.9)	46.8 (39.4)
All	**18.8 (20.9)**	**4.3 (5.7)**	**14.3 (13.0)**	**26.3 (30.6)**	**35.5 (28.7)**

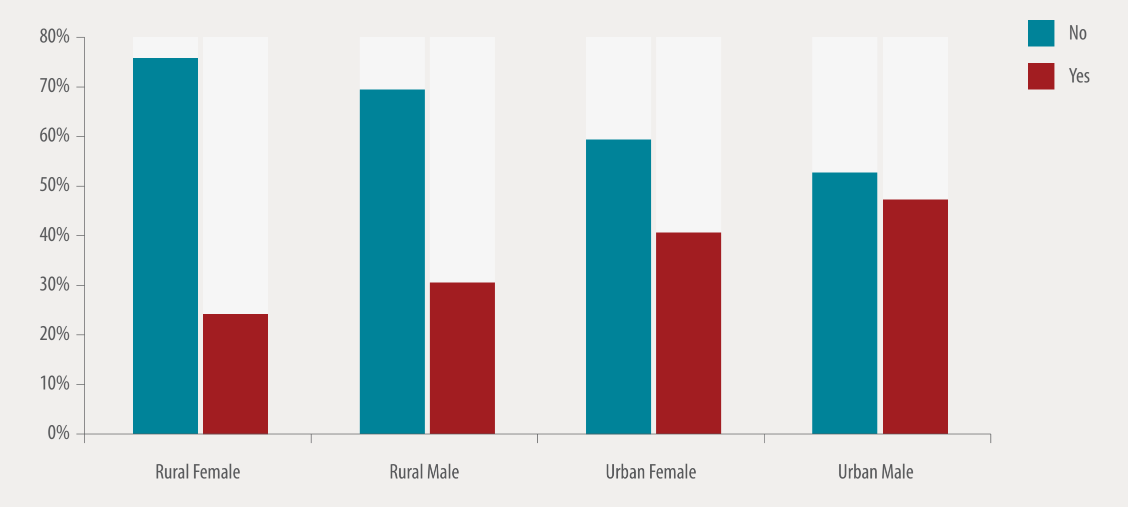
Notes: *Does not sum to 100% as the 'other' category is excluded)*

FIGURE 28: JOB EXPECTATIONS BY RURAL/URBAN (%), 15–19 AND 15–24



Alongside rapid economic transformation and job creation, clearly accentuated job expectations among urban adolescents and youth demand substantive efforts to ensure school completion and formal training as key in order that these ambitions can be fulfilled and so that young people can contribute to the country's economic development. In this regard, Figure 29 shows access to formal training disaggregated by gender. According to Figure 29, overall urban residents generally seem to have greater access to skills training than their counterparts in rural settings. Further, while urban males are the most likely to have received training (approximately 50%), rural females are the least likely with a little more than 20 per cent.

FIGURE 29: SKILLS TRAINING RECEIVED OR NOT BY GENDER AND RURAL/URBAN (%), 15–24



The ability to receive training, however, does not directly translate into opportunities to apply the acquired skills in the job market and/or to lead to income-generating activities. In this regard, Figure 30 points to astonishingly high gender inequalities with young women significantly less likely to be able to apply their newly acquired skills into Uganda's vibrant formal and informal economies. This is especially the case in urban areas, where 64 per cent of 15–24-year-old females who received some form of training are not using these skills for income generating activities. In addition to posing a real threat to adolescent and youth development, such signs of gender biased economic exclusion threaten to undermine Uganda's long-term prospects of wealth creation and economic development.

FIGURE 30: APPLICATION OF SKILLS RECEIVED FROM TRAINING FOR INCOME-GENERATING ACTIVITIES BY GENDER AND RURAL/URBAN (%), 15–24

Table 22 outlines the key reasons preventing trained young Ugandans from utilising their skills for income-generating activities. Approximately 90 per cent of 15–24-year-old females residing in urban centres identify lack of adequate capital and insufficient training as primary hurdles. Interestingly, however, nearly one in four 15-24 males living in urban centres identified not enjoying work as a key constraint. Pending further analysis, and assuming that trained adolescents and young Ugandans would always prefer working over not working, this evidence is indicative of structural gender biases in Uganda's labour markets as indicated by the greater availability and choice of employment opportunities for males over females.

TABLE 22: REASONS FOR NOT BEING ABLE TO APPLY TRAINING FULLY/PROPERLY BY GENDER AND RURAL/URBAN (%), 15–24

	Training was not long enough	"I don't have the capital"	"I don't enjoy the work"	"I don't have a certificate"
Rural Female	30.9	36.4	27.3	5.5
Rural Male	25.0	46.2	15.4	13.5
Urban Female	40.8	49.3	5.6	4.2
Urban Male	39.5	28.9	23.7	7.9

To elaborate, Table 23 shows that 18 per cent of 15–24-year-olds from urban households in the bottom welfare quintile who are out of school are involved in income-generating activities, and face an average of almost six months of unemployment or underemployment per year. This is in stark contrast with 83.5 per cent of young Ugandans from urban households in the top welfare quintile who are actively involved in income-generating activities.

TABLE 23: EMPLOYMENT BY URBAN SOCIOECONOMIC STATUS (%)

	All Urban	Urban / Bottom welfare quintile	Urban / Top welfare quintile
How Many Members Working in Household	2.1	1.9	2.2
Subsistence farming	8.1	9.4	7.1
Commercial farming	2.7	2.3	3.2
Wage employment	16.6	12	20.6
Non-farm self-employment	38.2	37.7	36.1
Salaried employment	31.9	35.4	30
Others	2.6	3.1	2.8
Involved in any Earning Activities in the Past Week? (15–24 years)	53.9	18	83.5
How Many Months Have You Been unemployed/underemployed (15–24 years)	4.4	5.9	3.4

CONCLUSION

Although nationally young people show a clear preference for living in urban areas, urban dwelling poses a number of threats to adolescents and youth from poorer households, especially girls and young women who are at particular risk of sexual violence and HIV/AIDS. Other factors young people themselves are concerned about are a lack of education and employment opportunities. Although overall urban dwellers generally have greater access to skills training, this does not necessarily lead to employment utilising those skills, especially among young women. As Uganda's urban youth population grows, urgent action is required to provide protection services and education and training opportunities that will enable young women and men to contribute to a vibrant economy.

> Climate change, environmental degradation and urbanization are increasingly responsible for creating new risks, and putting pressure on poverty reduction efforts while fostering and deepening socio-economic inequities.

9/Conclusion and policy recommendations

Climate change and urbanization have been widely identified as major global challenges in coming decades. As this report illustrates, children in Uganda – where both temperatures and urbanization are increasing at a rapid rate – are vulnerable to a range of both short- and long-term impacts, which will in turn affect the country's socioeconomic development.

Urban centres are central for climate change adaptation.

CLIMATE-RELATED HAZARDS

Decline in agricultural productivity affects food security and prices, and poses a threat to children’s nutritional status, health and well-being. While drought increases the risk of stunting, higher rainfall increases the risk of wasting. Coping strategies can cause parents to take their children out of school and damage the long-term prospects of individuals and society as a whole.

Drought events increase the likelihood of stunting. As stunting represents chronic malnutrition, exposure to droughts during infancy or at the age of 2 can increase the risk of stunting two years later. This implies that drought-induced malnutrition is therefore, to a certain extent, preventable. However, there is a need to intensify timely responses and improve targeting efforts. In addition, the parents’ level of education – unlike household wealth, which does not seem to have a significant impact – is an important determinant of stunting, particularly where the mother has lower than primary-level education. Conversely, too much rain puts children at risk of being wasted, typically associated with rapid weight loss due to illness, as higher rainfall may increase the incidence of diseases such as malaria and diarrhoea. Gender plays a role. Although girls are generally less likely to be stunted and wasted as compared to boys, they seem to be more vulnerable to climate variability. A reduction in rainfall increases the likelihood of stunting for girls while, in contrast, higher rainfall increases the likelihood of wasting for girls.

Climate variability also has an effect on school attendance. No evidence is found of parents pulling their children out of school to buffer labour stocks for consumption smoothing during negative rainfall shocks. However, higher rainfall increases the likelihood of school drop out for older children while the opposite is true for younger children, whereby higher rainfall enables them to stay on in school. School attendance is also affected by household economics. Children from less wealthy households are less likely to attend school when precipitation is high.

Also, while in general the likelihood of attending school is significantly lower in rural areas, the impact of climate variability is only significant in urban areas. In urban areas, during wetter years children are more likely to drop out of school. For early childhood, this is likely to be the direct result of poor, unhygienic living conditions resulting in heightened transmission of diseases like malaria and diarrhoea. For older children, this means that it is likely that households can still benefit from pulling their children out of school as an extra labour supply in a good harvest year while older children in rural areas and in less-educated households have already been out of school.

Climate-related hazards pose a threat to **children's nutritional status, health and well-being.**

POLICY
recommendations

to mitigate the impact of climate-related hazards on children:

- Promote immediate interventions during or after drought episodes to improve food security and nutritional status and prioritise families with young children, as well as children whose mothers have lower than primary-level education to reduce the likelihood of stunting.
- Strengthen the capacity to forecast climate shocks. It is important to closely monitor weather variation to control disease outbreaks associated with extreme meteorological conditions (e.g. rainfall), as well as plan adequate measures.
- Control disease outbreaks associated with higher precipitation by prioritising and investing in preventive services (e.g. the promotion of good hygiene and sanitation, provision of anti-malaria nets) and provide malaria treatment and nutritional supplements to prevent and reduce the risk of wasting.
- Increase resilience and smooth consumption patterns by investing in child-sensitive social protection:
  - Focus on the girl child. In particular, attention should be paid to potential differentials in food allocations by gender as girls are more vulnerable to climate variability.
  - Particular attention should also be given to children in urban centres, especially in slum areas.
- Enforce implementation of laws and national policies on child labour and on children's right to education.
- Invest in girls' education to keep them in school, and prevent child marriage and teenage pregnancies.

URBANIZATION

Rapid urbanization, while providing opportunities for many, poses particular threats to poor people when it is unplanned and under-resourced. Although urban dwellers are considered to be better-off than people who live in rural areas, this generalisation does not take into account the differences between the richest and poorest sectors of urban society. Urban households are less likely than their rural counterparts to own productive assets or for older household members to have access to informal income-generating activities that enable them to mitigate shocks, including climate-related hazards. Children and young people living in slums and informal settlements are disproportionately vulnerable to a variety of deprivations, including overcrowded living conditions, poor sanitation, low educational attainment and a lack of income-generating opportunities for their parents and, as they become adults, themselves.

Unprecedented population dynamics represent a number of challenges for local governments and municipalities, particularly in relation to service provision. With the expected population growth, there is a risk that the secondary towns experiencing rapid urbanization will grow into large unplanned settlements. **Disparities are significant, even more so in urban settings.** As urbanization increases – with more families relocating to urban centres and more children being born in them – careful planning will be required to ensure that the necessary investment and resources are available. More research needs to be carried out to inform this planning.

Adolescents and youth in urban areas face particular threats.

Although nationally young people show a clear preference for living in urban areas, urban dwelling poses a number of threats to adolescents and youth from poorer households, especially girls and young women who are at particular risk of sexual violence and HIV/AIDS. Inequality and low mobility become locked into a self-perpetuating cycle. Young people lose hope of ever being able to achieve economic success and are more likely to become involved in dangerous and illegal income-generating activities. There is an urgent need to better understand socio-economic dynamics in urban slums and the investment required to shift from traditional low-productivity economic activities towards more modern, higher-productivity economic activities.

Young people have expressed concerns about a lack of education and employment opportunities. Although overall urban dwellers generally have greater access to skills training, this does not necessarily lead to employment utilising those skills, especially among young women. As Uganda's urban youth population grows, urgent action is required to provide protection services and education and training opportunities that will enable young women and men to contribute to a vibrant economy.

Disparities are significant, **even more so in urban settings.**

POLICY recommendations

to reduce the risks of rapid urbanization and provide urban children and youth, especially girls and young women, with hope and opportunities:

- Design urban-centred social protection policies to cater for the great inequalities and highly vulnerable members of society observed within urban centres.
- Improve the quality of education in poor urban areas to increase school retention and attainment.
- Provide training in the skills necessary to survive in and contribute to a modern, urban society.
- Work with marginalised young people to give every child and young person a reason to believe in the prospect of a better future.
- Address discriminatory social norms and cultural values that force girls to drop out of school and into early marriage, and provide training for girls and young women to enable them to engage in safe and profitable income-generating activities.
- Invest in and conduct research to:
    - Ascertain the current situation and discrepancies in the lives of urban children and young people.
    - Better inform urban planning and prevent the growth of unplanned urban settlements and slums.

Appendix/Models used in calculating the impact of SPEI

EFFECT OF SPEI IN INFANCY ON STUNTING

The following linear regression model was used to measure the impact of SPEI on stunting:

$$(Stunting|a \geq A)_{i,a,g} = \beta_1 \overline{SPEI}_{T,g} + \beta_2 Survey_i + \beta_3 f(a_6, a_{12}, a_{18}, a_{24}, a_{36}, a_{48})_i + \alpha_g + \epsilon_{i,a,g}$$

Where *Stunting* takes the value 1 if child *i* of age at interview in grid cell *g* has height-for-age below -2 SD of the WHO Growth Standard and 0 otherwise, conditional upon the child being of age *A* or older at the time of interview. $\overline{SPEI}$ refers to the yearly average of the 3-month SPEI index in year *T* in grid cell *g* where *t* refers to an age of impact which is smaller than or equal to *a*. The function *f(·)* is a restricted cubic spline transformation with knots at 6, 12, 18, 24, 36, and 48 months of age at interview. The spline function fits polynomials of degree 3 between the defined knots in a way which ensures that levels and derivatives are equal on each side, and quadratic terms at each end. α_g are grid fixed effects.

EFFECT OF SPEI DURING LAST THREE MONTHS ON WASTING

The following model is fitted to wasting as a more immediate response to drought is to be expected than is the case with stunting:

$$Attendance_{i,g,t} = \beta_1 \overline{SPEI}_{g,t-1} + \beta_2 f(a_6, a_9, a_{12}, a_{15})_{i,t} + \alpha_g + \alpha_t + \epsilon_{i,g,t}$$

Where *Wasting* takes the takes the value 1 if child *i* of age *a* at interview in grid cell *g* has weight-for-height below -2 SD of the WHO Growth Standard and 0 otherwise. *SPEI* refers to the 3-month SPEI index in month *t*, where month *t* runs from age *a-2* until age *a*, creating an average of the index over the last three months. Other controls are the same as above.

EFFECT OF SPEI ON SCHOOL ATTENDANCE

The following regression model was used in the main specification:
Where *Attendance* is whether child *i* between the ages of 6 and 15 in school year *t* attended school in that year, which is either the year of the survey or the year before the survey. *SPEI* is the yearly average three-month SPEI index in year *t-1* in grid cell *g*. *Survey* are dummy variables for each of the three surveys. The function *f(·)* is a restricted cubic age spline with knots at 6, 9, 12 and 15 years at interview. The spline function fits polynomials of degree 3 between the defined knots in a way which ensures that levels and derivatives are equal on each side. α_g are grid fixed effects, and α_t are school year fixed effects.

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