JRIIE Journal of Research Innovation and Implications in Education
Center for Research Implications & Practice

Website: www.jriie.com **ISSN 2520-7504 (Online) Vol.4, Iss.2, 2020 (pp. 209-221)**

Effect of Temperature on Food Security in Kassebwera Parish, Butenga Sub County, Bukomansimbi District, Uganda

[1]Henry Stanley Mbowa, [2]Dr. Specioza Asiimwe, [3]Prof. Kaaya Siraje
[1]Kampala University, Uganda
[2]Kampala International University, Uganda
[3]Kabale University, Uganda
Email: mbowa200@gmail.com

Received May 28, 2020; Revised June 4, 2020; Accepted June 12, 2020

Abstract: *Over 800 million people in the world are food insecure whereby 180 (23%) million are found in the Sub Saharan Africa. The study set out to establish the relationship between temperature and food security in Kassebwera parish, Butenga Sub County, Bukomansimbi district, Uganda. The study employed both cross-sectional and descriptive survey designs which included mixed methods data collection approaches. The study targeted 1996 people from whom 322 respondents were determined using Krejcie and Morgan (1970) sample size formula. The study employed both purposive and simple random sampling techniques to select the respondents. Data was collected through observation schedule, interview guide and questionnaire. Data was analysed by SPSS (v.16) and content value analysis. Results revealed that, temperature had effects on food security (β= 0.176) that is, unit improvement in temperature results into 0.176 enhancement in food security. Results show a positive significant relationship between temperature and food security (r = 0.197; p < 0.01). The study recommended that, efforts by respective district authorities should be devoted to activities that promote and maintain ideal temperature conditions, awareness and capacity building on sustainable agricultural practices should be enhanced among the households to adapt to temperature changes and their effects on food security.*

Keywords: *Awareness, Food security, Kassebwera, Temperature, Uganda*

1. Introduction

Food security has been and remains a key issue to address across the globe so as to harness quality of life of the masses and thus this study is built on drought and food security. (Food and Agriculture Organization [FAO], 2006; 2008) note that, all the changes in the global temperatures will have significant impacts on food security in the world. They add that, changes will impact more all the facets of food security such as food availability, food accessibility, food utilization and food system stability. Khalafallah (2006) also explains that, richer societies have more ways of securing livelihoods and those options translate into resilience. He further asserts that, the availability of food on the market is obviously correlated with food security, but the relationship is not absolute, and many other factors act to determine whether an individual can buy, prepare, eat and utilize it efficiently. Smith and Haddad, as cited in Khalafallah (2006) further reveal that, between 1970 and 1995 increased food availability accounted for only about one quarter of the global reduction in child malnutrition. Thus, researchers note that, food production is necessary to eliminate food insecurity, though seldom sufficient.

Regrettably, over 800 million people in the world are food insecure whereby 180 million (23%) lie in Sub Saharan Africa (Anderson, as cited in Lolemtum *et al.*, 2017). In the East African region, drought has resulted into the worst food security crisis. East Africa in 20 years has more than 11.5 million people currently in need for food aid that is Djibouti, Kenya, Somalia and Ethiopia. Worse still, Government of Kenya (GoK) declared an impending drought as a national disaster with an estimate of 1.6 million people affected. Lolemtum *et al.* (2017) add that due to poor performance of rainfall, drought continued to affect both pastoral and marginal agricultural based livelihood zones and the impact on household's food availability as well as livestock productivity and it also resulted into high food prices (Ibid).

In Uganda, from March to August 2016, the El Niño event, resulted into a prolonged dry spell and insufficient rain thus, crop failure and inhibited harvests in various locations (Integrated Food Security Phase Classification Technical Working [IPCTWG], 2017).

The report adds that, forecasted El Niño event was followed by La Niña, potentially exacerbating the already fragile food security situation of millions of Ugandans (Republic of Uganda, 2017). Analyses from remote sensing data showed that, several areas in Uganda are experiencing deterioration in crop and pasture conditions that could have a bearing on crop performance and eventual harvests (Bindhi, 2013). Furthermore, Uganda had recorded an increase in occurrence and magnitude of weather extremes like increased temperatures which led to prolonged drought and erratic rainfall patterns (Bindhi, 2016). He further adds that, the changing weather patterns have made it difficult for farmers to plan for farming seasons using their traditional knowledge about the two planting seasons.

Additionally, poor crop harvests and low food stocks at household level are due to the effect of prolonged dry spells, Nakitende (2016) and crop and livestock diseases. Thus, prolonged drought and its agents like deforestation, insufficient rainfall totals, high temperatures, agriculture and the physical location of the district in the dry belt of Ankole-Masaka dry corridor (Participatory Ecological Land Use Management [PELUM], 2012) continue to pose threats to food security and people's wellbeing. Interestingly, drought as a major cause of food insecurity in the parish is due to deforestation, poor agricultural practices, wetland reclamation and inadequate knowledge on environmental conservation (Ibid). This implies that there are low rates of food security in Kasebwera parish which has been as a result of temperature changes couples with insufficient rains (Nabunya, 2017). Therefore, the research analyzes the effect of temperature on food security in Kasebwera parish.

2. Literature Review

Effect of temperature on food security

The mean global temperatures have been increasing since about 1850, mainly owing to the accumulation of Green House Gases (GHGs) in the atmosphere (FAO, 2008). This has been as a result of the burning of fossil fuels (carbon, coal and natural gas) to meet the increasing energy demand, and the spread of intensive agriculture to meet the increasing food demand which is often accompanied by deforestation. Therefore, the immediate impacts are expected to result from gradual changes in mean annual temperature and rainfall. Evidences indicate that, more frequent and intense weather events like drought, heat and cold waves, heavy storms, floods, raising sea level and increasing inequalities in seasonal rainfall patterns are already having immediate impacts on not only food production but also food distribution, infrastructure, incidence of food emergencies, livelihood assets and human health in both rural and urban areas (FAO, 2008). This implies that, gradual change in temperature will have an effect on land suitability for different crop and pasture growth including adverse impacts on health, and availability good-quality water for crops, livestock and inland fish production.

The impact of mean temperature increase is being experienced differently depending on location (Leff, Ramankutty & Foley, as cited in FAO, 2008), for example, moderate warming (increase 1^{o}C to 3^{o}C in mean temperature) affects crop and pasture yields in temperate regions. However, in Tropical and seasonally dry regions it had negative effects on production of local crops (FAO, 2008). Further, warming of more than 3^{o}C affected crop production in the World's regions. On that note, temperatures and radiation have compromised crop growth and yields for example damages to cereals and fruit trees in the few days of temperature below above the thresholds (Ibid). FAO further reports that increased intensity and frequency of storms, altered hydrological cycles, and precipitation variances also had long term implications on the viability of current Worlds' agro-ecosystems and future food availability. It can be noted that, wild foods are partially important to households which struggle to produce food or secure an income to improve their livelihood status. Thus, with dry and cold weather conditions affecting grains without special infrastructure for protection or immediate treatment, grains with high moisture content (12%-14%) may not be managed during low temperatures.

It is estimated that in 2030 global crop production will be slight up as result of changes in climatic variables like temperature (FAO, 2008; Ministry of Agriculture and Fisheries [MAF], 2016). This will result from the wide spread of decline in temperatures to the extent and potential productivity of crop land. It is reported that, the severest impact of declining temperatures will be felt in the food-insecure areas of Sub Saharan Africa (FAO, 2008). It is important to note that, increasing temperature may cause food quality to deteriorate, unless there is increased investment in cooling and refrigeration equipment or more reliance on rapid processing of perishable food to the existent their self-life. Additionally, results by MAF (2016) revealed that, during difficult situations where food is not enough/ available, families usually eat less preferred foods, sell their animals or other assets to buy food or reduce the meal portion. This implies that, families have to eat saved seeds, borrow money or food from others or ask some help (assistance) from government or donor agencies to meet their daily bread.

Interestingly, changes in land-use driven by changes in increased temperatures or precipitation will alter how people spend their time. This implies that, in some areas, children might have to prepare food while parents work in the field, increasing the risk that good hygiene practices may not be followed. Evidences from across the Continent, suggest that increase in temperature has already had impacts on crop production, and in the absence of sufficient adaptation efforts (Krishnamurthy *et al.,* 2014). They further stipulate that based on the projected temperature changes, some studies suggest that a potential future where South and South East Asia experience losses in suitability for bean production. This

means that beans which are important source of protein in the region, their production reduced which exacerbated malnutrition problems. It is also noted that one of the direct effect of changes in temperature on food access is, it affects its suitability by certain areas for crop production thereby resulting into a significant shift in livelihoods (Yadav *et al.,* as cited in Krishnamurthy *et al.,* 2014). This signifies a substantial shift in agricultural production giving rise to food prices in Asia which is detrimental to the poor households.

Some studies have attempted to quantify the potential impacts of rising temperatures on food prices at a global level (Fischer *et al.,* as in Krishnamurthy *et al.,* 2014). They further suggest that in Asia, food prices are expected to rise moderately in line with moderate increase of temperature after 2050. However, food prices are expected to increase more rapidly as the level of climate change increases (Nabunya, 2017). This assertion is contrary to the trend of evidences in Uganda where improvement in climate variable like rain and temperature have affected food prices leading to very low prices at which the food products are sold (Nabunya, 2017). It is worth noting that, a kilogram of maize dropped from Uganda shilling 700/= to 200/= at farm level (Nakitende, 2016). The same event of price fluctuation is applicable in both regions receiving favorable climatic conditions and harsh climatic conditions (IPCTWG, 2017). This has worsened the situation where people's livelihood has been totally affected. Those in the urban centre are also constrained with food accessibility and availability as well as utilization. The situation has been worsened by farmers refusing to sell their maize at such a very low price hence widening the gap between the rich and people living in poverty in the country.

This implies that low production coupled with increased food prices result into limited access to food especially by people living in poverty have no money (earns no income). Therefore, this is against the FAO's definition of food security which states that,

> *"…food security exists when all people at all people at all times have physical or economic access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, as cited in FAO, 2018)..."*

It is also not in accordance with FAO's vision,

> *…"a world without hunger is one in which most people able, by themselves, to obtain the food they need for an active and healthy life, and where social safety nets ensure that those who lack resources still get enough to eat" (FAO, 2007f, as cited in FAO, 2008)….*

Furthermore, the people living in poverty will spend little income more on purchasing food which will be of poor quality, hence stimulating malnutrition among the family members. Weather changes affect rural incomes, and since farmers/ communities depend on activities (farming and livestock) which rely on a reliable rainfall pattern, any change in climate variables could affect the income earning potentials for rural livelihoods. Fluctuating yields and crop losses on a long term and irregular basis threaten smallholder farmers' household incomes perpetuating the viscous cycle of poverty and distress (Krishnamurthy *et al.,* 2014; MAF, 2016). Thus, with such low incomes, farmers have a low purchasing power for food and invest on their farms and they are more vulnerable to weather shocks. These entirely will have adverse significant impact on food security (accessibility). McMicheal *et al.* & Patz *et al.* (as cited in Krishnamurthy *et al.,* 2014) affirm that climate change is linked to health both through changes in nutritional needs and impacts on nutrients absorption. For example, higher temperatures exert additional stress on people who are affected by diseases and nutritional requirements increase as a result. Climate change also affects sanitation systems, water quality and water availability.

Studies from Philippines and Asia by D'souza (as cited in Krishnamurthy *et al*., 2014) gratified the relationship between high temperature and common forms of food poisoning: Salmonellosis maclene, for example increase healthy for each degree increase in temperature. Further, in Philippines, increase in temperature was associated with increased episodes of diarrhea in adults. Several studies report a strong correlation between monthly temperature and diarrhea episodes (Krishnamurthy *et al.,* 2014). They further note that diarrhea, acute respiratory infections, measles and meningitis are all major food security and malnutrition related diseases. Such disease outbreak increases the nutritional needs of people living in poverty while reducing absorption of nutrients and their utilization in the body. With emphasis on the statement, scholars have reported several diseases which result from changes in temperature focusing on human diseases but forgot those pests and diseases which result and affect crop and animal growth, a basis for food security. For example, the emergence of Farry Army Worms (FAW) that emerged in Uganda due to the El Nino and La Nino of 2015/2016 (IPCTWG, 2017). This affected crops like maize, sorghum and millet, lowering the quality and quantity. This further lowers the production potentials from the farmlands which are still problem in Uganda and the Continent. Therefore, this was in position to identify and present the common crop pests and animal diseases that emerge as a result in temperature and affect crop and animal growth and production.

This concurs with the MAF (2016) which indicates that in Republica Democratica De Timor-Lestle, 48% of households reported sickness and death of their animals due to drought parameters like temperature. For example 70,017 animals died while 69,921 animals got sick resulting into an estimated loss of US Dollars 13,101,373 and 13,083,412 respectively in 2016. FAO (2008) claims that, there will be increase in mean temperatures and precipitation manifest not only through constant gradual changes but will instead be experienced as increased frequency, duration and

intensity of hot spells and precipitation events. It is also claimed that, annual occurrence of hot days and maximum temperature are expected to increase in all parts of the globe. In this case, the wet regions will become wetter and dry regions become drier.

Moreover, changes in the global temperatures will have significant impacts on food security in the world (FAO, 2008). The changes will impact more all the facets of food security such as food availability, food accessibility, food utilization and food system stability. This signifies that food security (access) will be a problem in the entire world in the future especially to the regions experiencing temperature changes. This implies that, when the situation worsens and the cost of food rises, those who earn/ have low incomes may fail to have access because not being available. Such consequences may affect the nutritional status of the people thus lowering their immunity, hence death. This implies that there is a need for appropriate sustainable development strategies ensure food security throughout the world (FAO, 2006). Food security has been compromised as a result of increase in temperature hence its deterioration. Therefore, food stability has been affected mostly as a result of decreased water availability. This means that there are low rates of food processing and cooking methods adapted in some areas.

FAO (2016) states that,

> *"the effects of climate change evidenced by high temperatures, more extreme weather events, water shortage, rising sea level, ocean acidification, land degradation, the destruction of ecosystem and loss of biodiversity have seriously compromised agriculture's ability to feed their most vulnerable population, impending progress towards the eradication of hunger, malnutrition and poverty."*

The report adds that, agriculture is being adversely affected by rising temperature, increased temperature variability, changes in level and frequency of precipitation, after a greater frequency of dry-spell and droughts, the increasing intensity of extreme weather, and the salinization of arable land and fresh waters (Ibid). This implies that, it becomes increasingly difficult to grow crops, raise animal, manage forests and catch fish, consequently, impacting more on food security in the regions experiencing such vulnerable of temperatures. However, it can be noted that, warmer temperatures may benefit the growth of certain crops, but if temperature exceed a crop optimal level, or if sufficient water and nutrition are not available, crop yields may fall (FAO, 2016). Fascinatingly, more extreme temperatures combined with decreasing rainfall, can present crop from growing at all. From that perspective, warmer temperature result in extinction of fish species, a shift in the habitat ranges of others and increased risks of diseases throughout the production chain.

Evidences show that, the more the impacts high temperatures on agricultural production in the World's regions, then lower in production of crop yields, fish stocks reduce and animal health. This lowers too people's incomes and their ability to access food hence an impact on their nutrition and people living in poverty are affected most (FAO`, 2006; FAO, 2008; FAO, 2016). This stipulates that, impacts of temperature changes are felt on food utilization for better nutrition. In this case, pathogens develop and water scarcity emerges, all which affect the water quality and hygiene habits hence resulting into more water borne diseases. The reports further reveal that, weather events pressurize on food stability, food availability, food access and food utilization through changes in seasonality, fluctuations in ecosystem productivity, increased supply risks and reduced supply credibility. A study by World Bank (Hallegate *et al.,* as cited in FAO, 2016) estimates that, in absence of economic growth, high impacts of climate variability would increase the number of extremely people living in poverty in 2030 by 122 million people; in a scenario of prosperity, the increase would be just 16 million. He adds that in 2050, about 5o million more people could be at risk of undernourishment because of climate change impacts evidence by high temperatures.

In a meta-analysis by FAO (2016) found out that, reductions in water availability and increases in the lengths of dry spells accelerate between 1.5^0C to 2^0C in the sub-tropical regions. In these regions, agricultural production will strongly be affected if temperature increases beyond 1.50C, and even more so if other factors like nitrogen and phosphorous limitations or heat stress contain the positive effects of carbon dioxide fertilizers. Schleussner *et al.,* as cited in FAO, 2016) clarify that, under 2^0C warming, the risk posed by extreme heat to crop yields in tropical regions is critical. It was agreed in 2015 by expert dialogue of United Nations Framework Convention on Climate Change (UNFCCC) that, an increase in the global temperature of 2^0C above pre-industrial levels is an upper limit, a defense line that needs to be stringently defended, while less warming would be preferable (UNFCCC, as cited in FAO, 2016) and impacts of climate change on crop yields.

In Uganda for example, it is reported that warmer temperatures are already changing rainfall patterns, causing snow and ice to melt in some parts of the country and droughts in other parts (Climate Sense, 2011). It is noted that, land is now dry which was wet before and floods are becoming common. It is also evidenced that, there are emergency of water shortages in Teso, Soroti and Karamoja due to high temperatures coupled with droughts. In some areas too, it has resulted to heavy downpour leading to the emergency of floods and landslides for example in Kabale in 2009 and Bududa in 2010 (Ibid; Government of Uganda [GoU], 2017). With such consequences, a total of 300,000 people were affected including losing their families and relatives, homes and crops (GoU, 2017). Thus, these demisfying catastrophes resulted into loss of foodstuffs

as well as lowering people's income hence affecting food security in the affected regions in Uganda.

The 2015/2016 El Nino events seriously impacted in the Eastern, Central and Western regions on Uganda of Uganda, 2017). In these areas especially the cattle corridor, reported massive crop failure, leading to little or no harvest resulting into an evolving food crisis. The report further stipulates that, the government's early warning system shows 25% of the Ugandan population was experiencing severe shortage of food. This was partly due to the delayed and short lived rainfalls which deteriorate the country's food security. Therefore, this implies that, high temperatures had been stimuli to sudden income shocks which have adverse significant effects on both the quality and quantity of food consumed in households depend on agriculture-related jobs. A study on Climate Change and food security in Ghana by Akudu & Alhassan (2013) revealed that, the impacts of climate change such as droughts and prolonged dry spells affect agricultural production as well as food and nutrition security. It is also noted that, there are likely to be increase in temperatures and change in rainfall patterns all of which affect agricultural production and food security in the country. The extreme weather events like droughts, prolonged-dry spell coupled with the global production increase leads to food demands to exceed global food supply which further escalates onto other issues like migration, domestic violence and theft/ murder. This explains that, all the above pose threats to food security and livelihoods among households in the communities of Uganda and the world at large.

Akudu & Alhassan (2013) confirm that, in Northern Ghana, food availability is affected through reduced production due to crop losses as a result of droughts, and floods as well as crop and livestock diseases triggered by extreme weather events. Amusingly, in Africa, food accessibility depends on the market and non-market distribution mechanisms which are at the mercy of favourable climate. Consequently, the capacity of individuals and households to buy food may be significantly reduced as incomes for the farmers in developing countries depends mostly on the capacity to sell surplus production. Therefore, in areas where temperatures are too hot or too cold, availability of certain food products also change the prices. This implies that with such, those smallholder farmers are not protected and social safety nets such as insurance schemes may suffer from changes in market price (Akudu & Alhassan, 2013). It can further be noted that too low market prices results into low incomes and if too high, farmers may fail to sell their produce.

Results computed by Aggarwal (as cited in Kaur, 2017) indicate that, there can be a 3% to 7% decrease in the production of wheat, soya bean and potatoes dues to a 1^{o}C rise in temperature. Predictions show that there will be a rise in temperature from 2.5^{o}C to 4.5^{o}C by the 2099 which would lead to 10 to 40% destruction of crops. IPCC as cited in Kaur (2017, p.14) adds that, forests show that, there is 2 to 5 percentage change in wheat production in India for a rise in temperatures between 0.5^{o}C to 1.5^{o}C. A study by Khan *et al.* (as cited in Kaur, 2017) reveal that, there has been predictions on the possibility of occurrence of extreme weather conditions by 2070. They add that, the average temperatures during Karif and Rabi cropping seasons are expected to rise till 2070 by 0.4^{o}C to 2.0^{o}C and 1.1^{o}C to 4.5^{o}C respectively. These changes in temperatures would in turn have a huge impact on the production of rice and wheat by 2060 which would in turn affect the livelihood and food security of one million people in India. Additionally, such temperature changes may not affect India and the Asian Continent alone but the consequences would be felt by countries in the other Continents of the World.

Finally, we would to keep in mind that, the above explained factors and statistics from the literature have had a serious magnitude impact on food security. Therefore, we call on communities and governments to mitigate the effects of temperature on food security.

3. Methodology

3.1 Study Area

The Map represents the villages where the study was carried out in Kassebwera Parish. Kassebwera parish was considered for the study because it was one of the parishes seriously hit by food insecurity due temperature changes Butenga Sub County. The villages from which the respondents were sampled included; Buyovu, Gayaza, Kakukuulu, Kanyogoga, Kassebwera, Katoma, Kawaala, Kikondeere, Kiryamenvu and Nkalwe as indicated in 3.1:

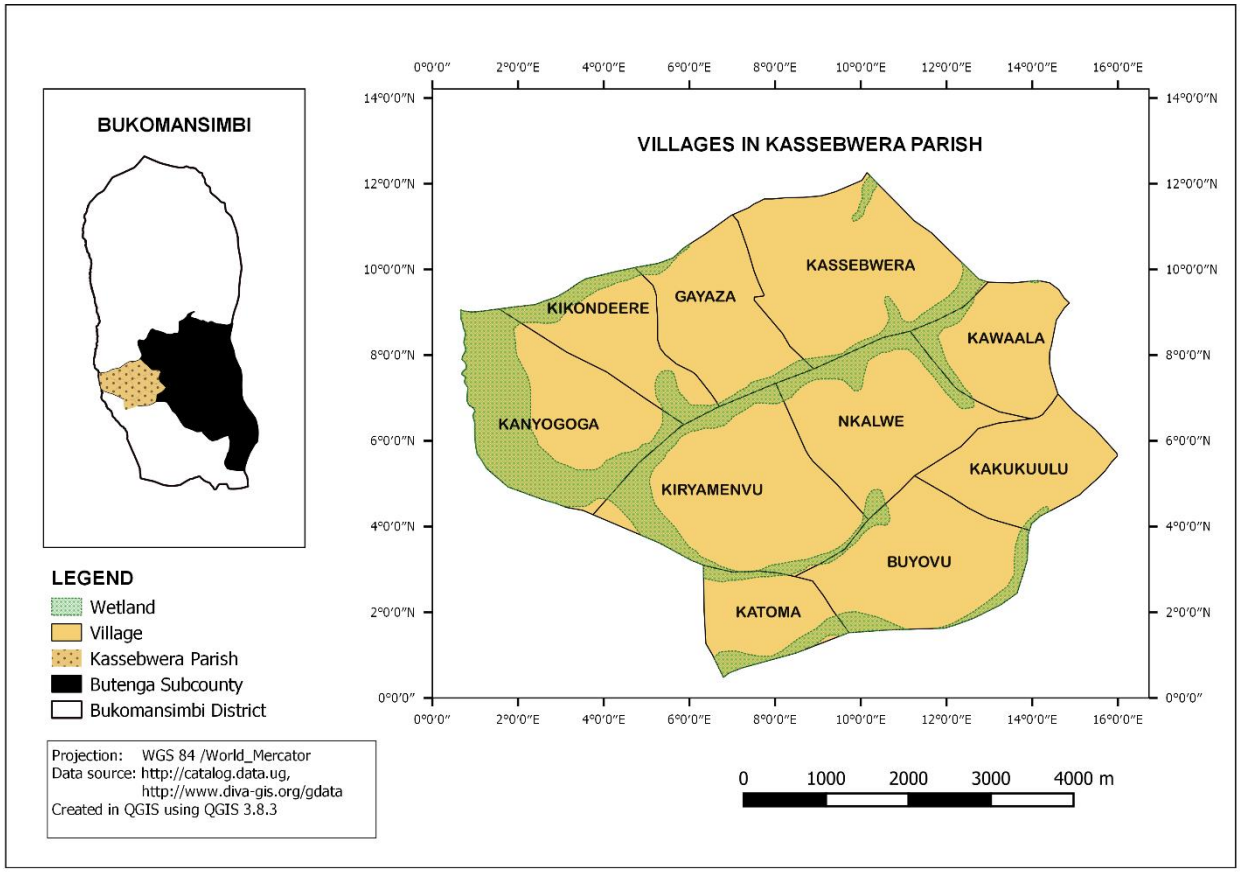

Fig. 1: Location of Kassebwera parish in Butenga Sub County, Bukomansimbi district

Source: http://catolog.data.ug, http://www.diva-gis.org/data. Created in QQGIS 2.18, 2019

3.2. Research design

The researchers employed cross-sectional and descriptive survey designs to assess the association between temperature and food security in Bukomansibi district of Uganda. In the study cross-sectional and descriptive survey designs were used to assess the adjustments to the farmers and community members in the area. The cross-sectional and descriptive survey designs were employed to yield a large amount of data at a point in time from a sizeable population in an economic way. Thus, this enabled the researchers to generalize results for the entire population. The designs allowed the collection of both qualitative and quantitative data which was analyzed using descriptive and inferential statistics.

3.3. Study Population

This is the total number of objects of interest to the researcher from which a preferred sample is drawn (Oso & Onen, 2005; Bailey, 2012). The study targeted a total of 1996 people who included farmers (crops & animals) (1881), administrators (17), Financial manager (17), Office of the Chief Administrative Office (4), District planners (5), Natural resources officers (15), Health Services Officer (12), Community based services officers (8), Religious leaders (10), NGOs officers (15), LCIII Chairperson (1), Parish officer (1) and LCI Chairpersons (10). Therefore, the study targeted various people (stakeholders) due to sensitivity of the problem under investigation and the relevancy of the study findings not excluding the gender factor.

3.4. Sample size

A sample of 322 respondents was selected to participate in the study. The sample size was calculated using Krejcie and Morgan 1970 sample size calculation formulae as indicated below:

$s = X^2NP\ (1- P) \div d^2\ (N -1) + X^2P\ (1- P)$, where;
s = Sample size
X^2 = Chi-square value for 1 degree of freedom at the desired confidence level, (3.841)
N = Population size
P = Population proportion (assumed to be .50, as it provides the maximum sample size)
d = Degree of accuracy expressed as a proportion (.05)
Therefore, $X^2NP\ (1- P) \div d^2\ (N -1) + X^2P\ (1- P)$
$= 3.841x1996x0.5 \div (0.05)^2(1996-1) +3.841x0.5\ (1-0.5)$
$= 1916.659 \div 5.94775 = 322.249$
Therefore, the sample size for the study was 322 respondents

3.5 Sampling procedures

The researchers employed both purposive and simple random sampling techniques to select the respondents based on their knowledge, competences and experiences to provide crucial information presumed vital to the study. Purposive sampling technique helps to collect first hand from the specific respondents for example, effect of temperature, food security, costs of food products from the respondents (Ahuja, 2005; Creswell & Plano, 2011). In addition, the technique is economical in nature, minimizes time wastage and provides reliable information to the study (Kothari, 2004). Therefore, the technique was used to collect data from the key informants that is; CAO, Administrators, Local Councils officers, NGOs, District Planning Unit, Health services officers, Community based services providers and Finance controllers.

On the other hand, simple random sampling technique was used to select respondents to participate in the study. In the study, simple random sampling technique was employed as a qualitative approach to eliminate bias through giving each respondent a chance of being selected to participate in the study. Simple random sampling technique is a strategy that, adds credibility to a sample when the potential purposeful sample is larger than one can handle. Additionally, in case of small sample size, the goal was credible, not representative hence, the ability to generalize research findings.

3.6 Data collection methods/ instruments

3.6.1. Interview

The researchers employed an interview guide as a tool to elicit information from the respondents. An interview is a proposed discussion between two or more people (Kaln & Cannell as cited in Saunders, Lewis & Thornhill, 2007). In the study, key informants' interviews were conducted to the respondents with knowledge and experience to provide local facts, attitude & beliefs on temperature and food security. Interviews were chosen to provide valid and reliable data. However, for this study, researchers employed semi-structured and in-depth interviews to collect qualitative data from respondents. For this case, questions varied depending on data required, and the researchers recorded responses using various recorders such as phones and note books. In order to obtain more information from the respondents, the researchers probed more from the respondents through unstructured interviews (informal). Accordingly, the researchers conducted interviews with specified respondents (key informants) based on the set questions but with predetermined answers. The researcher ensured an appropriate time frame for the interviews, gender and avoided annoying statements on the side of the interviewees.

3.6.2. Questionnaire

The researchers used a questionnaire as a tool to collect information from the sampled respondents. A questionnaire is a data collection tool where the person answering the questions actually records his or her own responses (Kevin, as cited in Saunders, Lewis & Thornhill, 2007). The questionnaire was used as an efficient tool to collect responses from a larger sample prior to quantitative data. Using the self-administered, the researchers designed and delivered the questionnaire by hand to the respondents who were unable read and write as per the specified and agreed time. The questionnaires were filled by the respondents according to his/her convenience. The questionnaire included both close-ended and open-ended; the close-ended questions were ranked on a five (5) likert scale that is 1-Strongly Disagree, 2-Disagree, 3-Neatral, 4-Agree and 5-Strongly Agree and the opinions from the respondents were gathered as specified. In addition, open-ended questions captured information from both independent and dependent variables of the study.

3.6.3. Observation

The researchers employed observation guide as a tool to collect information on the affected crops, households, plants, animals and environment. Observational data are the information collected through observing directly what is happening (Stake, 2010). ACF (2010) adds that, direct observation is an integral component of a transect walk. In the study, the researchers employed direct observation because of its importance in observing valuable insights in the environmental and social context in the study. To collect data using the tool, a transect walk throughout the parish to observe the elements as per the tool. Thus, the observation schedule was useful in gathering additional and sensitive information without talking to anyone affected by changes in temperature. The researchers observed elements affected by changes in temperature (plants, animals, water bodies, and vegetation), malnourished children, poverty hit households and the environment. During observation, focus was on crops, livestock, local surroundings, living conditions and interactions between the people. An observation schedule was designed to collect observable data and also to aid its analysis.

3.7. Reliability and validity

3.7.1. Reliability

Reliability refers to the consistence of research instruments (Arya *et al*., 2002; Kothari, 2004; Amin, 2005). Before administering the questionnaire and other tools, sampling procedures were by the experts more than two times (tests) for a two-day period to establish the problems with specific questions, test household selection procedures and receive constructive criticisms. Thereafter, the researchers conducted a pilot study to ensure reliability through administering the questionnaire to the respondents two times at different

intervals. The researchers ensured that the respondents answer the questions like in the main study. Later, the responses were calculated with a statistical test of Cronbach Alpha test reliability. Thus, variables with at least Cronbach Alpha of 0.7 from the two sets of data were considered reliable.

Table 1: Reliability Statistics

S/N	Variable	Number of items	Cronbach Alpha(α)
1	Temperature	27	0.754
2	Food Security	20	0.757

Source: Pretest Field Data (2019) as extracted from SPSS

3.7.2. Validity

Validity refers to the extent to which an instrument measures what it claims to measure (Arya *et al.*, 2002; McQueen & Krussen, 2002) or concern to whether the variable is the underlying cause of item co-variation (Devillis, 2003). This implies that, respondents are less likely to complete and return questionnaires perceived to be inappropriate. Consequently, to ensure validity, the researchers discussed the questions with the before forwarding them to experts on climate change and food security for verification. This cleared ambiguities caused by the instrument and the experts assisted to refine the instruments focusing on study objectives and content validity index was computed through;

CVI = No. of items rated relevant ÷ Total No. of items in the instrument

Thus CVI = 50/68 = 0.735

3.7. Data analysis

Quantitative data collected through the questionnaire were organized, coded and entered into SPSS Software (Version 16) for cleaning and analysis to generate descriptive and inferential statistics. Data analyzed helped to establish the relationship between temperature and food security. This was achieved through the use of Pearson product correlation coefficient and regressions analysis. Qualitative data was transcribed as per the observation schedule and interview guide used to collect it from the respondents. Data from the respondents was grouped into subthemes and categories to attach meanings until the final viewpoint was reached. Thus, the researchers used content analysis techniques to analyze data gathered through interview and observation. The content analysis examined the intensity with which certain words used, implying that, for effectiveness of total responses from instruments are classified and recorded into pragmatic content matrix (Komb & Tromp, 2006) and aid the practice.

4. Results and Discussion

4.1. Results

Effect of temperature on food security in Kassebwera Parish

This was based on the objective of the study, "to analyze the effect of temperature on food security in Kassebwera parish". This was accompanied with a research question, "What is the effect of temperature on food security in Kassebwera parish?" Therefore, all these were answered through a series of questions, and these were rated on 5 point Likert scale ranging from Strongly Disagree (SD) =1 to Strongly Agree (SA)=5, and the results are indicated in Table 2:

Table 2: Effect of temperature on food security

Statement	N	Min	Max	Mean	Std. Deviation
Temperature affects food security	187	1	5	4.21	.729
Hot temperature affects food availability	187	1	5	4.41	1.134
Hot temperature affects food access	187	1	5	4.57	.687
Hot temperature affects food utilization	187	1	5	4.05	.418
Warm temperature affects food availability	187	1	5	4.00	.402
Warm temperature affects food access	187	2	5	4.10	.352
Warm temperature affects food utilization	187	1	5	4.00	.440
Cold temperature affects food availability	187	1	5	4.13	.495
Cold temperature affects food access	187	3	3	3.00	.000
Cold temperature affects food utilization	187	1	5	2.71	1.408
Valid N (listwise)	187				

Source: Study Findings, 2019

Results presented in Table 2 above show that the respondents agreed that, temperature affects food security (Mean=4.21; Stdev=.729) in Kassebwera parish. Further, the respondents agreed that, hot temperature affects all the facets of food security that is food availability (Mean=4.41; Stdev=1.134), food access (Mean=4.57; Stdev=.687) and food utilization (Mean=4.05; Stdev=.418). More to that, the respondents agreed that, warm temperature affects all the parameters of food security for example, food availability (Mean=4.00; Stdev=.402), food access (Mean=4.10; Stdev=.352), and food utilization (Mean=4.00;

Stdev=.440). Moreover, the respondents agreed that, cold temperature affects food availability (Mean=4.13; Stdev=.495) in the parish, but when asked whether cold temperature affects food access they were neutral with a mean of 3.00 and a standard deviation of 0.000 while respondents were relatively neutral on whether cold temperature affects food utilization or not (Mean=2.71; Stdev=1.408).

Correlation between Temperature and Food Security

The study established the relationship between temperature and food security, and the results showed that there is a positive significant relationship between temperature and food security with a coefficient of ($r = 0.197^{**}$; $p < 0.01$) as summarized in Table 4.2:

Table 3: Temperature and Food Security

Variables		Temperature	Food Security
Temperature	Pearson Correlation	1	.197**
	Sig. (2-tailed)		.007
	N	187	187
Food Security	Pearson Correlation	.197**	1
	Sig. (2-tailed)	.007	
	N	187	187

*****. Correlation is significant at the 0.01 level (2-tailed).***

The results in Table 3 above further indicate that a unit change in temperature results into a 0.197 change in food security hence implying that the association between the two variables is weak.

Therefore, the study rejected the Null Hypothesis that is, *there is no significant relationship between temperature and food security in Kassebwera parish* and accepted Alternative Hypothesis, that is, *there was a significant relationship ($r = .197^{**}$; $P<0.007$) between temperature and food security in Kassebwera parish. This was so, because the P-value was less that the correlation value. This implies that, what sought to be wrong was later found to be correct as a result of a statistical test. Therefore, temperature had a relationship with food security in Kassebwera parish.*

4.2. Discussion

Effect of temperature on food security

Results indicated that the respondents agreed, temperature affects food security in the area. This perhaps is true because as weather patterns change, they hinge on agricultural activities which are sources of food for the households. Temperature as measured by its hotness, coldness and warmness as per this study, affects food supply availability, access and utilization. The results are in agreement with FAO (2016) which stipulates that, effects of temperature changes are felt on food utilization for better nutrition. Thus, in this case, pathogens develop and water scarcity emerges, all which affect the water quality and hygiene habits hence, resulting into more water borne diseases. The results agree with the study by World Bank (Hallegate *et al.*, as cited in FAO, 2016) which estimated that, in the absence of economic growth, high impacts of climate variability would increase the number of extremely people living poverty in 2030 by 122 million people; in a scenario of prosperity, the increase would be just 16 million. This meant that, as the population increases, the more the pressure on land and other natural resources which support agricultural activities for generating enough food available and accessible by the communities. Additionally, the prolonged dry-spell will significantly accelerate temperatures and results in water availability with is crucial for agricultural production in various regions (FAO, 2016).

Interestingly, when the respondents were asked, "hot temperature affects food availability, they agreed with a mean of 4.41 and standard deviation of 0.729. The results ascertain that, hot temperature has an adverse significant effect on food availability in the area. This agrees with MAF (2016) which revealed that, during difficult situations where food is not enough/ available, families usually eat less preferred foods, sell their animals or other assets to buy food or reduce the meal portion. This implies that, hot temperatures affect the soils moisture and dry-up of water sources of which agriculture depend. Based on field observation, hot temperature had affected seriously banana plantations, maize and bean which were the main source of food in the area.

The respondents further claimed that, the hot temperature affected their animals like goats, cows and pigs, thus lowering supply of milk which was crucial for body metabolism and functioning. The results also agreed with MAF (2016) which indicated that over 70,017 animals died while 69,921 animals got sick resulting into an estimated loss of USD 13,101,373 and 13,083,412 respectively in 2016 as a results of hot temperatures. One of the respondents reported that between February and April, she lost four acres of bananas and cassava due to hot temperature, she added that when his *shamba* dried-up, she had no food and income too, to support her family both socially and economically. The finding concur with Krishnamurthy *et al.* (2014) & MAF (2016) who asserted that, with low incomes, farmers had a low purchasing power for food and investment on their farms and they were more

vulnerable to weather shock. It was reported that, due hot temperature which made food unavailable to the households, it meant that, families had to eat saved seeds, borrow money or food from others or asked some help (assistance) from government or donor agencies to meet their daily bread.

More to that, the respondents agreed that, hot temperature affected food access. This implies that, in cases of hot temperatures in any given region, access to food becames a menace. Respondents noted that during the period of intense heat they had no access to food for their families. This was as a result of the effects of hot temperatures on crop gardens. One of the respondents noted that, "*I had the money to buy the food but I had no access to it unavailable in the community"*. This meant that, to get food for the family, you had to move a long distance to access the food. Those people who had to move and search for food from other communities, they had to undertake an opportunity cost of their activities. Limited access to food resulted into significant impacts to health and disposable income, hence disease out-break and poverty among the households. In addition, diseases coupled with hot temperatures worsened food access as supply for labour reduced and even the planted crops could not survive the intense heat hence low/unreliable food production. The results concur with Krishnamurthy *et al.* (2014) who explained that, variable weather patterns and extreme climatic events could affect households' ability to access food through increased food prices and impact on livelihood activities. It was further noted that, one of the direct effect of changes in temperature on food access is, it affects its suitability by certain areas for crop production thereby, resulting into a significant shift in livelihoods.

Respondents further agreed that, hot temperature affects food utilization. It was noted that food utilization is crucial to the functioning of human body as it also increases immunity against diseases. When food is properly utilized, it ensures better health and hard work. Unfortunately, in certain circumstances, where there is no proper use, hard work cannot be exercised. Respondents asserted that, due to hot temperatures their crops dried-up, animals died which limited food available for use by households. This implies that people depended on unbalanced diets, poor quality food and eating a single meal a day. Thus, this results into disease outbreak, and hinders nutritional needs of people living in poverty while reducing absorption of nutrients and their utilization in the body (Krishnamurthy *et al.*, 2014). Some respondents clarifies that, due to intense heat/hot temperatures, household relied on eating raw mangoes, cocoyam and yams which had low nutrients but eaten for just survival. This is clarified by FAO (2018) who asserts that, people living in poverty would spend his or her little income on purchasing poor food quality, hence stimulating malnutrition among the family members. This further reveals that, the changes would impact more on all the facets of food security such as food availability, food accessibility, food utilization and food system (FAO, 2008).

More so, the respondents agreed that, warm temperature affected food availability. Warm temperature affects the rainfall formation and patterns which are key for crop growing, and supports food availability. Climate Sense (2011) reported that, warmer temperatures are already changing rainfall patterns, causing snow and ice to melt in some parts of the country and droughts in other parts. Further, warm temperature results into too much rains (torrential rains) which once in a while and cause serious damage to the crops and animal as well as houses and other property. In some areas too, it has resulted to heavy downpour leading to the emergency of floods and landslides for example in Kabale in 2009 and Bududa in 2010 (Climate Sense, 2011; GoU, 2017) and all these resulted into loss of food and property to the community. This implied that, food availability become a serious problem to such areas, due to loss of foodstuffs. However, moderating warming (increases of 1^{o}C to 3^{o}C) is expected to benefit crop and pasture yields in temperate regions, hence leading increase supply of food production and making food available to the household. Akudu & Alhassan (2013) also confirm that, in Northern Ghana, food availability was affected through reduced production due to crop losses as a result of droughts, and floods as well as crop and livestock diseases triggered by extreme weather events.

Furthermore, the respondents agreed that, warm temperature affects food access by households in the area. It was revealed that, warm temperature may results into torrential rains in certain places and make road impassable to bring food closer to the people. On the other hand, heavy rains as a result of warm temperatures had impacts on food crops which lowered food accessibility. It was further revealed that, warmer temperatures might benefit the growth of certain crops, but if temperature exceed a crop optimal level, or if sufficient water and nutrition are not available, crop yields may fall, FAO (2016) which creates a danger for food access. Evidences indicate that, more frequent and intense weather events like heavy storms, floods, raising sea level and increasing inequalities in seasonal rainfall patterns are already having immediate impacts on not only food production but also food distribution, infrastructure, incidence of food emergencies, livelihood assets and human health in both rural and urban areas (FAO, 2008).

Fascinatingly, the respondents agreed that, warm temperature affects food utilization. Results implied that, warm temperature affect the ways in which food is being used. As indicated above that, warm temperature influences heavy rains/storms, which affect infrastructure, gardens, mobility of cars transporting foodstuffs where they are demanded. The results agreed with GoU (2017) who affirms that, demisfying catastrophes resulted into loss foodstuffs as well as lowering people's income hence affecting food security especially it utilization in the affected regions in Uganda.

Respondents reported that, though, warm temperatures result into torrential rains, the case is different in our

area. Therefore, respondents revealed that, food utilization is still a challenge because the roads which connect to Kassebwera parish becomes impassable when it rains and food is not brought near the community. It was revealed that, people ate a single meal in a day and no chance for having a balanced diet for improving their nutritional status. Intergovernmental Panel on Climate Change (IPCC, 2007) adds, the rise in the sea water and increase in precipitation levels, higher chains of flooding may lower the capacity of food utilization by giving rise to numerous nutritional diseases. Further, it is reported that, El Nino had harmed crop and livestock production and agricultural livelihoods across the Globe, threatening food security and nutrition of 60 million people (FAO, 2016).

Additionally, the respondents agreed that, cold temperature affected food availability. The cold temperature and dry conditions which have negative impacts for crop growth hence lowering food availability in the area. It was reported that, the cold temperature does not influence the growth of the crops, implying that they take a long time to reach the consumption stage. Thus, FAO (2008) claims that, with dry and cold weather conditions affecting grains without special infrastructure for protection or immediate treatment, grains with high moisture content (12%-14%) may not be managed during low temperatures. This further asserts that storage of harvests becomes hard as the weather does not favour the drying of crops, hence limiting their storage for future availability and use.

Further still, when asked whether, "cold temperature affects food access," the respondents remained neutral. The results simply implied that, the respondents were not aware of the effects of cold temperature on food access. Cold temperature significantly affects food access because it does not favour safety storage of harvests. It revealed that, the longer the duration for a plant to grow, the easier it is affected by the changing weather patterns. For this case, the unfavorable conditions set in before the crops are mature to provide access to food to be used by a household. Therefore, in areas where temperatures were too hot or too cold, availability of certain food products also changed the prices which limited their accessibility. This means that, with such, those smallholder farmers are not protected and social safety nets such as insurance schemes may suffer from changes in market price (Akudu & Alhassan, 2013).

Lastly, the respondents agreed that, cold temperature affects food utilization. The researchers note that, the utilization of food depends on food availability and access. In areas where temperatures are favourable, food would be available and accessible by the household. However, food maybe available and accessible but, poorly utilized due to household's ignorance and family size. The cold temperature limits availability and access of food, and the households had not been unable to utilize the food. One of the respondents noted that,

> *"…despite of the cold temperatures limiting food utilization, the strongest factor limiting food usage in the community was ignorance on how to prepare and eat the food. Another respondent stated that, for us here were are used to eating a single type of food, because we lack the knowledge on how to prepare and eat the food…"*

5. Conclusion and Recommendations

5.1 Conclusion

The study concluded that temperature is measured by three parameters that cold, hot and warm of which all have had adverse effects on food security (food access, availability and access) in Kassebwera Parish. However, these parameters affect food security differently; cold temperatures limit food security in the way that they hinder crop growth, ripening and drying of food products (harvests).Warm temperature results into torrential rains in certain places which make the roads impassable hence a hinderance to bring food products near to the people. Further, torrential rains impact on plant growth hence an effect on food security. Such rains also lead to rotting of the harvests before reaching market places due to impassable roads. On the other hand, intense hot temperatures limit access to food requirements in Kassebwera parish as their daily bread. With this, the parish receives very little or no rains due to hotness which would not support agricultural productivity, hence food insecurity.

5.2 Recommendations

1. Efforts by respective authorities at the parish should devote to activities that promote and maintain ideal temperature conditions. This is because temperature has the highest effect on food security. Thus planting trees and engaging into green activities is believed to result into moderate temperature conditions to enhance food security.

2. Bukomansimbi District Local Government should liaise with the Meteorological Department of Uganda to ensure proper weather focus particularly on temperature and its effects for the community to take precautionary measures. This is because temperature has an effect on food security.

3. Sensitization, awareness and capacity building should be enhanced among the households to able them adapt to drought/temperature effects on food security in the area. This should involve tree planting, growing drought resistant crops, innovative agriculture practices, and sustainable food use and runoff water harvesting technologies.

4. The parish should liaise with the sub county and the district to take initiative and improve

the feeder roads which are impassable especially during the torrential rains as a result of warm temperatures. This will make roads passable and access of food by the community.

Acknowledgement

As Authors, we acknowledge Butenga Sub County and Bukomansimbi district management and staff who authorized and participated in the study respectively. We also thank Mr. Wangi Ambrose for his indebted time rendered while in the field as a research assistant. Finally, we thank all the participants from Kassebwera Parish who accepted and participated in the study.

References

Action Contre la Faim International (ACF, (2010). ACF food security and livelihoods assessment: A practical guide for fieldworkers. Technical department of food security and livelihoods, ACF International.

Ahuja, R., (2005). Research Methods, New Delhi, Rawat Publications.

Akudugu, A.M & Alhassan, A.R. (2013). The Climate Change Menace, Food Security, Livelihoods and Social Safety in Northern Ghana. International Journal of Sustainable Development & World Policy 1(3):80-95. ResearchGate.

Amin, M. A., (2005). Social Science Research, Conception, methodology and analysis. Kampala, Makerere University Press.

Arya, D., Jacobs, L.C., Razavieh, A., (20002). Introduction of Research in Education. Belmont, CA, Wordsworth.

Bindhe, E. (2013, October 11). Seven injured as hailstorms devastate Bukomansimbi and Lwengo districts. Report on Environment Analysis. Retrieved from https://ugandaradionnetwork.com/story on 11 April, 2018.

Bindhi, E. (2016, September 2). Bukomansimbi wetlands vanish as dry spell hits farmers. Report on environment. Uganda Radio Network.

Bukomansibi District Local Government Statistical abstract (2012). Republic of Uganda.

Climate Sense. (2011). The world is in our hands. Our climate is changing. 1st Ed. Carbon Foundation for East Africa (CEFA).

Creswell & Plano, Clark (2011). Best Practices for Mixed Methods Research in the Health Sciences. thttps://www2.jabsom.hawaii.edu/native/docs/tsudocs/Best Practices for Mixed Methods Research.

Devillis, R. F., (2003). Scale development, Theory and applications (2nd Ed.). Thousand Oaks, CA, Sage.

Food and Agriculture Organisation (FAO, 2006). The impact of disaster on agriculture and food security. www.faoorg/resilience. ISBN 978-92-5-108962-0.

Food and Agriculture Organisation (FAO, 2008). Climate change and food security. A framework document. Rome-Italy. FAO Inter Departmental Working Group on Climate Change, Viale Dellie Terme di Carucalla, Rome Italy.

Food and Agriculture Organisation (FAO, (2016). 'Food security'. FAO Policy brief Number 2, June. Rome.

Food and Agriculture Organisation (FAO, 2018). The state of food and agriculture: climate change, agriculture and food security. Food and Agriculture Organization of the United Nations, Rome. 2016ISBN 978-92-5-109374-0.

Government of Uganda (GoU, 2017). National food security assessment report for January, 2017.

http://catolog.data.ug, *http://www.diva-gis.org/data*. *Created in QQGIS 2.18, 2019*

Integrated Food Security Phase Classification Technical Working Group (IPCTWG, 2017). Integrated food security and livelihoods phase classification (IPC) analysis for Uganda: Evidence and standards for better food security and livelihoods decisions, Government of Uganda (November, 2017 to February, 2018).

Intergovernmental Panel on Climate Change (IPCC, 2007) Forth assessment report: Climate Change 2007. http://www.wmo.int/paper/partner/ippcc/index_en.html.

Kaur, J. (2017). Impact of climate change on agricultural productivity and food security, resulting in poverty in India. A master's Thesis University of Ca'Foscarri, Venezia.

Khalafallah, M.R. (2006). Impact of drought on food security: Comparative study of sorghum production in Gezira, vs North Kordofan and North Darfur. Unpublished MSc. thesis, University of Khartoum.

Kombo, D. K., & Tromp, D. L. A., (2006). Proposal and Thesis Writing, Nairobi, Kenya, An introduction Paulines Publications Africa.

Kothari, C.R., (2004). Research Methods. Methods and techniques (2nd, Ed.), Wishwa Prakashan.

Krejcie, R. V. and Morgan, D. W. (1970). Determining sample size for research activities, Educational and psychological measurement, 30, 608, Sage Publications.

Krishnmurthy, P.K., Lewis, K., & Choutlarton, R.J. (2014). Climate impacts on food security and nutrition: A review of existing knowledge on food security, livelihoods and nutrition in Karamoja, Metoffice and WFP, Bangkok, Thailand.

Lolemtum, T.J., Mugalavai, M.E & Obiri, A.J. (2017). Impact of drought on food security in West Pokot County, Kenya. IJPRPs Vol. 7, Issue 6, June, 2017. ISSN 2250-315. P9 (1-9).

McQueen, R & Knussen, C. (2002). Research Methods for Social Sciences: An introduction. Pearson Education Limited, Prentice Hall.

Ministry of Agriculture and Fisheries. (2016). Rapid drought impact assessment: El Nino 2015/2016. The Ministry of Agriculture and Fisheries, Republica Democratica De Tomor-Leste.

Nabunya, M. (2017). Contribution of Agroforesrty practices to reducing farmers' vulnerability to climate variability in Rakai district Uganda. Unpublished thesis, Universitat Dresden. www.agroforestrynetwork.org. Retrieved on 27th September, 2019.

Nakitende, H. (2016, November 18). Hunger: A deeper crisis that threatens to plunge millions into poverty. The Sunrise. Retrieved from http://www.sunrise.ug on 11 April, 2018.

Participatory Ecological Land Use Management (PELUM). (2012). Enhancing Smallholder Farmers' Adaption to Climate Change through Sustainable Agriculture. PELUM, Uganda.

Saunders, M., Lewis, P & Thornhill, A. (2007). Research methods for business students. 4th Edition Pearson Education Limited.

Stake, R.E. (2010). Quantitative research: Studying how things work. New York. NY: Guilford Press, 244 pages.