Doctoral Thesis (Abridged)

博士論文 **(要約)**

The Health-Economic Burden of Climate Change and Climate Variability: An Empirical Study from Uganda

（気候変動・気象変化の健康・経済的負担：ウガンダにおける実証的研究）

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Graduate Program in Sustainability Science – Global Leadership Initiative

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Abstract

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Supervisor: ONUKI Motoharu

Healthy lives for all is a key pillar of sustainable development as envisioned by the third sustainable development goal (SDG 3). The realization of this goal is however likely to be jeopardized given the current trend of climate change and climate variability. The Intergovernmental Panel on Climate Change projects possible increases in surface temperatures in the range of 2-4^{o}C by 2100. Similarly, heat waves, cyclones, droughts, floods and other extreme weather events have also increased and anticipated to increase further, both in terms of severity and frequency. The potential health impacts of climate change and climate variability are diverse and are both direct and indirect. Indirect effects include but are not limited to injuries, illnesses and deaths due to heat waves, floods and other extreme weather events. Indirect effects include increased incidence of vector borne disease like malaria and dengue fever which result from increased multiplication of disease-causing vectors and/or their expansion into previously inhabitable regions.

Torrential rainfall that results in massive flooding could also be associated with increased spread of water-borne diseases like diarrhea. Malnutrition is another potential indirect effect of climate change and climate variability. Floods, droughts and other extreme weather events

often reduce food production and jeopardize food security, leading to increased malnutrition rates especially among children. The challenge is more pronounced among poor agrarian countries which are heavily reliant on rain-fed agriculture. Despite the increasing scholarly importance of climate-health interlinkages, empirical evidence on the same is scanty and largely concentrated in the Global North while Sub-Saharan Africa is less represented, partly due to data limitations. This is the main motivation for this dissertation, which attempts to provide micro level empirical evidence on the health-economic burden of climate change and climate variability in Uganda.

Uganda has experienced major changes to its traditional climate. Between 1960 and 2010, surface temperatures are estimated to have risen by 1.3^{o}C and are anticipated to rise further by 1.5^{o}C by 2030. Although rainfall totals have not changed substantially, the frequency of torrential rains and unpredictability of rainy seasons pose major threats especially to rural smallholder livelihoods. The number of droughts experienced in some vulnerable regions are particularly worrisome: Between 2001 and 2011, the country experienced five major droughts with devastating consequences. The effect of climate change in general and weather shocks in particular are projected to cause economic damage worth 2-4% of GDP in the four sectors of Agriculture, Water, Energy and Infrastructure. The micro level impacts however remain less investigated especially with regards to public health.

The main objective of this dissertation is to quantify the effects of climate change and climate variability on the incidences of morbidity due to selected climate-sensitive diseases, as well as their economic burden in terms of related healthcare expenditure. The analysis is organized in four main chapters of the dissertation. Chapter 3 presents descriptive analysis of rainfall and temperature trends for Uganda and Teso sub-region for the period 1921-2015. It reveals that although rainfall amounts have not changed substantially during this period, there are clear changes in the distribution of rainfall across seasons in the past three decades (1980-2010). Specifically, the amount of rainfall is reducing in the first rain season (March-May) and increasing in the first dry season (June-August), possibly indicating either delaying or shifting rainfall from the former to the latter season. Temperature on the other hand increased substantially during the same period especially in the second dry season (December-February). Chapter 4 examines the relationship between climate change and the incidence of diarrhea using outpatient and long-term rainfall and climate data from the Teso sub-region, one of the most vulnerable sub-regions in the country. The study's novelty is the use of outpatient diagnosis data to measure the monthly number of hospital visits linked to diarrhea, as opposed to self-reported illnesses elicited through household surveys which are potentially prone to recall bias. Hypothetically, the number of diarrhea cases is expected to respond to extreme weather, given that the disease is highly sensitive to water availability. Indeed, descriptive analysis confirms this hypothesis: monthly rainfall and hospital visits due to diarrhea are negatively and significantly correlated, indicating higher cases of diarrhea during relatively dry months. Regression results further confirm this negative relationship: Estimates from Poisson, Negative Binomial and OLS regression models show that during months when rainfall is 20% lower than the month-specific long-term (80-year) average, the number of diarrhea cases increases by 11-20%. Analysis disaggregated by age and gender categories indicates that monthly diarrhea cases for males aged 0-4 years, females aged 0-4 years, males aged five years and above and females aged five years and above increase by 13-18%, 11-19%, 17-20% and 12-26%, respectively, when monthly rainfall is 20% lower than the month-specific long-term average. In line with previous literature, and based on focus group discussions during data collection, the pathway of this observed effect seems to be reduced availability of clean water during relatively dry months. This leads people to use unsafe water for drinking and cooking as well as deterioration in hygiene conditions like hand washing after toilet, ultimately quickening the spread of diarrhea pathogens among community members.

Chapter 5 of the dissertation investigates the quantitative link between drought exposure at the household level and morbidity of household members in Uganda. The main hypothesis in the chapter is that households affected by drought face greater health burden in terms of its members suffering more (self-reported) illnesses. The study utilizes longitudinal survey data from the Uganda National Panel Survey (UNPS) collected by the Uganda Bureau of Statistics in four waves: 2009/10, 2010/11, 2011/12 and 2013/14. Approximately 3,000 households were interviewed in each of the UNPS waves. The Health module elicited information on the illnesses household members suffered in the 30 days before the survey year, which is used in constructing the outcome variables of interest. Marginal effects from Probit regression models reveal members of drought-affected households are 10-13 percentage points more likely to report illnesses in general. Further results disaggregated by type of illness show that the likelihoods of reporting fever, cough, diarrhea and severe headache are 11-14, 7-8, 5-8 and 12-14 percentage points higher, respectively, among drought-affected households relative to unaffected ones. Albeit significant at only the 10% level, the drought effect on diarrhea is also positive. This indicates that drought exposure deteriorates the health of members of affected households.

In Chapter 6, the economic burden associated with drought exposure among affected households in Uganda are unraveled. Like in chapter 5, analysis in this utilizes UNPS data covering a panel period of four years between 2009 and 2014. Information on household expenditure on healthcare and other consumption components is drawn from the Expenditure section of the household module. This is the source of the main outcome variable, which is the per capita spending on healthcare for the household members that reported illnesses. Basic OLS regression results indicate substantial increase in per capita healthcare expenditure while non-health expenditure significantly reduces when a household is affected by a drought. More robust estimates based on Tobit Random Effects (Tobit-RE) reveal increases in healthcare expenditure in the range of 23-29% while non-health expenditure reduces by approximately 7-10% when a household is affected by a drought. This perhaps indicates that households reallocate resources from non-health consumption to supplement healthcare expenditure during and/after drought.

The results presented in the dissertation carry key implications for the resilience of human health and healthcare systems amidst climate change and climate variability. First, they provide empirical evidence on the micro level impacts of these global threats, which has been critically lacking in Uganda particularly and Sub-Saharan Africa generally. Providing knowledge on this association is a first step to the incorporation of climate knowledge in healthcare planning processes, for example the integrated disease surveillance and response systems. This could help evidence-based strategies to increase the resilience of the health sector, households and individuals. Having reliable information on the climate-health co-dynamics could indeed help in better prediction of disease outbreaks and design appropriate response strategies. Secondly, the finding that diarrhea cases increase during dry months calls for the need to properly plan water resources especially during periods of drought. Thirdly, there is need to raise people's awareness about the potential health effects of droughts, which could help them take precautionary measures including appropriate utilization of water resources, improving hygiene practices, securing precautionary medical supplies and saving funds for the expected increase in healthcare expenditure. Finally, the huge drought-related healthcare cost implies a huge financial burden that could plunge the already poor and vulnerable households into further poverty.

Dedication

I dedicate this dissertation to my parents; Kantobo Loyce and Wamanya Warren, my husband; Kasim Ggombe Munyegera, my three children; Mutebi Abdul-Rahman, Namutebi Lashrah and Mubiru Ramadhan, my brothers and sisters.

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CHAPTER 1

Introduction

1.1. Background

Climate change and climate variability are ranked among the main threats to global order due to their impending damage to places, sectors of economic development and livelihoods (World Economic Forum, 2018). The manifestations of climate change and climate variability vary from region to region but generally include significant changes in climatological statistics such as average and peak temperatures, humidity, atmospheric pressure, precipitations, wind patterns, and water salinity and decreases in mountain and polar glaciers (McMichael, 2013). Extreme weather events, whose occurrence is reportedly increasing, are one of the major indicators of climate change and climate variability.

The Intergovernmental Panel on Climate Change predicts that surface temperatures could increase by 2-4^{0}C by 2100 (Solomon et al., 2007). Although the causes are quite diverse, there is a consensus in the literature that these are largely human (Griggs and Noguer, 2002; Judkins, 1999). In fact, the single most important cause of global warming is the emission of greenhouse gases from fossil fuel-based power generation, transport, agriculture and mining sectors that increase the heat-retaining capacity of the lower atmosphere (McMichael, 2013; Judkins, 1993). Irrespective of the cause however, what is much daunting is the expected impacts on various sectors and livelihoods, especially in developing countries which contribute the least and have the least adaptive capacity (Patt et al. 2010). Changes in surface temperatures, humidity, atmospheric pressure, precipitations and wind patterns pose an impending threat to environmental, social and economic sustainability. Extreme weather events like floods and droughts are also reportedly on the rise, both in terms of frequency and incidence (IPCC, 2014). Evidence from existing literature shows that such events are associated with deterioration in human health through different pathways. Human health is among the sectors that are vulnerable to climate change and climate variability (Hear after, the term “health” is used for human health because the latter is the focus of this dissertation). Understanding the co-dynamics of major climate variables and health indicators – for example the incidence of climate-sensitive infectious diseases – is important for healthcare planning amidst climate change and meteorological variability (Ebi et al., 2016). However, the causal relationship between climate change and climate variability on the one hand and health on the other has not been sufficiently investigated empirically, although understanding this relationship is recognized as one of the critical components of climate change adaptation strategy (Bypass, 2009). Particularly, it is predicated that the impact of climate change on health will be most severe in sub-Sahara Africa (Boko et al., 2018).

One of the critical challenges in climate-health research is the difficulty in identifying the complex relationship and to distinguish climate impact on health from the impacts of other surroundings that influence health (Bannister et al., 2015). Existing literature indicates that the potential climate impacts on health are diverse and are both direct and indirect. Direct effects include but are not limited to injuries, illnesses and deaths due to heat waves, floods and other extreme weather events (Haines et al., 2006). Indirect effects include increased incidence of vector borne diseases like malaria and dengue fever which result from increased multiplication of disease-causing vectors and/or their expansion into previously inhabitable regions.

In some highland areas which were less prone to malaria, the incidence of this disease has been shown to increase in response to warmer temperatures which provided conduce breeding conditions for malaria-transmitting mosquitoes (Zhou et el., 2004). Increases in malaria incidences in the Kenyan highlands have also been found to associate with warmer temperatures that provided conducive breading conditions for mosquitoes (Githeko et al., 2004). Torrential rainfall that results in massive flooding could also be associated with increased spread of water-borne diseases like diarrhea (Funari et al., 2012). Malnutrition is also reported as another potential indirect effect of climate change and climate variability. Floods, droughts and other extreme weather events often reduce food production and jeopardize food security, leading to increased malnutrition rates especially among children (Haines et al., 2006; Funari et al., 2012; Sellman and Hamilton, 2007; Vu and Glewwe, 2011). The challenge is more pronounced among poor agrarian communities which are heavily reliant on rain-fed agriculture. Finally, global warming is associated with a higher concentration of pollutants in the atmosphere, which could result in increased cases of respiratory and cardiovascular diseases (Jacob & Winner, 2009).

The growing body of literature on the climate-health interlinkages notwithstanding, empirical studies on the direct and indirect effects of climate change and climate variability are quite limited. Even then, majority of these are focused on the Global North – especially North America and Europe – leaving a big literature gap in the case of the Global South – particularly Sub-Saharan Africa (Verner et al., 2016, Bypass, 2009). The lack of a clear understanding of the relationship between climate change and climate variability on the one hand and human health on the other inhibits strategies to increase the resilience of the health sector and people against these threats in the context of Sub-Saharan Africa. In fact, empirical evidence on the climate-health interlinkage is crucial to understanding the co-dynamics of climate and health indicators and better plan healthcare services to avert and/or cope with the adverse health effects of climate change and climate variability.

1.2.Objective and structure

The main objective of this dissertation is to investigate the health-economic burden of climate change and climate variability in Uganda. Chapter 2 describes the conceptual framework and reviews existing literature about climate-health interactions. Chapter 3 provides a brief overview of – location, health, climate and socio-economic situation – of two study areas; Uganda and the Teso sub-region of Uganda. Chapter 4 then examines the impact of climate variability on the incidence of diarrheal diseases in the Teso sub-region. In order to analyze the health implications of drought at the national level, chapter 5 investigates the association between drought exposure and morbidity – using self-reported illnesses as a proxy – using nationally representative household survey data. Chapter 6 builds on this analysis by examining the financial implications of drought-induced morbidity estimated as per capita healthcare expenditure attributable to drought exposure. Finally, chapter 7 concludes the dissertation with a summary of the main findings and key recommendations. Although chapters 5 and 6 have a limitation of relying on self-reported illness as in many other previous studies, this chapter benefits from complementary observed outpatient data in chapter 4 which confirms that the relationship between climate change and health exists even after controlling for potential recall bias.

CHAPTER 2

Conceptual Framework, literature review and study area

2.1.Climate change, climate variability and extreme weather events

Climate change is defined differently among literatures. The Inter-party Coalition on Climate Change defines climate change as a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer (Solomon et al., 2007). In this sense, it refers to any change in climate over time, whether due to natural variability or as a result of human activity. Literally 'climate change' denotes to long-term change in the statistical distribution of weather patterns (e.g. temperature, precipitation, etc.) over decades to millions of years of time (Rahman, 2013). On the other hand, the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (UNFCC, 1994). The Intergovernmental Panel on Climate Change (IPCC) provides an alternative definition of climate change, as the occurrence of a value of a weather variable above (or below) a threshold value near the upper (or lower) ends of the range of its observed values in a specific region (IPCC, 2011). This definition of climate change includes change due to natural variability alongside human activity (UNFCC, 2011).

According to Wu et al. (2016), climate change refers to long-term statistical shifts of the weather, including changes in the average weather condition or in the distribution of weather conditions around the average, that is, extreme weather events. Climate variability on the other hand refers to variations in the mean state of climatological statistics on all temporal and spatial scales beyond those of individual weather events (UNFCC, 2011). Variability may result from natural internal processes within the climate system (internal variability) or from variations in natural or anthropogenic external forces (external variability) (Smith, 2010). Smith et al (2010) provides criteria to differentiate climate variability from climate change. According to their definition, climate variability takes place over a shorter period, from months to less than 30 years while the climate change occurs over a time horizon longer than 30 years (Smith et al., 2010). climatological statistics

As above mentioned, climate change defined as long-term shifts of the weather from climatological statistics by Wu et al. (2016) includes extreme weather events which is referred as changes in the average weather condition or in the distribution of weather conditions around the average. These are defined as events that have extreme values of certain meteorological variables (Stephenson et al., 2008). Typical examples of extreme weather events are excessive rain that often results in floods, droughts, floods, storms, among others (McMiacheal et al., 2004; Karl et al., 1995). This dissertation define extreme weather events as months during which rainfall and temperature values are unusually below or above the month-specific long-term average. Extreme weather events are linked to the ongoing trend of both climate change and climate variability in such a way that both the frequency and intensity of extreme weather events like floods and droughts increase as both climate change and climate variability take place.

2.2.Pathways of climate change influences on human health

Climate change and climate variability and the associated extreme weather events influence human health through several pathways which are often exacerbated and amplified by other global changes. The 1948 Constitution of the World Health Organization defines health as a state of complete physical, mental and social wellbeing which is not simply the absence of disease or illness (WHO, 2006). Other scholars give an alternative approach to the definition of health as personal satisfaction level of individuals in society (Bellieni and Bounocore, 2009). In this dissertation, health refers to the state of wellness in which individuals are free from disease or illness. As summarized in Figure 1, climate change works through both direct and indirect pathways to influence human health. Climatic conditions influence environmental systems and social conditions which affect food yields, water supplies and disease patterns and ultimately pose risks on human health. Direct health effects include injury, death and post-event traumatic stress. The indirect effects are of three broad categories. The first category is the disruption of food production systems and food price hikes that result in malnutrition and other diseases related to food insufficiency and nutrition deficiency. The second category is the deterioration of water resources which leads to increased spread of water-borne diseases like diarrhea. The final category is the alteration of microbial ecology, leading to increased spread of malaria, dengue fever and other vector-borne diseases.

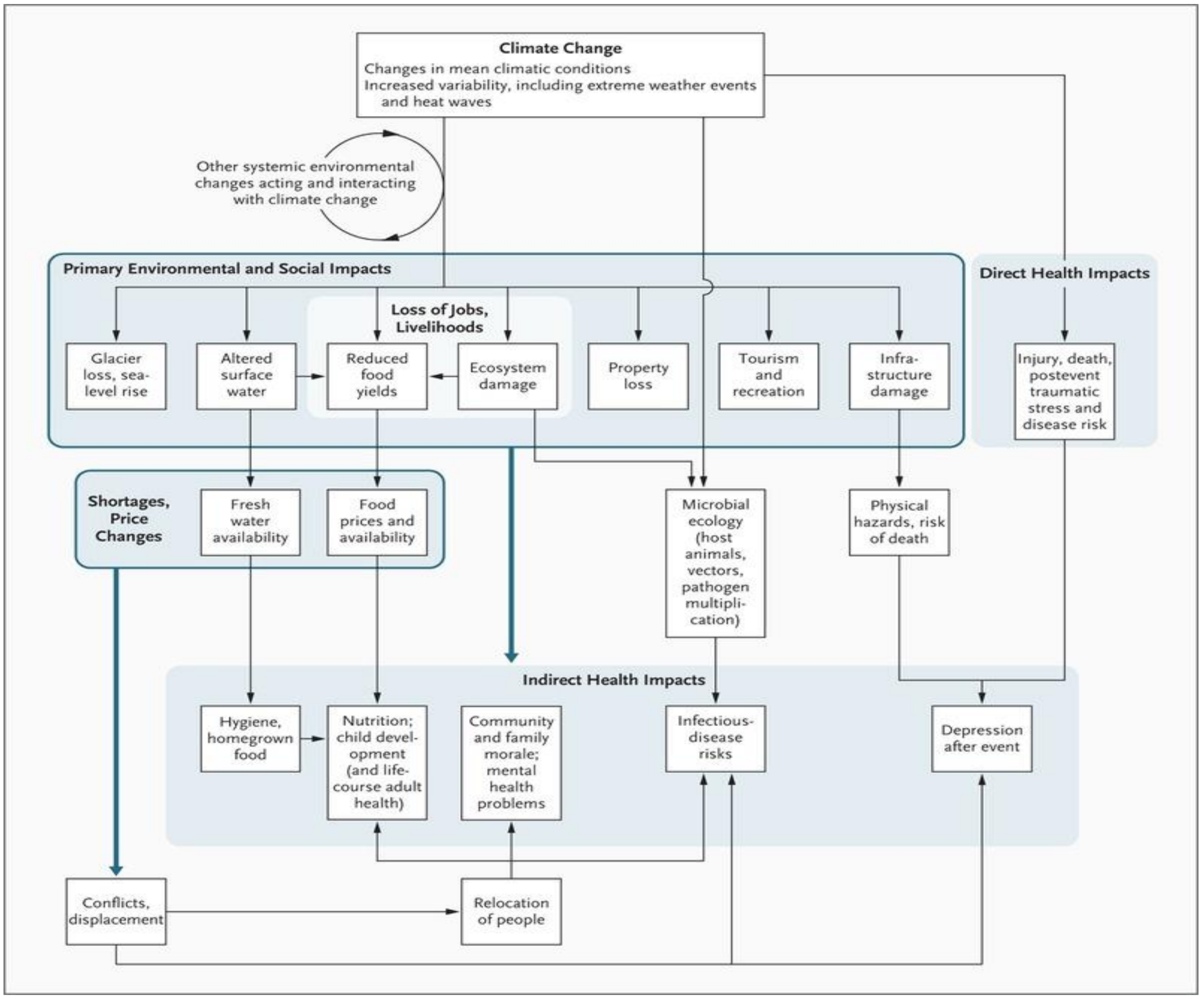

Figure 1: Pathways of climate change influences on human health

Source: McMicheal (2013).

Existing literature shows that the health effects of climate change and climate variability could be both positive and negative, partly depending on geographical location. Mid-latitudes are anticipated to benefit from reduced pneumonia, bronchitis and arthritis following warmer surface temperatures (Franchini & Mannucci, 2015). In many parts of the world however, the observed and projected health effects are largely negative, especially those resulting from increasing surface temperatures. The main observed effects of higher temperatures include higher cases of acute coronary syndromes and myocardial infarction (Dilaveris et al., 2006; Goerre et al., 2007), heat-related illnesses and deaths among children and the elderly in (Medina-Ramon et al., 2006), hospital visits related to angina pectoris (Abrignani et al., 2009) and asthma (Lin et al., 2009).

Drought have also been linked to higher cases of diarrheal diseases in 13 African countries (Bandyopadhayay et al., 2012). The reported pathway is the reduced availability of clean water and the deterioration of hygiene practices during extremely dry seasons. In addition, long-term health effects of water stress and droughts have been empirically identified. The study however was restricted to diarrhea and made no reference to other potentially climate-sensitive illnesses. It is important to understand how climate-sensitive diseases respond to changing and varying climatic conditions. Another study that attempted to analyze the health effects of climate variability reported potential positive association between rainfall on the one hand and malaria and gastrointestinal illnesses on the other (Labbé et al., 2016). However, the study used a qualitative approach rather than quantification of the malaria-rainfall relationship. Additionally, it used information only from the Southwestern region and as such, the findings therein are not country representative. The growth rate of rural Zimbabwean children aged 12-24 months is retarded by 1.5-2cm when subjected to rainfall 20-30% lower than the long-term average. By symmetry, rainfall figures significantly higher than long-term averages are associated with higher survival rates for Indian girls relative to boys

(Rose, 1999). In Vietnam, Lohman and Lechtenfield (2015) provide empirical evidence on the short-term negative impacts of drought exposure on the health condition of household members and the associated increase in healthcare expenditure.

2.3.Vulnerability to climate change in the study area – Uganda

Climate change and climate variability are likely to exacerbate the health burden in Uganda, a country that never achieved most of the health-related millennium development goals (MDGs) especially on child and maternal mortality (WHO, 2018). The country has experienced enormous changes to its climate, including increases in surface temperatures by 1.5ºC between 1960 and 2010 (Future Climate for Africa, 2011). With increased occurrence and intensity of droughts and floods, the socio-economic danger is imminent. It is estimated that the four sectors of agriculture, energy, water and infrastructure, the economic loss resulting from climate change and climate variability is projected to amount to 2-4% of cumulated GDP between 2010 and 2050 (Uganda Ministry of Water and Environment, 2015). The potential threat to the agriculture sector is particularly daunting. Between 2006 and 2013, two thirds of Ugandan households that graduated from poverty were reported to move back into it, partly as a result of weather shocks (World Bank, 2016). Government spending on public transfers is also too low to insulate the bottom poor from poverty and vulnerability: public transfers in Uganda account for 0.4% of GDP, a very low proportion relative to 1.1% Sub-Saharan Africa average (World Bank, 2016).

The 2016 World Bank Poverty Assessment Report for Uganda provides preliminary empirical evidence on the pathways through which climate variability – with a focus on rainfall shortages – translate into socio-economic outcomes. The estimates from household survey data between 2006 and 2013 reveal that a 10% rainfall shortage results into significant reductions in agricultural incomes, which range between 38% to 8.7% in the Northern and Eastern regions, respectively. Likewise, reduction in water sufficiency by 10% comes plummets household per capita consumption by 4.8%. Akampumuza and Matsuda (2017) corroborate these findings by demonstrating that household consumption expenditure per adult equivalent increases by 17% following drought exposure in the Teso sub-region.

Approximately half of the country's disease burden is constituted by communicable diseases including climate-sensitive diseases like diarrhea and respiratory infections (WHO, 2018). There are some clear indications on the possible link between climate change and variability on the one hand and human health on the other. The 2017 global Climate Risk Index report places Uganda in 57th position out of 191 countries, with an annual average of 33 fatalities linked to climate change over the past two decades between 1996 and 2015 (Kreft et al., 2017). This is clearly indicative of the fact that individuals and households vulnerable to climate change and climate variability could face dramatic deterioration to their health status. Water stress following long dry spells could spur the spread of water-borne diseases.

Understanding the patterns and causes of diseases is crucial predicting and planning healthcare services to counter major climate-related epidemics (Lohman and Lechtenfeld, 2015). It is however intriguing that Uganda has not initiated actions to build institutional and technical capacities to work on climate change as reported in the 2015 WHO/UNFCC Climate and Health Country Profile for the country. Likewise, a national assessment on the health impacts of climate change is largely inexistent in the country. The healthcare budgeting processes have also not allocated sufficient funds to strengthen the resilience of the health infrastructure, neither has climate information been incorporated in the Integrated Disease Surveillance and Response (IDSR) system. This dissertation attempts to generate knowledge and empirical evidence on this under-researched topic with a view of informing health policy to increase the resilience of the health sector and the population against adverse climate and weather extremes. The analysis in dissertation uses a combination of disease diagnosis data from outpatient records, longitudinal household survey data and climate records.

CHAPTER 3

Socio-economic, Health and Climate Change the Study Area

This dissertation is based on two main study areas, that is, Uganda and Teso sub-region. The role of this chapter is to provide an overview of the climatic, health and socio-economic conditions of the two study areas.

3.1. Overview of Uganda

3.1.1: Location

Uganda is located in East Africa, with common borders with Kenya in the East, South Sudan in the North, Democratic Republic of Congo in the West and Tanzania and Rwanda in the South. The country is composed of four administrative regions – Central, Western, Eastern and Northern. These are then divided into sub-regions – West Nile, Acholi, Karamoja and Lango from the Northern region; Western and Southwestern from Western region; Teso and Elgon from Eastern region and Central 1 and Central 2 from Central region. The sub-regions are presented in Figure 2. Sub-regions are then sub-divided into 121 districts and 146 counties. The counties are further sub-divided into sub-counties, parishes and villages, which are the lowest units of administration.

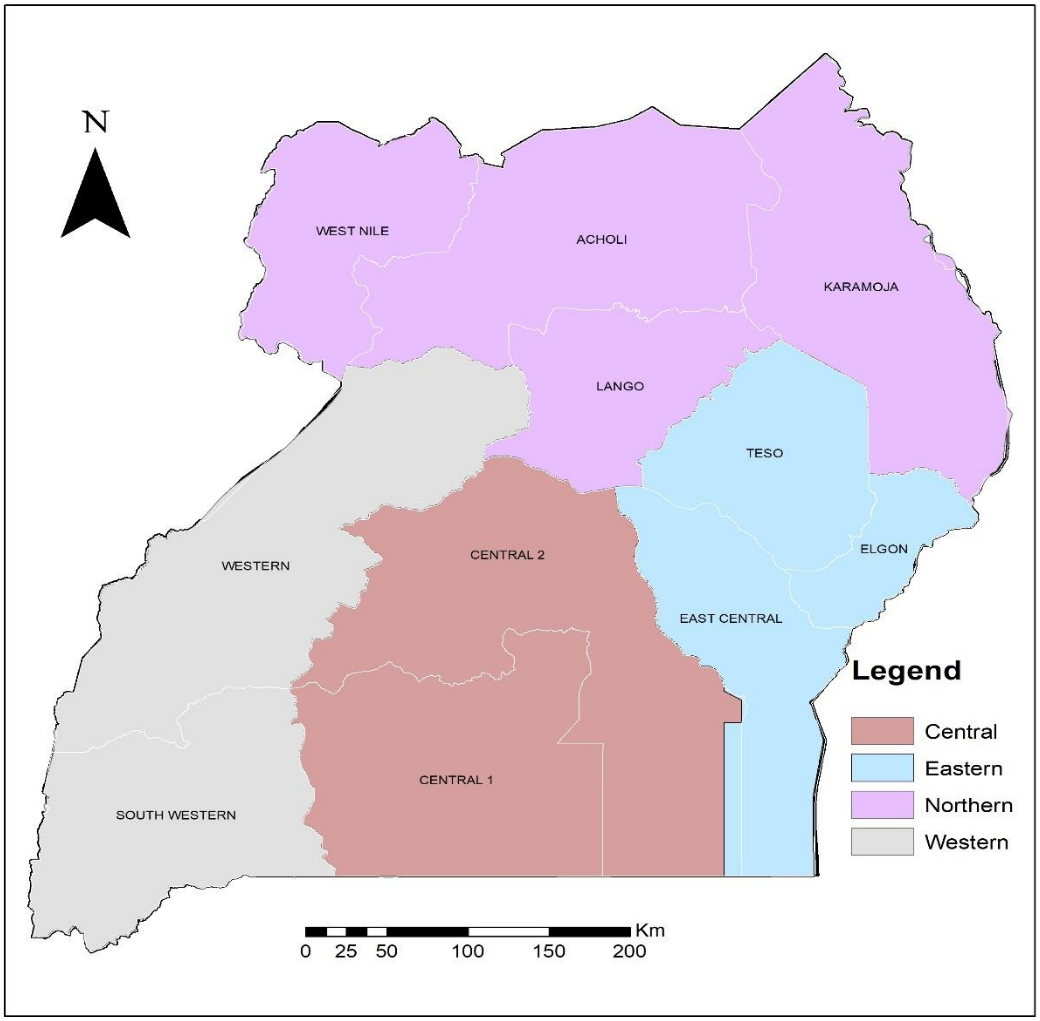

Figure 2: Map of Uganda showing sub-regions

Source: Made by author

Note: GIS shapefiles were obtained from openAfrica.

3.1.2: Socio-economic status

Figure 3 presents the trend of Uganda's population recorded every after 10 years between 1911 and 2014, as presented in the 2017 Statistical Abstract (UBOS, 2017). The country's population is on a positive trajectory, increasing exponentially from decade to decade. With annual population growth rate estimated at 3.3% in 2017, the country has among the fastest growing populations in the world (World Bank, 2017).

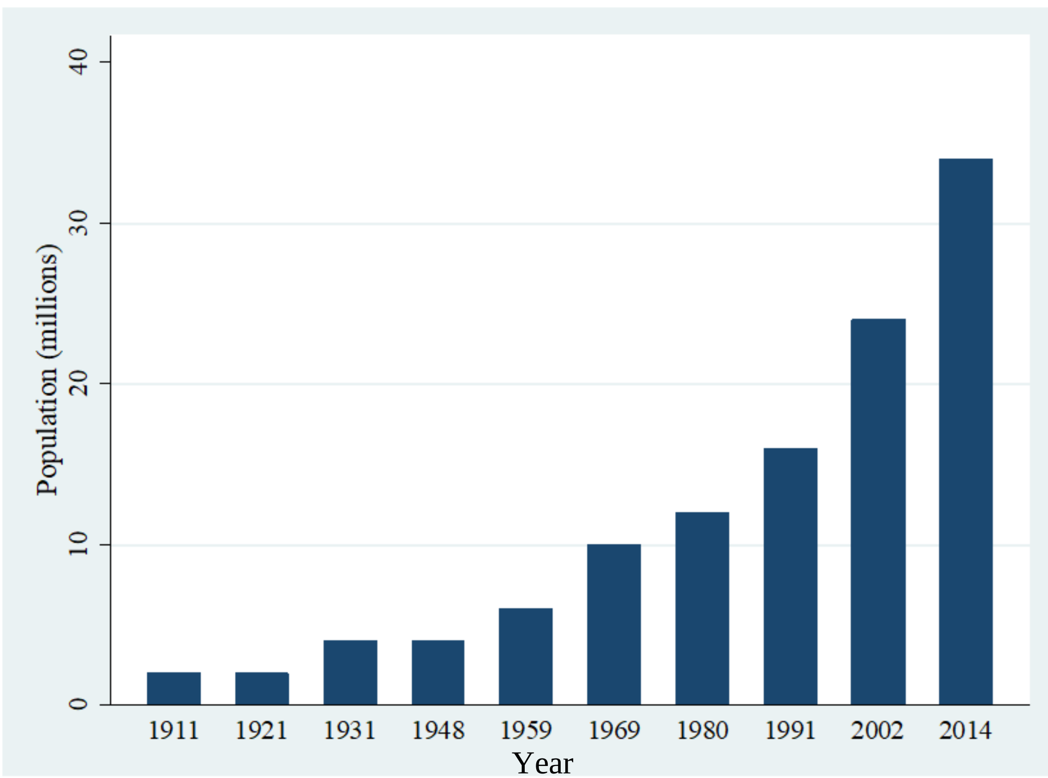

Figure 3: Total population of Uganda between 1911 and 2014

Source: Uganda Bureau of Statistics Statistical Abstract 2017 based on census data.

Uganda experienced annual growth rate of gross domestic product (GDP) of four percent in 2017 (World Bank, 2018). Indeed, average growth rate was 4.5% for the past five years, higher than the average growth rate recorded in Su-Saharan Africa in the same period. GDP per capita however increased only slightly from to reach USD 621 in the same year (World Bank, 2018). The 2016 World Bank Economic Outlook Report for Uganda estimated that 33.2% of households in the country (representing 43% of the population) lived below the international poverty line of $1.9 per day in 2015, which is an improvement from 41.5% in 2010 (World Bank Economic Outlook 2016).

Figure 4 shows Uganda's gross domestic product (GDP) and GDP per capita for the period 2001-2018. The two variables exhibit a positive trend over this period. GDP was approximately six billion United States dollars in 2001 and by 2018, it had increased to approximately 28 billion US dollars. Similarly, GDP per capita increased from 240 US dollars in 2001 to 643 US dollars in 2018. In order to examine the trend of the country's economic growth over the same period, Figure 5 presents the growth rate of Uganda's GDP and GDP per capita. Both variables fluctuated during this period with a continued decline in both variables for period between 2014 and 2017 and then increased in 2018. According to the 2016/17 Uganda National Household Survey (UNHS), the proportion of Ugandans living below the national poverty line was estimated at 27% in 2017 (UBOS, 2018). It is a remarkable improvement from 34.6% in 2013 and 53.2% in 2006.

Agriculture, which is the main source of income and livelihood, employs approximately 25.6 million people (68% of the country's population) according to the 2016/17 Labor Force Survey (UBOS, 2018). The sector is predominantly rain fed (Thomas et al., 2007; Thornton et al., 2009) and smallholder with 90% of farms less than two hectares (Lowder et al., 2016).

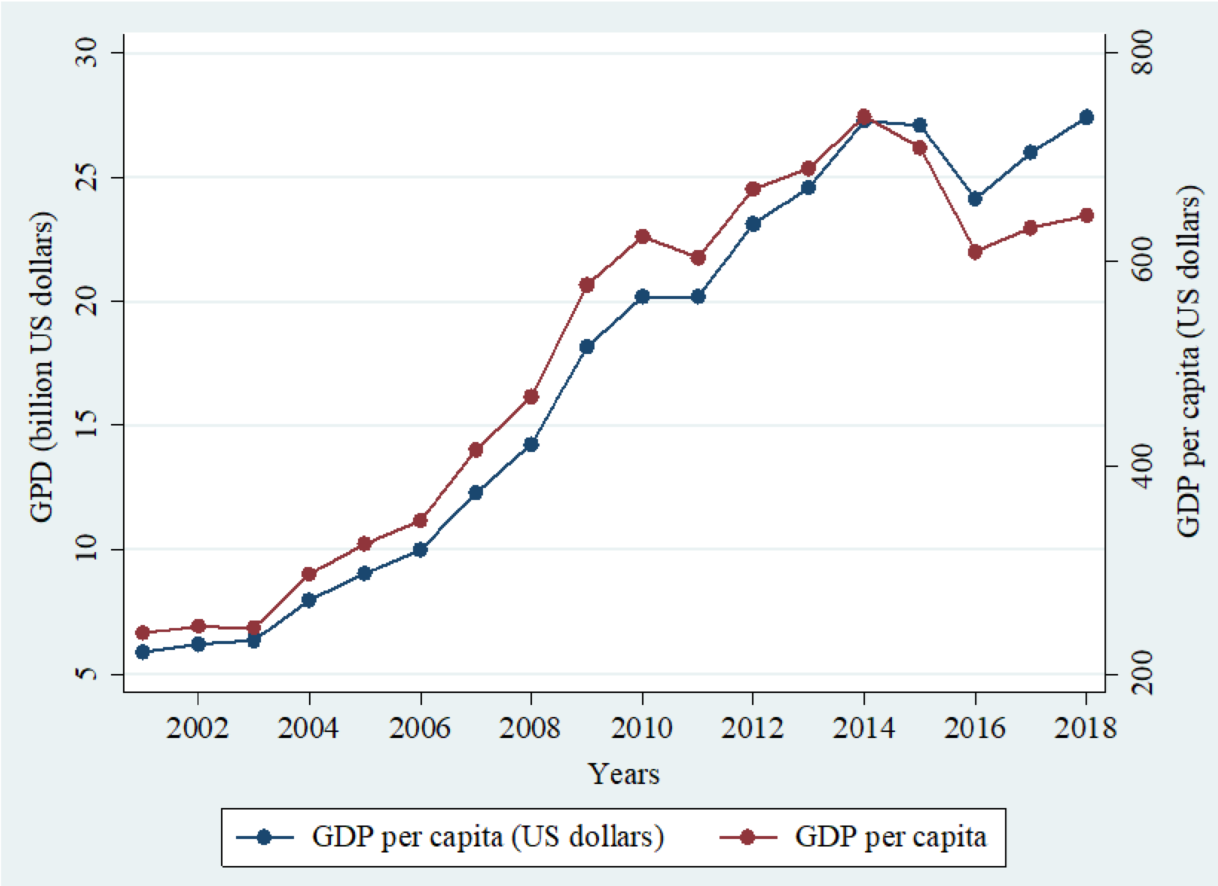

Figure 4: Uganda's nominal GDP and GDP per capita in current US dollars 2001-2018

Data source: World Development Indicators.

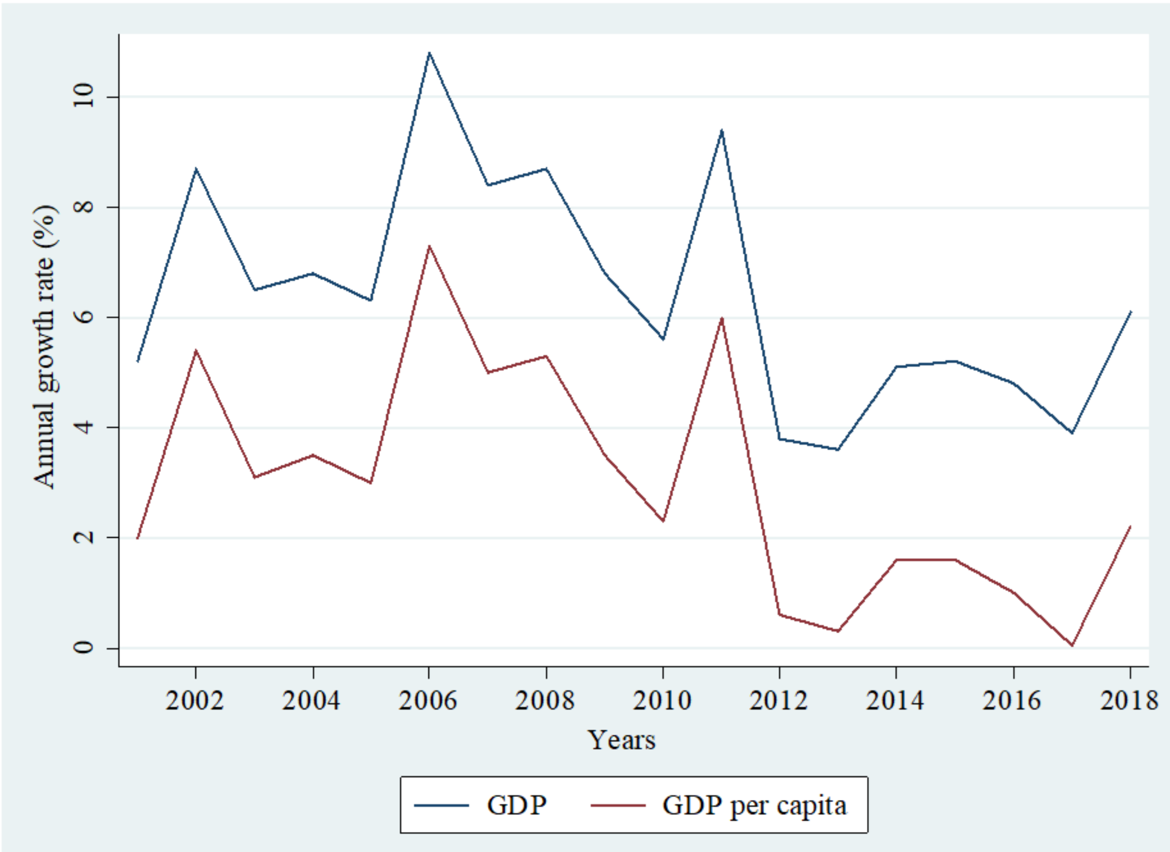

Figure 5: Annual growth rate of Uganda's nominal GDP and GDP per capita 2001-2018

Source: Made by author using data from World Development Indicators.

Climate change and the associated extreme weather events could erode the potential gains from the recently realized economic growth. At the macro level, the damage from climate change to agriculture, water, infrastructure and energy sectors is estimated at 2-4% of GDP between 2010 and 2050 (Uganda Ministry of Water and Environment, 2015). At the micro level, vulnerability to extreme weather events pose further danger of throwing people back into poverty. The threat is amplified by the fact that over two thirds of the population derive their livelihoods from agriculture, the biggest percentage of which is rain-fed and subsistence. Since extreme weather events disproportionately affect the welfare and livelihoods of the poor (Mendelsohn et al., 2006; Bohle et al., 1994), their increased frequency and intensity of occurrence could pose serious implications regarding income distribution in the country. The country is already facing daunting inequality problem with a GINI coefficient of 0.395 in 2013 (UNDP, 2015). Inequality has already evidently discounted development outcomes in the country: adjusting for inequality reduced the country's Human Development Index (HDI) from 0.463 to 0.274 in 2013 (UNDP, 2015).

3.1.3. Health status

Uganda's health sector registered improvement in a number of health indicators between the financial years 2015/16 and 2016/17. Access to antenatal care was reported to increase by 11% between the two periods while supervised deliveries and postnatal care attendance improved by 26%, respectively (WHO, 2018). Nonetheless, the sector still faces a number of challenges especially with regards to increasing and persistent trends of certain infectious diseases. Physical access to health facilities remains a challenge: urban and rural residents travelled 2.0km and 3.2km, respectively, to access public hospitals in 2016. As of 2015, life expectancy at birth among men and women was estimated at 60 and 65 years, respectively (Ministry of Health, 2015). Maternal and under-five mortality rates remained as high as 336 and 64 per 1,000 people in 2017, respectively (Ministry of Health, 2016). Figure 6 presents the major causes of death among under-five in-patients for the financial year 2015/16, based on the Ministry of Health's Annual Health Sector Performance Report for Financial Year 2015/16 (Ministry of Health, 2016). The figure reveals that 5,295 (43%) of under-five in-patient deaths registered were caused by malaria. Other major causes of death included pneumonia, anemia, neonatal sepsis (for newborns aged 0-7 days), diarrhea, septicemia, injuries (trauma due to other causes), respiratory infections, injuries due to road traffic accidents and gastrointestinal disorders. Malnutrition is yet another key health challenge in the country, as 33.5% of children under five years of age were stunted in 2011 (Mawa and Lukwago, 2018). The status of hygiene practices in the country is also quite poor, with approximately 25% and 78% of households having no access to a toilet and hand washing facility, respectively by 2016 (Ministry of Health, 2016). This could indeed exacerbate the spread of hygiene-related infectious diseases like diarrhea.

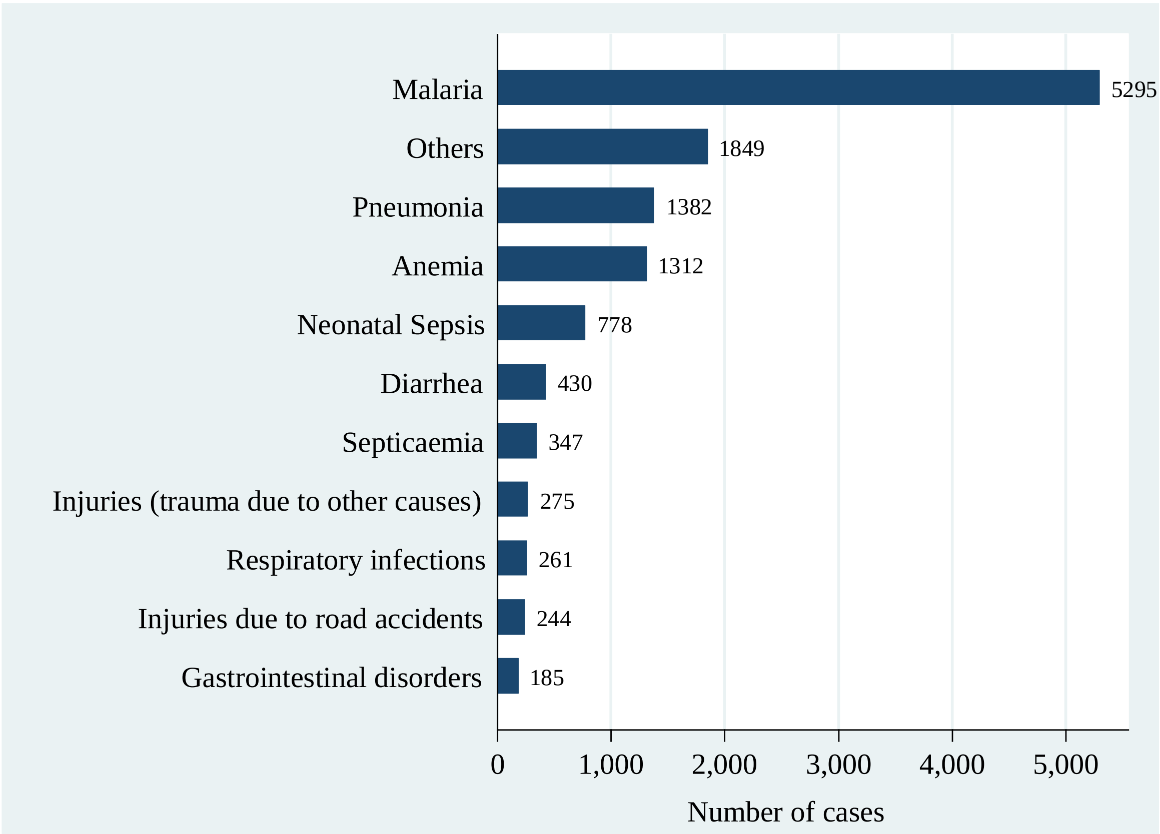

Figure 6: Leading causes of death for under-5 in-patients in 2015

Source: Uganda Ministry of Health (2016).

3.1.4: Climate

The climate of Uganda is bimodal in nature, with two rainfall and dry seasons (Egeru, 2012). The first and longer rainy season lasts between March and May while the second and shorter rainy season occurs between October and November (Mubiru et al., 2012). The first and shorter dry season occurs between June and August, while the second and longer dry season lasts between December and February (Nimusiima et al., 2013). There are however claims that the country's climate is gradually changing and becoming increasingly marred with extreme weather events like droughts and floods whose occurrence is becoming not only more frequent but also more intensive (Irish Aid, 2017). In the decade between 2001 and 2011, the country experienced five major droughts – in 2001, 2002, 2005, 2008 and 2011 (Oxfam, 2008; Guha-Sapir et al., 2012).

In this section, Uganda's climate and rainfall are analyzed using climate data covering the period 1921-2010, obtained from the Climate Change Knowledge Portal (2019). For most of the time in the section, rainfall and temperature variables are analyzed in 30-year periods. The choice of 30-year periods is based on the fact that the World Meteorological Organization recommends using at least 30-year periods for deriving climatological values (Brisson et al., 2015). Indeed, three decades constitute the classical period for performing the statistics used to define climate (Goosse et al., 2010). Other scholars have projected that surface temperatures could rise further by 1.5^{o}C by 2030 while the number of extremely hot days could rise by 15-43% by 2060 (Future Climate for Africa, 2011).

Figures 7 and 8 show total annual rainfall and mean monthly temperature for Uganda for the period 1921-2015. Although there does not seem to be a systematic increase or decrease over the years, rainfall is volatile as it fluctuates from year to year. Temperature seems to be on a positive trajectory especially in the past two decades between 1990 and 2010.

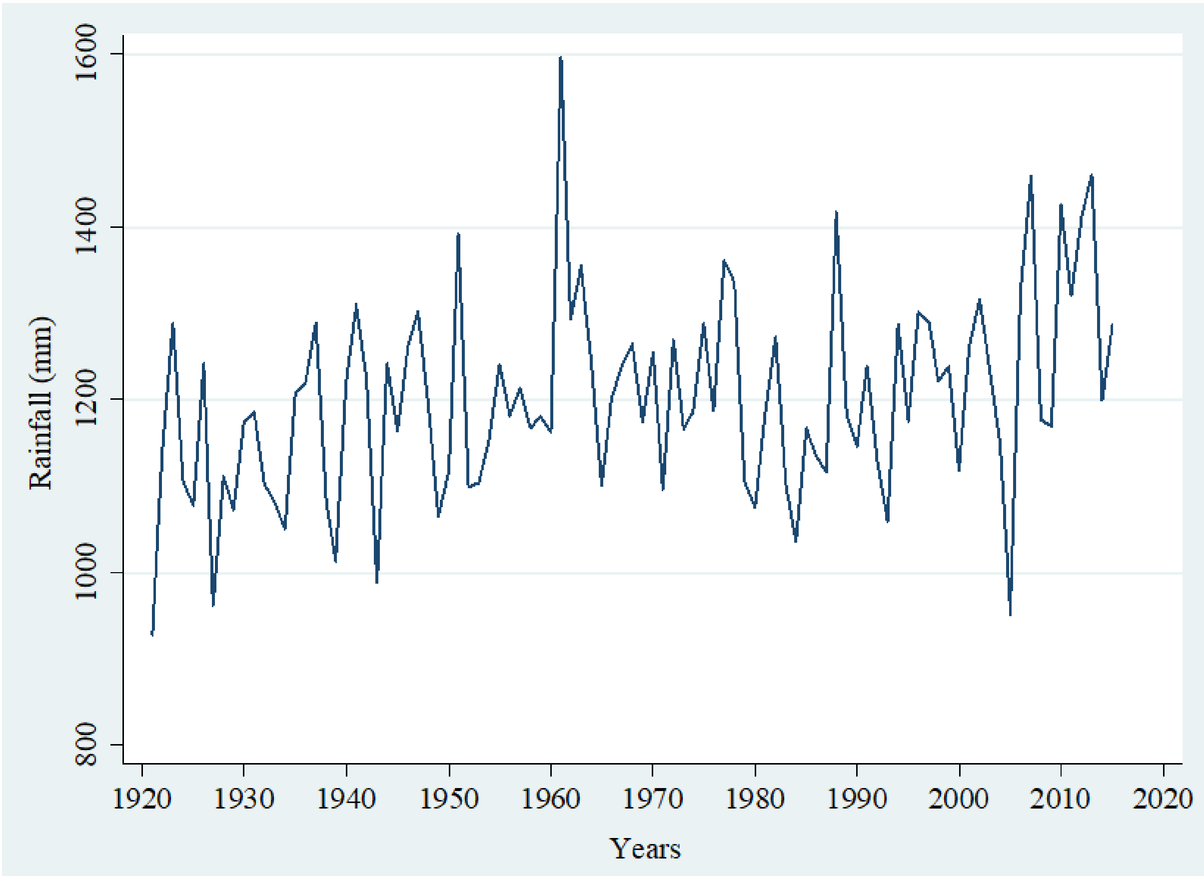

Figure 7: Total annual rainfall for Uganda 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

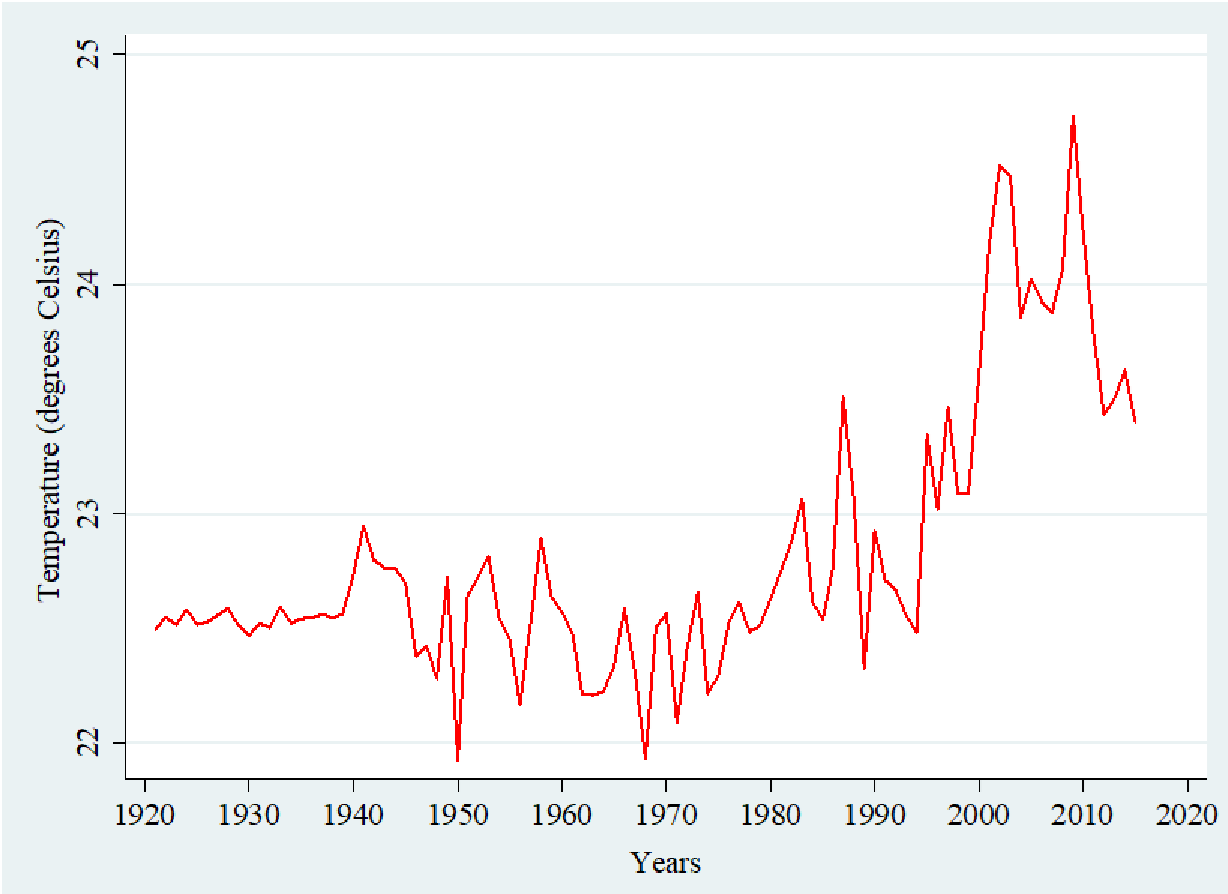

Figure 8: Mean monthly temperature for Uganda 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

In Figure 9, the same rainfall values are presented for three time periods; 1921-1950, 1951-1980 and 1981-2010. From one 30-year period to another, there are some changes in total annual rainfall. An increase of 76mm (6.6%) was observed between the periods 1921-1950 and 1951-1980 followed by a decline of 14mm (1.1%) between 1951-1980 and 1981-2010.

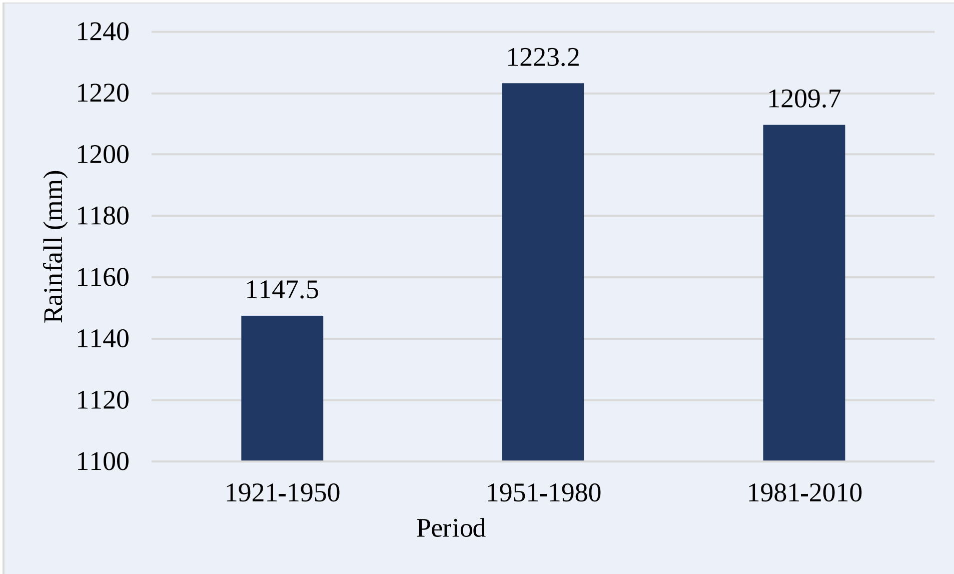

Figure 9: 30-year averages of mean monthly rainfall: Uganda 1921-2010

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

Figure 10 presents monthly rainfall for Uganda for the period 1921-2015 disaggregated by month. Figure 11 then presents 30-year averages of monthly rainfall between 1921 and 2015. Both figures reveal that while rainfall has increased in some months like January, September, October and November, others like February, April and May have exhibited slight decrease in rainfall. Other months like March, April, June, July, August and December have shown no change in rainfall during the analysis period. The clearest changes happened in the second rainy season between September and November. Rainfall in this season increased systematically between 1921 and 2015. There is also a slight decrease in April and May rainfall and a slight increase in June rainfall. A decrease in April and May and an increase in June could perhaps indicate that rainfall towards the first rain season (April and May) could be delaying and instead falling at the start of the first dry season in June. There is no systematic change in rainfall in the second dry season between December and February (Mubiru et al., 2012).

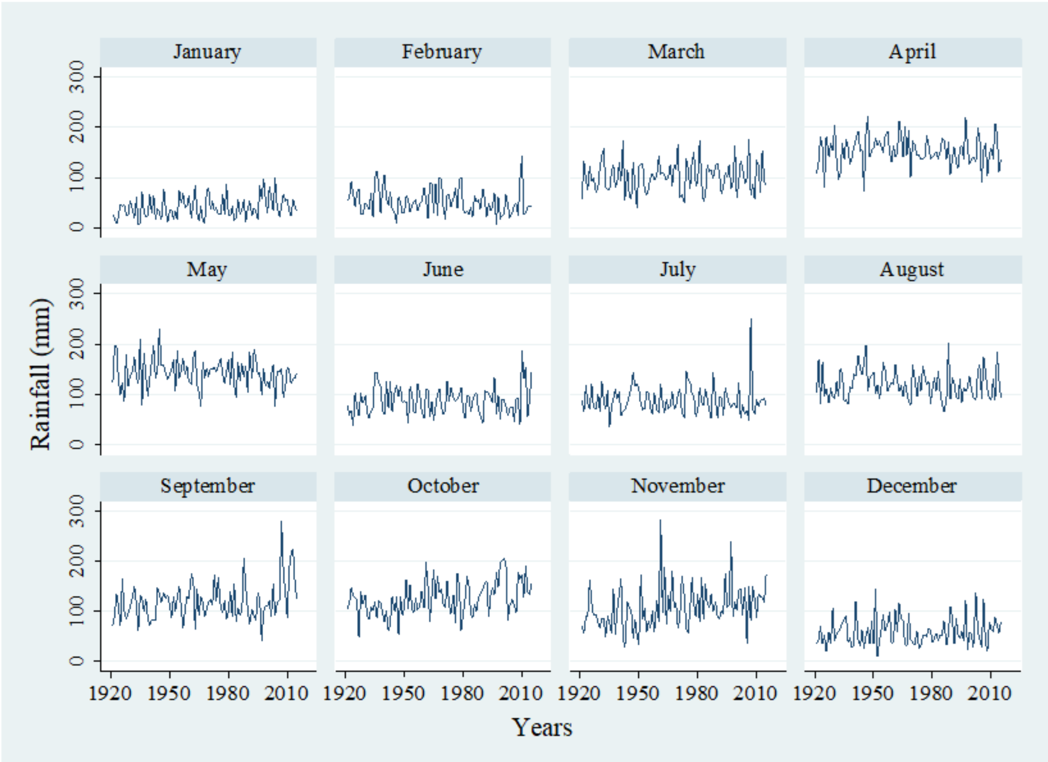

Figure 10: Long-term monthly rainfall for Uganda 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

There are some observable spikes in the rainfall trends for some months. For instance, February rainfall for the year 2010 was 142.1mm, much higher than the long-term average of 53.2mm for the entire period 1921-2010. For the case of 2010, this observation is consistent with official reports that the various parts of the country experienced unusually heavy rainfall that resulted in flooding particularly in the East (IFRCRCS, 2010). Similarly, 280.1mm of rainfall were recorded in September 2007, quite higher than the long-term average of 115.7mm. This confirms official reports of major floods that affected many parts of the country (FAO and WFP, 2008). Likewise, rainfall in September 2012 was 216.5mm which was higher than the long-term September average. This coincides with reports of torrential rainfall that caused severe flooding especially in the North (ReliefWeb, 2012). Other cases of observable rainfall spikes include June 2015, June 2012, June 2010 and November 2015.

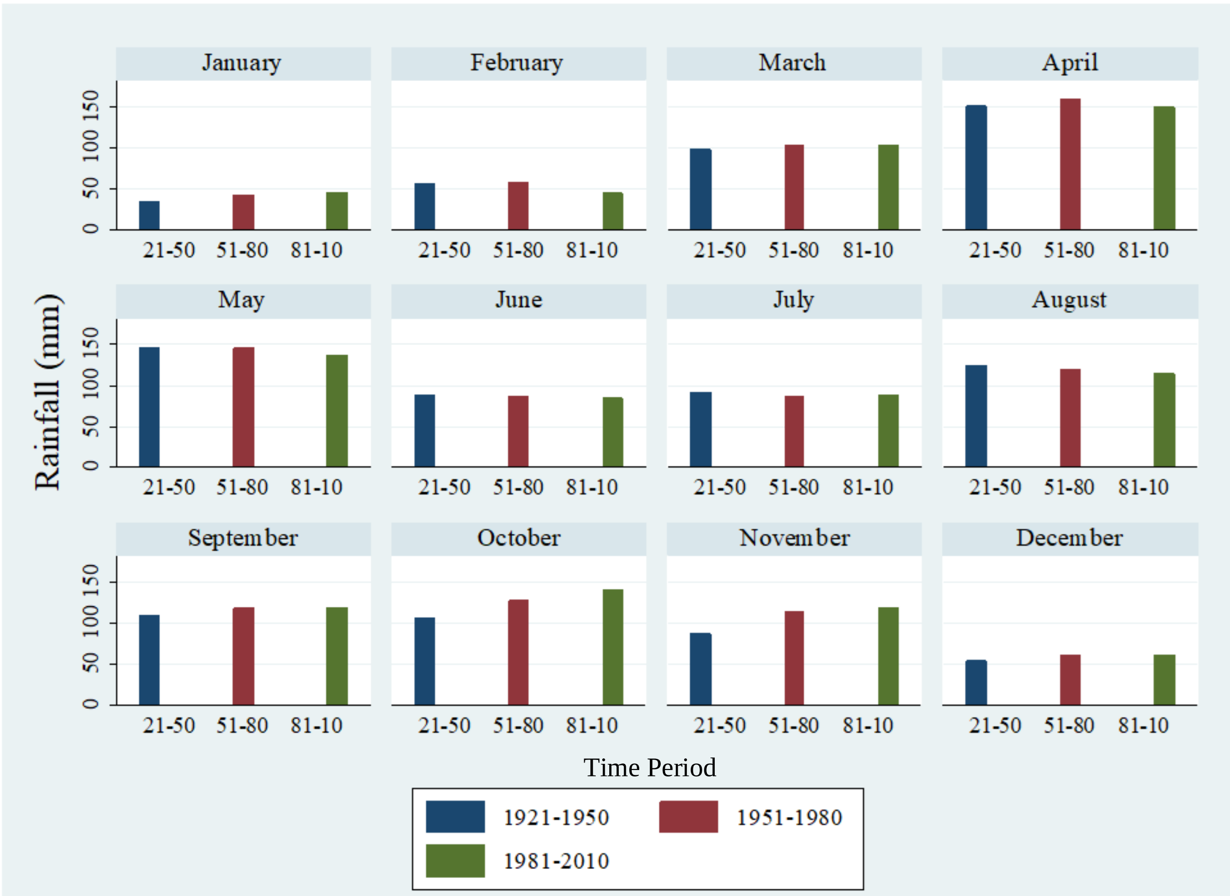

Figure 11: Mean monthly rainfall for Uganda 1921 (30-year averages)

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

The trend of mean monthly temperature is presented in Figure 12 for the period 1921-2015. Figure 13 then presents mean monthly temperature disaggregated by three 30-year periods; 1921-1950, 1951-1980 and 1981-2010. Clearly, mean monthly temperature has increased over the analysis period for almost all the 12 months of the year. For most of the months, the increase seems to be more pronounced in the past three decades between early 1990's and mid 2010's. The first dry season

(June-August) seems to have become hotter, as temperatures for the months of June, July and August increased between 1921 and 2015. On the other hand, the second rainy season (September-November) exhibited no notable change in temperature during the same period. The second dry season also showed a positive temperature trend, with figures increasing in December, January and February. Besides the increasing trend in these months, there are observable spikes in some years, representing higher temperatures compared to the long-term average recorded in the 1921-2010 period. In December 2003, average monthly temperature was 25.8ºC, which is much higher than the average of 22.8ºC recorded in the 1921-2010. Similarly, February temperature was 26.6ºC in 2008, much higher than that recorded in the period 1921-2010 which was 23.4ºC. With 26.5ºC, January 2004 was also a hot month relative to the long-term average.

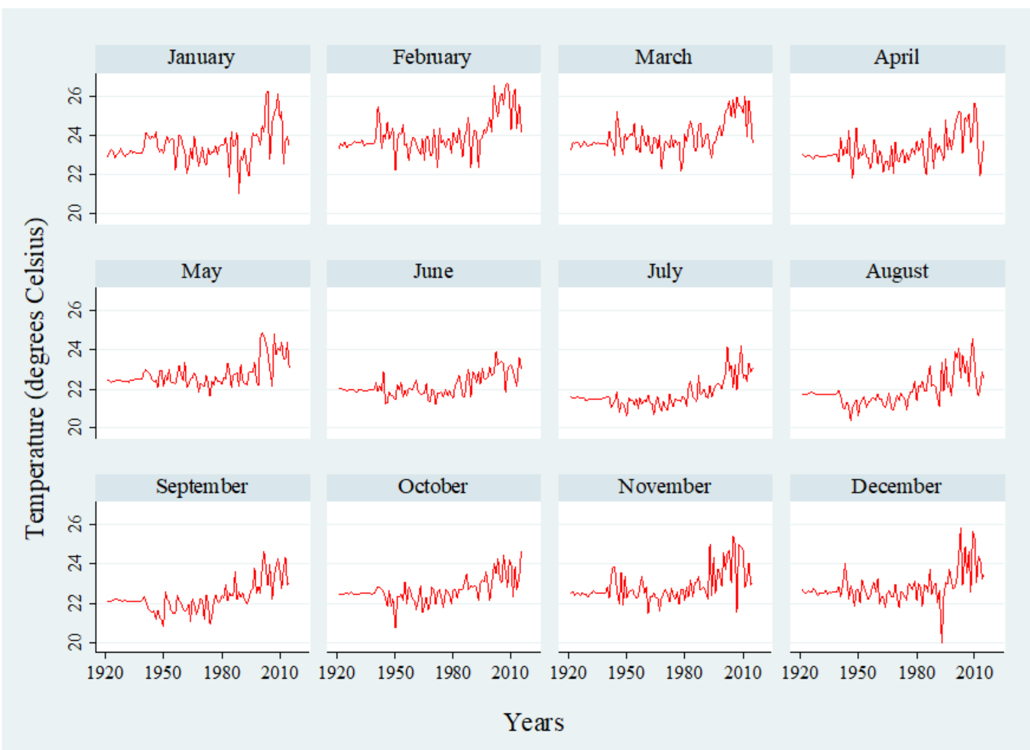

Figure 12: Long-term mean monthly temperature for Uganda 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

Figure 13: Mean monthly temperature for Uganda 1921-2015 (30-year averages)

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

Figures 14 and 15 present the coefficients of variation (CVs) for Uganda's rainfall and temperature, respectively, for the period 1921-2015. The CV value for each time period is calculated as the ratio of the standard deviation of the respective variable to its mean. This helps to show how much the value of the respective variable in each time period is dispersed around the mean. In other words, the higher the CV, the higher the variable is dispersed around the mean and vice versa. The advantage of using CV is that it enables comparison of dispersion of two or more variables which are measured in different scales, for example rainfall (millimeters) and temperature (degrees Celsius).

For instance, the CVs for rainfall and temperature for Uganda were 47.1% and 5.1%, respectively, for the period 1986-2015. Clearly, his indicates that rainfall was more dispersed that temperature during this time period. In both figures, CVs for rainfall and temperature are plotted against time periods, which are divided into 30-year moving intervals. For instance, the first period represents 1921-1950; the second period represents 1922-1951, and so on.

The figures show increased variation of rainfall in February, April, June, July and August. The highest increase in rainfall variation occurred in September. This, and the previous findings of increasing rainfall in September, could indicate that the month could be experiencing higher and torrential rainfall between 1921 and 2015. On the other hand, the dispersion of November rainfall reduces over time, reduced dispersion of rainfall in this month. With regards to temperature, there is a positive trend in the coefficient of variation for almost all months, indication increasing dispersion of temperature especially during the most recent 30 periods (between 1957-1986 and 1986-2015).

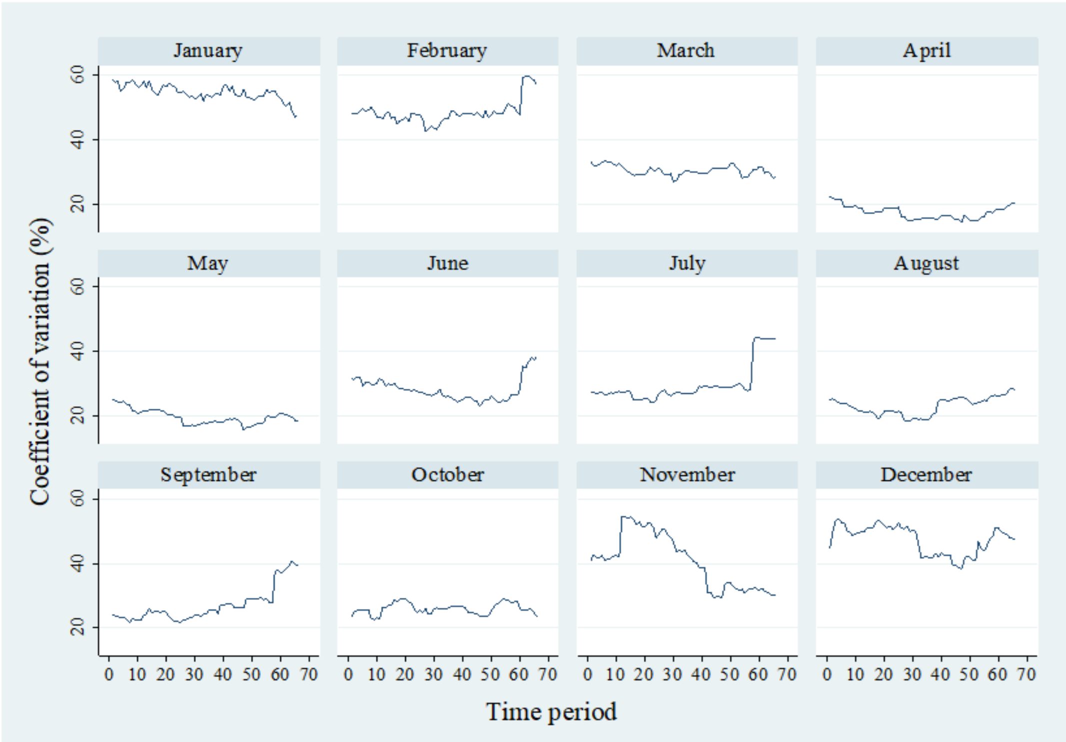

Figure 14: Coefficients of variation for Uganda's Rainfall 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

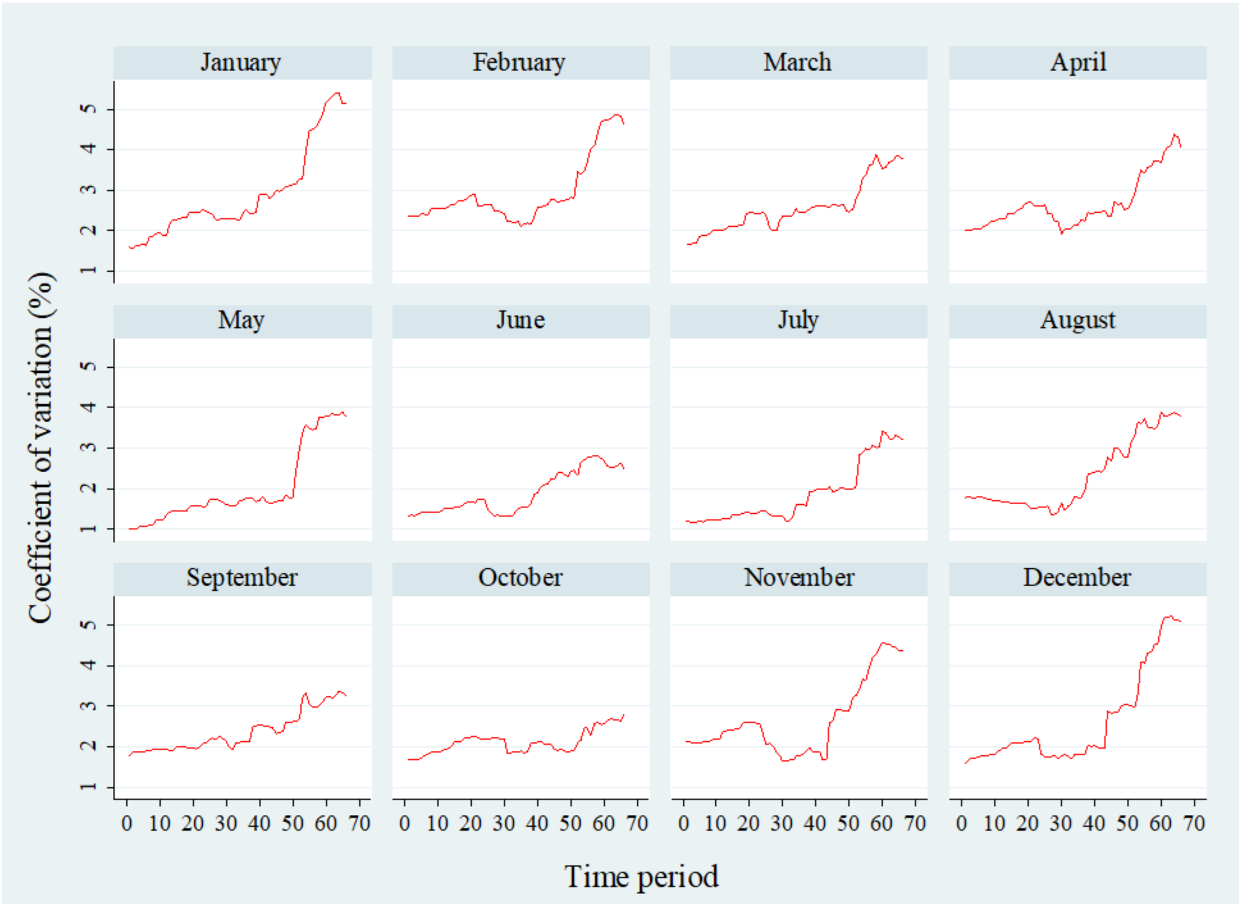

Figure 15: Coefficients of variation for Uganda's Temperature 1921-2015

Source: World Bank Group, Climate Change Knowledge Portal (2019). Accessed January 19, 2019 at http://sdwebx.worldbank.org/climateportal/

3.2. Overview of Teso sub-region

3.2.1. Location

Teso sub-region is located in the Eastern region of Uganda as presented in Figure 16. It comprises of eight districts – Kumi, Ngora, Soroti, Serere, Amuria, Bukedea, Kaberamaido and Katakwi. With a total land area of 13,027 square kilometers and total population of 1,819,790 people, the sub-region has an average population density of 140 per square kilometer of land, based on the 2014 population and housing census (UBOS, 2014).

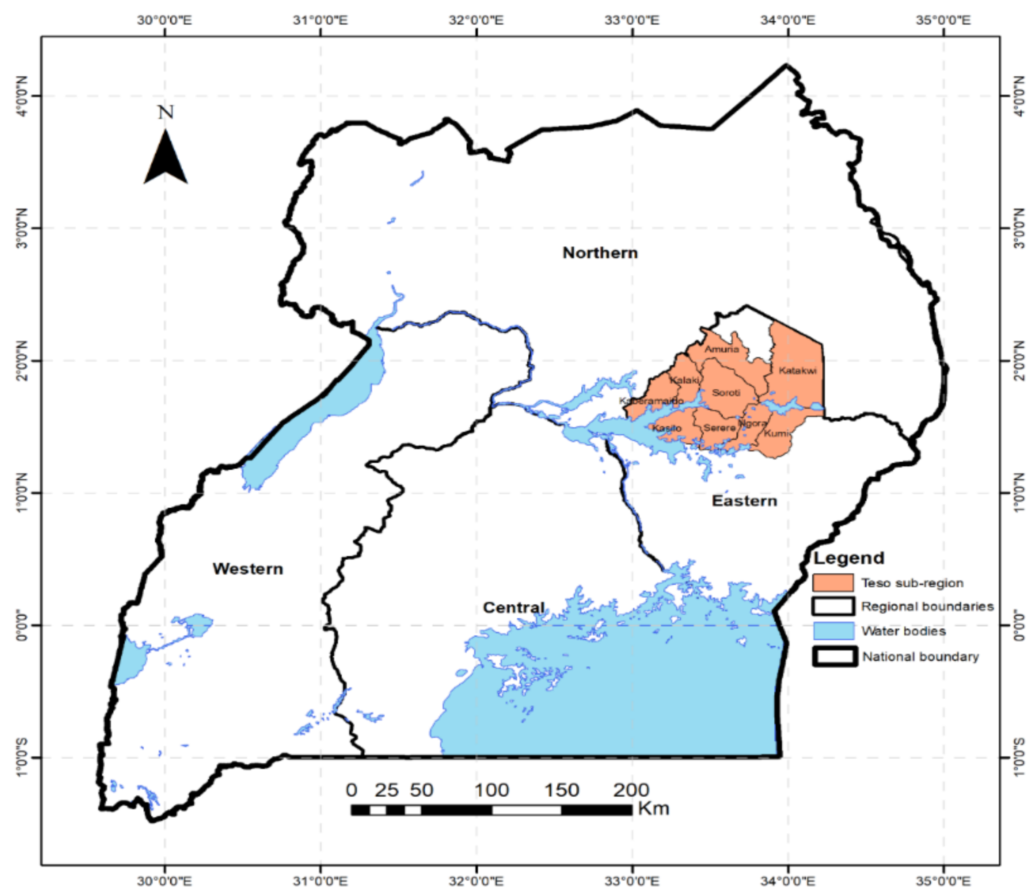

Figure 16: Location map of the Teso sub-region

Source: Made by author

Note: GIS shapefiles were obtained from openAfrica.

3.2.2. Socio-economic status

The sub-region also lags behind many other sub-regions regarding socio-economic status, particularly poverty levels. The Eastern region – where the Teso sub-region is located – had the highest poverty rate in Uganda in 2018, estimated at 24.5% which is much higher than the national average of 19.7% (World Bank, 2018). Within the Eastern region, Teso sub-region has the highest poverty rate estimated at approximately 28%. Farming is the main economic activity, and major crops grown include cassava, sorghum, millet sweet potatoes and ground nuts on a subsistence scale. Farming in the sub-region is predominantly smallholder, practiced on farms of three acres in size on average and is heavily reliant on natural conditions – particularly rainfall – as irrigation systems are not readily available (Uganda Investment Authority, 2016). This poses a great risk to crop yields and farm incomes.

3.2.3. Health status

Like the national level situation presented earlier, health in the Teso sub-region is marred with numerous challenges related to the prevalence of certain diseases, physical access to and quality of healthcare services, among others. According to the 2014 Demographic and Health Survey, 14% of the sub-region's children were stunted (UBOS, 2016). The same report estimated that the proportion of households with access to an insecticide-treated mosquito net was only 64%, which presents a high risk of malaria in the area. There is a high prevalence of anemia (hemoglobin levels below 110g/dl); 59% of children aged 6-59 months and women aged 15-49 years were characterized as anemic in 2014 (UBOS, 2016). Approximately 37% of the population in the sub-region travel more than a kilometer to access safe drinking water, which compounds the risk of diarrhea due to the use of unsafe water. This proportion is much higher than that reported at the national level in the same year, which was approximately 21%.

3.2.4. Climate

With regards to climate, Teso enjoys a bimodal type of climate similar to the country-level type described in the previous section. The traditional climate however seems to undergo gradual changes over the past decades. Figure 17 reports annual rainfall for the sub-region between and 2015. Overall, the sub-region's rainfall fluctuated over the years, with some indication of slight decreases in rainfall over the past two decades.

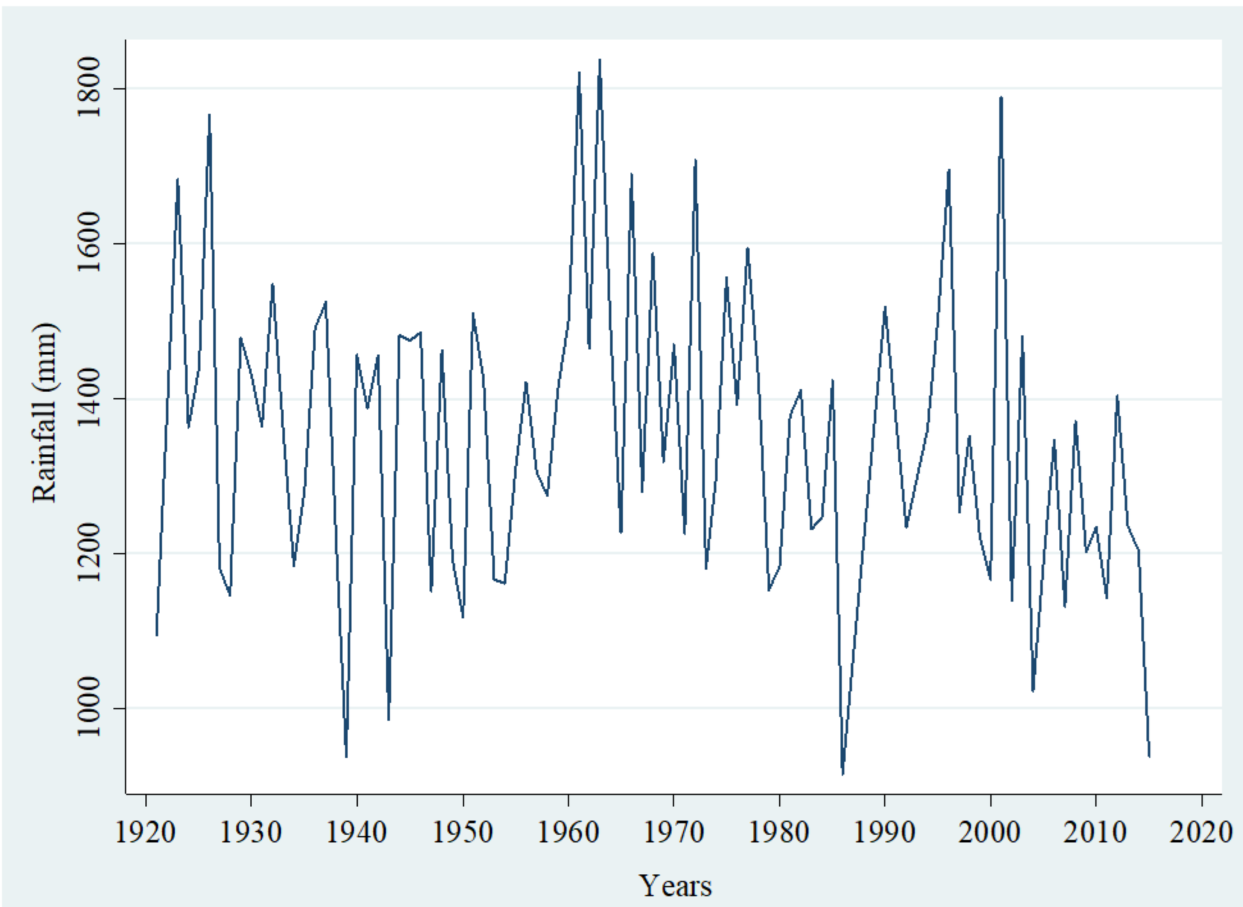

Figure 17: Total annual rainfall for Teso sub-region 1921-2015

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

Similar rainfall trends for the Teso sub-region are presented in Figure 18, in which the analysis period is segregated into three 30-year categories During the periods 1921-1950 and 1951-1980, the sub-region experienced an increase in rainfall by 62.4mm (4.6%). This was however followed by a decline of 33.9mm (2.4%) between the periods 1951-1980 and 1981-2010. This decline is much higher than that presented earlier for Uganda. Precisely, annual rainfall reduced by 15% between 1951-1980 and 1981-2010. It is therefore possible that the pace of climate change in Uganda could vary by geographical area, with Teso sub-region likely to experience greater changes than the national average. Indeed, the sub-region has been cited among the most vulnerable areas to climate change and climate variability in the country (Egeru, 2012). For instance, it experienced five droughts between 1990 and 2010 – 1998, 1999, 2002, 2005 and 2008. During the 2007 flood that swept through Eastern and the Horn of Africa in 2007, about 30 people in the sub-region died and an estimated 8,500 acres of cropland was lost. This was followed by a drought in 2008 which was associated with severe hunger. Shortly after, the sub-region was struck by a drought in 2009, followed by a short drought and flood in 2010 (FAO/WFP, 2008). Reports from the district agriculture offices confirmed tremendous declines in food production following periods of massive floods and droughts (FAO/WFP, 2008). This is often a combined result of crop loss in producing villages and disrupted food flow channels when roads are destroyed by floods. Micro level evidence indicates that when households in the sub-region are exposed to drought, they experience significant declines in food security and that the decline is more pronounced among female-headed households who have less coping capacity (Akampumuza and Matsuda, 2017).

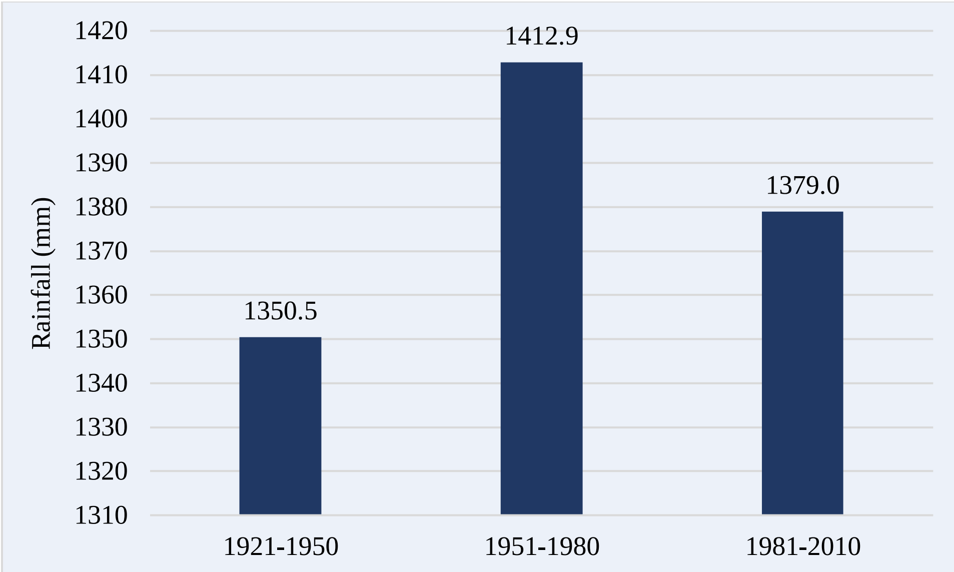

Figure 18: 30-year averages of mean monthly rainfall: Teso sub-region 1921-2010

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

Figure 19 below presents monthly rainfall for the Teso sub-region over between 1921 and 2015. As in the case of Uganda presented earlier, there are spikes in rainfall in some of and years. For example, monthly rainfall for February 2010 was 212.6mm which was quite higher than the long-term average of 58.9mm recorded in the period 1921-2010. Other months with high rainfall in May include 427.2mm and 259.3mm recorded in 1991 and 1998, respectively. In November, rainfall spikes are observable in 1972 and 2008. Generally, the past three decades between 1980 and 2010 have more spikes, indicating increasing rainfall variability in the sub-region.

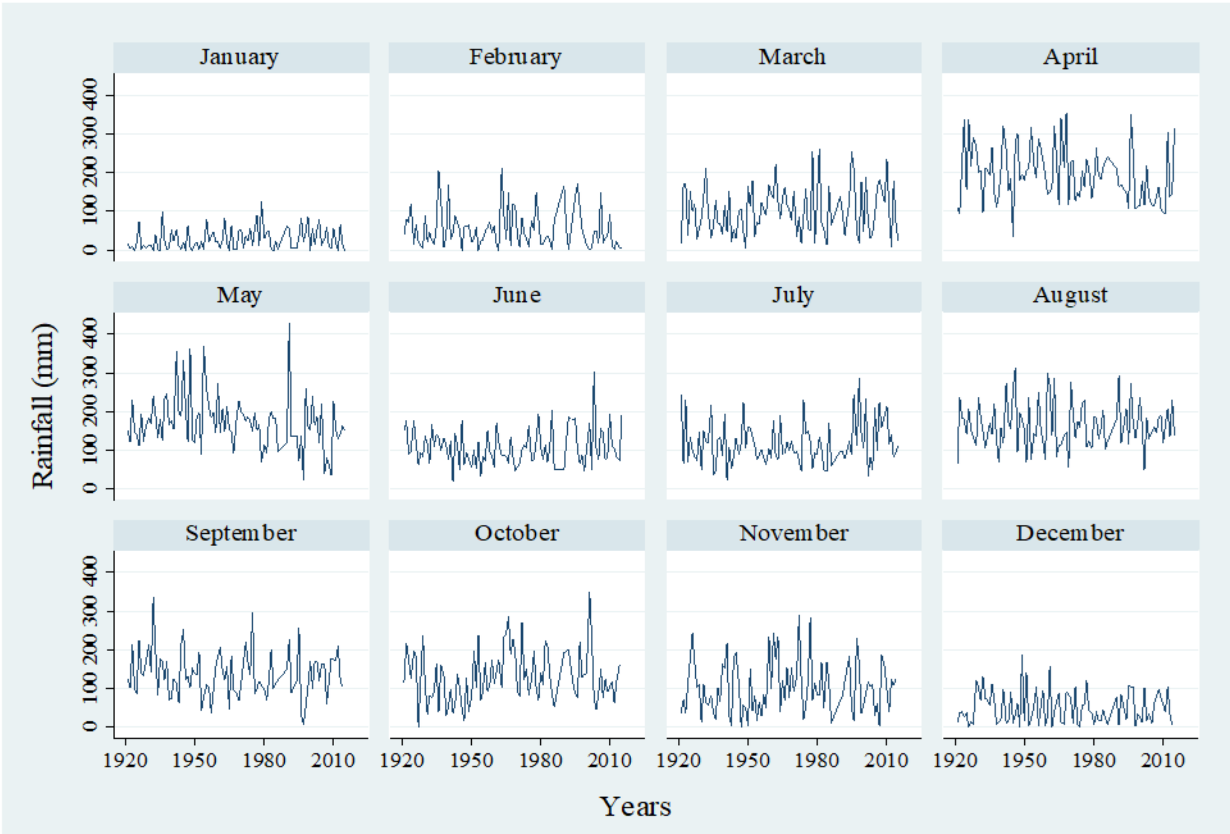

Figure 19: Long-term monthly rainfall for the Teso Sub-region 1921-2015

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

Similar trends of monthly rainfall are then presented in Figure 20, disaggregated not only by month but also by three 30-year periods. While there is a clear decrease in April and May rainfall between 1951-1980 and 1981-2010, October rainfall slightly increased in the same period.

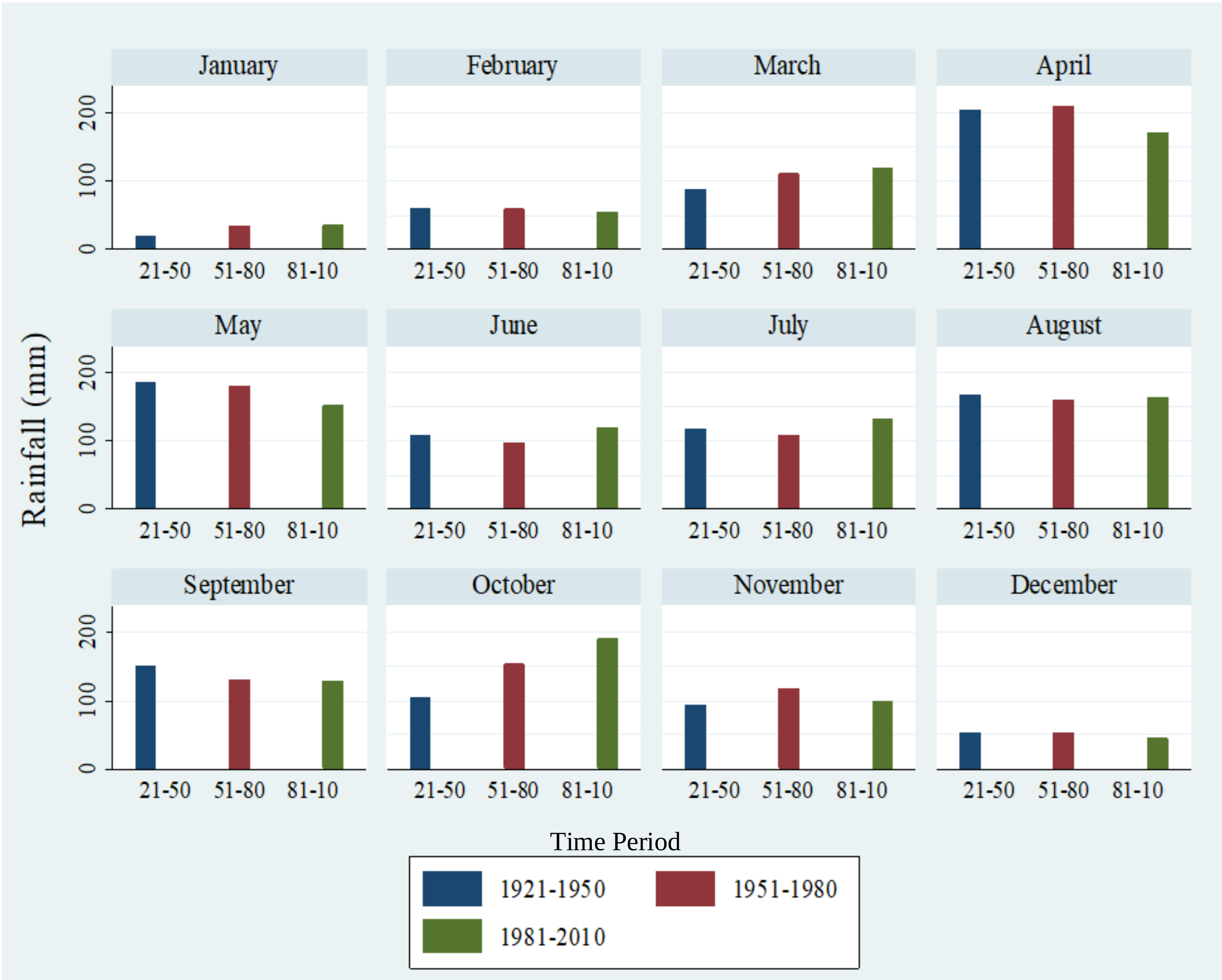

Figure 20: Monthly rainfall for Teso sub-region 1921-2015 (30-year averages)

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

Coefficients of variation for monthly rainfall for Teso sub-region are presented in Figure 21. A decreasing trend for the coefficients of variation in January suggests that rainfall in this month has become less variable over the analysis period. On the other hand, the trend for May is positive, indicating increasing variability of May and October rainfall between 1921 and 2010.

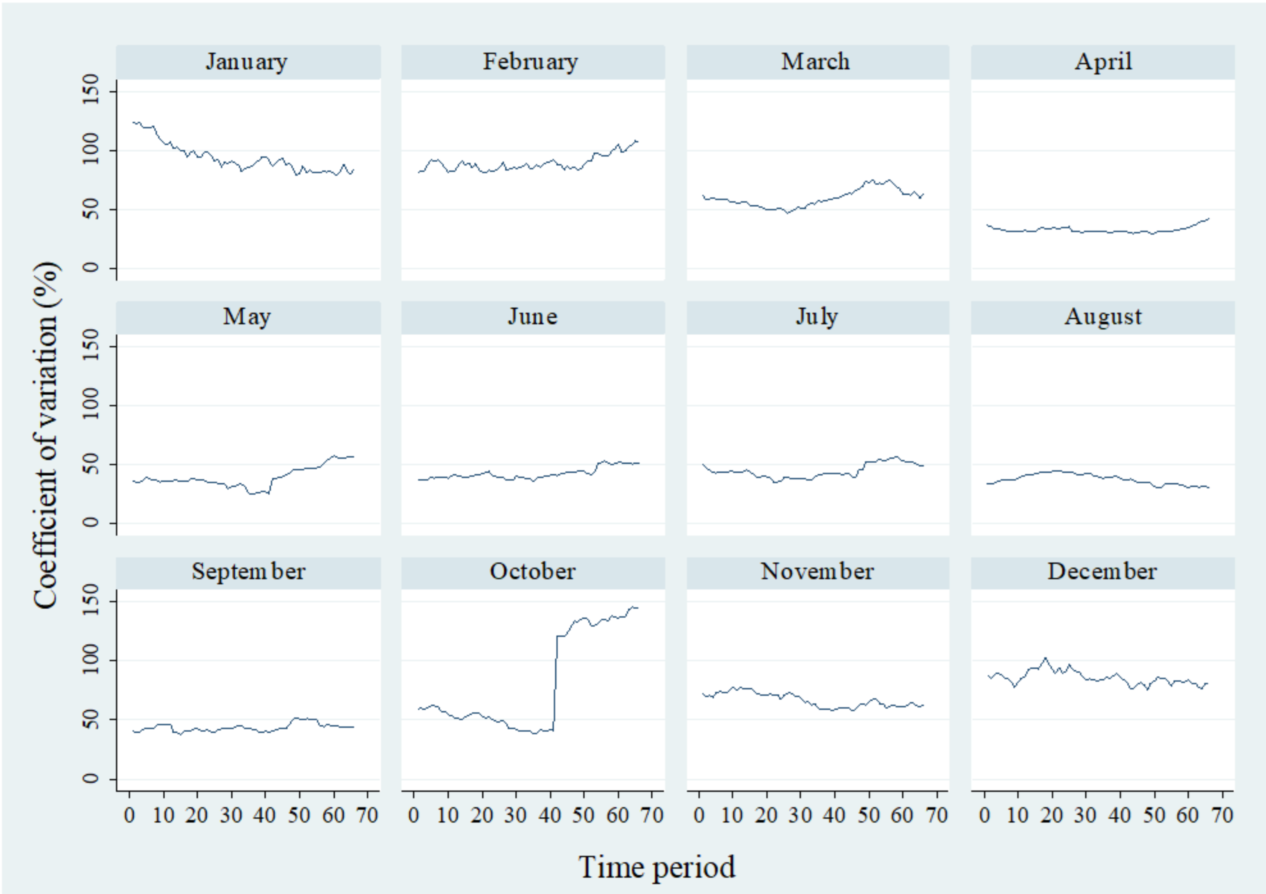

Figure 21: Coefficients of variation for Teso sub-region's rainfall 1921-2015

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

Figure 22 plots the monthly rainfall, minimum and maximum temperatures for Teso sub-region for the period 2006-2011. The relationship between rainfall and maximum temperature is negative, suggesting that months with low rainfall coincide with high temperature and vice versa.

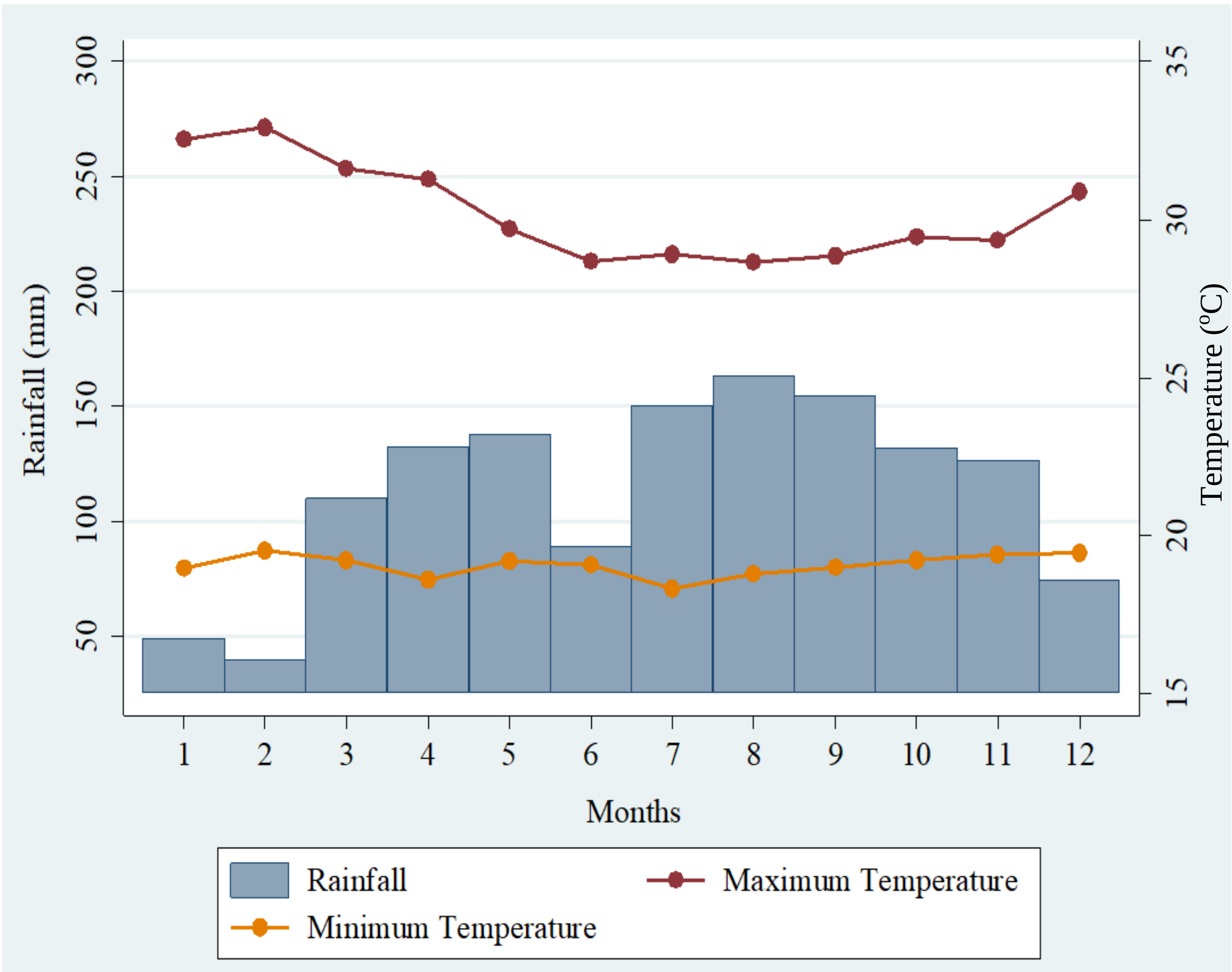

Figure 22: Relationship between rainfall and temperature for Teso sub-region 2006-2011

Source: Made by author using rainfall data from the Uganda National Meteorological Authority.

3.3. Summary

This chapter has presented an overview of the climate and socio-economic and health situation of Uganda and Teso sub-region. The chapter reveals that the bimodal type of Uganda's rainfall has not changed over the period 1921-2015. However, the distribution of rainfall across months and seasons has changed during the same period. Rainfall in the months of April and May reduced over the past three decades while that of June increased. This perhaps indicates that the first rain season rainfall is increasingly delayed and instead experienced at the beginning of the first dry season. On the other hand, the country's temperature increased between 1980 and 2010, particularly in the second dry season between December and February. The chapter also reveals a connection between climate change and climate variability and socio-economic outcomes. This suggests the possibility that climate change and climate variability could exacerbate the already high rates of poverty, vulnerability and inequality in a country.

Chapter _4___ (pp. __42__ to _84___) of my doctoral thesis cannot be made public on the Internet for (5) years from the date of doctoral degree conferral because that part will be submitted for publication.

Chapter _5___ (pp. _85___ to __109__) of my doctoral thesis cannot be made public on the Internet for (5) years from the date of doctoral degree conferral because that part will be published.

Chapter _6___ (pp. _121___ to __149__) of my doctoral thesis cannot be made public on the Internet for (5) years from the date of doctoral degree conferral because that part will be published.

CHAPTER 7

Conclusions and implications

7.1. Conclusion

Climate change and climate variability are among the greatest threats to global stability and order due to their impending danger on various sectors. With regards to human health, their observed and projected effects are both direct and indirect. The direct pathways include but are not limited to heatwaves associated with respiratory infections and heat-related mortality. Examples of indirect pathways include alteration of disease patterns, resurgence and emergence of existing diseases and emergence of new ones especially in previously uninfected regions. Empirical evidence on the climate-health linkage is however still scanty especially in developing countries, partly due to data unavailability. This dissertation contributes to closing this research gap by empirically examining the health-economic burden of climate change and climate variability in Uganda, a Sub-Saharan African country with limited empirical evidence on the topic.

The analysis is presented in four parts. The first part (chapter 3) provides a detailed descriptive analysis of rainfall and temperature trends for the period 1921-2015. The chapter reveals that notable changes in rainfall and temperature especially in the past three decades between 1980 and 2010. Rainfall in the first rainy season (March-May) reduced while that of June increased, possibly indicating shifting rainfall season from the first rain season to the first dry season. With regards to temperature, the second dry season (December-February) seems to have become hotter during the same period. The second part (chapter 4) analyzes the effect of abnormally low rainfall on the incidence of diarrhea using outpatient and climate data from Teso sub-region of Uganda, a region highly susceptible to weather shocks. The key novelty of this study is the use of actual disease diagnosis from outpatient records as a measure of observed diarrhea cases as opposed to reliance on self-reported illnesses from household surveys. This ameliorates potential recall bias in reporting exposure to diarrheal cases. Regression results indicate that outpatient visits related to acute diarrhea tend to increase during months when rainfall figures are 20% lower than the month-specific 80-year average. It is presumed that the pathway to the observed effect is the reduced availability of safe drinking water during extremely dry months which presents unprotected springs and ponds as inevitable alternative sources.

It is important to note that the above results represent a single region of Uganda; Teso sub-region which has been selected as the appropriate area to establish climate change evidence. Given the fact that the whole country is in amidst of public health crisis due to climate change, it is therefore vital to conduct a nationally representative investigation of the relationship between climate change and climate variability on the one hand and morbidity on the other. The third part (chapter 5) of the dissertation analyzes the relationship between household level exposure to drought and the incidence of illnesses at the individual level using nationally representative household survey data from the Uganda National Panel Survey (UNPS). The results reveal that household members subjected to drought are more likely to report illnesses in general and fever, cough diarrhea and severe headache in particular.

From the economic burden point of view, different reports and published articles have acknowledged the fact that climate change will cause huge financial losses at regional, national and household level. It is expected that the poor – whose ability to cope with the consequences of climate change is limited – will face increased financial burden in the event that weather shocks strike. However, empirical evidence to support the claim is still weak. Therefore, the fourth and final part (chapter 6) of the dissertation explores the financial burden of drought-related morbidity using four waves of the Uganda National Panel survey conducted by the Uganda Bureau of

Statistics between 2009 and 2014. Overall, results indicate that households that report having experienced drought within 12 months of the survey date spend 23-29% more on healthcare relative to those unaffected by drought. Similarly, drought-affected households spend a larger proportion of their budgets on healthcare and less on non-healthcare expenditure, partly supporting the conjecture of resource reallocation away from the latter to supplement the former during and/or after drought.

7.2. Implications

Several implications emerge from the results presented in this dissertation. First, they provide empirical evidence on the micro level impacts of climate change and climate variability. In particular, empirical evidence on the impact of drought on health has been critically lacking in Uganda particularly and Sub-Saharan Africa generally. Providing knowledge on this association is a first step to the incorporation of climate knowledge in healthcare planning processes, including the integrated disease surveillance and response systems. This could help increase the resilience of the health sector, households and individuals to the potential adverse effects of climate change and climate variability. Adequate and precise knowledge on the co-dynamics of climate variables and climate-sensitive infectious diseases could indeed help in better prediction of disease outbreaks and design appropriate response strategies to counter them. Secondly, the finding that diarrhea cases increase during dry months calls for the need to properly plan water resources especially during periods of extreme weather. This also entails sensitization of people to not appropriately manage scarce water resources and improve hygiene practices even during episodes of droughts and water shortage. There is also need to create people's awareness to be on the lookout for certain infectious diseases when droughts are anticipated. This could help households to better prepare for weather shocks by securing precautionary medical supplies and saving funds for the expected increase in healthcare expenditure. Finally, the increase in out-of-pocket healthcare expenditure by drought-affected households implies that such weather shocks could plunge the already poor and vulnerable households into further poverty.

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Appendix

Photos from the field – Teso sub-region

Water vendors

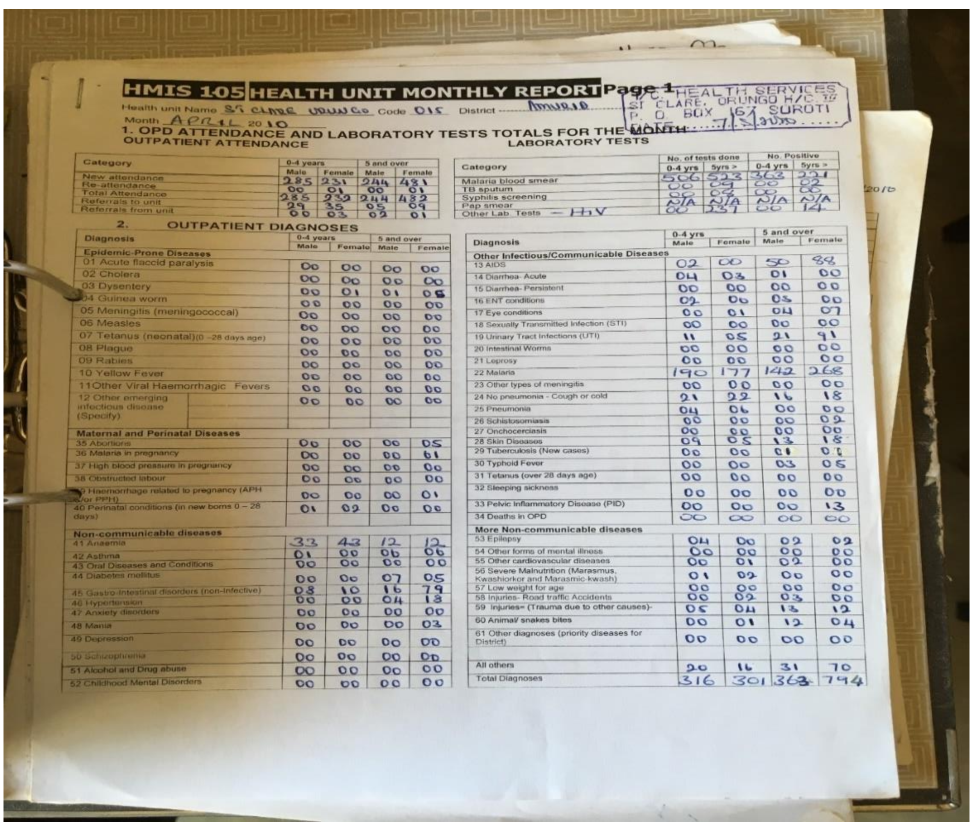
Appendix 1: Vendor going to fetch water for sale

Appendix 2: Vendor carrying jerry cans of water for sale

Collecting outpatient data archives

Appendix 3: Checking through outpatient records

Appendix 4: At Amuria health data office, the lady (biostatistician) helps to retrieve data files



HMIS 105 HEALTH UNIT MONTHLY REPORT Page 1

Health unit Name St. Clare Orungo Code 015 District Amuria

Month April 2010

H/C. HEALTH SERVICES
ST CLARE, ORUNGO H/C III
P. O. BOX 167 SOROTI
DATE 7/5/2010

1. OPD ATTENDANCE AND LABORATORY TESTS TOTALS FOR THE MONTH

OUTPATIENT ATTENDANCE

Category	0-4 years Male	0-4 years Female	5 and over Male	5 and over Female
New attendance	285	231	244	481
Re-attendance	00	01	00	01
Total Attendance	285	232	244	482
Referrals to unit	29	35	05	09
Referrals from unit	00	03	02	01

LABORATORY TESTS

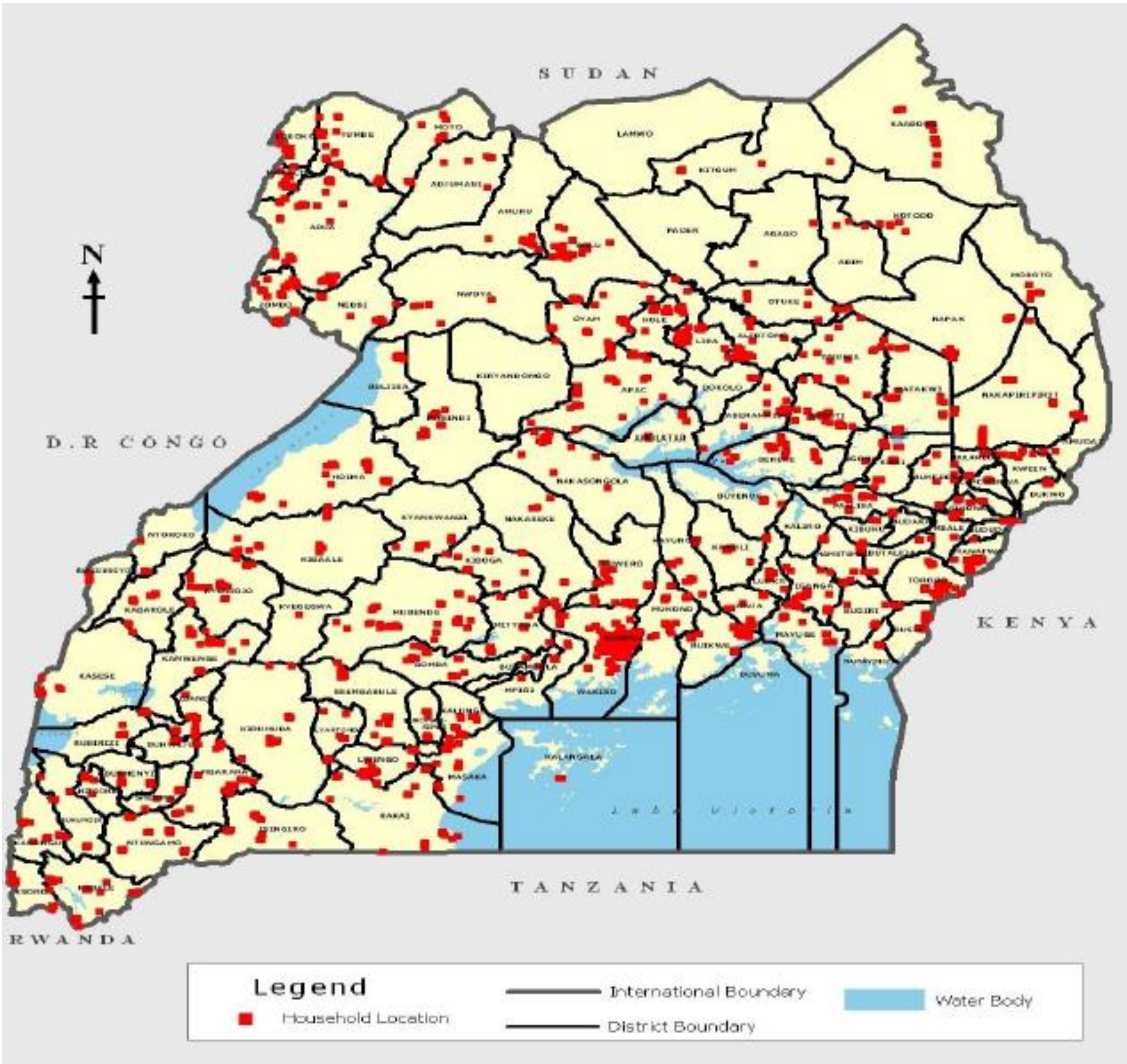
Category	No. of tests done 0-4 yrs	No. of tests done 5yrs >	No. Positive 0-4 yrs	No. Positive 5yrs >
Malaria blood smear	506	523	363	221
TB sputum	00	09	00	02
Syphilis screening	00	04	00	00
Pap smear	N/A	N/A	N/A	N/A
Other Lab. Tests — HIV	00	237	00	14

2. OUTPATIENT DIAGNOSES

Diagnosis	0-4 years Male	0-4 years Female	5 and over Male	5 and over Female
Epidemic-Prone Diseases				
01 Acute flaccid paralysis	00	00	00	00
02 Cholera	00	00	00	00
03 Dysentery	00	01	01	05
04 Guinea worm	00	00	00	00
05 Meningitis (meningococcal)	00	00	00	00
06 Measles	00	00	00	00
07 Tetanus (neonatal)(0 –28 days age)	00	00	00	00
08 Plague	00	00	00	00
09 Rabies	00	00	00	00
10 Yellow Fever	00	00	00	00
11 Other Viral Haemorrhagic Fevers	00	00	00	00
12 Other emerging infectious disease (Specify)	00	00	00	00
Maternal and Perinatal Diseases				
35 Abortions	00	00	00	05
36 Malaria in pregnancy	00	00	00	61
37 High blood pressure in pregnancy	00	00	00	00
38 Obstructed labour	00	00	00	00
39 Haemorrhage related to pregnancy (APH &/or PPH)	00	00	00	01
40 Perinatal conditions (in new borns 0 – 28 days)	01	02	00	00
Non-communicable diseases				
41 Anaemia	33	43	12	12
42 Asthma	01	00	06	06
43 Oral Diseases and Conditions	00	00	00	00
44 Diabetes mellitus	00	00	07	05
45 Gastro-Intestinal disorders (non-Infective)	08	10	16	79
46 Hypertension	00	00	04	18
47 Anxiety disorders	00	00	00	00
48 Mania	00	00	00	03
49 Depression	00	00	00	00
50 Schizophrenia	00	00	00	00
51 Alcohol and Drug abuse	00	00	00	00
52 Childhood Mental Disorders	00	00	00	00

Diagnosis	0-4 yrs Male	0-4 yrs Female	5 and over Male	5 and over Female
Other Infectious/Communicable Diseases				
13 AIDS	02	00	50	88
14 Diarrhea- Acute	04	03	01	00
15 Diarrhea- Persistent	00	00	00	00
16 ENT conditions	02	00	03	00
17 Eye conditions	00	01	04	07
18 Sexually Transmitted Infection (STI)	00	00	00	00
19 Urinary Tract Infections (UTI)	11	05	21	91
20 Intestinal Worms	00	00	00	00
21 Leprosy	00	00	00	00
22 Malaria	190	177	142	268
23 Other types of meningitis	00	00	00	00
24 No pneumonia - Cough or cold	21	22	16	18
25 Pneumonia	04	06	00	00
26 Schistosomiasis	00	00	00	02
27 Onchocerciasis	00	00	00	00
28 Skin Diseases	09	05	13	18
29 Tuberculosis (New cases)	00	00	0?	0[illegible]
30 Typhoid Fever	00	00	03	05
31 Tetanus (over 28 days age)	00	00	00	00
32 Sleeping sickness	00	00	00	00
33 Pelvic Inflammatory Disease (PID)	00	00	00	13
34 Deaths in OPD	00	00	00	00
More Non-communicable diseases				
53 Epilepsy	04	00	02	02
54 Other forms of mental illness	00	00	00	00
55 Other cardiovascular diseases	00	01	02	00
56 Severe Malnutrition (Marasmus, Kwashiorkor and Marasmic-kwash)	01	02	00	00
57 Low weight for age	00	00	00	00
58 Injuries- Road traffic Accidents	00	02	03	00
59 Injuries= (Trauma due to other causes)-	05	04	13	12
60 Animal/ snakes bites	00	01	12	04
61 Other diagnoses (priority diseases for District)	00	00	00	00
All others	20	16	31	70
Total Diagnoses	316	301	363	794

Appendix 5: Copy of Health Information Management System (HMIS) form



Appendix 6: Map of Uganda showing the distribution of Uganda National Panel Survey (UNPS) households

Source: Adopted from UNPS Wave 3 Report (2011)

Section 5: Health

Ask the following questions about all members of the household (usual and regular).

PERSON ID	*INTERVIEWER:* *IS [NAME] ANSWERING FOR HIMSELF OR HERSELF?* 1= Yes (>>4) 2= No	*WHAT IS THE ID CODE OF THE PERSON RESPONDING FOR [NAME]?*	During the past 30 days, did [NAME] suffer from any illness or injury? 1= Yes 2= No (>> NEXT PERSON)	For how many days did [NAME] suffer due to illness or injury during the past 30 days? DAYS	For how many days did [NAME] have to stop doing [NAME]'susual activities due to illness or injury during the past 30 days? *DAYS SHOULD BE LESS THAN OR EQUAL TO COL 5.* DAYS	Can you describe the symptoms that [NAME] primarily suffered due tothe major illness or injury during the past 30 days? *RECORD UP TO 2 SYMPTOM CODES* *SEE CODES AT RIGHT*		Was anyone consulted (e.g. a doctor, nurse, pharmacist or traditional healer) for the major illness/injury during the past 30 days? 1= Yes (>> 10) 2= No	Why was no one consulted for the major illness? *SEE CODES AT RIGHT* [>>NEXT PERSON]	Where did [NAME] go for the first consultation during the past 30 days? PUBLIC SECTOR 1= Government hospital 2= Government health centre 3= Outreach 4= Government Community Based Distributor PRIVATE SECTOR 5= Private hospital 6= Pharmacy/ drug shop 7= Private Doctor/Nurse/Midwife/Clinic 8= Outreach 9= NGO Community Based Distributor OTHER SOURCE 10= Shop 11= Religious Institution 12= Friend/ Relative 13= Traditional Healer 96= Other (specify)	Distance to the place where this treatment was sought for in km? KMS	What was the cost of this consultation, including any medicine prescribed even if purchased elsewhere? SHILLINGS
1	2	3	4	5	6	7A	7B	8	9	10	11	12
01												
02												
03												
04												
05												
06												
07												
08												
09												
10												

CODES FOR COL7
1= Diarrhoea (acute)
2= Diarrhoea (chronic, 1 month or more)
3= Weight loss (major)
4= Fever (acute)
5= Fever (recurring)
6= Wound
7= Skin rash
8= Weakness
9= Severe headache
10= Fainting
11= Chills (feeling hot and cold)
12= Vomiting
13= Cough
14= Productive cough
15= Coughing blood
16= Pain on passing urine
17= Genital sores
18= Mental disorder
19= Abdominal pain
20= Sore throat
21= Difficulty breathing
22= Burn
23= Fracture
96= Other (specify)

CODES FOR COL 9
1= Illness mild
2= Facility too far
3= Hard to get to facility
4= Too dangerous to go
5= Available facilities are too costly
6= No qualified staff present
7= Staff attitude not good
8= Too busy / long waiting time
9= Facility is inaccessible
10= Facility is closed
11= Facility is destroyed
12= Drugs not available
96= Other (specify)

Appendix 7: UNPS Questionnaire – Health module

Source: Adopted from UNPS (2011) Household Questionnaire