Effects of Climate Change on Rural Livelihoods in Busia County, Kenya

Agnes Mugure Sorre.
Department of Natural Resources,
Moi University, P.O. Box,
3900-30100, Eldoret,
Kenya.
Email: mugure.ag@gmail.com

Abstract
Climate change is considered the worst threat to sustainable livelihoods in the world. Kenya, like in most African countries, farming which is the major source of livelihood depends almost entirely on rainfall. This makes rural livelihoods especially among smallholder farmers vulnerable to climate change. This study investigates the effects of climate change on livelihoods of smallholder farmers in Busia County. A household survey, focus group discussions, key informant interviews and field observations were used to collect qualitative and quantitative data from 376 respondents selected using multistage and simple random sampling techniques. Study results indicate that respondents understood climate change as altered weather patterns, changes in temperature, rainfall amount and rainfall patterns. Farmers in the study area noted increased temperature, decreased rainfall amount and rainfall variability over the last twenty years, which have led to droughts, floods and erratic rains within and between seasons. Such changes have severely affected food crop production, food security and household expenditure, while livestock keeping, fishing, off-farm and non-farm activities are less affected. Thus, households that relied entirely on food crop production are more affected by climate change. Therefore, diversification into less precarious ventures that include off-farm and non-farm activities would help in spreading and reducing climate risks. This study recommends that any development effort towards enhancing rural livelihood should support diversification activities in order to build resilience.

Key words: *Climate change; rural livelihoods; Busia County; Kenya*

Introduction

Climate change is considered the worst threat to sustainable development and livelihoods globally. Studies have shown that about 90% of all natural disasters facing the world today are related to severe weather and extreme climate change events (GOK, 2010). Climate change has become evident worldwide through, temperature and rainfall variations, and other climate change-related impacts, such as prolonged flooding, increased heat waves, increased length and frequency of droughts, sea level rise, and increased salinity (Rahman et al., 2007). Research from different parts of the world indicate that there is a wide agreement among the scientific community that climate variability and change is taking place with impacts on the people's livelihoods (IPCC, 2007).

Africa is one of the most vulnerable continents to climate change and variability, a situation that is aggravated by the interaction of multiple stresses, occurring at various levels (IPCC, 2007; Boko et al., 2007). This is to a certain extent due to low adaptive capacity and higher reliance on natural resources, such as agricultural land, forests and water which are very sensitive to changes affecting the environment. Climate change will likely reduce the length of growing seasons as well as force large areas of marginal agricultural potential out of production, creating semi-arid conditions that make agricultural production more risky especially in Africa (IPCC, 2007; Fisher et al., 2005; Thornton et al., 2006). Globally, millions of people will be exposed to water stress, and access to food in many African countries will be compromised (IPCC, 2007). For instance food production assessment indicates that domestic food production has already declined by 10% in several of the sub-Saharan countries (Fisher et al., 2005). It has also been projected that a reduction in yield in some countries would be as much as 50% by 2020, with small scale farmers being the most affected IPCC, 2007). Ecosystems, land use and livelihoods of local communities are among the aspects influenced by climate change and variability (Boko et al., 2007).

Agricultural production in most African countries depends almost entirely on the rainy season, a situation that makes Africa largely vulnerable to climate change. Increased droughts negatively affect food availability, as it happened in the horn of Africa and southern Africa during the 1980s and 1990s (IPCC, 2007; IPCC, 2001). Many regions are likely to be adversely affected by climate change (IPCC, 2007; Boko, 2005), whereby, with a temperature increase of 3°C alongside the global warming anomaly, about 250 - 550 million people may be at risk of hunger with more than half of these people concentrated in Africa and Western Asia (IPCC, 2001).

Thus, Kenya with a landmass of about 582,350 km² of which only 17% is arable while 83% Consists of semi-arid and arid land (ASAL), faces the risks of negative impacts associated with climate change. Temperatures have risen throughout the country while rainfalls have become irregular and unpredictable with more intense downpour. Extreme and harsh weather is now a norm in Kenya. More specifically, since the early 1960s, both minimum (night time) and maximum (daytime) temperatures have been on an increasing (warming) trend. The minimum temperature has risen generally by 0.7 – 2.0ºC and the maximum by 0.2 – 1.3ºC, depending on the season and the region (GOK, 2010). As noted by Maitima *et al.* (2009), Kenya has in the last 100 years recorded 28 major droughts with three of them occurring during the last decade. As regards rainfalls, the most visible feature is the increased variability year to year, and during the year. There is a general decline of rainfall in the main rainfall season of March-May (the "Long Rains"). In other words, drought in the Long Rains Season is more frequent and prolonged. On the other hand, there is a general positive trend (more rains) during September to February. This suggests that the "Short Rains" (October-December) season is extending into what is normally hot and dry period of January and February (GOK, 2010).

These changing climatic (rainfall and temperature) patterns have had adverse impacts on Kenya's socioeconomic sectors including widespread economic losses, energy crisis, water shortages and food insecurity. Natural disasters associated with climate variability and change have in the past cost huge losses in Kenya. For instance, the 1999 and 2000 droughts in Kenya caused damages equivalent to 2.4% of the Gross Domestic Product (GDP). The Stern Report of 2006 predicts that the cost of climate change in Africa could be as high as 7-10% of GDP by 2100, whereas a recent study on the economic impacts of climate change in Kenya has estimated that the annual cost of climate change impacts will be in the tune of USD 1 to 3 billion by the year 2030 (GOK, 2010).

Busia County has also had its own share of climatic challenges. The County continues to suffer low agricultural productivity due to declining soil fertility and extreme climate events mostly drought and floods. Historical data shows that drought frequency has remarkably increased from every 10 years to every 2-5 years with flood-prone areas like Budalang'i expected to have more floods. The most problematic hazards in the County were identified as moisture stress mostly in the drier areas, increased temperature and intense rain/soil erosion (MoALF, 2016).

It is within this context that this study was conducted to establish climate change and its effects on the livelihoods of majority of smallholder farmers' who rely on climate sensitive livelihood activities. The main objective of this study was to assess the impacts of climate change and variability on rural livelihoods with particular focus on smallholder farmers' in Busia County, Kenya.

Study Area

Busia is one of the forty seven (47) counties of Kenya and is situated at the extreme western region of the country. The County borders three other counties which include; Bungoma to the north, Kakamega to the east and Siaya to the South West. Part of Lake Victoria is in Busia County on the South East and borders the Lake with the Republic of Uganda to the West. It lies between latitude 0º and 0º 45 north and longitude 34º 25 east (Figure 1).

Busia is one of the forty seven (47) counties of Kenya and is situated at the extreme western region of the country. The County borders three other counties which include; Bungoma to the north, Kakamega to the east and Siaya to the South West. Part of Lake Victoria is in Busia County on the South East and borders the Lake with the Republic of Uganda to the West. It lies between latitude 0º and 0º 45 north and longitude 34º 25 east.

Busia County receives an annual rainfall of between 760mm and 2000mm. Fifty percent of the rain falls in the long rain season which is at its peak between late March and late May, while 25% falls during the short rains between August and October. The dry season with scattered rains falls from December to February. The temperatures for the whole County are more or less homogenous. The annual mean maximum temperatures range between 26ºC and 30ºC, while the mean minimum temperature range between14ºC and 22ºC.

Most parts of Busia County fall within Lake Victoria Basin. The altitude is undulating and rises from about 1130m above sea level at the shores of Lake Victoria to a maximum of about 1500m in Funyula and North Teso Hills. The central part of the county, especially Butula and Nambale Sub-counties, are occupied by peneplain marked by low flat divides of approximately uniform height, often capped by lateritic and a shallowly incised swampy drainage system.

The Samia Hills represent a basement complex and consist of acidic and sub-acidic lavas, tuffs, and agglomerates, banded quartzite and iron stones. The Kavirondo series rocks are developed around Busia, Nambale and Butula, while granites dominate the northern parts of the County. The northern central region features granite out crops, which is essentially part of the peneplain and is characterized by the presence of large granitic hills in Amukura and Chelelemuk. The southern part is covered by a range of hills comprising the Samia and Funyula hills, which run from the north east to the south west culminating at Port Victoria; forming a very conspicuous topographic feature. The southern part is covered by the Yala Swamp, which is a down warped area associated with the formation of Lake Victoria. This area is covered with locustrine and alluvial deposits of recent and Pleistocene times.

Whereas most parts of Busia County have sandy loam soils, dark clay soils cover the northern and central parts of the County. The land formation and structure makes the northern part suitable for both food and cash crops like tobacco and cotton. The lower northern parts of Nambale, Butula and Amukura in Teso South are suitable for maize, robusta coffee and sugarcane cultivation. The central southern parts of the County are suitable for maize, cotton and horticultural crops. Apart from the lower parts of Samia and Bunyala Sub-Counties to the south which require irrigation, most parts of the county have high potential for agriculture and promises faster growth (GOK. 2013).

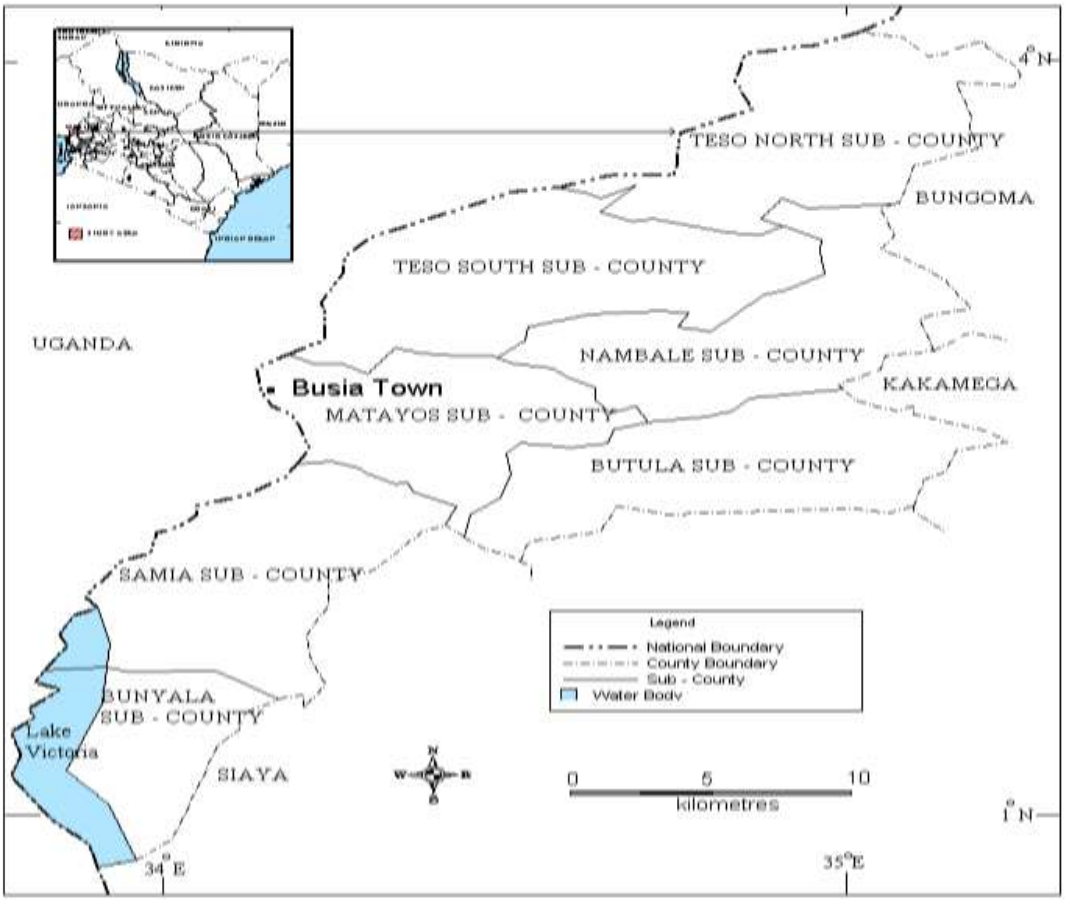

Figure 1: Map of Busia County Indicating the Study Area

Methodology

Descriptive survey was employed used to generate both qualitative and quantitative data. Multistage and simple random sampling procedures were used to select a sample size of 376 farmers from the County. The seven sub-counties that form Busia County, namely Teso north, Teso south, Samia, Nambale, Bunyala, Matayos and Butula were divided into their respective locations. Thereafter, simple random sampling was used to select two locations from each sub-county namely, Teso North (Ang'urai east, Ang'urai south), Teso South (Ang'orom, Chakol north), Samia (Bwiri, Nangina), Bunyala (Bunyala west, Bunyala North), Nambale (Bukhayo north and Bukhayo central), Butula (Elugulu, Marachi central), Matayos (Busibwabo, Mayenje). Subsequently, households from the selected locations were randomly selected proportionate to the sub-county sample size and the questionnaire proportionately administered to household heads in the selected locations.

Results and Discussions

Although a number of studies have underscored the importance of farmers' perceptions of climate change in choosing to adapt (Adger et al., 2009), others have argued that farmers' behavior is shaped more by their perceptions of climate change and climate risk, rather than by the actual climate patterns (Adger et al., 2009; Mertz et al., 2009). Though farmers' perceptions are based in part on past observations and experiences, several studies have suggested that farmers place greater emphasis on recent climate events in forming their perceptions of climate risk and in making decisions about adaptive behavior (Maddison, 2007; Gbetibouo, 2009).

Results from this study indicate that when asked of their understanding of climate change, 63% of the respondents reported that they have heard and understand climate change, while 37% indicated that they have not heard about climate change and do not understand what it means. Farmers understood climate change as unpredictable weather pattern (27.8%), change in temperature leading to prolonged drought (35.9%), change rainfall pattern (25.7%), high rainfall (7.7%), and others (2.9%). Majority of the respondents had attained primary education (87%), which could enhance understanding of climate change. However, Juana et al. (2013) concluded that climate change awareness is high based on an analysis of empirical studies conducted in Africa, while contrary studies by GOK, (2010) indicated low levels of climate change awareness among Kenyans.

Further, majority of the respondents (98%) reported to have noticed long-term changes in temperature and rainfall, while 2% had not noticed any change over the last 20 years. This implies high level of alertness of changes taking place within their environment.
In terms of temperature, majority (97.6%) of the respondents perceived an increase in average temperature, 0.6% perceived a decrease in temperature, 1.3% perceived temperature variation, while 0.5% of the respondents did not perceive any change in temperature for the past 20 years. These perceptions were similar across all the Sub-Counties despite their differences in agro ecological conditions. Although there was limited temperature data for the last 20 years, climate profile report for Busia County indicated that since 1981, the first wet season has experienced a moderate (1.0ºC) increase in mean temperature and reduction in crop cycle, while the second wet season experienced a slight increase in temperature (0.5ºC). Heat stress has also been reported as a climate change hazard in Busia County (MoALF, 2016), a clear indication of rising temperatures in the study area.

According to UNEP (2002) and Künzler (2011) the mean annual temperatures in Kenya had increased by 1°C between 1960s and 2003 and the observations indicate significantly increasing trends in the frequency of hot days by 15.6 % per year, and much large increasing trends in the frequency of hot nights by 31 % per year.
In terms of rainfall, study results indicate that 73.9% of the farmers perceived a decrease in the average rainfall, 4.5% reported an increase in annual rainfall, and 19.7% indicated varying rainfall trend and a further 1.9% did not perceive any change in average precipitation for the past twenty years. Some respondents indicated increased annual rainfall over the last 20 years. Focus group participants reported that, rainfall amount has increased where by a lot of rain fall within a short period of time and sometimes causes floods. Busia County Climate profile report indicated that, an increase in frequency and intensity of rainstorms have caused flash floods in Busia County and a tendency towards a slight increase in precipitation during the first wet season and a significant increase in precipitation of approximately 25% in the second wet season since 1981, which has resulted to increased precipitation hazard (MoALF, 2016).

The general farmers' perception about decreasing and varying annual rainfall is supported by long-term (1995-2015) rainfall data from Busia County meteorological station (Figure 2). Respondents indicated that amount of rainfall in a particular season has decreased over the years. Focus group participants indicated that rains have been coming late within a season and in some instances ended early before the normal timing, reducing the length of the growing season. The participants indicated that, under normal circumstances, long rains which are the predominant in Busia County used to start in late February or early March, but this has changed. Currently, rains start in mid-March and sometimes late March, and in 2016, rains began in April and ended in May, affecting the length of a season.

In terms of rainfall variability, respondents indicated that rains have become unpredictable over the years. They explained that long time ago, it was easy to predict rainfall patterns and farming seasons unlike today. Traditionally, the long rain season (March-April-May) and the short rain season (October-November-December) were clear and farmers were accustomed to the seasons timing. However, for the last twenty years, seasons have become unpredictable due to erratic and inconsistent rains within and between seasons over the years. This has put farmers in a precarious state with some not able to plan for the different agricultural activities in each season.
Data from meteorological department indicate high rainfall variability over the years (Figure 2).

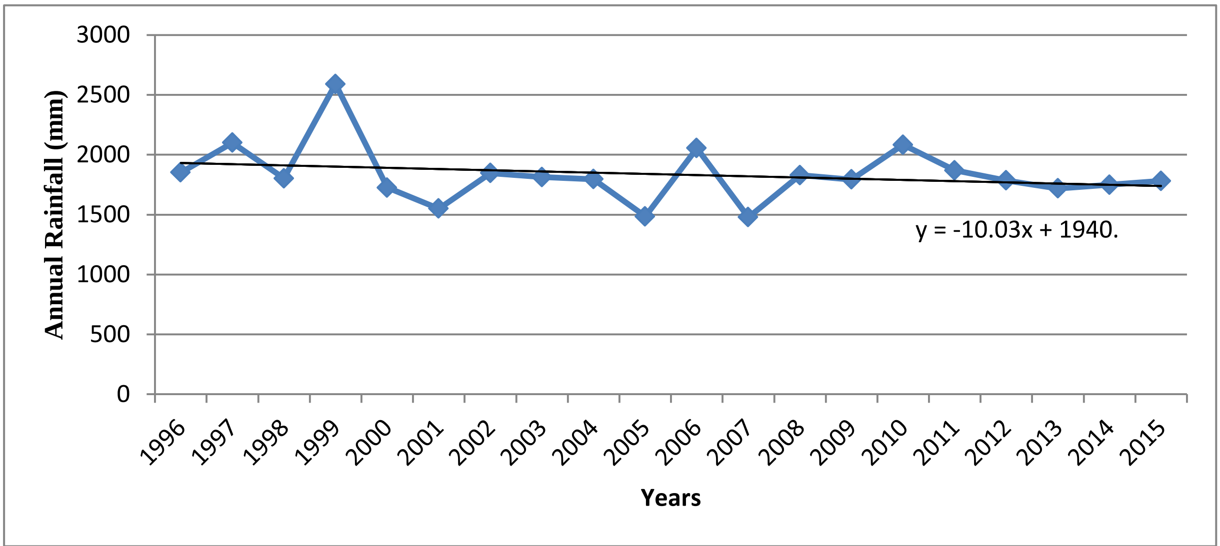

Figure 2: Annual Rainfall for Busia County (1996-2015).
Source: Meteorological Office

Similarly, data from Alupe KARI, Amagoro and Port Victoria meteorological rainfall stations indicated high rainfall variability over the years (Figure 3). Rainfall variability is looked at in terms of time when rains begin in a season, amount of rain in that season, and the time that rain lasts within a season over the years. Thus, Figure 3 indicates high rainfall variability in timing, length and also amount of rainfall in the selected stations over the years indicated. This means that, timing and amount of rainfall vary within a certain year. This has made farmers not to rely on the usual cropping calendar with some not planning for a season, and farming activities are carried out haphazardly.

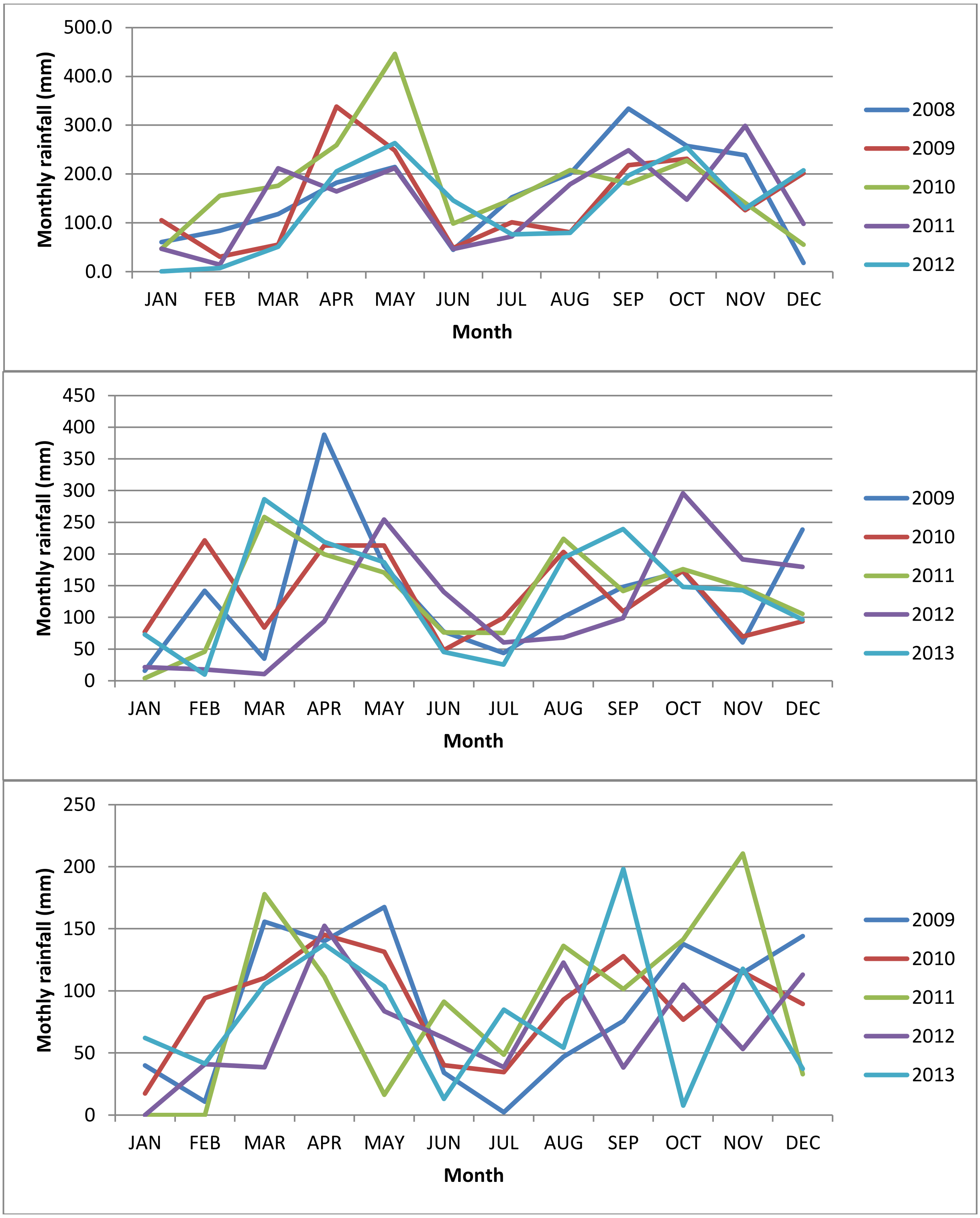

Figure 3: Monthly rainfall for Alupe KARI (Top), Amagoro (Middle) and Port Victoria (bottom) Rainfall Stations
Source: Meteorological Office

Further, Focus Group participants indicated that in the year of study, 2016, there was delay in the onset of rains where rains began in April when they should have started in March, and ceased in late May, when maize was at tussling stage, leading to a massive maize crop loss. During visits to the farms in the study area and informal interviews with farmers between June and August 2016, the researcher observed that most of the maize on the farms had prematurely dried and farmers were cutting them down as livestock fodder. One of the agricultural officers in Nambale Sub-County indicated that, rainfall variability and the low harvest was not a unique episode to the year 2016 as many farmers had witnessed similar trends in previous years due to incidences of erratic rainfall patterns.

A visit to the Busia Agriculture Training Centre (ATC) revealed similar findings as observed by one of the officers at the institution who said that: “This year our demonstration farm performed poorly because of rainfall challenges. There was massive crop failure for most farmers and even here at ATC, our groundnuts failed” (An agricultural officer at Busia ATC, 4th October, 2016).

Similar findings were also reported in Busia County, where dry spell in 2015 extended from November - December to November – February 2016. This in turn affected the start of the planting season from January/February to March hence interfering with the cropping cycle (MoALF, 2016). Sun et al. (2012) pointed out that, variability of rainfall patterns leads to a redistribution of rainfall in which dry seasons get wetter and wet seasons get drier.

Climatological data for Busia County also indicates high variability in terms of annual average rainfall distribution within the Sub-Counties for the period 1974-2016 (See Figure 4). Nambale and Butula Sub-Counties receives the highest amount of rainfall 1775-2100 mm of rainfall; Teso north, Teso south and Matayos Sub-Counties receive 1450-1775mm; Samia Sub-County receives 1125-1450 mm, while Bunyala Sub-County receives the lowest 800-1125 mm of rainfall.

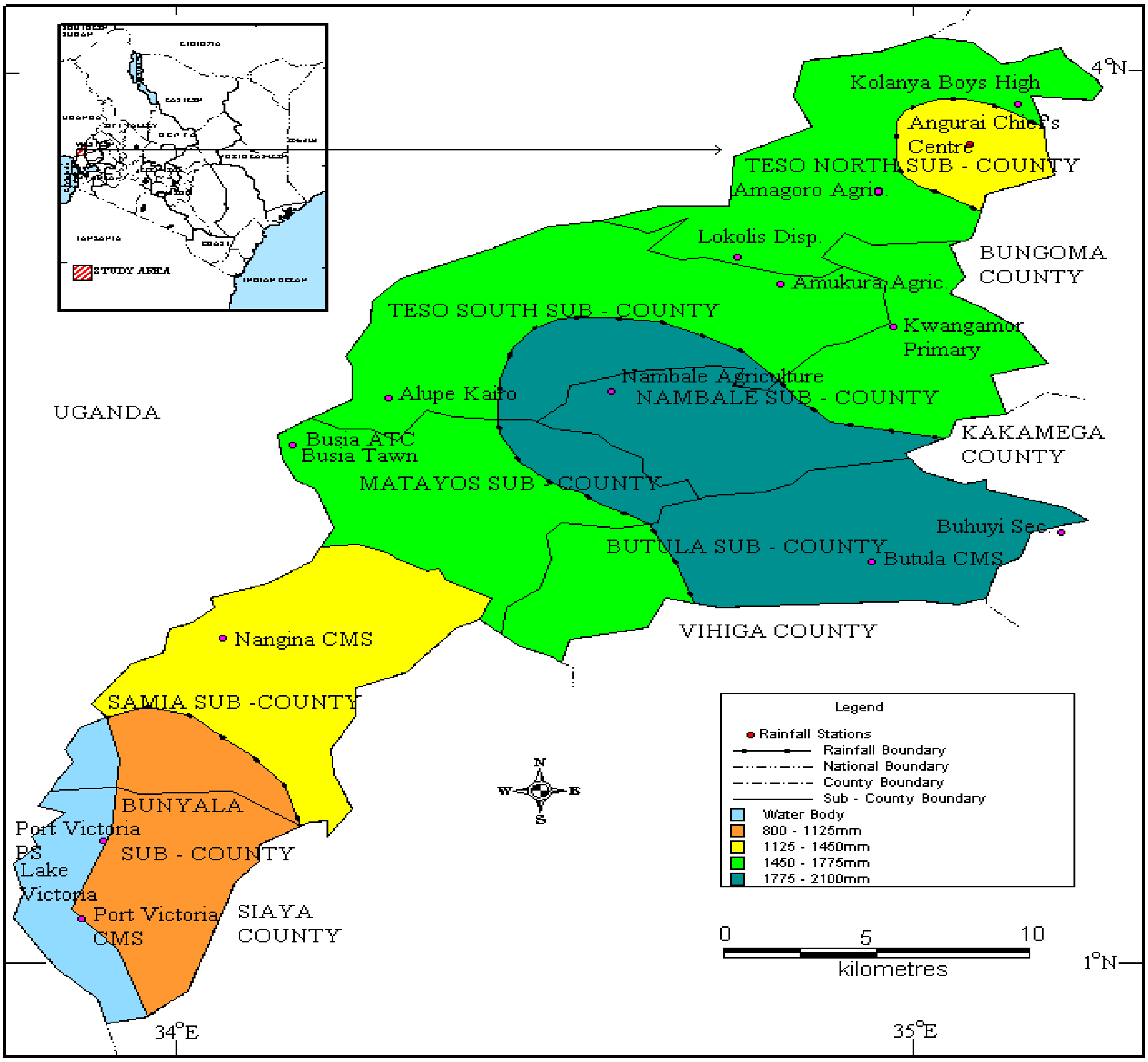

Figure 4: Annual Average rainfall Distribution for Busia County (1974-2016)
Source: Meteorological Office

The Annual average rainfall is higher at the upper part of the County and reduces towards the lower part of the County. However, there is high rainfall variability within the Sub-Counties as indicated in Figure 4. For instance, Nambale Sub-County has two distinct climatic zones with the upper part receiving 1450-1775 mm and the lower part 1775-2100 mm of rainfall. This implies that agricultural activities must be distinct for within a Sub-County. Similar findings were reported in Busia County climate profile report that weather in Samia Sub-County is manifested in erratic rainfall with the lower Samia receiving 600-700mm of rainfall while the upper Samia gets 800-1200mm for 1 to 2 months. Similarly, Bunyala sub-county which hosts Lake Victoria is hotter than the rest of the County. Consequently, it experiences long dry spells with the lowest amounts of Rainfall between 400-600mm per annum (MoALF, 2016).

Climate Change shocks and their Effects on Livelihoods in Busia County

Respondents were asked to identify climate shocks that they have experienced for the last 20 years and their level of occurrence. Respondents indicated drought (Dry spell), floods and erratic rainfall as the main climate shocks experienced (Figure 5).

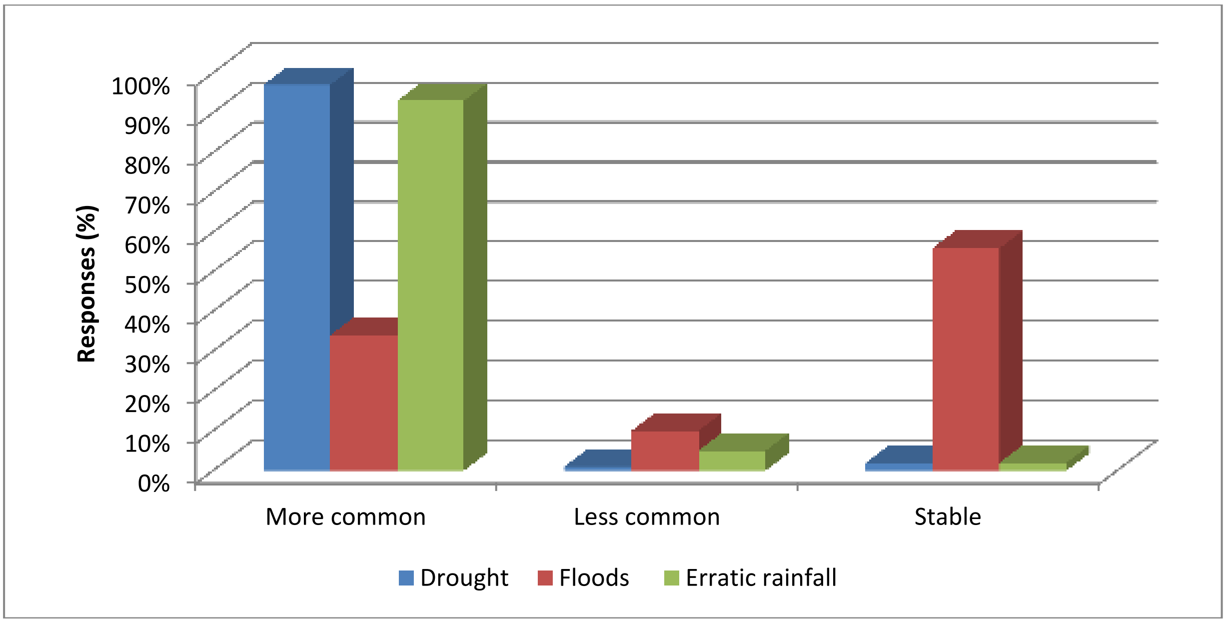

Figure 5: Responses on Climate Change Shocks Experienced in the Study area

The most common climate shock as reported by the respondents was drought (97%) and erratic rainfall (93%), while floods were less common and more stable. Focus Group participants indicated that Busia County has been experiencing long dry spells accompanied by high temperatures that make the County dry and hot. Further information from meteorological department indicated that Busia County is currently the warmest in western Kenya while Vihiga is the coldest. This was explained by the fact that Busia has the closest proximity to Lake Victoria and the Equator, which makes it prone to high temperatures. However, because of climate change, the temperatures have remained relatively high leading to sustained dry spells that manifest as droughts.

According to United States Geological Survey, USGS (2011), increased frequency of droughts observed in the last 20 years is likely to continue as long as global temperatures continue to rise. Therefore, Africa and Kenya in particular is not spared. This is evidenced by the current study findings as 97.3% of the respondents reported that droughts had become more common over the years. Similar findings were reported by MoALF (2016) that farmers in Busia County had observed that drought and flood events that were rare in the 1940s to the 1990s have become more frequent in the recent past. The same report indicated that the drought of 2016 led to scarcity of water in Teso North, which necessitated supply of relief water and crop failures which led to high food prices which are unaffordable to most residents in the County due to high poverty levels. Formerly, droughts used to occur in an interval of about every ten years. Later the frequency of droughts reduced to five years and currently, dry spells are experienced almost every other year (Linne et al., 2013).
Other findings by NEMA (2008) report indicated that serious drought events were reported to have occurred in the Kenya at least 12 times in the past (50 years). Humanitarian Information Unit, HIU (2007) asserted that Kenya is frequently affected by severe drought and that based on historical rainfall records, there is greater than 40% likelihood that Western Kenya will most likely experience severe drought within the rainy seasons of any given year. Studies by FAOSTAT (2000) and UNEP (2002) reported that the frequency and severity of droughts and floods have increased over the past 50 years, especially in Eastern Africa.
In terms of floods, 34% reported that floods have become common, while 56% reported that floods are stable. Respondents indicated that floods were more common before the dykes

were erected in 2013, but since then, flood incidences have reduced. However, flashfloods are common during high intensity rainfall within a short period of time. This study established that floods have largely been occurring in Bunyala Sub-County unlike other Sub-Counties in Busia County. However, respondents from Nambale and Matayos Sub-Counties which are served by river Walatsi and river Sio respectively reported floods along the rivers in the short rain seasons.

Similar findings were reported where in 2003, floods in Budalang'i displaced 24,000 people (approximately 4,000 households) from their homes, property destroyed, livelihood activities disrupted and water contaminated (Paron et al., 2013). In 2011, floods in Bunyala drowned animals and led to an outbreak of waterborne diseases such as cholera (Opondo, 2013) and in 2016, again in Bunyala, 639 households were displaced and big losses incurred due property destruction and livestock drowning.
Erratic rainfall was also reported by 93% of the respondents. As earlier discussed, unpredictable rainfall in the start and end of the main season coupled with the length of the rains has become a norm in Busia County distorting the cropping calendar.

Livelihood Activities among Smallholder Farmers
Agriculture including both crop farming (99%) and livestock keeping (74%) is the main livelihood activity among respondents in Busia County. Others include horticulture (52%), farm casual labour (11%), fish keeping (3%), marketing of crop produce (6%), and marketing of livestock produce (3%). Further, 55% of the respondents engaged in non-farm activities to supplement income from farm related activities, while 45% did not (See Figure 6). Non-farm activities included bodaboda business, charcoal/firewood/brick making, vending, alcohol brewing, artisan, kiosk among others.

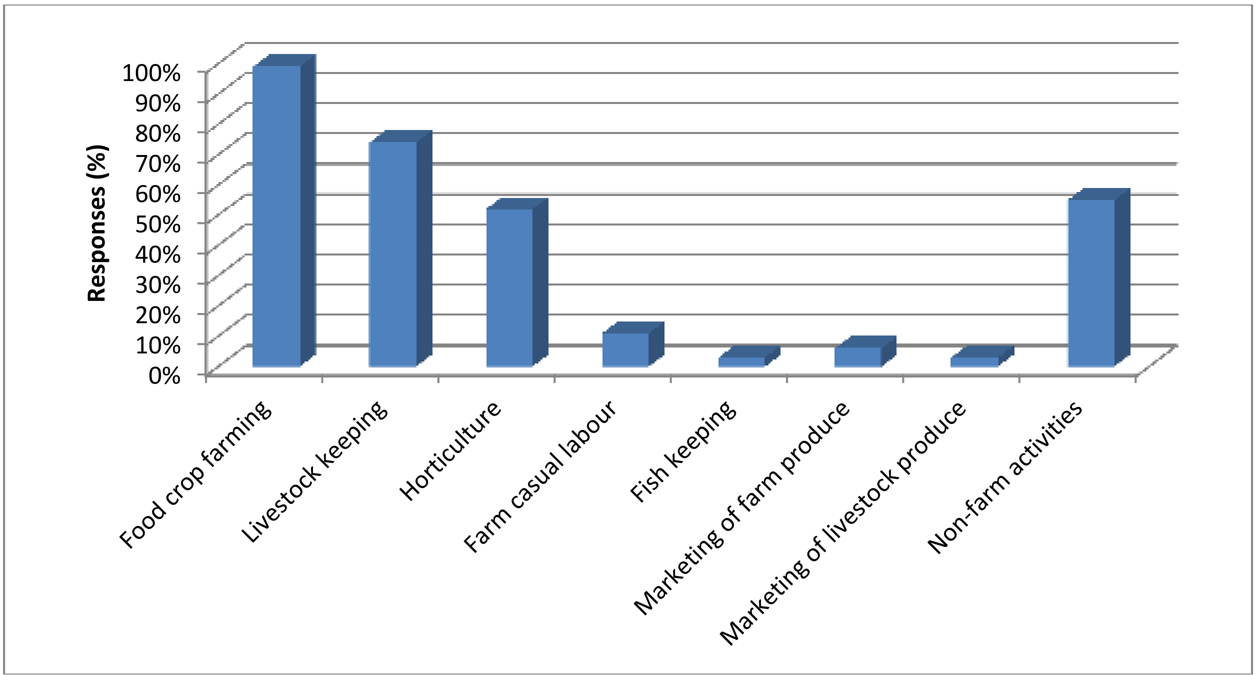

Figure 6: On-farm and Off-farm Activities in the Study Area

Effects of Climate Change on Livelihoods of Smallholder Farmers
Study findings indicated that crop farming (96%) Household expenditure (88%) and food security (80%), while fishing (75%), non-farm activities (73%), livestock (66%) and off-farm

activities (50%) were the least affected livelihood activities in the study area. Livestock (30%), wetlands/biodiversity (42%) and property (32%) were moderately affected by climate shocks (See Figure 7).

Respondents indicated that, an erratic and reduced rain within the main rain season largely affected food crop farming in Busia County. As earlier discussed, delayed rains, reduced amount of rainfall within a season and rains ceasing early has led to unpredictable seasons. Further, livestock pastures are also affected by drought and floods especially in Samia and Bunyala Sub-Counties.

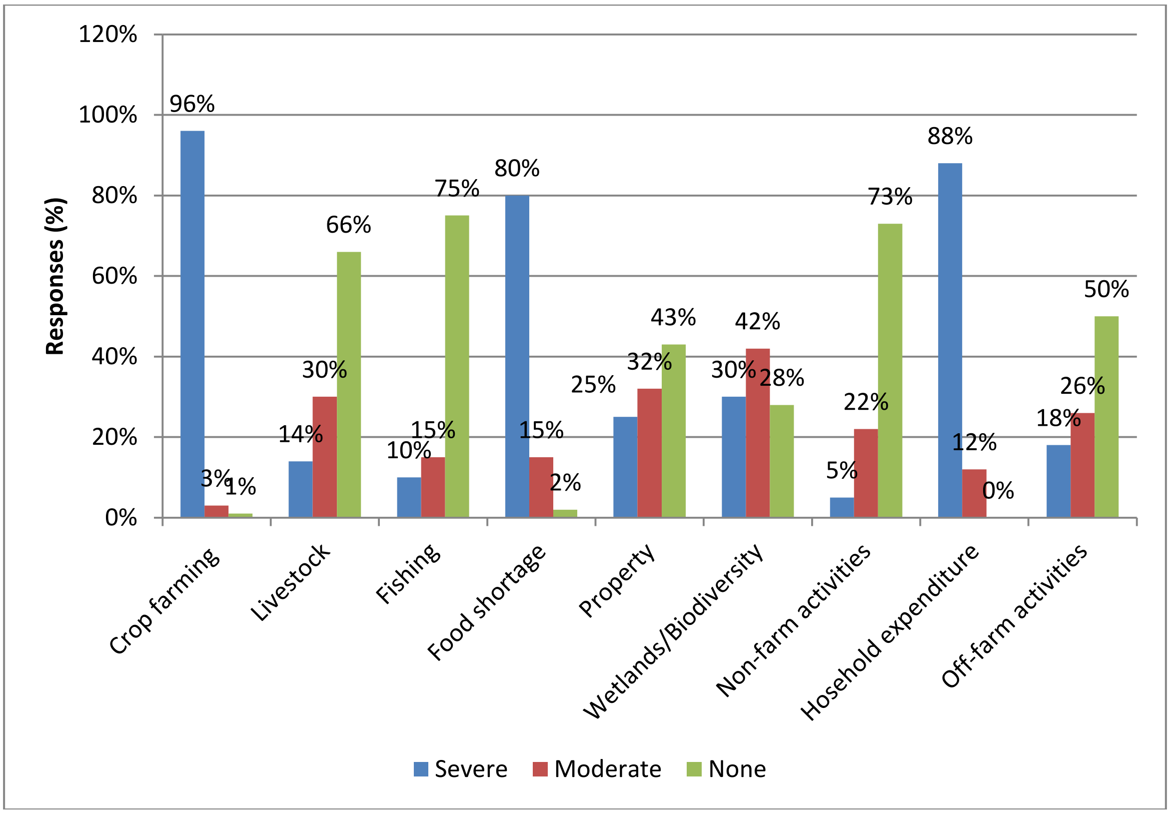

Figure 7. Effects of Climate Change on Livelihood activities in the Study Area

Climate change is expected to result in crop failures caused by irregular rainfall and seasonal shocks (i.e., losses from floods and extended dry spells). Within-season' rainfall variability is also critically important, as it determines such variables as: the effective onset of the crop season; the timing, length and severity of dry spells during the growing season; and the effective end of the season (Stern and Cooper, 2011). These variables in turn are reflected in the risk that a 'failed season' will occur (AGRA, 2014).

The IPCC (2001) cautioned on the likelihood that agricultural productivity will decrease in the tropics, even as a result of small temperature increases. Another study in India by Asha et al., (2012) found that almost 100 % of the small farmers and 92.22 % of the sample farmers reported that decline in rainfall was the major reason for reduction in the rain fed crop yields over the period, followed by the pest and disease to the extent of 72.22%, and changes in temperature and seasonal patterns. Similarly, previous studies indicated that, for rain-fed farmers, both 'between seasons' and 'within season' variability of rainfall are the dominant factors in determining the seasonal outcome of cropping and livestock enterprises (AGRA, 2014).

Fishing (75%), non-farm activities (73%), livestock (66%) and off-farm activities (50%) were the least affected livelihood activities. This implies that, livelihood activities that are less reliant on weather patterns are less affected by long term weather changes. Livestock keeping being the second livestock activity after crop farming is highly relied upon during low crop produce. A study by Sorre (2017), which found that households that had livestock were more food secure than those without, which suggested an association between livestock keeping and food availability at the household level. Further, other studies indicated that in mixed-farming systems, livestock reduce the risks resulting from seasonal crop failures, as they add to the diversification of production and income sources (Sansoucy et al., 1995). Livestock also play a critical role in the process of the agricultural intensification by providing draft power and manure (AGRA, 2014).

Engaging in non-farm activities and off-farm activities in the study area were least affected by climate shocks. Respondents indicated that, non-farm and off-farm activities helped to diversify food sources and income, hence cushioned farmers from risks associated with climate shock that include food shortage and high household expenditure. Livelihood diversification is pursued for a mixture of motivations and these vary according to context: from a desire to accumulate, invest and the need to spread risk or maintain incomes, to a requirement to adapt to survive in eroding circumstances or some combination of these (Abimbola & Oluwakemi, 2013).

Several studies have reported a substantial and increasing share of off-farm income in total household income (Haggblade et al., 2007). Reasons for this observed income diversification include declining farm incomes and the desire to insure against agricultural production and market risks. Even as some households are forced into off-farm and non-farm activities, owing to less gains and increased uncertainties associated with farming (crop and market failures), others would take up off-farm employment when returns to off-farm employment are higher or less risky than in agriculture Mainly, households diversify into non-farm and off-farm activities in their struggle for survival and in order to improve their welfare (Matsumoto et al., 2006).

Conclusion and Recommendations

This study shows that, smallholder farmers perceived an increase in temperature, and a reduced and varying rainfall as long term climate changes. Drought and erratic rainfall are the most common climate shocks, while floods are stable in the study area. Food crop farming and livestock keeping are the major household livelihood activities, while non-farm activities are carried out by slightly more than half of the households in the study area. Besides, climate shocks have severely affected crop farming, food security and household expenditure, while fishing, livestock keeping; non-farm and off-farm activities are the least affected by climate change. Climate related events such as drought, floods and erratic events have serious impacts on livelihoods. However, livelihood diversification helps to spread risks emanating from climate change. The study recommends that any development effort towards lessening the impacts of climate change on smallholder farmers should focus on aiding supplement activities in off-farm and non-farm activities. This allows for livelihood diversification thus, reducing or spreading risks associated with climate change.

Acknowledgement

The author greatly acknowledges the French Institute for Research in Africa (IFRA) for their field grant, which facilitated data collection for this study.

References

Abimbola, O., & Oluwakemi, A. (2013). Livelihood diversification and welfare of rural households in Ondo State, Nigeria. Journal of Development and Agricultural Economics, 5(12), pp. 482-489.

Adger, W., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D., Naess, L., Wolf, J., &Wreford, A. (2009). Are there social limits to adaptation to climate change? *Clim. Change* 93, 335–354.

Asha latha, K. V., Munisamy Gopinath, & Bhat, A.R.S. (2012). Impact of Climate Change on Rainfed Agriculture in India: A Case Study of Dharwad. International Journal of Environmental Science and Development, 3(4), pp. 368-371.

Boko,M., Niang,I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha,B., Tabo, R.,& Yanda, P. (2007). Africa: Climate Change 2007: Impacts, Adaptation and Vulnerability," In: M. L. Parry, O. F. Canzian, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, Eds., Contribution of *Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University Press, Cambridge, 2007, pp. 433-467.

FAOSTAT. (2000). FAO STATISTICS Database. Rome: United Nations Food and Agriculture Organization (FAO).

Fischer, G., M. Shah, F. N. Tubiello & H. vanVelthuizen. (2005). "Socio-Economic and Climate Change Impacts on Agriculture: An Integrated Assessment, 1990-2080," *Philosophical Transactions of the Royal Society B*, 360(1463), pp. 2067-208. doi:10.1098/rstb.2005.1744.

GOK. (2010). National Climate Change Response Strategy: Executive brief. Nairobi: Government Printers.

Government of Kenya. (2013). Busia County Integrated Development Plan. Nairobi: Government Printers.

Gbetibouo, G. A., Ringler, C., & Hassan, R. (2010). Vulnerability of the South African Farming Sector to Climate Change and Variability: An Indicator Approach. *Natural Resources Forum*, 34, 175-187.

Haggblade, S., Hazell P. & Reardon, T. (2007) Transforming the rural non- farm economy. John Hopkins University Press, Baltimore.

HIU. (2007). Horn of Africa: exposure to drought. Humanitarian Information Unit.

IPCC. (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Cambridge: Cambridge University Press.

IPCC. (2001) . Climate Change 2001: Impacts, Adaptation, and Vulnerability. In: J. J. McCarthy, O. F. Canziani, N. A. Leary, D. J. Dokken and K. S. White, Eds., Contribution of *Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.

Künzler M. (2011). Climate change and disaster risk in Kenya. Bern: Bread for All.

Juana J., Kahaka, Z., & Okurut, F. (2013). Farmers' Perceptions and Adaptations to Climate Change in Sub-Sahara Africa: A Synthesis of Empirical Studies and Implications for Public Policy in African Agriculture. *Journal of Agricultural Science, 5(4),121-135*.

Maddison, D. (2006). The perception and adaptation to climate change in Africa. *CEEPA. Discussion paper No.10. Centre for Environmental Economics and Policy in Africa*. Pretoria, South Africa: University of Pretoria.

Maitima, J. M., Mugatha, S.M., Reid, R.S., Gachimbi, L.N., Majule, A., Lyaruu, H., Pomery, D., Mathai, S.& Mugisha, S. (2009). The linkages between land use change, land degradation and biodiversity across East Africa. *Afr. J. Environ. Sci. Technol*, 3(10), 310-325.

Matsumoto, T., Kijima, Y., & Yamano, T. (2006). The role of local nonfarm activities and migration in reducing poverty: evidence from Ethiopia, Kenya, and Uganda. *Agric. Econ.* 35,449-458.

Mertz, O., Mbow, C., Reenberg, A., & Diouf, A. (2009). Fermers' Perceptions of Climate Change and Agricultural Adaptation Strategies in Rural Sahel. *Environmental Management,43*, 804-816.

MoALF. (2016). Climate Risk Profile for Busia. Kenya County Climate Risk Profile Series. The Kenya Ministry of Agriculture, Livestock and Fisheries (MoALF), Nairobi, Kenya

NEMA (2008) Effects of climate change and coping mechanisms. State of the Environment Report Kenya 2006/7. Ministry of Environment and Natural Resources, Nairobi

Opondo, D.O. (2013). Loss and damage from flooding in Budalangi District, Western Kenya.

Loss and Damage in Vulnerable Countries Initiative, case study report. Bonn: United Nations University Institute for Environment and Human Security.

Paron, P., Olago, D. O., & Omuto, C. T. (2013). Kenya: A Natural Outlook: Geo Environmental Resources and Hazards (Vol. 16).

Rahman, A. A., Alam, M., Alam, S. S., Uzzaman, M. S., Rashid, M., and Rabbani, G. (2007). *Risks, vulnerability and adaptation in Bangladesh.* Background paper commissioned for the 2007–2008 Human Development Report. New York, US: UNDP.

Sansoucy, R., M. A. Jabbar, S. Ehui and H. Fitzhugh (1995). Keynote paper: The contribution of livestock to food security and sustainable development, in: Livestock Development Strategies for Low Income Countries, FAO/ILRI, Rome/Nairobi.

Stern, R. D. and Cooper, P. J. M. (2011). Assessing climate risk and climate change using rainfall data–a case study from Zambia. *Experimental Agriculture* 47: 241–266.

Sun, F., M. L. Roderick, and G. D. Farquhar. (2012). Changes in the variability of global land precipitation, *Geophys. Res*. Lett., 39, L19402, doi:10.1029/2012GL053369.

Thornton, P.K., P. G. Jones, T. M. Owiyo, R. L. Kruska, M. Herero, P. Kristjanson, A. Notenbaert, N. Bekele and Co-authors. (2006). “Mapping Climate Vulnerability and Poverty in Africa,” Report to the Department for International De- velopment, International Livestock Research Institute, Nairobi, 2006.

UNEP. (2002).Africa Environment Outlook: Past, Present and Future Perspectives. http://www.unep.org/dewa/Africa/publications/AEO-1/002.htm

USGS. (2011). More frequent droughts likely in eastern Africa. United States Geological Survey (USGS). http://www.usgs.gov/newsroom/article.asp